

June 2021

Mid Wales Applied Research and Innovation Study

A Report to the Growing Mid Wales Partnership



SQW

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1. Introduction to the Study

- 1.1** This document presents the **Mid Wales Applied Research and Innovation Study**. Commissioned by the Growing Mid Wales Partnership, the Study was led by independent economic consultants SQW, and delivered over the November 2020 to May 2021 period. Further detail and underpinning evidence is provided in a separate supporting annex.
- 1.2** Covering the areas of Ceredigion and Powys, the purpose of the Study was two-fold:
- to provide a **robust evidence base on applied research and innovation in Mid Wales**; this includes examining the capabilities of the region, its relationships and linkages with other places, and key strengths and weakness
 - to develop a **Vision for applied research and innovation in Mid Wales**; this will provide the strategic framework, and an overarching agenda, to shape the on-going process of project development, categorisation and decision-making by regional partners.
- 1.3** An important driver behind the commissioning of the Study was the Mid Wales Growth Deal, for which Heads of Terms were agreed with the Welsh and UK Governments in December 2020. This followed the publication in April 2020 of the 'Vision for Growing Mid Wales' which had identified applied research and innovation as one eight Strategic Growth Priorities. The Growth Deal provides an important strategic backdrop to this report, and Growth Deal funding will play an important role potentially in taking forward projects aligned with the Vision.
- 1.4** However, it is important to recognise **that this Study is not specifically focused on the Growth Deal, nor is it a 'bidding document'**. Rather the purpose is to provide an evidence base and strategic agenda around which applied research and innovation activity in the region can be framed over the medium to long term, informing projects, programmes and processes that deliver positive economic outcomes.

Study process

- 1.5** Practically, the Study has involved:
- a **'top-down' review of data and documents** related to applied research and innovation, and relevant wider contextual conditions and performance
 - **strategic consultations with key regional partners**, gathering primary evidence on the region's key strengths and weakness in applied research and innovation
 - **'deep-dive' research on four areas** identified through the 'top down' review and strategic consultations: Agri-food and Bioscience; Low Carbon and Green Energy; Advanced Manufacturing; and Enabling Digital Technologies
 - the research included a desk-based analysis of documents and data relevant to each area, and over 40 consultations with stakeholders and businesses across the region

- **two online workshops with regional partners** to present emerging findings and secure feedback in relation to the evidence base and draft vision
 - **regular meetings and engagement with the Study Steering Group** which involved representatives from: Growing Mid Wales, Welsh Government, Aberystwyth University, AberInnovation, Powys County Council, and Ceredigion County Council.
- 1.6 Collectively, over 75 individuals involved in applied research and innovation in Mid Wales provided inputs to the Study.

Study parameters

- 1.7 Five important points in relation to the Study parameters are noted:
- First **the focus was on Mid Wales as an integrated region**, it did not seek to disaggregate or compare performance within the region, for example between Ceredigion and Powys. The spatial distribution of applied research and innovation assets/activity matters, and is discussed in the Study. However, the purpose is to understand what this means for the capabilities and offer of the region overall, not its constituent local areas.
 - Second, **the focus was on Mid Wales absolutely**, whilst data on relative position/performance is discussed where relevant, the Study did not seek to ‘rank’ or ‘benchmark’ Mid Wales to other places in Wales, or elsewhere. Indeed, as discussed throughout, Mid Wales is unique and distinctive, and such an approach would be potentially quite misleading.
 - Third, **the focus was on the applied research and innovation of Mid Wales capability and offer as a place**. The Study is not a review, audit, assessment or commentary of the individual applied research and innovation activities, priorities or investments of specific institutions, in the public or private sector. Importantly, it did not include a formal mapping of levels of innovation within individual businesses across the region.
 - Fourth, and linked to this, the focus was on evidencing and characterising the applied research and innovation offer in the region in terms of assets, priorities, existing strengths and opportunities for the region itself and for UK Plc. The research has considered how this can be maximised, but did not seek to assess or estimate its economic or wider societal impact.
 - Fifth, as reflected in the title, **the focus was on innovation and applied research**, which encompasses activities directed primarily towards practical aims/objectives, and/or which seeks to produce new products or processes or to improve existing products or processes. Basic or pure research is important – and core to research assets in the region - however is not the focus of this Study, which is concerned ultimately with how research and innovation can best contribute to regional economic performance and growth.

2. Strategic context

Key messages

A wealth of evidence demonstrates the link between investment in research and innovation and economic growth and productivity. However, a range of factors influence the effectiveness and impact of local innovation ecosystems.

Applied research and innovation are prominent in the strategic economic policy agenda affecting Mid Wales. Both the UK and Welsh Government are committed to supporting investment and activity in this area, which is seen as crucial in delivering against productivity and wider societal goals. However, the end of Structural Funds and uncertainty over successor schemes presents challenges.

The 'Vision for Growing Mid Wales' identified applied research and innovation as a key strategic priority for the region in 2020.

Why applied research and innovation matters ...

- 2.1** There is a wealth of empirical evidence demonstrating the link between investment in research and innovation and economic growth. As summarised by one major study:

Research and Innovation (R&I) are key drivers of productivity and economic growth Firms and economies achieve large and significant returns on these investments, which also create new and better jobs. The importance of R&I increases even further as our economies become more knowledge-based and intensive in intangible assets. R&I investments are also crucial to address key societal challenges and improve well-being. They contribute to improving health outcomes, fight against climate change, and build more inclusive and resilient societies.ⁱ

- 2.2** There are various factors which can enable or hinder this relationship between research and innovation and economic growth, including knowledge flows, access to talent and skills, technology changes, and the diffusion and adoption of new technologies and innovations across the business base. Indeed, research and innovation systems (often termed 'innovation ecosystems') are complex, which require various parts, processes, interventions and conditions to perform optimally. This is discussed in more detail in Section 4.
- 2.3** There is also an increasing recognition of the role of place in research and innovation. This is particularly in the context that since the Global Financial Crisis, the UK's geography of economic recovery and growth has been highly uneven. Growth has been concentrated in London and its hinterland, while much of the rest of the UK (including Wales, and Mid Wales) has fallen further behind; disparities – on economic indicators (e.g. GVA per capita/job) and measures aligned to well-being (e.g. disposable household income and life expectancy) – have increased substantially. This has been associated with uneven levels of investment in research and innovation, and areas characterised by this (relatively) low level of investment tend to correlate with those identified as being in need of 'levelling up'. It is within this context that considerations of the applied research and innovation offer of Mid Wales, and the opportunities for growth this brings, are grounded.

... and its role in the strategic policy agenda

At UK and Welsh levels

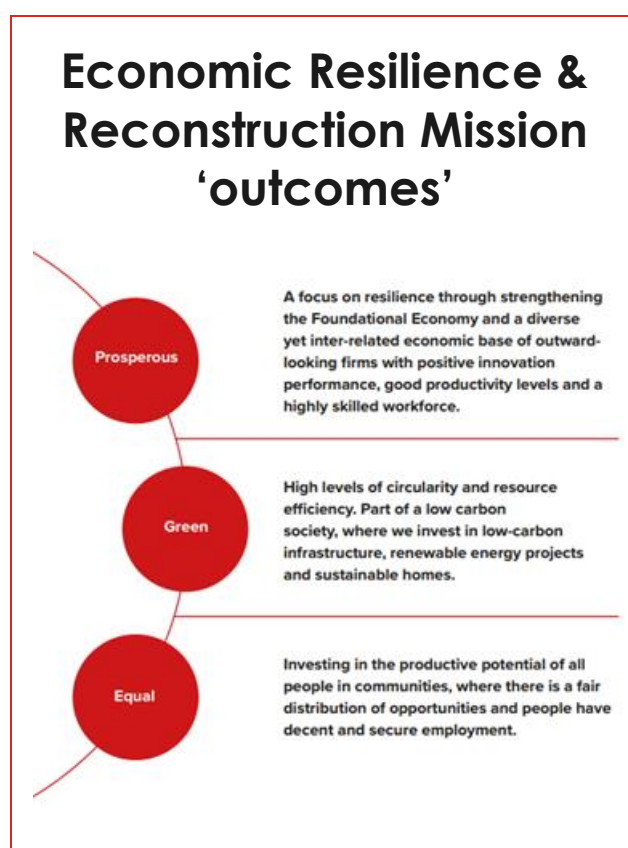
- 2.4** The **importance of research and innovation to economic performance is reflected in policy priorities across all levels**. Notably, the UK government has committed to raise total R&D investment – an important part of the overall research and innovation process – to 2.4% of GDP by 2027. The recent ‘Build Back Better’ plan established Innovation as one of three ‘pillars of growth’ⁱⁱ. Many of the aims set out in the Plan are relevant to and align with the focus of this Study in Mid Wales, including the importance of skills and talent, supporting adoption and diffusion among SMEs, and access to finance and funding.
- 2.5** Three additional strategies are proposed by the UK Government which are currently in development at the time of writing (June 2021):
- **R&D People and Culture Strategy**: this will aim to put the UK at the forefront of attracting, retaining and developing diverse, talented people and the teams.
 - **UK R&D Place Strategy**: this will set out plans to drive greater place-based outcomes from the UK R&D system, focusing on how R&D can help to accelerate economic recovery and support ‘levelling up’ across the UK.
 - **Innovation Strategy** which will set out a vision for the UK to become one of the world’s most innovative nations; while the Innovation Strategy is likely to present a macro view of the UK-wide research and innovation system. The region will need to be cognisant of the Strategy and its focus to best position Mid Wales – both strategically, and in terms of alignment to potential funding streams and interventions – to respond to its intent.
- 2.6** The recently published ‘Plan for Wales’ sets out the UK Government’s existing commitments to Wales. Covering a broad range of policy areas, the Plan reflects the wider policy agenda, with a recognition of both the importance of research and innovation to supporting economic growth and recovery in Wales, and by highlighting existing investments and activities that are seeking to deliver against this intent. Important from a Mid Wales perspective include the focus on developing the Welsh low-carbon and renewable energy resources – a particular area of interest for this Study – and the Government support for the proposed Global Centre of Rail Excellence in Powys (and neighbouring Neath Port Talbot).
- 2.7** This focus on the role of research and innovation was recognised by the Welsh Government in 2017’s ‘Prosperity for All: Economic Action Plan’, with **innovation seen as key to addressing the longstanding productivity deficit to the rest of the UK**. Within this context, the Reid Review of Government Funded Research and Innovation in Wales (also published in 2017) highlighted that in many ways, Wales performs well when it comes to collaboration between the research base and industry. However, the review also found that the research base was not sufficiently at scale to deliver its full economic potential, and that 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.

2.8 More recently the ‘Strength in Diversity’ report (also by Professor Reid) again highlighted the strengths of the Welsh innovation landscape, including industrial engagement in collaborative R&D, but emphasised changes in the funding and policy landscape, and the key challenges faced by the Welsh research and innovation base. These challenges include the end of Structural Funds (which have been crucial for funding research and innovation across Wales, including in the capacity of the research base), and uncertainty over the successor scheme, alongside uncertainty over the shape and nature of UK engagement in Horizon Europe (the successor to Horizon 2020).

2.9 Notably, with arrangements for the Shared Prosperity Fund to be confirmed, wider research and innovation funding sources are likely to become increasingly competitive, including for example, funding through the Industrial Strategy Challenge Fund, meaning an increasing imperative to ensure strategic alignment with the UK Government’s “Research and Development Roadmap”.

2.10 The effects of COVID-19 on research and innovation activity, investment, and outcomes are also potentially pronounced, and profound. This is recognised in the Welsh Government’s ‘Economic resilience and reconstruction mission’, which sets out an agenda to ensure economic resilience and reconstruction which responds both to the current COVID-19 crisis, and anticipates the consequences of EU Exit.

2.11 **Research and innovation are important cross-cutting issues across the Mission**, particularly in relation to the ‘Prosperous’ and ‘Green’ outcomes; the percentage of businesses which are innovation-active is one of the measures by which success in economic reconstruction will be measured.



2.12 Taking forward this agenda will also be informed by the recent **review for the Welsh Government on the innovation landscape in Wales**. The findings – that there is excellent innovation across Wales but that this operates at too small a scale – is consistent with earlier analysis. The implications of this work are not yet known fully, however, they will be crucial for Mid Wales going forward, and this Study provides an important opportunity to inform and influence these policy discussions, to help best position the region in this changing landscape.

In Mid Wales

- 2.13** This emphasis on research and innovation as crucial for economic growth – and recovery from COVID-19 nationally is also reflected at a regional level in Mid Wales. As noted in Section 1, the ‘**Vision for Growing Mid Wales**’ in April 2020 identified **applied research and innovation as a key strategic priority in delivering the regional-vision** (Figure 2-1).

Figure 2-1: Vision for Mid Wales in 2035



Source: A Vision for Growing Mid Wales

- 2.14** Importantly, applied research and innovation does not stand alone. There are crucial relationships with other strategic priorities, both ‘horizontal’ to enabling priorities including Enterprise and Skills and Employment, and Digital Infrastructure, and ‘vertical’ to specific sector opportunities, notably in Agriculture, Food & Drink.
- 2.15** Further, the supply of sites and premises are a vital consideration. We do not consider this in detail in this Study, as in-depth work on this issue has recently been completedⁱⁱⁱ. However, it is highlighted that **the provision of appropriate sites and premises for business to start-up and expand will be crucial to unlocking the applied research and innovation potential of the region going forward.**

3. Applied Research and Innovation: ‘State of the Region’

Key messages

Mid Wales is a distinctive economy, shaped by its spatial and cultural context. Mid Wales is known for its natural beauty and remoteness, with a diverse mix of natural landscapes; Agriculture and Tourism account for over one-quarter of employment; and the region is more reliant than most places on micro-businesses.

Mid Wales also faces major economic challenges, with an ageing and declining population, and an entrenched productivity challenge: in 2018, productivity stood at 65% of the UK-level. The scale of the productivity challenge is more pronounced in Mid Wales than in other Welsh Growth Deal/City Regions.

Mid Wales has significant applied research and innovation assets including: Aberystwyth University, an internationally significant institution with expertise in agriculture and biological sciences noteworthy; specialised institutions and assets across a range of disciplines; and some highly innovative and entrepreneurial businesses, including emerging ‘clusters’ in specific locations/areas.

Strengths of the region include a strong flow of graduate start-ups from regional assets; the on-going development of AberInnovation as a focal point for knowledge exchange and enterprise development; and well-developed collaborations and relationships with research and innovation assets nationally and internationally.

Applied research and innovation in Mid Wales faces challenges. There is an under-representation of start-ups and innovation active and high growth firms in the business base; modest levels of knowledge exchange historically, with few academic spin-outs; and relatively low levels of success in leveraging public and private finance for applied research and innovation. Skills gaps and issues recruiting well-qualified/ambitious staff to support innovation are also present.

Although challenging to evidence formally, issues of co-ordination, partnership working and cultures, behaviours and capacities are also seen to be operating sub-optimally, limiting the region’s ability to leverage fully the economic opportunity from its applied research and innovation assets and activities.

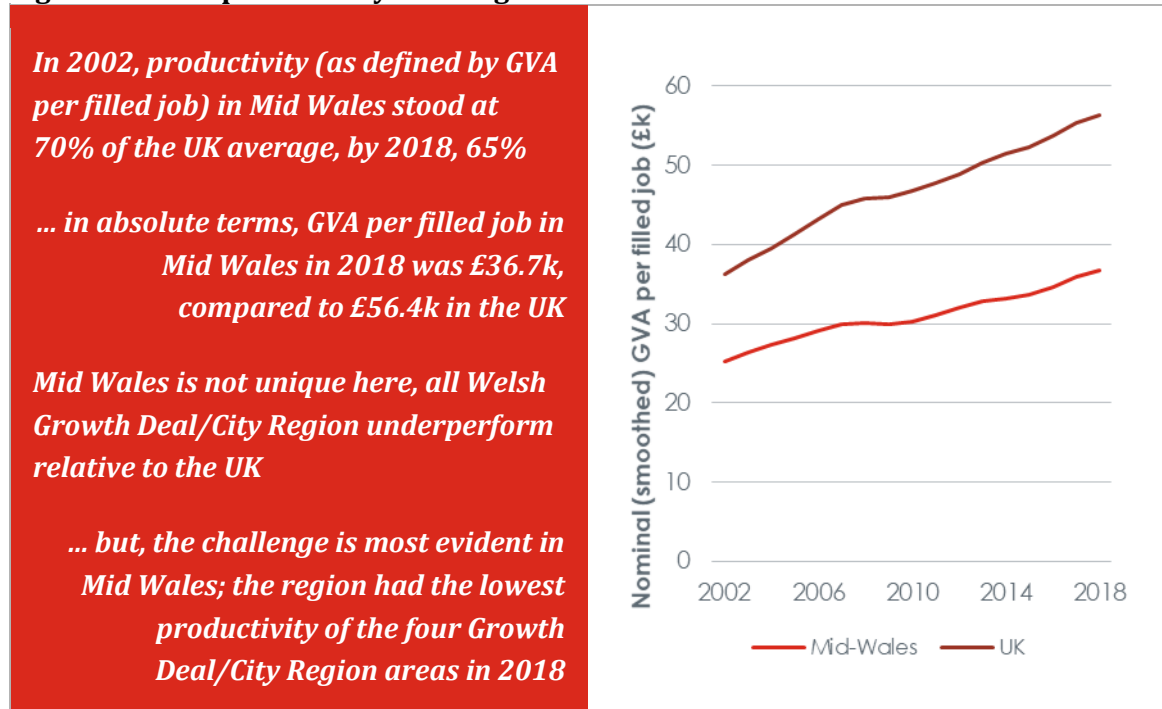
Understanding the place, and its economy

- 3.1 This report is concerned principally with the region’s applied research and innovation assets, capabilities and opportunities. However, for context, and to position this applied research and innovation perspective, the paragraphs that follow provide a brief description of Mid Wales more broadly, as a place and an economy.
- 3.2 Crucially, Mid Wales needs to be recognised as a **truly distinctive and differentiated “place”**. Accounting for over a third of the land-mass of Wales, Mid Wales is known for its natural beauty and remoteness, and has a diverse mix of natural landscape including the Brecon Beacons National Park, Cambrian Mountains and coastal areas. The region’s main urban centres – Newtown, Llandrindod Wells, Brecon and Welshpool in Powys, and Aberystwyth in Ceredigion – play important roles as administrative, service, and commercial

centres, supported by a network of smaller market towns and settlements. Aberystwyth is also a university town, home to around 8,000 students. The culture and heritage of the region is too an important differentiating characteristic: 29% of the region's residents are Welsh speakers, (rising to almost half of residents in Ceredigion) and the region is home to the National Library of Wales, the internationally-renowned Hay Festival and Green Man Festival, and the Royal Welsh Agricultural Show. This distinctiveness provides genuine opportunities to be exploited through, and provide the basis for, applied research and innovation.

- 3.3** At the same time, it is impossible to understand regional applied research and innovation without recognising that the spatial context also presents challenges. Across a region as large, dispersed, and in places remote, as Mid Wales, there are significant issue related to: **connectivity**, in terms of transport, telecommunications, and supply-chains; the **scale and density of economic activity**, with few areas with high concentrations of businesses and employees that can benefit from agglomeration and knowledge-exchange; and in terms of **networks, relationships and priorities**, reflecting the sheer size and diversity of the region, and requiring different policy emphases and agendas in different places to respond to different economic contexts and drivers. Further, the region has an **ageing and declining population**: over 2010-2019, the population fell by 1.4%, but the working age population by 7.9%, with 10,000 fewer people of working age at the end of the last decade than at the start.^{iv}
- 3.4** The **economic profile of the region is also shaped fundamentally by the spatial context**. Agriculture and tourism – both seasonal and with low overall levels of productivity generally – are central to the economy: together, 'Agriculture, forestry & fishing' and 'Accommodation & food services' account for over a quarter of regional employment (27%), compared to 10% across Great Britain. Related to this, Mid Wales is more reliant than most places on micro-businesses, with relatively few medium-sized or large firms.
- 3.5** Importantly, and reflecting in part these challenges and the sectoral mix of the business and employment base in the region, **Mid Wales faces an entrenched productivity challenge**, summarised in Figure 3-1.
- 3.6** There is no short-term fix to this productivity challenge, and applied research and innovation will play only one role alongside other priorities and activities. However, the opportunity for applied research and innovation to support productivity improvement has been a central and consistent theme of this Study, reflecting the commitment of partners to deliver against regional imperatives. To 'move the dial' on productivity performance, identifying, supporting and leveraging fully the assets and strengths fully across the applied research and innovation base will be critical.

Figure 3-1: The productivity challenge for Mid Wales



Applied Research and Innovation ‘assets’

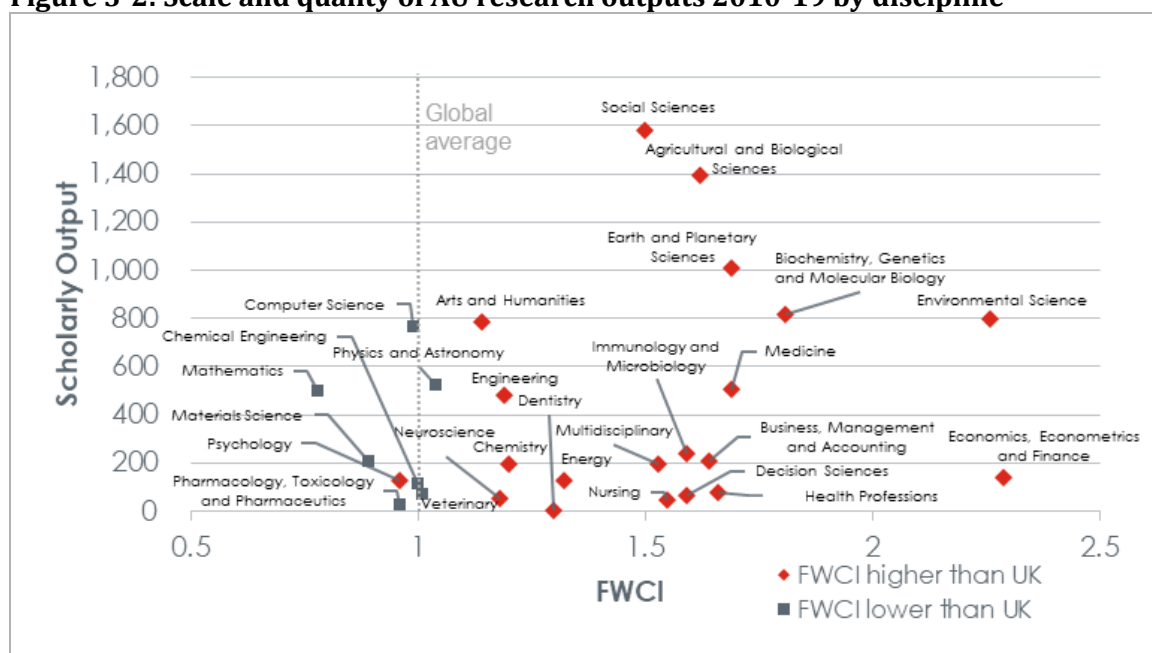
Research and translation organisations

- 3.7** Aberystwyth University (AU) is the largest player in relation to research across the region, and it features extensively in the rest of this report. An internationally significant institution – ranked within the top 500 global universities^v – the university is crucial as:
- a source of research activity and outputs, both basic and applied across its departments and research centres: the University generated approximately 6,350 scholarly outputs^{vi} over 2010-2019, 8% of the Welsh total; and supported over 700 academic staff (7% of all across Wales) and approximately 1,900 staff in all in 2019/20^{vii}
 - the host/founder of key translational assets including the Institute of Biological, Environmental & Rural Sciences (IBERS), AberInnovation, and VetHub1, which play a key role in developing, testing, and progressing new ideas and concepts that have the potential to be commercialised or translated into new products, processes, and services
 - an attractor of students, providing opportunities for employers to access skills and new ideas, as a source of entrepreneurship and new businesses, and in providing a vibrancy and energy for the regional economy and its culture.
- 3.8** As a multi-disciplinary institution, AU has academic expertise across a broad range of disciplines and subjects. However, from an applied research perspective, AU’s strengths in agriculture and biological sciences are particularly important and noteworthy. This was reflected in AU’s strong performance (in a joint submission with Bangor University) in the 2014 REF for the ‘Agriculture, Veterinary and Food Science’ Unit of Assessment (UoA), where

it ranked in the UK 'top ten' in 'research power' and 'impact'. The university also performed strongly in 'Earth Systems and Environmental Sciences' (again with Bangor), and 'Geography, Environmental Studies and Archaeology' (UoAs).

- 3.9** To provide a further perspective on the applied research strengths of AU, considering both recent activity and reflecting long-term strengths, Elsevier's Sci Val database for the 2010-2019 period has been analysed. This provides data on the scale and quality of research outputs across disciplines, the latter measured by Field Weighted Citation Index (FWCI)^{viii}.
- 3.10** As shown in Figure 3-2, disciplines with both (in relative terms) high-scale and high-quality outputs at AU include Agriculture and Biological Sciences; Environmental Science; Biochemistry Genetics and Molecular Biology; and Earth and Planetary Sciences. More detailed sub-discipline data is in Annex E, where two themes emerge: a set of related strengths within agriculture and biological sciences including 'Dairy', 'Plants/genes', 'Wheat', 'Biofuels', and 'Parasites'; and second, a set of strengths in digital technologies and computational science including 'Remote sensing and satellite imagery', 'Algorithms', and 'Modelling'.

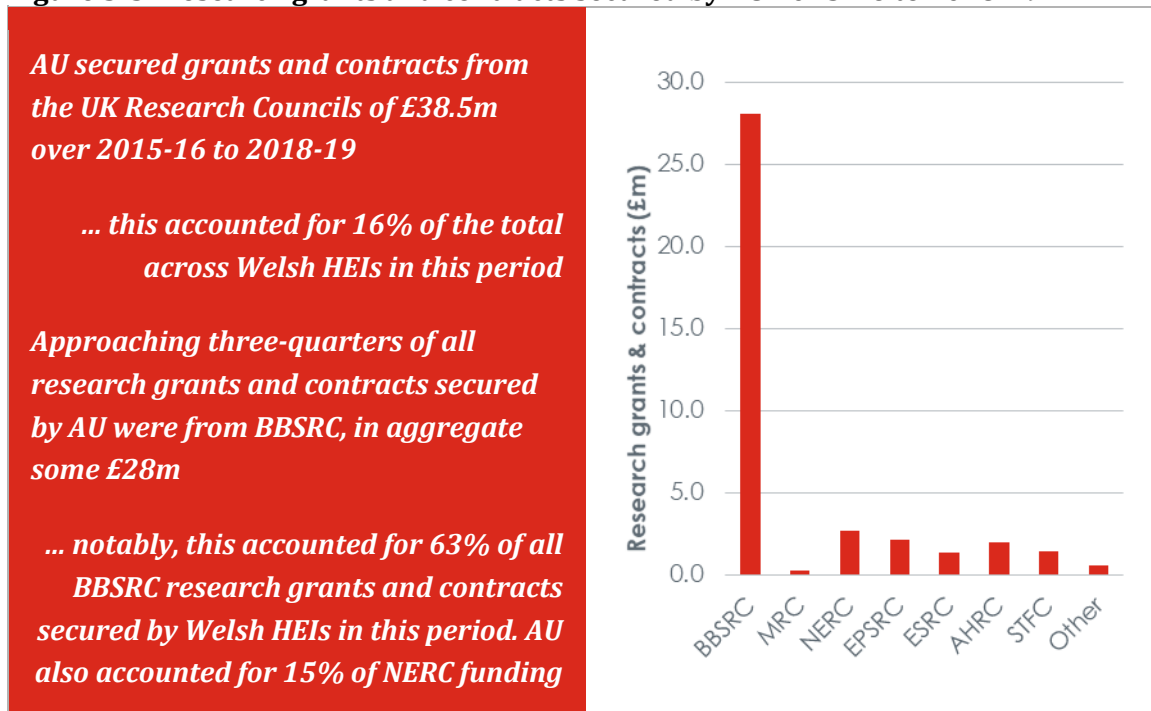
Figure 3-2: Scale and quality of AU research outputs 2010-19 by discipline



Source: SQW analysis of Sci Val © 2020 Elsevier

- 3.11** AU's strength in agriculture and biological sciences is also demonstrated through competitively secured research grants/contracts from UK Research Councils, as shown below: funding from the BBSRC is central to the university, and Welsh capacity and research strength in this crucial research area; this reflects IBERS' status as is one of eight BBSRC 'strategic institutes' nationally.

Figure 3-3: Research grants and contracts secured by AU 2015-16 to 2018-19



Source: Data from ONS Subregional Productivity February 2020

- 3.12** Other research and translation institutions are more specialised, either as a function of their mission e.g. the Centre for Alternative Technology is dedicated to researching and communicating positive solutions for environmental change, or because of their distinctive subject focus e.g. the Lampeter Campus of the University of Wales Trinity St David which focuses on humanities subjects, reflecting its historic role and traditions.
- 3.13** Two other important assets are noted: the National Library of Wales, one of six UK legal deposit libraries and an important centres for research in relation to Welsh culture and heritage, and Food Centre Wales, which offers advice, technical services and training to business start-ups, SMEs and food manufacturers. The role and contribution of these assets is discussed in more detail below and in the insights from the deep-dive research.

... and in the business base

3.14 Mid Wales is home to approximately 8,500 enterprises (with a least one employee), 8% of the total across Wales. However, consistent with the natural landscape, the business base contains both a high (relative) proportion of activity in agriculture, and a large number of businesses with no employees (i.e. sole traders), many of whom are farmers. Taking into account the latter, there were some 12,600 VAT and/or PAYE based enterprises in the region in 2020, of which 37% were in 'Agriculture, forestry & fishing'.

3.15 Key findings on levels of engagement in innovation across the business base are discussed in 'perspectives' below. Further, there is no single or simple definition of what constitutes a business engaging in innovation activity. However, at an overarching level, some reflections can be made on the private sector innovation assets:

- the region contains a modest, but important group of large, internationally significant businesses in high-technology and/or knowledge-based industries: examples include CastAlum, CellPath, and Control Techniques (part of the Nidec Corporation)
- the region is home to some highly innovative and entrepreneurial small businesses; some of these are related to the higher education institutions, formally or informally, whilst others have gravitated to the area owing to its unique spatial and quality of life offer.

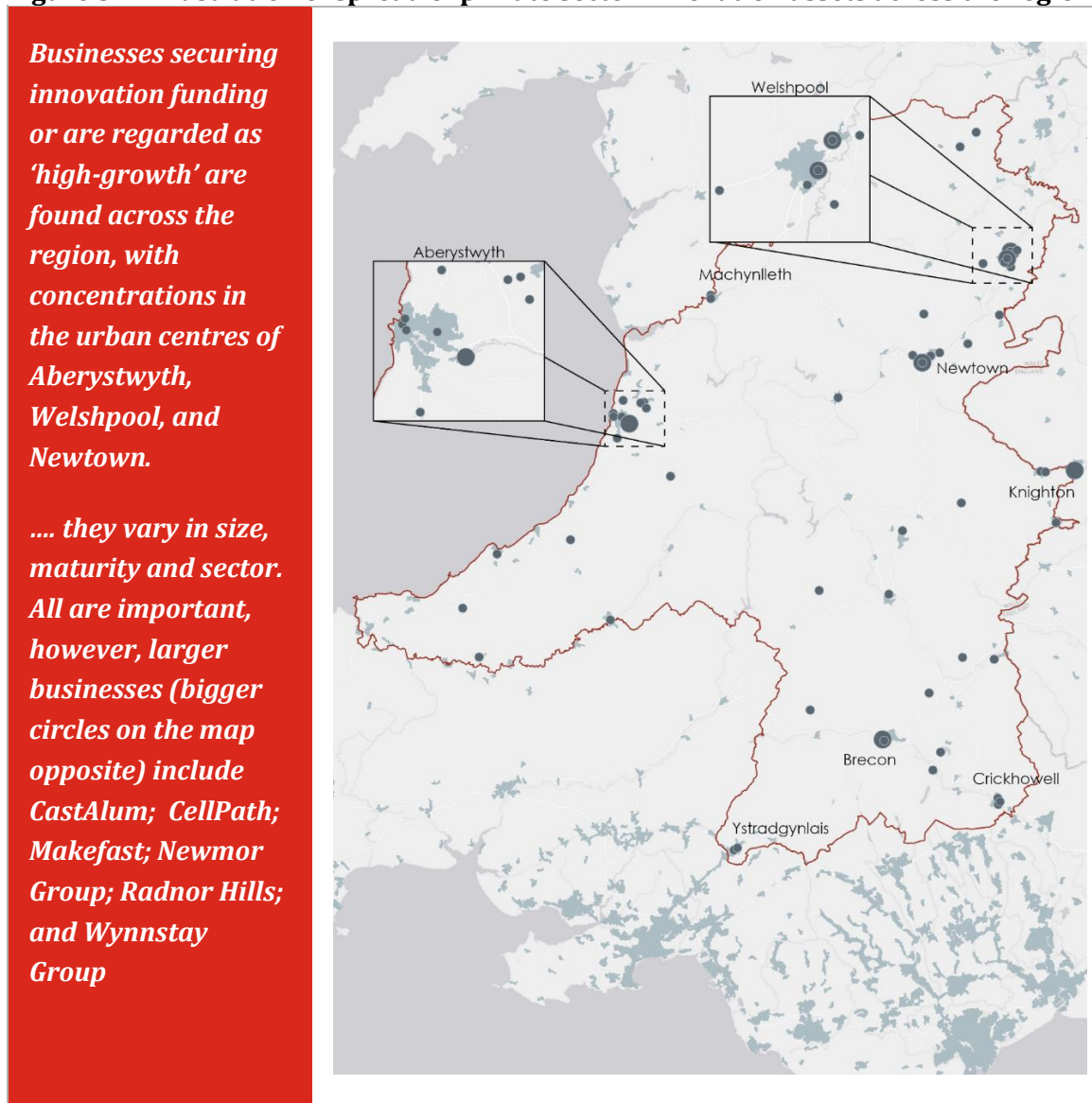
3.16 To provide some insight on the breadth and scale of the private sector innovation asset base, the map below triangulates data from a range of sources, including businesses that have secured Innovate UK or Horizon 2020 grants, businesses identified in the Beauhurst database of high-growth firms in the UK, and businesses involved in KESS2 projects. This map is not intended to be comprehensive – and we recognise that many more individual businesses across the region may be undertaking innovation activity, be this in terms of new product, processes, or organisational innovation. However, the map does provide some insight on the breadth and location of businesses across the region relevant to the applied research and innovation agenda.



There are good companies out there engaged in innovation, but they tend to be scattered across the region, and that coverage is not spread-out evenly



Figure 3-4: Illustration of spread of private sector innovation assets across the region



Source: Produced by SQW 2021. Licence 100030994. Size of dot represents number of employees

3.17 The map indicates that the region does have important private sector innovation assets. However, it is also important to recognise that in relative terms, the region's private sector base is not as strong as it could be in supporting the development, adoption, and diffusion of innovation. Three data-points can be used to illustrate this issue. First, the ONS has developed a formal definition of 'Science and Technology' sectors. Whilst imperfect (as are all sector-based definitions, with businesses working increasingly across industrial classifications and owing to the convergence of technologies), this definition provides a useful indicator of the relative scale and concentration of employment focused on science and technology activity in different places, a useful proxy for levels of innovation. The latest data indicate approximately 10% of employees in Mid Wales were in 'Science and Technology' sectors, compared to a national (GB) average of 18%.

3.18 Second, ONS' 'Business Demography' series provides estimates on the number of 'high growth enterprises' in local areas across the UK,^{ix} Again, this is not a direct proxy for innovation,

however the two are commonly correlated. The latest data indicate Mid Wales accounted for 6.5% of Welsh high growth enterprises, below the share of all enterprises (8.3%).

- 3.19** Third, levels of entrepreneurship in Mid Wales is low relative to Welsh and UK comparators: in 2018, there were 49 ‘business births’ per 10,000 of the working age population in Mid Wales compared to 64 in Wales, and 89 across the UK. Innovation happens across the business base in both established and new firms, but high rates of new business starts-ups are a feature of successful and innovation ecosystems.

Applied Research and Innovation ‘perspectives’

- 3.20** Recognising the key assets supporting applied research and innovation in the region is crucial. A

key focus of this Study is to understand in more detail the processes and mechanisms through which these assets translate into outcomes and impacts of wider benefit for the economy. The deep-dive research covered in the next Section provides detailed insight into these processes in four areas of strength and opportunity for the region: Agri-food and Bioscience, Low Carbon and Green Energy, Advanced Manufacturing, and Enabling Digital Technologies. More broadly from an overall perspective, five important perspectives on applied research and innovation emerged from the quantitative and qualitative evidence. Taken together, they highlight both the strengths and the weakness of the current regional offer and landscape.

Perspective 1: Knowledge exchange processes and capacities

- 3.21** As discussed, Mid Wales is home to internationally recognised academic expertise at Aberystwyth University, and has a collection of other research assets with specific and targeted research strengths. However, the evidence indicates **modest levels of knowledge exchange in the region historically, as measured by standard metrics.**
- 3.22** Notably, despite its applied research strengths, over 2014/15 to 2018/19, there were no formal spin-offs from Aberystwyth University (with or without university ownership), and only one staff start-up. The number of licences granted by the university (including patents, copyright, design, registration and trade-marks) was also modest in this period.
- 3.23** Care is needed in interpreting data on knowledge exchange metrics as different institutions prioritise different mechanisms to realise benefits for the economy and society, including spin-offs and licencing, but also consultancy, collaborative research, and contract research. To provide insight into the *relative* position of Aberystwyth University, Table 3-1 shows the relative ranking of the value of income from these sources in Welsh and UK contexts. The data indicates that the position of the university has not shifted materially in relative terms over this period; this may not be unexpected, but provides scope for greater impact.



Mid Wales is dominated by micro and small firms which don't have dedicated R&D teams, and have little resource to invest in R&D



Table 3-1: Relative position of Aberystwyth University income from consultancy, collaborative research, and contract research in Wales (of 8) and UK (of 166)

	Comparators	2014/15	2015/16	2016/17	2017/18	2018/19
Consultancy	Wales	7	7	7	8	7
	UK	128	128	136	138	127
Collaborative research	Wales	-	4	4	4	4
	UK	-	56	69	58	52
Contract research	Wales	4	4	3	4	5
	UK	68	63	50	64	75

Source: HE Provider Data: Business and Community Interaction

3.24 This said, the research identified two noteworthy positive themes on knowledge exchange:

- The flow of graduate or student start-ups, from a range of regional institutions.** There were over 150 *graduate* start-ups from Aberystwyth University over 2014/15 to 2018/19 (within the top-40 for all UK institutions), and CAT has a strong record in generating low carbon/sustainability-focused spin-outs/start-ups. Further, whilst the data is not disaggregated by campus, and many will be from campuses based outside of the region, UWTSO also performs very strongly in generating graduate start-ups (c.350 over 2014/15 to 2018/19, 15th highest across UK institutions). Whilst not all of these businesses will have stayed (or been started) within the region (this data is not recorded/available^x), this flow of graduate start-ups provides a major potential source of innovation and business growth to be exploited if sustained going forward. Retaining more of them in the region over the long-term is crucial.
- The role of AberInnovation as a focal point for knowledge exchange and enterprise development.** Drawing on the research strengths of the University in agri-science and bio-science, AberInnovation has become a crucial element of the regional innovation ecosystem, and now is home to a substantive and growing community of SMEs, research partnerships (also generating income for the university), and the location for the delivery of knowledge exchange activities and programmes, including BioAccelerate. The role of AberInnovation in translating knowledge from the university to the wider business base was recognised consistently in the qualitative research for this Study.



CAT has been at the forefront of applying research and new techniques, and then taking them forward through spin out companies



Perspective 2: Innovation engagement and funding

3.25 A range of data-points provide insight into the level of engagement in innovation across the region, and the finance/funding that supports this activity. Overall, the data indicate **levels of**

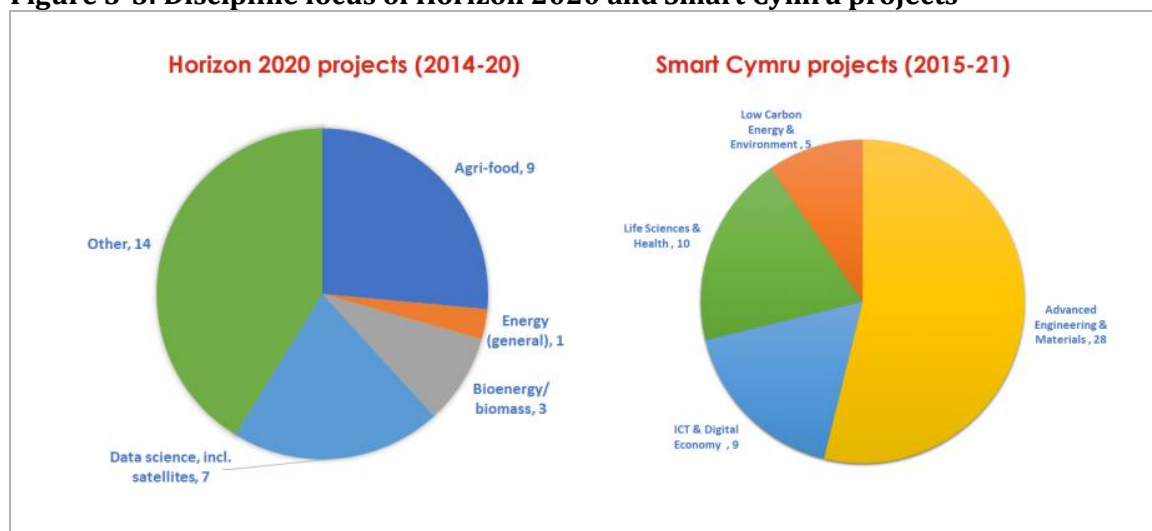
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innovation are modest both absolutely and in relative terms. Arguably, the region is not maximising its potential in leveraging public applied research and innovation funding. Detailed information is provided in the supporting Data Annex. The following are highlighted:

- **100 R&D tax credit claims were made in 2017/18.** However, and perhaps reflecting the composition of the regional business base, this represents a lower percentage of all Welsh R&D tax credit claims than the Mid Wales share of the business base in Wales would suggest. In addition, the level of claims has remained relatively stable in recent years unlike the 10% growth seen in Wales and the UK as a whole
- **28 organisations in Mid Wales have been involved in KESS2 projects**, which link companies/organisations with academic expertise in Welsh universities (including Aberystwyth); 18 of these organisations are based in Aberystwyth
- **businesses in the region were awarded 52 Smart Cymru projects over Q1 2015-Q1 2021** (to a total value of £1.8m); this was a 7.4% share of the value of awards across Wales over this period, compared to the region accounting for 8.3% of the business base
- **20 Mid Wales-based organisations have been involved in Innovate UK projects over 2015/16 to 2020/21** (in 40 projects, of which 20 were led by Mid Wales organisations), and seven organisations involved in Horizon 2020 projects (in 34 projects).

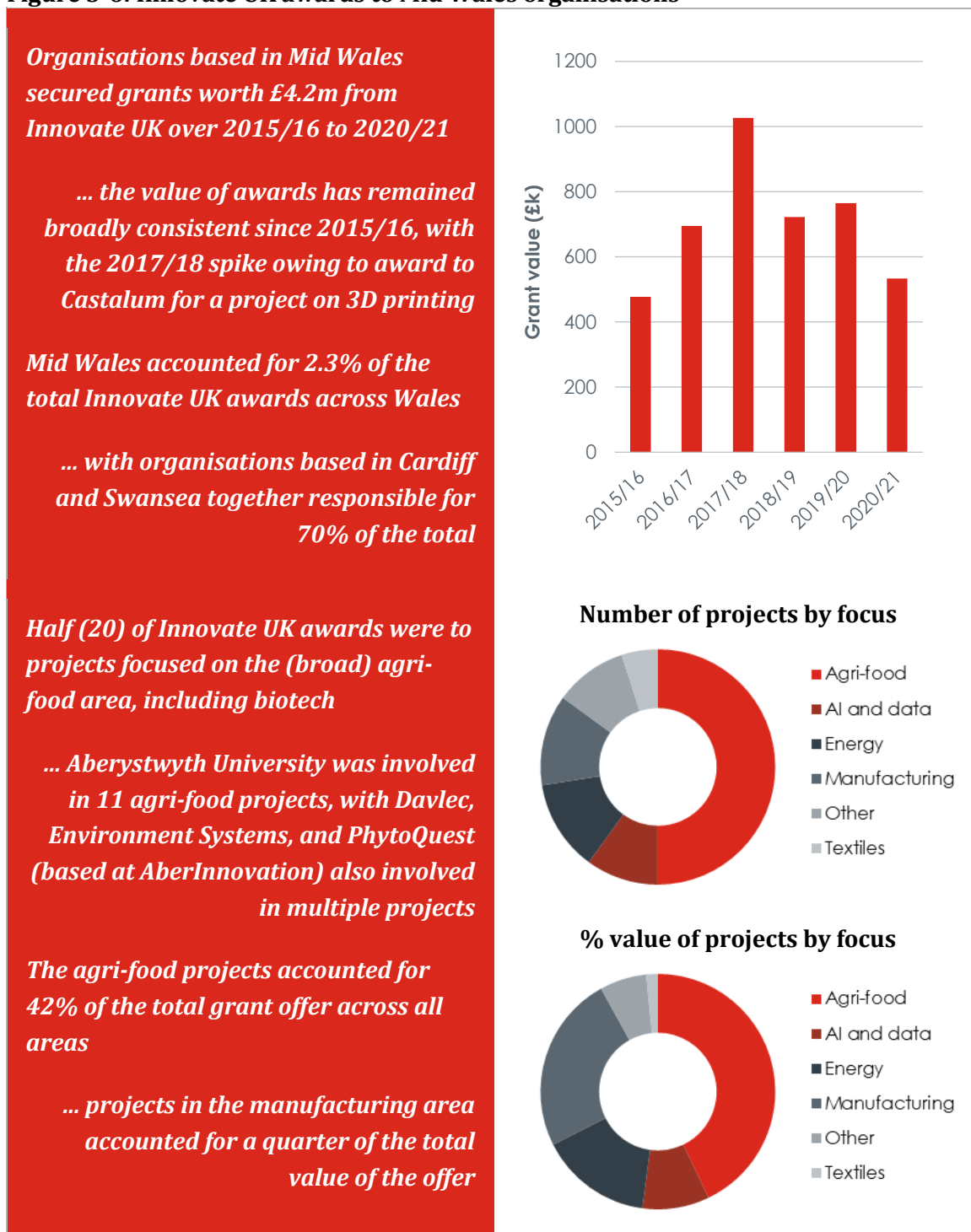
3.26 The sector/discipline focus of the Horizon 2020 and Smart Cymru awards are shown in Figure 3-5. More detailed information on the Innovate UK awards is set out in Figure 3-6.

Figure 3-5: Discipline focus of Horizon 2020 and Smart Cymru projects^{xi}



Source: Horizon 2020 and Welsh Government

Figure 3-6: Innovate UK awards to Mid Wales organisations



Source: SQW analysis of Innovate UK grants database

3.27 Both Innovate UK and Horizon 2020 data highlight **the central role of Aberystwyth University in leveraging innovation funding to the region**: the university was involved in 15 of the 43 Innovate UK projects, and 29 of the 34 Horizon 2020 awards.

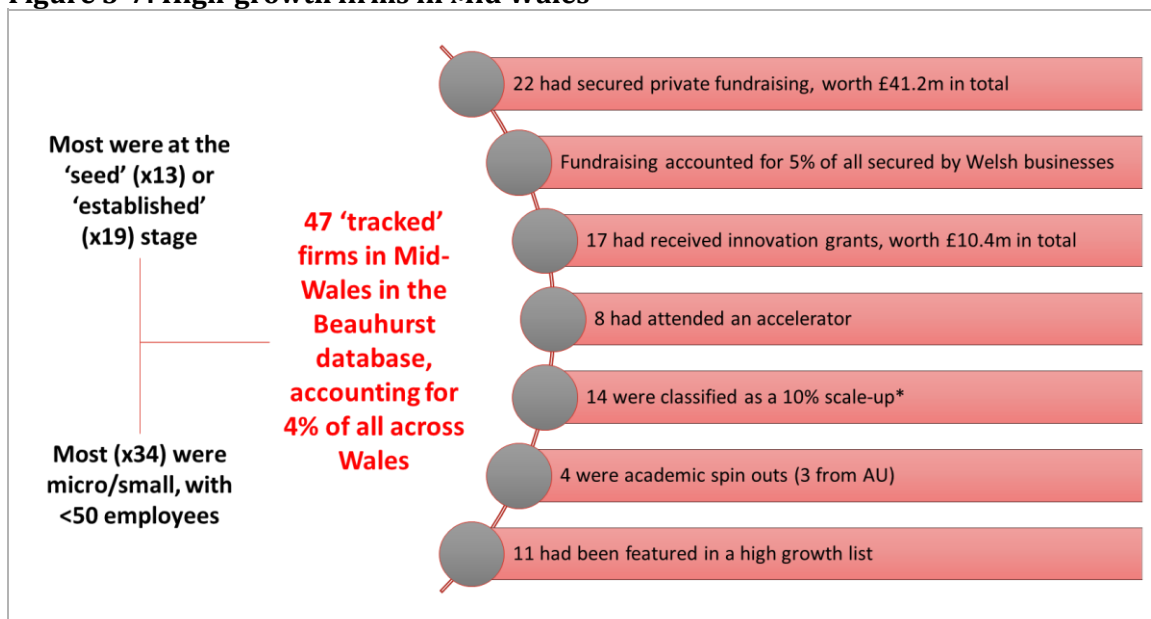
3.28 The data above provide insight into Innovate UK funding secured by specific organisations. However, a substantial volume of support has also been provided to a broader pool of businesses and individuals via Structural Funds projects. The focus here is on projects funded via Structural Funds that are *relevant directly to applied research and innovation*. Further to

funding for investments in key assets including Vet Hub1 and Beacon at Aberystwyth University (discussed in more detail in the 'deep dives'), key projects include:

- The **Geographical Data & Earth Observation for Monitoring (GEOM) project** delivered by Aberystwyth University and involving QinetiQ, supporting SMEs and organisations in Wales exploit the spatial intelligence market
- **BioInnovation Wales**, a partnership between IBERS and Swansea University helping employers address high level skills shortages in the agri-food and biotech sector by targeting target people already working in the sector, offering bespoke qualifications and industry accredited skills tailored to industry needs
- **Sêr Cymru II** – a programme aimed at growing and developing academic research expertise in Wales. Both Aberystwyth University and University of Wales Trinity Saint David are host institutions for the programme, and the Sêr Cymru II funded **Centre of Excellence for Bovine TB** is based at Aberystwyth University
- **The Future Foods project**, focused on supporting technology transfer and university-enterprise cooperation primarily benefiting SMEs in the Welsh food industry
- The ongoing **Advanced Design Engineering** project delivered by University of Wales Trinity Saint David focusses on supporting manufacturing businesses to adopt advanced technology in their process and production
- Aberystwyth University is also a partner in delivering applied research and innovation Structural Funds projects lead by other institutions. For example:
 - **FLEXIS West** (focussed on energy research) and the pan-Wales **Supercomputing Wales** project which are both led by Cardiff University
 - **ASTUTE 2020** (which supports businesses to adopt advanced manufacturing technologies) and **Solar Photovoltaic Academic Research Consortium (SPARC II)** both led by Swansea University
 - **Centre for Photonics Expertise** (an academic-industrial collaborative research partnership) led by Wrexham Glyndŵr University.

3.29 The findings above have focused on public sources of funding for applied research and innovation. However, more limited data is available on private-sector finance. Data from the Beauhurst database of high-growth firms in the UK provides some insights. This is important as entrepreneurial finance is often considered crucial in supporting the development of effective innovation ecosystems and establishment and growth of new venture start-ups, often involving high risk equity investment in potential high growth firms. Such equity investment can play a role in forming a cohesive finance escalator for university applied research, and the commercialisation of innovative spin-outs.

Figure 3-7: High-growth firms in Mid Wales



*Source: SQW analysis of Beauhurst databaseⁱⁱⁱ * Annualised average growth rate of at least 10% in turnover over 3 accounting years AND it had at least £200k in revenue in its base year; OR It had an annualised average growth rate of at least 10% in headcount over 3 accounting years AND it had at least 20 employees in its base year.*

3.30 Consistent with the wider evidence, this data suggests that the region is currently under-represented in a Welsh context in terms of high-growth firms and private finance. This said, it is notable in itself that the region currently contains approaching 50 high-growth firms, which are recognised as important for driving economic growth and productivity.

Perspective 3: Skills and human capital

3.31 Skills across the workforce sit outside the formal remit of this Study, and will be addressed through the work of the recently established Mid Wales Skills Partnership. However, whilst Mid Wales performs strongly overall on skills (with relatively more people with at least degree-level qualification and fewer with no qualifications than the UK and Wales) **skills gaps and issues in recruiting well-qualified and ambitious (particularly young people) to support innovation across the business base was consistently identified as a challenge for the region in the Study.**

3.32 This reflects in part the geography of Mid Wales, and wider trends in the UK labour market, with young people increasingly attracted to work in major cities offering both employment and wider quality of life opportunities. Further, as noted above the working-age population in the region has been declining over time, limiting the local talent pool for employees. Skills gaps were identified in consultations with a particular emphasis on digital skills and advanced manufacturing, which are discussed in more detail in Section 4 deep-dive findings.



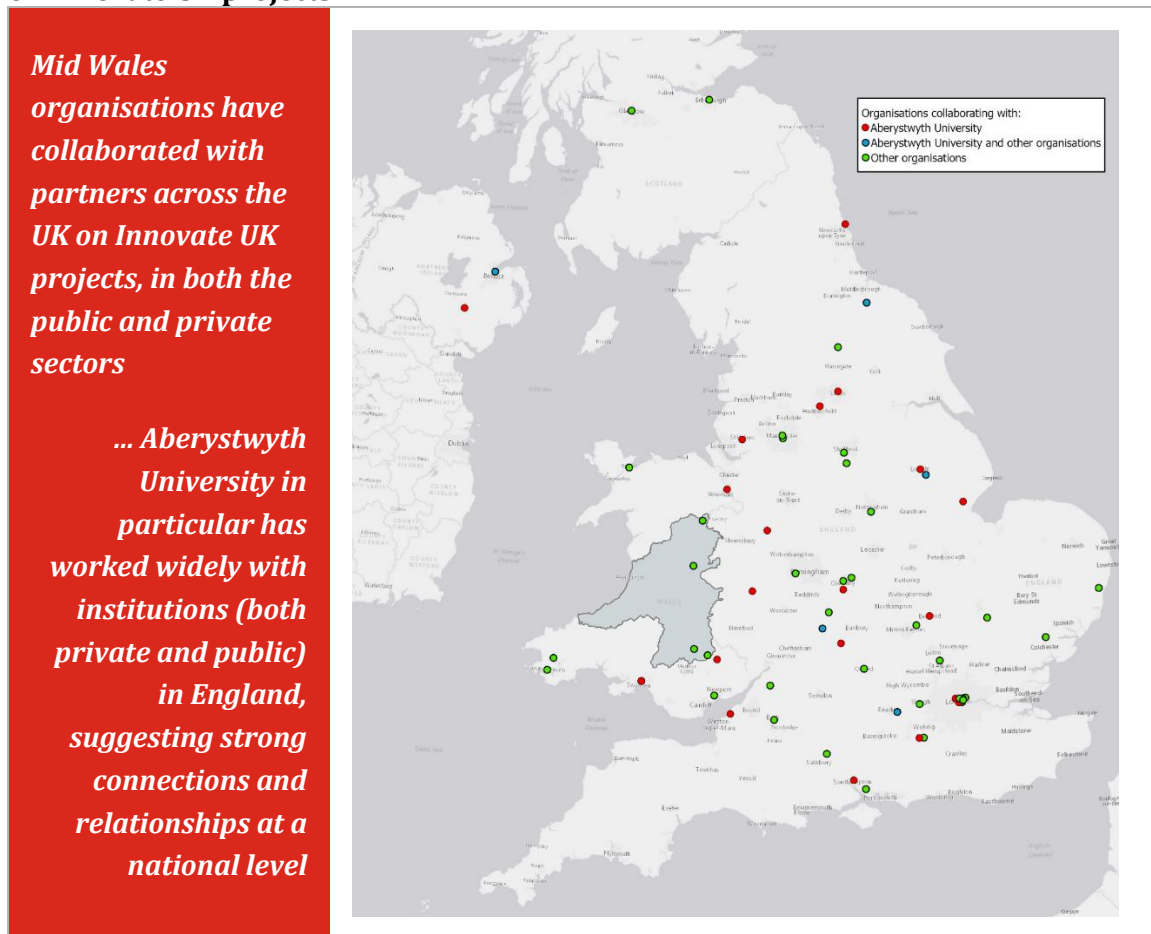
You'll regularly find companies whose growth plans are on hold because of an unfilled recruitment opportunity. It is a big problem for the region

Perspective 4: Links and relationships



- 3.33** A premise underpinning this Study, is that the strength – actual or potential – of the regional offer in applied research and innovation rests in part on the linkages – both formal and informal – between its institutions. “Links” are very difficult to measure formally. At a high level, some insight can be provided by considering the extent to which regional actors are collaborating on formal applied research and innovation activity and projects. As discussed in the next section, the deep dive research identified some important and developing links, for example between Aberystwyth University, CAT and the Lampeter Campus at UWTSD.
- 3.34** However, beyond these focused relationships, evidence on regional collaborations in applied research and innovation is limited. For example, it is notable that of the 40 Innovate UK projects over 2015/16 to 2020/21 involving Mid Wales organisations, in only three cases did this involve more than one organisation in Mid Wales. Where the projects involved collaboration (in nearly all cases) this was overwhelmingly with organisations outside of Mid Wales; the spatial distribution is summarised below. Two Aberystwyth University projects also included international collaborations, with partners in France and India, both involved in crop/seed science related projects.
- 3.35** It is not unexpected that Innovate UK projects commonly involve organisations outside of Mid Wales, with regional leads seeking to engage expertise where it is found, and organisations Mid Wales often acting as partners to projects led by organisations based elsewhere. However, the level of intra-regional collaboration in these projects is arguably lower than it could be if the regional innovation ecosystem was operating optimally.

Figure 3-8: Location of UK organisations co-operating with Mid Wales organisations on Innovate UK projects



Source: Produced by SQW 2019. Licence 100030994

3.36 During consultations with stakeholders across the region, there was consistent feedback that there was scope for greater levels of academic-to-business and business-to-business collaboration. Given the scale and breadth of the region, and the relative novelty of pan-regional working, it is perhaps not unexpected that these linkages are not yet fully developed.

3.37 Further, given the importance of personal relationships and shared spaces, localised networks - often shaped around individual assets and businesses - are likely to remain crucial. However, the Study suggests that there is scope to strengthen both formal and informal networks within and across the region.

3.38 This said, **linkages with applied research and innovation actors outside of the region are also crucial**; this is particularly relevant for Mid Wales given its own asset base.

“
Alignment between research and businesses in the region is not where it needs to be. The region needs to look at how it can better capitalise on its research strengths
 ”

Particularly important are linkages with proximate institutions, notably the universities of Bangor, Cardiff and Swansea, as well as leveraging linkages with UWTSU's Swansea campus.

3.39 In this context, Aberystwyth University is a genuinely national and international actor, providing the region with important linkages to skills, ideas, and innovations elsewhere. For example, Sci Val data indicates the university was involved in co-authored publication with over 2,000 institutions worldwide, including over 500 with institution in the USA, over 400 in China, and over 300 in Germany. The most regular collaborator institutions in the UK and overseas are shown below (including the number of co-authored publications).

Table 3-2: Most regular collaborators for AU co-authored publications (2014 to 2021)

UK institutions (Welsh in bold)	International institutions
<ul style="list-style-type: none"> • University of Cambridge -122 • Bangor University - 105 • University of Edinburgh - 99 • Cardiff University - 87 • Swansea University - 85 • University of Leeds - 85 • University of Oxford - 83 • University of Sheffield - 83 • University of Manchester - 77 • University of Exeter - 73 • University College London - 66 • University of Birmingham - 66 	<ul style="list-style-type: none"> • CNRS (French National Centre for Scientific Research) - 149 • CSIC (Spanish National Research Council) - 77 • Chinese Academy of Sciences - 77 • INRAE (French National Institute of Agricultural Research) - 77 • University of New South Wales - 63 • University of Copenhagen - 59 • Wageningen University & Research - 55 • Aarhus University - 48 • Shanghai University - 44

Source: SQW analysis of Sci Val © 2020 Elsevier

3.40 More detailed findings on collaborations in the deep-dive areas are discussed in Section 4, including the importance of links to external research and translation assets for businesses engaged in innovation activities, including university-led centres of applied research in Wales

Perspective 5: Attitudes and mindsets

3.41 One final overarching perspective is highlighted, related to attitudes and mindsets regarding applied research and innovation across Mid Wales. This is inherently *not* about data and quantitative evidence, and therefore more challenging to demonstrate formally. However, an important theme that emerged from the qualitative research for this Study was **the need for Mid Wales to be more open and willing to engage and invest in applied research and innovation activity**. There was a perception of a 'cultural reluctance' to take risks, prioritise and promote applied research and innovation at a regional level, including where this may involve hard choices on resource allocation and prioritisation.

3.42 To be clear, this was not a criticism of the actions or approaches by specific institutions, individuals or organisations, rather, that at a pan-regional level, traditionally there have not been the incentives, networks and mechanisms (including funding) to deliver a more ambitious approach to supporting applied research and innovation.

3.43 This cultural challenge was associated by some with the economic, functional and demographic structure and profile of the region, and the (relatively) modest base of institutions engaged visibly in applied research and innovation.

3.44 This said, there was consistent feedback of a positive shift in recent years in this space, including an increasing recognition of, and focus

by, Aberystwyth University in its role as a regional economic actor, as reflected in its current 2018-2023 Strategic Plan that sets out the objective to grow the contribution of the university to the local and wider economy and the underpinning Research and Innovation Strategy. Given the vital role of Aberystwyth University in the regional applied research and innovation landscape – in leveraging funding, as a collaborator on innovation projects, and in delivering knowledge exchange activities – this provides a positive foundation for embedding a broader approach to recognising the importance of applied research and innovation. The qualitative feedback also showed a clear appetite from academic partners and innovative businesses in the region to engage in more applied R&I activity.

3.45 Further, there was a view that more could be done to showcase and champion the region's capabilities and strengths both nationally and internationally, helping to build new relationships, strategic partnerships and generate interest and momentum in the region. These distinctive capabilities and strengths have been considered in more detail in the deep-dive research discussed in the next section.



There needs to be a cultural and behavioural shift to promote applied research and innovation activity. This is fundamental to ongoing business success



4. Insights from the ‘deep-dive’ research

Coverage

- 4.1 In the first part of this Section, we present a summary of key messages from the thematic deep dive research covering the four following areas:



- 4.2 The deep dive research has been informed by data analysis, review of literature and a total of 41 consultations with public sector bodies, representative organisations and innovative firms across the region. Please turn to Annexes A to D for more detailed analysis on each theme.
- 4.3 The second part of this Section then synthesises the deep dive evidence, drawing out the common (or theme specific) opportunities and challenges, exploring linkages and relationships *between* the themes, and identifying the implications for strategic priorities for applied research and innovation in Mid Wales.

Framing the deep dive analysis

- 4.4 Two points are highlighted regarding the focus and approach to the deep dive research. First, the deep dives represent broad thematic areas, and focus on competencies and specialisms in applied research and innovation, not specific industrial sectors or markets. The purpose of the themes was to provide an accessible analytical framework for the Study to focus on, and to frame the data analysis and engagement process.
- 4.5 Second, and in this context, **the research process was an explicitly ‘exploratory’ one**, that did not set out with a defined list of sectors or disciplines, but broad hypotheses (as set out in the Brief for this Study, and the Vision for Growing Mid Wales) on what the region is seen to be fundamentally ‘good at’ in applied research and innovation and/or what it ‘could be good at potentially’. The Study was tasked with testing the validity of the themes, and, where appropriate, drilling down to focus on particular specialisms where the region had genuine excellence, leadership, credibility and opportunity. The findings therefore reflect a mix of quantitative and qualitative evidence from the study analysis, and are somewhat different in their emphasis, scope, and depth.

Thematic summaries

Agri-food and Bioscience

- 4.6** Agri-food and Bioscience is an evidenced and well-recognised strength of the Mid Wales applied research and innovation system, with scale, diversity and depth. Expertise in plant breeding/soils, biorefining, and animal health are well-established, with emerging and connected opportunities in food manufacturing, veterinary science, agri-technologies (such as AI and satellite navigation), and controlled environment agriculture.
- 4.7** Aberystwyth University is the key institution, complemented by other research and innovation centres, HQs of national sector bodies, and a growing cohort of innovative agri-tech firms. But challenges are evident in maximising the commercialisation potential of research, academic/business engagement, and promoting the adoption of innovations across the agri-food business base. Further to this, more could be done to strengthen and promote regional agri-bioscience expertise as an integrated ecosystem of strengths/critical mass, encourage greater collaboration within and across key sectors (including into low carbon and digital), and leverage the translation of research for local economic and environmental benefit.
- 4.8** Based on the evidence gathered for this deep dive, it is imperative that the region: first, ensures that research strengths generate maximum economic value (i.e. via commercialisation where appropriate); second, ensures that innovative firms in the sector are supported to re-locate, start up and grow in Mid Wales (i.e. ensuring the “stickiness” of private-led R&I) and third, takes advantage of the strong alignment between the region’s research and innovation expertise and environment to ensure economic benefits are maximised in the effect in the local economy, which relies on effective knowledge transfer and diffusion on the supply side, and “innovation readiness” and adoption on the demand side.
- 4.9** In this context, key applied research and innovation priorities in Agri-food and Bioscience are to:
- Address co-ordination failures at a strategic level, to provide clear strategic leadership and co-ordination, an agreed strategic direction to accelerate the development of this sector, and facilitate opportunities associated with connecting local research expertise/the local environment as an ideal test bed/local businesses as prime beneficiaries.

“
Expertise in plant breeding/soils, biorefining, and animal health are well-established, with emerging opportunities in food manufacturing, veterinary science and agri-tech
 ”

- Address co-ordination/networking failures at an operational level, to (i) facilitate collaboration and synergies between strengths within agri/bioscience sector and across sectors, particularly to low carbon and digital, (ii) encourage more extensive/new academic-to-businesses and business-to-business collaborations across the region, and (iii) maximise the networks (and associated benefits/opportunities) associated with having national sector bodies headquartered and major agri innovation assets present in the region.
- Address funding gaps to (i) raise awareness of/facilitate access to existing public funding and private financing opportunities, and/or (ii) consider developing a locally tailored, flexible financing mechanism to de-risk innovation/act as a bridge to existing sources of finance, potentially using this as a mechanism to encourage local/cross sector collaboration and locally-based start-up/growth of innovative firms.
- Address the lack of appropriate grow-on space and larger-scale testing facilities, to ensure that growing innovative firms are able to stay in Mid Wales, and medium/larger innovative firms are attracted to the region.
- Address information failures (and potentially adoption finance gaps) hindering knowledge diffusion/spillovers of local research expertise to agricultural businesses in the region to maximise local economic benefits.

SWOT assessment

Strengths

- Well-established and nationally/internationally recognised, predominantly (but not entirely) academic driven, strengths in:
 - **Plants and soils:** seeds/plant breeding, especially in grasses/oats, and associated sustainable land/soil management (and carbon capture/GHG reduction)
 - **Biorefining:** developing new/innovative feedstocks (e.g. miscanthus via seeds) and refining processes (linking to plants, and low carbon)
 - **Animal health:** expertise in livestock nutrition and emissions (linked to grasses/soils) and disease/infection (linked to veterinary).
- **Strong research institution** in Aberystwyth University (AU), with high quality and volume of academic outputs in key/relevant subject areas. Existing linkages across relevant departments, incl. IBERS, Geography and Computer Science.
- **Strong performance by AU in leverage of R&D funding:** including CR&D with business as route to commercialisation. Provides extensive R&D facilities/test beds, particularly at pilot scale.
- Multiple other assets, including **HQs of agri-related public and private organisations** (e.g. sector representative bodies and business support providers), and a **small but growing group of innovative agri-tech firms**
- Multiple examples of **R&I project activity and collaborations**, including intra-regional, most involving or led by AU.

Opportunities

- Major strategic opportunities/challenges where Mid Wales is very well placed to contribute, both research expertise and application to local agricultural sector, e.g. competitiveness, productivity and adding value to the agri sector *alongside* sustainable land management (in the context of

Weaknesses

- **A lack of strategic leadership and strategic collaboration across the sector(s) and across different types of organisation.** Issues include:
 - a reliance on bilateral or project-based collaborations, often via personal or historic relationships
 - a perceived lack of alignment and co-ordination between partners (academic/industry/Govt), or ownership of/responsibility for co-ordination
 - the lack of a collective ambition or proactive plan for growth that partners can rally and collaborate around
 - the lack of a forum to explore cross-agri and cross-sector (e.g. digital) opportunities.
- Scope for a **more consistent and co-ordinated narrative externally** in the promotion of Mid Wales' applied R&I strengths in this sector.
- **Barriers to academic-business engagement** and the appetite/need to do more in this space. Challenges identified in businesses accessing the local research offer.
- **Barriers to business-to-business collaboration**, including a lack of awareness/network to explore potential synergies between firms in Mid Wales.
- **Commercialisation capacity and skills issues** within the academic base, including investment readiness and business acumen.
- **Innovation adoption challenges across the agricultural sector**, including the lack the resource, capacity, knowledge or confidence to adopt new innovations.
- **R&I funding gaps** for later stage R&D to reach commercialisation and scale-up, and limited engagement with private finance.

<p>CAP reform), reduction in GHG emissions, zero waste, and post-pandemic concerns relating to disease/vaccines.</p> <ul style="list-style-type: none"> • A strong supply of graduates and post-docs from AU with highly relevant skills sets and fresh thinking for new and growing agri-tech firms in the region. • Key emerging sub-sector opportunities for Mid Wales in: <ul style="list-style-type: none"> ➤ Veterinary science: a number of recent developments, including VetHub1 and its CAT 3 labs, Vet School, Ser Cymru expert and Centre of Excellence for TB. Plus related assets, e.g. Welsh Veterinary Science Centre and the Iechyd Da (Veterinary Consortium), Barrett Centre for Helminth Control. Particular expertise in parasitology, infectious disease, vaccines. Bilateral connections to well-established expertise above ➤ Food manufacturing: R&I expertise relates to food testing/analysis of nutrition and the development of new products. • Other opportunity areas, are currently very niche/nascent: <ul style="list-style-type: none"> ➤ Agri-tech, particularly in terms of (i) related capabilities in earth observation, remote sensing, satellites and (ii) expertise in AI and robotics: existing pockets of expertise at AU and presence of technology-led, highly innovative small firms, but scope to strengthen <i>via collaboration/ association with agri expertise above</i> ➤ Big data/analytics in the context of agriculture, connecting the extensive volume of data generated by some of the key assets in Mid Wales (e.g. National Plant Phenomics Centre) with the University's computing and data analytics/modelling expertise and IBERS' supercomputer ➤ Controlled Environment Agriculture: strong but very small-scale expertise at present, a key opportunity for Mid Wales relates to combining expertise in computer science, remote sensing, robotics alongside plant breeding and nutrition ➤ Zero carbon farming, where Mid Wales is home to a variety of landscapes/environments available to trial, demonstrate and test low 	<ul style="list-style-type: none"> • Insufficient grow-on space and testing facilities at scale, specifically in terms of grow-on space for innovative agri-tech firms seeking to scale-up, and specialist facilities for later stage R&D/testing at scale in order to support commercialisation (e.g. in biorefining, vaccine testing). • The lack of knowledge amongst young people of opportunities in this sector, and the need to inspire and raise the aspirations of young people in relation to well-paid career opportunities. <p>Threats</p> <ul style="list-style-type: none"> • Growth in key competitor areas, which outpaces Mid Wales, both in terms of their expertise and, in some cases, more effective internal co-ordination and external promotion. There may be scope to strengthen relationships with assets/strengths outside of Mid Wales in order to achieve a combined critical mass by working more effectively together. • Brexit, and potential loss of markets for sector and R&I funding streams (with associated uncertainty around replacements at this stage) • Leakage of opportunities to proximate institutions over the border, potentially offset by the opportunity to enhance relationships (e.g. with Harper Adams and the Agri-EPI Centre focused on precision farming in Shropshire).
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<p>carbon technologies/practices, but this could be better 'packaged' and promoted as a zero-carbon farming offer/solution</p> <ul style="list-style-type: none">➤ Linking animal health expertise to human health, potentially via collaboration between Mid Wales expertise in disease with human health expertise outside of the region➤ Alternative proteins, particularly in terms of plant and fungal protein➤ Green construction materials, transferring expertise in plants/seeds/non-food crops into sustainable materials (links to Low Carbon and Green Energy).	
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Low Carbon and Green Energy

4.10 Mid Wales has emerging and focused applied research and innovation strengths in Low Carbon and Green Energy. The region's offer is framed principally around maximising the potential from key education and research assets (Aberystwyth University and the Centre for Alternative Technology). These assets complement and can help to leverage fully the economic potential from the natural landscape, and the renewable energy opportunities this provides, including the region as a 'test-bed' for low carbon/sustainability initiatives.

4.11 The deep-dive research identified distinct areas of applied research and innovation focus including biomass and biowastes (which is integrated with and complements the Agri-food and Bioscience deep-dive area), sustainable construction materials and retrofitting, and supporting the commercial exploitation of, and innovation in, renewable energy generation. However, there is currently less integration and engagement – strategically and operationally – across institutions and sub-disciplines than there could be. Broader infrastructure, funding, and skills issues are also key barriers.

4.12 In this context, key applied research and innovation priorities in Low Carbon and Green Energy are to:

- Address coordination/networking failures at a strategic level to provide clear strategic leadership and co-ordination, an agreed strategic direction to accelerate developments in this area, and facilitate opportunities associated with connecting local research expertise/the local environment as an ideal test bed/local businesses as prime beneficiaries.
- Address coordination/networking failures at an operational level to facilitate collaboration and synergies between strengths within low carbon/green energy and across to related areas, particularly to agri/bioscience and advanced manufacturing, (ii) encourage more extensive/new academic-to-businesses and business-to-business collaborations across the region, and (iii) maximise the networks (and associated benefits/opportunities) associated with having nationally and internationally significant assets (in particular CAT) present in the region.
- Develop the institutional capacity of the region, to provide the people, assets and funding to develop and grow applied research and innovation activity within the area, both in terms of operational and leadership / coordination capacity.



The Mid Wales offer is framed around education and research assets, and leveraging the natural landscape, including as a 'test-bed' for low carbon initiatives



SWOT assessment

Strengths

- **Research capacity and expertise networks in energy and environment:** with significant scale and high-quality research at Aberystwyth University, notably in renewable energy, sustainability and the environment, and water science (plus associated and related disciplines); the University also has established research relationships with other key research centres across the UK, and key innovation assets/projects e.g. IBERS, BEACON.
- **Presence of the Centre for Alternative Technology:** at the forefront of applying research and new techniques in environmental sustainability, and a strong track-record in growing successful spin-outs/start-ups (50+).
- **Innovative companies:** a modest, but important and competitive, collection of innovative firms operating in the (broad) Low Carbon and Green Energy area, including those with links in some cases to regional (and non-regional) research and education assets.
- **Underpinning regional landscape and natural environment:** the region is well-placed for exploitation of research and innovation related to renewable energy and low-carbon agriculture (including energy crops) in particular.

Opportunities

- **Developing relationships between key regional education and research institutions:** notably between Aberystwyth University (including IBERS) and Centre for Alternative Technology, as well as key Further Education institutions in Neath Port Talbot College and Black Mountains College, with a range of opportunities currently under discussion/in progress.
- **Scope to leverage existing renewable energy generation assets/infrastructure** for onshore wind, hydroelectric, solar PV: potential for regional research and innovation to support an increase in renewable energy generating capacity, primarily in terms of onshore wind, as well as solar PV and hydrogen, under the right policy conditions.
- **Sub-discipline opportunity areas** with scope to exploit further research and education strengths, specifically:

Weaknesses

- **Centre for Alternative Technology research capacity:** constraints on research potential and scope owing to teaching commitments at the Centre.
- **Business support and funding:** funding for specific technologies/ applications is reported to be hard to find and access. For micro businesses, moving from conceptual stage to product delivery/ application is difficult, with further business support (both financial and in terms of capacity development) needed.
- **Sub-optimal networks/collaborations:** greater collaboration and cross-fertilisation is needed amongst businesses, and to foster linkages between the research and education base and businesses; this is evident at both a strategic and operational level.
- **Skills for innovation:** reported lack of knowledge/expertise in the region to implement renewable energy projects and exploit new innovations (e.g. in the construction sector); this is exacerbated by national skills deficit in the circular/sustainable economy.

Threats

- **Regional infrastructure (hard and soft) limits exploitation of new and emerging technologies:** this includes issues related to grid capacity, industry-wide skills deficit and training provision, and charging network (to support low emissions vehicles).
- **Policy and funding uncertainty and change:** limiting investment decisions, and need for a clear regional response in the broader energy policy landscape; the Mid Wales Energy Strategy is intended to provide this regional clarity and focus (with innovation a key priority, and relevant priorities including

<ul style="list-style-type: none"> ➤ Biomass and biowastes including anaerobic digestion (with strong links to agri-tech/bioscience) ➤ Sustainable construction materials and retrofitting, including building on research/teaching/out-reach activity at AU, CAT and UWTSD, and in-region activity from Wood Knowledge Wales (with potential links to advanced manufacturing regional businesses) ➤ Hydrogen, with a separate feasibility study on the use of hydrogen as a renewable energy source for off-grid opportunities for transport and collaborative R&D activity currently underway (involving regional businesses) • Supportive (broadly-cast) policy and strategic agenda at Wales, UK and international levels, driving consumer and public policy demand for low carbon products/services/solutions. 	<p>decarbonisation of housing and building stock, and zero carbon transport)</p> <ul style="list-style-type: none"> • Key competitor areas secure funding and investment: for renewable energy (solar, on- and off-shore wind), North and South Wales, Scotland, South East and South West England. For biomass, South East and South West England have low carbon generation sites. West Midlands has multiple R&D centres, particularly in low emission vehicles, energy storage and systems, renewable energy and fuel cell and battery technologies.
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Advanced Manufacturing

4.13 Advanced Manufacturing is an important component of the Mid Wales applied research and innovation landscape. There are industry-led specialisms in automotive and power electronics, automation, additive manufacturing, plastic injection mouldings and components. Alongside several large R&D- and innovation-active companies, the region contains innovative SMEs engaged in applied research and innovation, with plans to grow and invest.

4.14 These businesses benefit from strong regional business networks, and the unique characteristics of the region, which can help attract and retain skilled people. Opportunities for growth include exploiting links to decarbonisation, electric vehicles, 5G, and the Internet of Things, and developing a nascent “Power Valley” cluster in motion engineering control drives and power electronics in the Severn Valley area. Advanced Manufacturing strengths can also underpin innovation in other disciplines.

4.15 However, the applied research and innovation Advanced Manufacturing offer remains modest in scale, largely dispersed and quite disparate, with under-developed relationships between the business base and regional research assets; as linkages to assets outside of the region are stronger. Further, there are concerns over the alignment of skills supply and education/training provision to business needs, and a lack of appropriate sites and premises, and funding, to support start-ups and growth-oriented businesses.

4.16 In this context, key applied research and innovation priorities in Advanced Manufacturing are to:

- Strengthen the skill supply for advanced manufacturing, to facilitate and enable effective research and innovation and address issues if recruitment faced by regional businesses
- Promote more consistently and vocally regional advanced manufacturing strengths, including better articulating the links and relationships across sectors and disciplines
- Improve networking/collaboration, including developing stronger local supply chains, enhanced brokerage/facilitation to link the business base to the regional knowledge base
- Invest in high quality sites and premises to support applied research and innovation
- Support the business base to better understand, apply for, and secure greater levels of, competitive innovation funding.

“
Overall, the offer remains modest in scale and dispersed, with a need to develop better links between the business base and regional research assets
 ”

SWOT assessment

Strengths

- **Presence of innovative firms engaged in applied research activity, with plans for further future investment:** this includes businesses in related disciplines (which helps resilience and reduces exposure to risk for the region) in
 - automotive and power electronics
 - automation
 - additive manufacturing
 - plastic injection mouldings and components.
- **Broader manufacturing business base in the region,** with concentrations of employment and businesses in manufacture of electrical equipment, metal structures and machining.
- **Networking and coordination improving within the manufacturing base:** the Mid Wales Manufacturing Group was reported to be important in supporting this development.
- **Examples of business-academic collaboration/partnerships:** the deep-dive research identified some (albeit modest) collaborative activities between businesses and regional HEIs, and funded project activity. The research also indicated that leading companies are well connected to academic and innovation assets outside the region that match their specialisms.
- **Specific areas of research strengths at Aberystwyth University with potential for industrial application/exploitation and links to the business base:** analysis of bibliometric data indicates areas include electronic, optical and magnetic materials; electrical and electronic engineering; and control and systems engineering.
- **Characteristics of the region (environment, culture, quality of life, etc.) are seen as positive factors that underpin applied research and innovation strengths,** with companies observing that this provides a point of difference and helps attract/retain excellent people.

Weaknesses

- **Relatively small number of major AM companies in the region actively engaged in applied R&I:** areas of advanced manufacturing specialisms based on small and medium sized businesses, with limited connections between firms in most cases, and no core assets, major institutions, or locations to act as a hub for fostering partnerships and 'regional working'.
- **Lack of engagement and strategic and targeted alignment between regional academic research strengths and business activity:** outside of the specific examples identified, the level of engagement between industry and the academic base appears to be limited.
- **Significant skill shortages and recruitment challenges for key roles that are needed to drive applied research and innovation:** primary research with businesses for the deep-dive analysis indicated concerns that current education and training are not meeting industry needs.
- **Lack of awareness both internally and externally of targeted advanced manufacturing specialisms and capacity:** there is a perception that the region's strengths are not well articulated or promoted amongst policy makers, funders, and industry.
- **Access to and availability of funding for applied research and innovation:** a perceived and reported lack of support to help companies access research and innovation funding from regional, Welsh and UK sources.
- **Limited supply of appropriate quality sites and premises:** particularly for start-ups and expansion of innovative early-stage advanced manufacturing firms.

Opportunities

- **Developing a currently nascent but evolving ‘cluster’ focused on motion engineering control drives and power electronics** in the Severn Valley area i.e. the “Power Valley” cluster.
- **Advanced manufacturing strengths could underpin innovation in other key sectors if appropriate linkages can be facilitated and developed**, particularly related to supporting a ‘green recovery’ e.g. enhancing agricultural efficiency, decarbonisation.
- **Improve collaboration around key Advanced Manufacturing themes by better coordinating the applied research and innovation efforts of regional stakeholders.** Help companies and other applied research and innovation stakeholders ‘join the dots’.
- **Opportunity for greater industrial engagement with Aberystwyth University:** for example in advanced materials, condensed matter physics, materials chemistry, mechanics of materials and physics.
- **Better promotion of regional strengths and opportunities in areas of advanced manufacturing specialisms (as above):** this would help to improve workforce recruitment and retention.
- **Exploiting (or developing) linkages and potential with proximate research and innovation assets**, including AMRC Cymru which has a focus on automation and digitalisation and well-aligned to regional strengths, and assets in the Cardiff and Swansea Bay City Regions.

Threats

- **Fragility of international supply chains:** forcing companies to re-shore and establish local supply chains (opportunity and threat).
- **Uncertainty over international trade patterns and demand:** potential implications of Brexit over the medium and long-term for access to markets and uncertainties over wider global trade.
- **Key competitor areas across Wales and England:** the specific comparators vary across the areas identified as advanced manufacturing strengths and specialisms; this said, potential to develop linkages with key RTOs and assets outside of the region drawing on existing business networks and relationships.

Enabling and Digital Technologies

4.17 The region contains applied research and innovation capacity and potential in Enabling and Digital Technologies. Specifically, there are pockets of excellence in AI, robotics, sensors and geoinformatics/earth observation. However, at present this is at a modest scale relative to the economic profile of the region, and not operating as a reinforcing set of relationships and processes. Much of the expertise remains in the research base and has not yet been exploited for regional (or wider) economic and social benefit. In this context, a particular opportunity exists to work with the region's identified strengths in agri-tech to apply digital expertise.

4.18 There are also plans for major investments related to Enabling and Digital Technologies – the National Spectrum Centre – Phase 2, Global Rail Centre of Excellence, and Wales Trusted Digital Repository – each of which would be nationally unique assets, increase the amount of applied research and innovation conducted in the region, and have the potential to generate benefits for the UK as a whole. For example, spectrum technologies are used by multiple industrial sectors which rely on mobile communications, radar, telemetry, sensors, broadcasting and navigation. Local research on these technologies could therefore have national impact. There is also an opportunity to exploit these investments to lever maximum local economic impact.



Expertise in the research base has the potential to be more fully exploited for the region, including in AI, robotics, sensors and earth observations



4.19 In this context, key applied research and innovation priorities in Enabling and Digital Technologies are to:

- Enhance and/or develop new linkages and relationships with existing strengths in other themes to unlock new innovation opportunities, particularly with the agri-tech sector. This will involve addressing co-ordination/networking failures to facilitate collaborations and synergies across sectors of relevance to the underpinning technologies.
- Seek to maximise the local economic impact associated with the creation of nationally significant research and innovation assets such as the National Spectrum Centre. This may include putting in place programmes to support local businesses to undertake R&D activity with the proposed new assets, and addressing information failures to explain to local businesses the potential benefits of collaboration.
- There is also an opportunity to support the development of Phase 2 of the National Spectrum Centre to facilitate research activities that could lead to positive externalities, specifically the creation of local and national economic benefits for industries which rely on spectrum technologies.

SWOT assessment

Strengths

- **Research strengths at Aberystwyth University:** including computer science; AI, robotics and remote sensors; and earth observation and satellite navigation with both high-quality and scale of research activity; important links here to the research and innovation strengths in the agri/bioscience deep-dive area (including collaborative R&D activities between computer science academics and agri-tech SMEs based at Aber Innovation); plus wider knowledge exchange with industry and the public sector, including Health Boards. The BSc course in Artificial Intelligence and Robotics is also important in training the next generation.
- **Network of research collaborations with external partners:** this includes participation by AU in the Centre for Doctoral Training in Artificial Intelligence, Machine Learning and Advanced Computing (led by Bangor University) and Supercomputing Wales projects, and co-authored publications with universities in the UK and internationally.
- **Growing (albeit small scale) base of innovation active businesses in the area with alignment to regional research strengths,** with some evidence of engagement with the regional research base.
- **Presence in the region of the National Library of Wales:** providing hub for (largely academic) applied research and innovation activity on digitisation and data storage technologies and systems .
- **Presence in the region of the National Spectrum Centre – Phase 1:** a collaboration between QinetiQ and Aberystwyth University, exploiting regional research strengths and the natural environment to test spectrum technologies, with links to the existing QinetiQ-operated site at Aberporth
- **Investment in modern digital infrastructure,** including from Ceredigion Council in LoRaWAN coverage (Long Range Wide Area Network, used by Internet of Things networks) and Vodafone's OpenRAN 4G (Open Radio Access Network) site at the Royal Welsh Showground near Builth Wells.

Weaknesses

- **Scale and lack of critical mass,** notably in the business base with Location Quotients below the national level in relevant industrial sectors.
- **Current lack of clustering/sense of belonging to a broader network of relationships and networks amongst actors in the deep-dive area:** applied research and innovation activity is limited in scale dispersed across the region. Outside of Aberystwyth University, the expertise is focused on specific businesses which operate in diverse sub-sectors, and have 'loose ties' to the local academic and wider innovation community.
- **Spatial context of Mid Wales** provides challenges for securing investment, talent and commercial interest, and for intra-regional collaboration and engagement (this is also limited by the size of the business base).
- **Lack of targeted or focused innovation programmes or assets** within the region in relation to Enabling Digital Technologies which could provide the support and capacity necessary to drive knowledge exchange and scale-up of business-led innovation activity (although AU's Old College development will include space for creative and digital businesses).

Threats

- **Regional infrastructure (hard and soft) limits exploitation of new and emerging technologies:** this includes issues related to digital infrastructure (e.g. lower superfast broadband connectivity than Welsh average), and skills deficit and training provision (e.g. Newtown College no longer offers higher level courses in electronics or marketing).

Opportunities

- Emerging **thematic opportunities** for Mid Wales to leverage further economic potential through knowledge exchange (including via collaborative R&D and commercialisation activity) from existing research capacity in:
 - Data and computer science, with specific opportunity identified around application of AI, robotics and remote sensors in the agri/bioscience deep-dive area
 - Earth observation and satellite navigation, leveraging links to agri-tech sector and innovation assets.
 - **Specific project-related opportunities** in the region offer potential for exploitation and leverage, and can act as mechanisms around which expertise and investment can be corralled and co-ordinated
 - Radio spectrum technologies through Phase 2 of the National Spectrum Centre, including innovation activities and training/research in Radio Spectrum Engineering
 - Cultural digitisation: opportunity to expand regional strengths in records/storage technologies and systems with the Wales Trusted Digital Repository proposal – collaboration with Aberystwyth University would allow the local application of leading research in storage, and facilitate future research using the digitised records
 - Global Rail Centre of Excellence: addresses UK level need for an integrated testing facility for rail infrastructure and rolling stock, with potential R&D requirements to be exploited by regional actors (both academic and industry) – the crossover with communications and sensors would add value to the NSC offer, but much of the GCRE’s potential for economic impact is outside the scope of Enabling and Digital Technologies.
 - **Quality of life offer:** the deep-dive research indicates that high-tech and innovative businesses have been attracted and retained by the ‘lifestyle offer’ including the natural characteristics of the region, offering scope to encourage more in-movers.
- **Extremely competitive market for talent, investment, and funding** notably in areas such as AI, robotics and computer science with key national research and innovation assets and critical mass of businesses and investors located in major urban centres (especially London, but also Manchester, Bristol etc.).

Synthesis of deep dive evidence

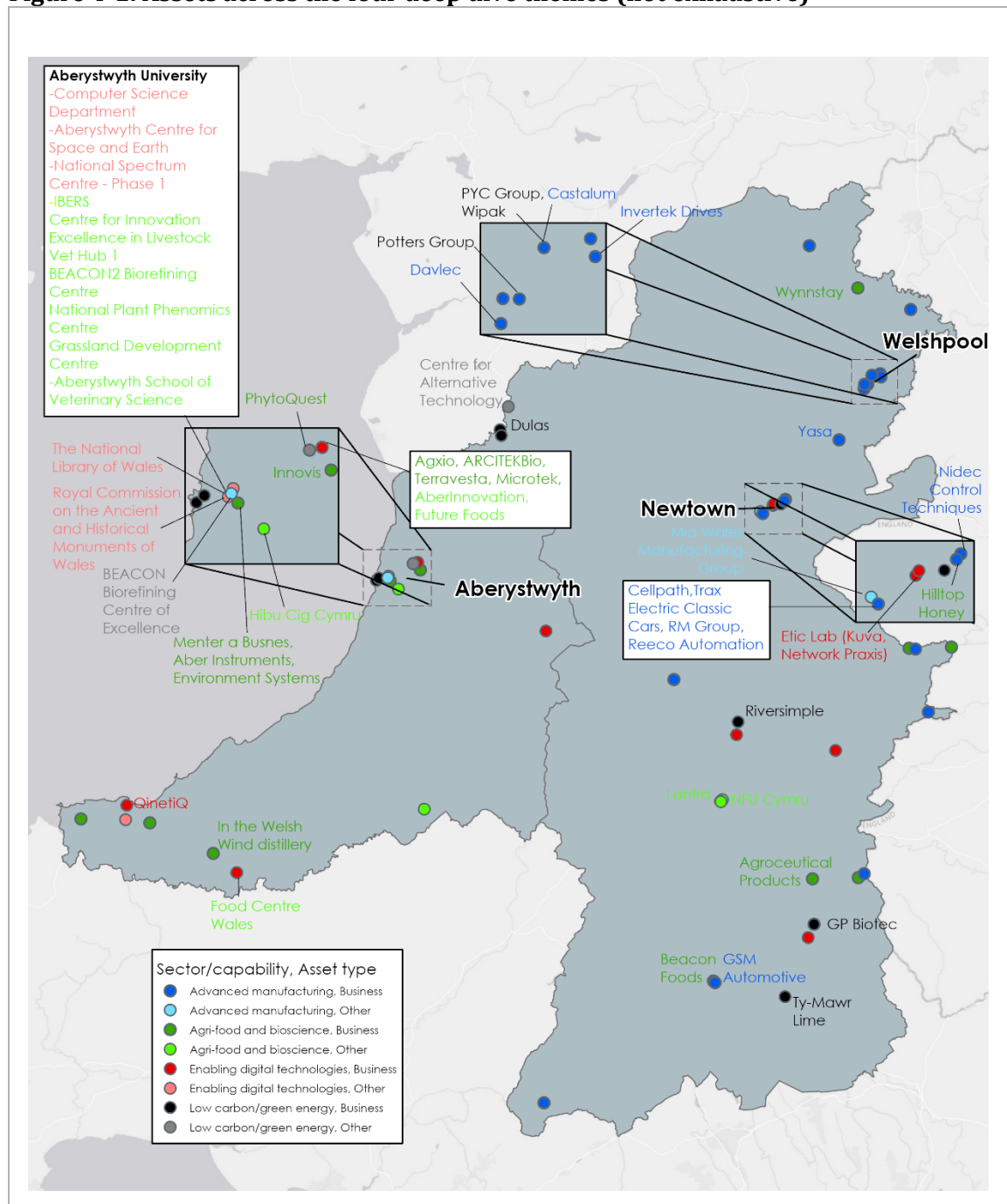
Strengths and opportunities

4.20 Overall, the deep dive evidence strongly confirms Mid Wales' strengths and opportunities in a related set of agri-food and bioscience capabilities, demonstrates a relatively small and quite nascent but highly competitive, industry-led and innovative cluster of advanced manufacturing firms, and for low carbon, a collection of strengths in biomass/energy/wastes (across the supply chain, from bio crops through to refining), sustainable construction materials and retrofitting, and renewable energy generation. The agri-food/bioscience and low carbon/green energy strengths present a particularly distinctive opportunity for the region, given the strong association between the research/business base and the natural environment of Mid Wales. In relation to enabling and digital technologies, it is a 'story of two halves': on one hand, there are pockets of largely research-led excellence in AI, robotics, sensors and geoinformatics/earth observation; and on the other, there are some major and nationally significant (but largely unrelated) assets, which are at different stages of development, maturity and certainty. This area is clearly one of opportunity for the region, but this is at this stage can be characterised as 'aspirational' than 'evidential'.

4.21 Three other points are noted:

- As illustrated in Figure 4-1, whilst the applied research and innovation assets spanning the deep dive areas are located across the region, there are 'spatial clusters' of assets in and around Aberystwyth in the West and Newtown and Welshpool in the North East. This does, however, contain a very diverse set of businesses of different scale and R&D intensity, with a large number of very small but highly innovative firms through to a smaller number of multi-national firms.
- Importantly, all four themes align very closely with – and have scope to make a distinctive contribution to – national strategic priorities, particularly those relating to net zero/climate change, the need for technological convergence and digitisation (across multiple applications) with links to productivity performance, and, specifically for agri-food in the context of post-CAP reforms, the importance of sustainability and resilience in the sector.
- Our horizon scanning of national/global trends also highlights crucial challenges which the region's applied research and innovation offer is well-placed to address. This includes, for example, enabling a green recovery and societal trends towards lower carbon living (e.g. housing, food), global food demand and intensification of farming, shifts towards higher value production (e.g. manufacturing and food), and infectious diseases in the post-Covid-19 context. This alignment with the policy and broader 'mega-trends' landscape provides a supportive and helpful backdrop to progressing the applied research and innovation agenda in Mid Wales.

Figure 4-1: Assets across the four deep dive themes (not exhaustive)



Source: Produced by SQW 2021. Licence 100030994

Mapping strengths, opportunities and relationships

4.22 Looking across the thematic deep dives, the evidence suggests there are four broad “sets” of applied research and innovation strength or opportunity in Mid Wales (see Figure 4.2):

- capabilities where there is strong and consistent evidence to show that Mid Wales has a **genuine depth and breadth of distinctive applied research and innovation**

strengths, particularly in plants and crops, animal health, bioenergy, and food manufacturing.

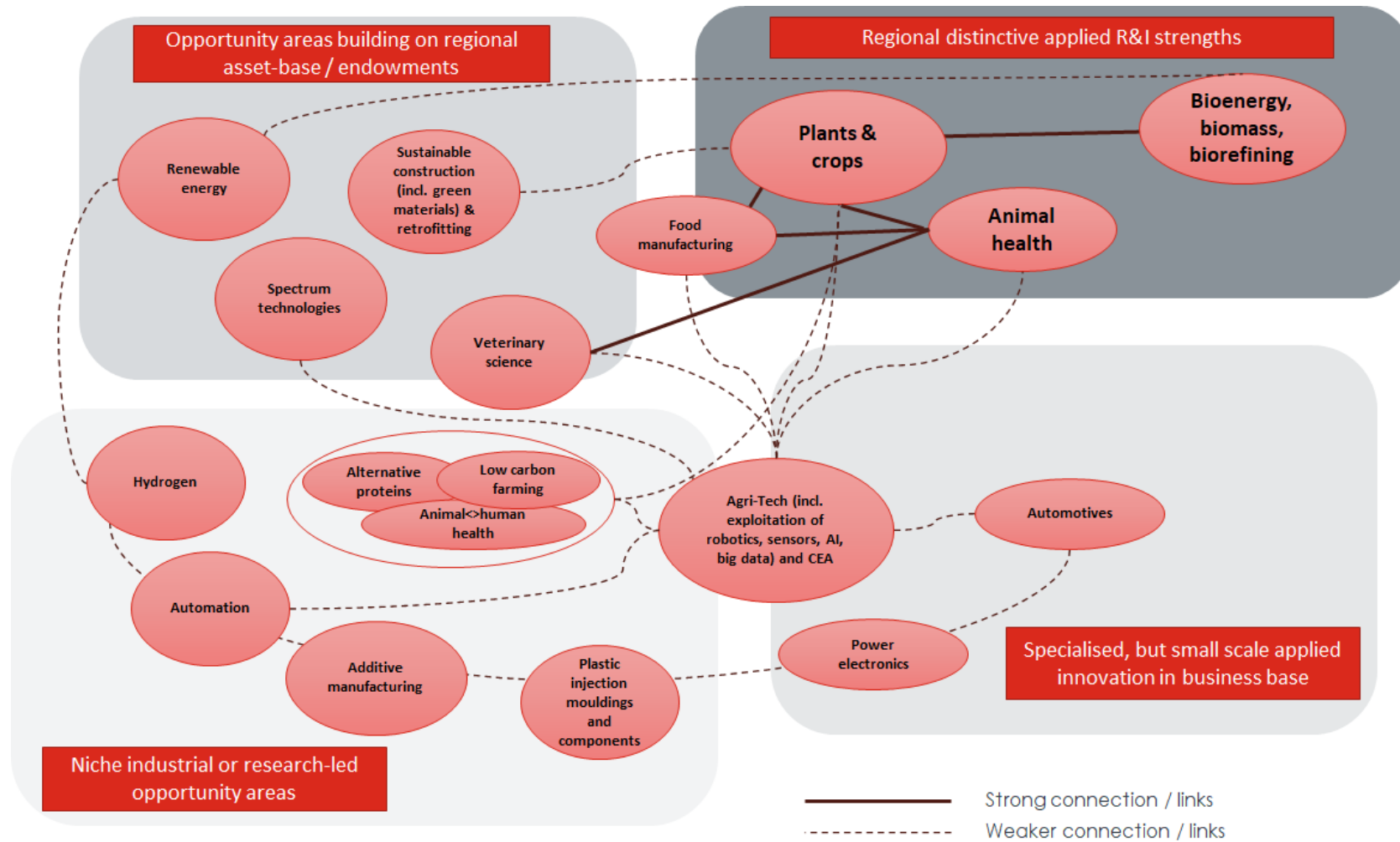
- capabilities where the deep dive evidence suggests there are **opportunities to build on the regional asset base and existing strengths**, for example in veterinary science, sustainable construction and spectrum technologies.
- capabilities that are **smaller in scale relatively, but specialised expertise in the business base**, notably in agri-tech, automotives and power electronics
- a series of more **niche industrial opportunities** (e.g. in terms of automation and hydrogen) and **heavily research led opportunities** (e.g. translating expertise in animal health into human health).

4.23 This deep dive analysis confirms the depth of expertise in some areas and demonstrates the range of applied research and innovation opportunities for the region. However it also indicates how some areas of expertise are relatively small-scale and/or disparate at present. The evidence also suggests that many of the opportunity areas are quite heavily research-based, and the extent to which these span across the business base is more limited (with the exception of advanced manufacturing and some aspects of agri-food/bioscience); the economic contribution of this research offer is therefore not currently being realised fully.

4.24 That said, the deep dive research has highlighted the **extent of complementarities between many of these strengths and opportunities**. In some cases, the evidence suggests strong connections between capabilities are well-established and actively encouraged (shown by the solid lines in the diagram overleaf). Examples include plants/crops and animal health, where expertise in Mid Wales has been brought together to develop a distinctive specialism in crops/feedstock and emissions associated with livestock. These strong connections are most evident *within* themes. However, our research also highlights other **potential links within and across themes** (shown by the dashed lines in the diagram). Many of these are relatively weak or nascent links at present – in some cases, based on a small number of projects or ad hoc/bilateral relationships, and in other cases, barely developed at all.

4.25 If these links could be strengthened – particularly *across* areas of expertise in mid Wales – it could form a distinctive and complementary “package” of expertise. **By connecting areas of expertise more effectively there is scope to create a critical mass of applied research and innovation strengths in related and complementary capabilities**. For some of the region’s nascent opportunities, it is through developing these *in combination with* existing strengths that growth might be accelerated. This could bring mutual benefits to both existing strengths and nascent expertise, to raise Mid Wales profile as a national/international player in these fields *and* to benefit the local economy (e.g. via growth of indigenous firms and attracting inward investment). A good example of this is the region’s expertise in AI; this is small-scale on its own, but when connected to strengths in plants, animal health and veterinary science, the region starts to build quite a distinctive and well-rounded offer in this space.

Figure 4-2: “Types” of R&I strength or opportunity in Mid Wales



Source: SQW

Challenges and barriers

4.26 The deep dive research identified several challenges and barriers hindering applied research and innovation in these areas – either *within* some of these capabilities (i.e. the nodes in Figure 4-2) or *across* them. Many of these are common and apply across the four themes, whereas others appear to be relatively theme-specific, as illustrated in Table 4-1.

Table 4-1: Key challenges and barriers identified in the deep dive research

	Agri-food and Bioscience	Low Carbon and Green Energy	Advanced Manufacturing	Enabling and Digital Tech
Strategic leadership / collaboration*	✓	✓	✓ (fostering collaboration around strategic themes)	
Awareness / promotion externally	✓ (coherence of)		✓	
Small scale or disparate strengths			✓	✓ (and lacking 'sense of belonging')
Academic-business engagement	✓	✓	✓	✓
Business-to-business collaboration	✓ (lack of awareness/networks)	✓ (lack of awareness/networks)		✓ (so few firms)
Commercialisation capacity and skills issues	✓ (especially academic base)	✓		
Innovation adoption challenges	✓			
R&I funding gaps and access to capital (public and private)	✓ (later stage R&D and scale-up)	✓ (commercialisation and capacity devt)	✓ (especially support to access)	✓ (knowledge exchange and scale up)
Grow-on space and/or larger-scale testing facilities	✓ (especially scale-up firms & larger-scale testing)		✓ (especially for start-up and scale-up firms)	✓ (spectrum technology testing facility)
Education provision and skills supply / alignment	✓ (awareness of opportunities schools/young people)	✓ (national skills shortage)	✓ (alignment between business base and academic offer; plus skills shortages)	✓ (national skills shortage, very competitive market)

Source: SQW

4.27 Across the piece, four issues appear to be crucial:

- **strategic leadership** within (and potentially across) the applied research and innovation thematic strengths; note, this in no way negates the existing work of actors across the region within specific areas, but the evidence suggests more could be done to strengthen region-wide collaboration and leadership at a strategic level
- **collaboration and networking**, which includes academic-business and business-to-business collaboration *within* themes, and engagement *across* themes
- **the skills/capability and finance to innovate and commercialise**, i.e. to progress applied research and innovation to the point of financial returns (and local economic benefits)
- **the contextual conditions** that are important to enable innovative firms to grow, particularly in terms of **workspace, testing facilities and skills**.

4.28 Taking these strengths, opportunities and challenges together, we then reflect on the types of market or other failures at play in Mid Wales. This is an important step in the process, to underpin the rationale for intervention and subsequent discussions around what *types* of intervention might be appropriate in response and how these could be prioritised. Whilst there is variation in the relative importance of each market or other failure across the themes, the key market and other failures appear to be:

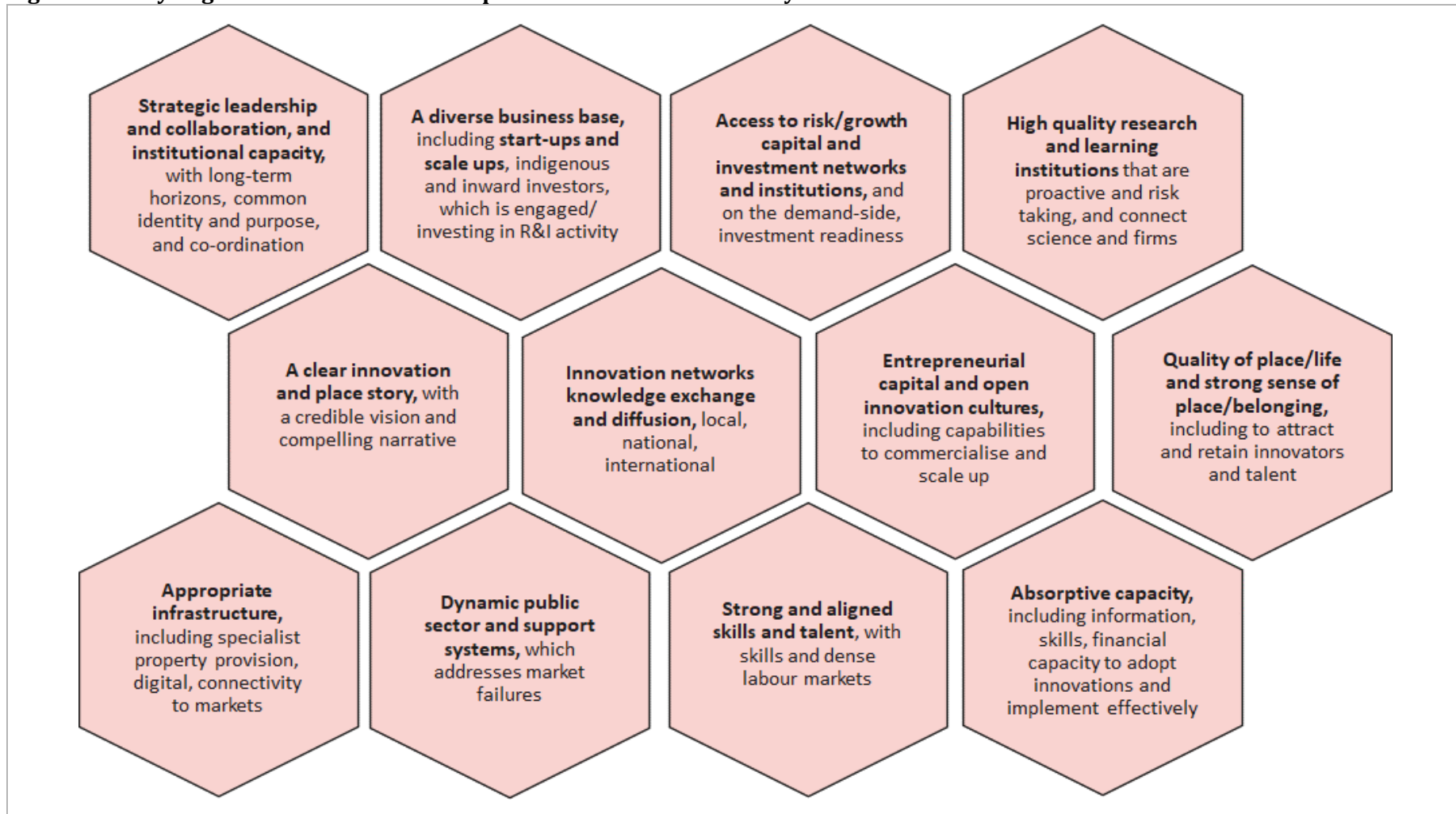
- **co-ordination and network failures**. This applies at three levels in Mid Wales: first, the need for stronger co-ordination/collaboration at a strategic level (also **institutional failures**); second, the lack of co-ordination within and between themes at an operational level (business-to-business and business-academic); and third, the need for better co-ordination between research, government and private sector actors.
- **a range of information failures**. This includes issues around risk and uncertainty, particularly in the context of commercialisation, knowledge exchange and diffusion, and the adoption of new innovations across the local economy.
- **positive externalities, particularly in terms of clustering**, whereby it is difficult to realise the potential benefits of clustering with firms acting independently due to a lack of coordination.
- **infrastructure failures**, where no single organisation has the resource or capacity to invest in infrastructure at the required scale to grow Mid Wales' R&I capacity alone.

Key 'ingredients' for a successful innovation ecosystem

4.29 In thinking through the implications of the findings set out above, and the broader evidence on the 'State of Region' discussed in Section 3, it is worth reflecting on the **key 'ingredients' for a successful place-based innovation ecosystem**.

- 4.30** There is no simple ‘one size fits all’ approach here, and we need to recognise the unique and distinctive nature of Mid Wales: what ‘works’ in some places (particularly smaller, more tightly defined and more urban places) clearly is not relevant for Mid Wales. There is also a need to recognise the importance of ‘path dependency’ in this space, where what has gone before – and the nature and stock of the assets in place – is often crucial. This said, there is a wide body of evidence on effective innovation ecosystems, and a summary of the key messages from this literature are summarised in Figure 4.3. We can see how, for example, the evidence above suggests Mid Wales performs strongly in terms of a high-quality research base (although this is largely reliant on one institution in Aberystwyth University) and quality of place, but less well in terms of innovation networks and access to risk capital. The innovation ecosystem also needs to be positioned in the wide regional ‘system’ and the extent to which education and skills, physical infrastructure, housing etc are working to support applied R&I (and vice-versa) is important - particularly in a place seeking to raise productivity and deliver economic growth outcomes.
- 4.31** A key question for this study is the extent to which Mid Wales’ strengths and weaknesses (vis-à-vis the ‘ingredients for success’ above) have implications for Mid Wales’s ability to:
- **Position and promote Mid Wales as a national/international leader in applied R&I in relevant fields**, which has consequences for (a) its contribution to UK PLC and the nation’s strategic priorities, (b) the region’s ability to compete effectively for national R&I funding and (c) the extent to which commercial gains from nationally/internationally significant R&I generated in Mid Wales is *secured in the region*.
 - Ensure that the applied research and innovation that takes place in Mid **Wales generates maximum economic benefits *within the region*** where possible.
- 4.32** These ‘ingredients’ also matter in terms of the region’s ability to ‘look outwards’ as a way to boost innovation/economic outcomes *within* the region. This could be by ensuring that Mid Wales’ firms are able to tap into and benefit from applied research activity undertaken outside of the region; or ensuring that assets in Mid Wales can grow through networking with expertise across the UK and globally (i.e. through collaboration rather than co-location, and where possible attracting inward investment and talent into the region as a result).
- 4.33** It is also important to recognise that different aspects of Mid Wales’ applied research and innovation activity will play different roles in the region, and the extent to which (and how) that presents opportunities for local growth will vary. For example, nationally/globally significant research or assets are important, but some may or may not have a significant economic impact on the region (or be expected to) beyond the direct effects of creating high value jobs and profile for the region. The emphasis here may be on ensuring that ‘ingredients’ are in place to enable these assets to grow, attract talent and become fully embedded in Mid Wales. In other areas, particularly where there is strong alignment between the research base and local economy, the focus may be on ensuring that the ‘ingredients’ that facilitate commercialisation, knowledge transfer and diffusion (on the supply side) and absorption (on the demand side) are in place.

Figure 4-3: Key 'ingredients' for a successful place-based innovation ecosystem



Source: SQW

Imperatives for applied research and innovation in Mid Wales

4.34 In this final sub-section, we identify a series of imperatives for developing a stronger applied research and innovation ecosystem, with greater local impact, in Mid Wales. These are grounded in the evidence base, and have been identified in light of (i) the key strengths and opportunities, pinch points and market failures across the four themes, (ii) the discussion above on ‘ingredients’ for success, and (iii) in the context of the Growing Mid Wales Partnership and Growth Deal, the emphasis on delivering economic growth through high value jobs and GVA.

4.35 Key imperatives are as follows:

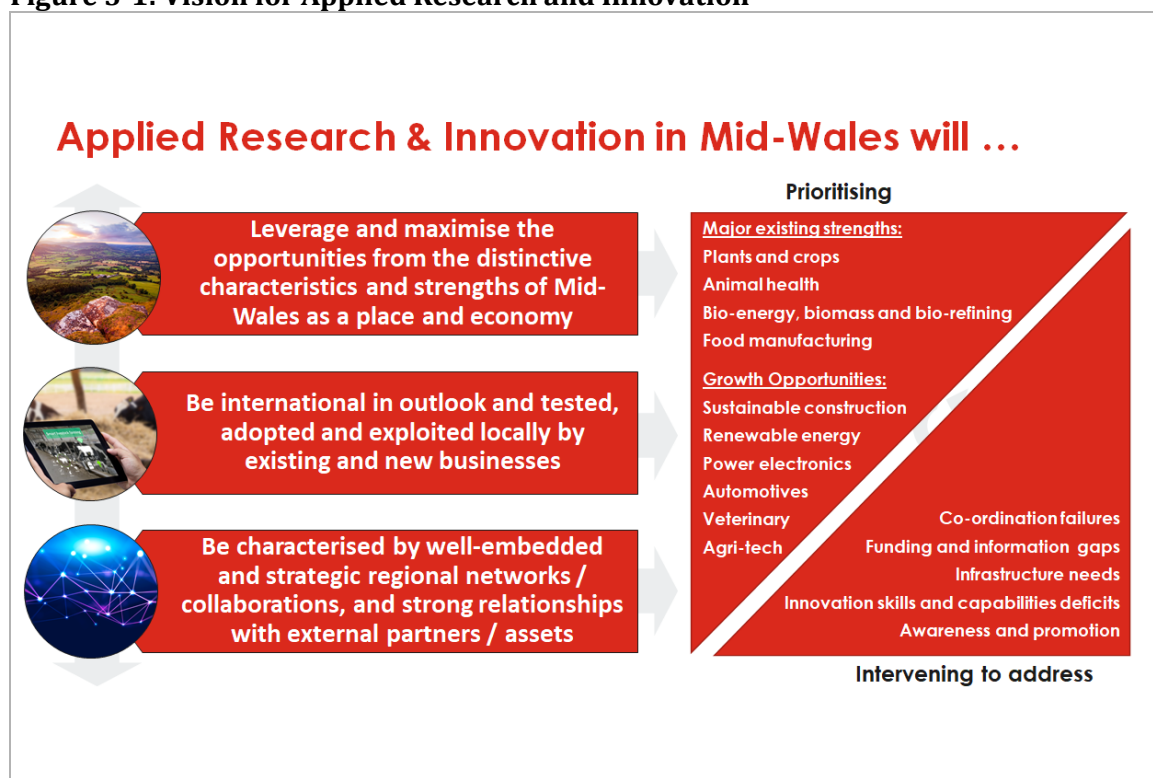
- Address co-ordination failures at a strategic level, to provide clear strategic leadership and co-ordination *within* and *across* themes, and linked to this, develop a coherent and co-ordinated narrative to better promote Mid Wales’ strengths externally.
- Address co-ordination/networking failures at an operational level, facilitating networking and collaboration between innovators in the region, within and across themes (business-business and academic-business).
- Address information failures hindering collaborative R&D within the region and knowledge diffusion/spillovers of local research expertise to local businesses in the region to maximise local economic benefits.
- Address funding gaps to support commercialisation and scale-up, including via private sector financing.
- Ensure innovative firms are able to attract and retain relevant skills to grow, and more effectively connect career opportunities and local education base to create a pipeline of local talent.
- Address the lack of appropriate high-quality space (including grow-on space) and larger-scale testing facilities, to ensure that growing innovative firms are able to stay in Mid Wales, and medium/larger innovative firms are attracted to the region.
- Address information failures (and potentially adoption finance gaps) hindering knowledge diffusion/spillovers of local research expertise to agricultural businesses in the region to maximise local economic benefits.

5. A Vision for Applied Research and Innovation

Introducing the Vision

- 5.1** Drawing on the evidence generated through the Study both quantitative and qualitative, and considering the issues to be addressed in the region, and the opportunities to be exploited by the region, and the wider evidence on the ‘key ingredients’ for a successful innovation ecosystem, a Vision for Applied Research and Innovation in Mid Wales is set out in Figure 5-1 below.
- 5.2** Crucially, the purpose of the Vision is not to establish new quantitative targets or restrictive performance measures, or tie partners into specific investments or activities (or rule any out). Rather, consistent with the remit of the Study, **the Vision aims to provide a strategic framework, and an overarching agenda around which regional partners can coalesce and collaborate, to shape the on-going process of project development, categorisation and decision-making by regional partners.** The Vision sets a collective, long-term agenda for the region, aligned with the overarching ‘Vision for Growing Mid Wales’ to 2035.
- 5.3** The Vision will also play an important role in demonstrating to organisations and influencers outside Mid Wales – including the Governments in Cardiff and London – a clarity of focus, purpose, and strategic intent in applied research and innovation to inform and influence policy and funding discussions and decisions.

Figure 5-1: Vision for Applied Research and Innovation



Source: SQW

5.4 Five points are highlighted regarding the Vision:

- First, whilst as noted above the purpose is not to tie partners into specific investments or activities, the Vision does include a clear focus on prioritising at a strategic level those areas where the Study indicates the region has genuine and distinctive strengths and clear opportunities. This includes particularly those areas related to the Agri-food and Bioscience capabilities evidenced through the Study. This area is clearly fundamental to the region's applied research and innovation offer, and this needs to be recognised and reflected in the Vision. However, this is not to say that other aspects of Mid Wales' applied research and innovation base are not important and have the potential to support growth.
- Second, alongside this focused intent, the Vision emphasises the importance of what might be termed 'ecosystem' factors in relation to networks, collaborations and relationships. Long-term, as technologies, markets, and business models evolve, new specific opportunities will emerge. However, looking to enhance and develop more fully the underpinning ecosystem working across the region will be vital in all future scenarios. Indeed, the need to respond effectively, collectively, and nimbly to changes in the policy and funding environment are likely to be increasingly important in the next few years as the UK recovers from the pandemic; this will require better leadership, co-ordination, networks, linkages and knowledge-flows across the region.
- Third, whilst the focus is on Mid Wales and the need for the region to exploit and focus on what it is good at and where it is distinctive, the Vision also seeks to reflect the need to remain connected and engaged with external partners, growth opportunities and thinking. This is particularly important for a region like Mid Wales with a modest indigenous asset base in applied research and innovation.
- Fourth, an important theme in the qualitative research for the Study was a consistent view of the need to address the internal and external awareness of the applied research and innovation of the region, and how this is promoted and communicated; and this has been reflected in the Vision. Whilst the Vision is not intended to be primarily a 'marketing exercise', and the other cases for intervening are equally important, perception does matter, and can influence investment decisions and policy priorities. Indeed, as discussed in Section 4, a clear innovation and place 'story', alongside a common identify and sense of purpose are important 'ingredients' in successful innovation ecosystems. Helpfully, these factors are largely within the control of local actors to define and disseminate.
- Fifth, and implicit within the Vision, is the importance of maximising positive externalities through applied research and innovation that will lead to economic impact in the region, particularly by encouraging and ensuring mechanisms are in place to facilitate knowledge, market and talent spillovers.

... and taking it forward

- 5.5** Delivering successfully against the Vision for Applied Research and Innovation will be the responsibility of a wide range of partners and stakeholders across the region over the medium to long-term. Indeed, it is important to recognise that the Vision does not represent a short-term fix, rather, it seeks to set an agenda that will need sustained effort and commitment over the coming years, aligned to the broader 'Vision for Growing Mid Wales' to 2035.
- 5.6** This said the expectation is the Vision for Applied Research and Innovation (and the wider findings and contents of this Study) will help to directly inform the work of partners in developing specific interventions and projects to enhance the regional applied research and innovation offer. This will include – but not be confined to – ideas and concepts to funded potentially by the Mid Wales Growth Deal, in line with the categorisation, and subsequent project development, prioritisation and appraisal and assessment processes established by the Growing Mid Wales Partnership. In supporting this process, a range of concepts and project ideas were identified in the Study, particularly around the deep-dive areas, and considering broader innovation ecosystem factors. These are provided in the supporting annex for information.
- 5.7** In developing a plan for applied research and innovation investment, choices will need to be made. The priorities presented above are designed to inform what types of intervention might be appropriate in response to the opportunities and challenges identified across the four themes, and how these could be prioritised. Some priorities may require direct investment in response, whereas others may require investment to create the conditions for innovation to flourish. Timing will also be an important consideration: some priorities may be addressed through smaller-scale investment and 'quick wins', others will require longer term endeavours to 'shift the dial'. Some priorities will need to be tackled in the short term to lay the foundations for other issues to be addressed in the longer term.
- 5.8** Finally, reflecting the focus of the Vision on developing well-embedded networks and partnerships, it is noted that one suggestion raised in the Study was the opportunity to consider 'pivoting' the Steering Group that has overseen the work (and potentially the wider group of stakeholders involved in the workshops) into a longer-term regional forum for overseeing progress in delivering against the Vision for Applied Research and Innovation. This is ultimately the decision of regional partners. However, in our view this would both ensure continuity of focus, and play a useful role as a visible and clear practical action and in demonstrating a commitment to enhancing regional collaboration in an applied research and innovation context.

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- ⁱ European Commission (2017) The Economic Rationale for Public R&I funding and its Impact
- ⁱⁱ Treasury (2021) Build Back Better: our plan for growth
- ⁱⁱⁱ Mid Wales Employment Sites and Premises Needs Assessment and Action Plan, April 2020
- ^{iv} ONS, Population estimates - local authority based by single year of age
- ^v Ranked in the 401-500 band in the Times Higher Education World University Ranking 2021 and ranked 485 in the QS World University Rankings 2021
- ^{vi} Journal articles, conference proceedings, trade publications, book series, and stand-alone books
- ^{vii} HESA, HE staff by HE provider and activity standard occupational classification
- ^{viii} FWCI indicates how the number of citations received by an entity/group's publications compares with the average number of citations received by all other similar publications in the data universe. A FWCI of 1 indicates that the entity/group's publications have been cited exactly as would be expected based on the global average for similar publications; a FWCI of more than 1 indicates that the entity/group's publications have been cited more than would be expected based on the global average for similar publications; a FWCI of less than 1 indicates that the entity/group's publications have been cited less than would be expected based on the global average for similar publications
- ^{ix} Defined as enterprises with average annualised growth greater than 20% per annum, over a three year period. Growth can be measured by the number of employees or by turnover. For this analysis growth has been measured using employment.
- ^x The HE-BCI data refers to graduate start-ups which are recorded in the HE-BCI data where there has been formal business/enterprise support from the HE provider and the business has started-up within two years of this support
- ^{xi} Note that the Horizon 2020 projects have been coded by SQW, the Smart Cymru projects have been coded by the Welsh Government Innovation Team
- ^{xii} The Beauhurst database covers firms back to 2011 that have met at least one of Beauhurst's triggers for high growth firms (see <https://www.beauhurst.com/data/>). In relation to spin outs, the database identifies three firms in Mid Wales that currently meet these triggers and were spin outs from Aberystwyth University.

Contact

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