

# Impacts of academic research from Welsh universities

A comprehensive review of the REF 2014 impact case studies

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Cover image: Word cloud of frequently occurring words in the Welsh impact case studies, excluding words such as 'research', 'impact' and 'work', and common verbs such as 'used'.

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# Contents

List of figures .....	2
Acknowledgements.....	3
Executive summary .....	4
<b>1   Background</b>	<b>9</b>
Overview of the Research Excellence Framework 2014 .....	10
Researching research impact.....	12
Impact from research in Wales .....	13
<b>2   Methods</b>	<b>17</b>
Sampling.....	18
Analytical approach.....	18
Caveats and limitations.....	19
<b>3   Findings: Comparative overview of research impact from Welsh universities</b>	<b>21</b>
Disciplinary areas underpinning the REF 2014 impact case studies for HEIs in Wales.....	22
The nature of impacts reported by HEIs in Wales.....	24
Geographical reach of the research and impact activities.....	31
<b>4   Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities</b>	<b>37</b>
Areas of impact for Wales's research .....	38
Activities and mechanisms that enabled impact.....	45
Beneficiaries of research from Wales HEIs .....	54
The benefit of academic research to Wales .....	60
<b>5   Concluding reflections</b>	<b>65</b>
Reflections on the nature of impact from research in Wales .....	66
Reflections for future research.....	67
<b>References &amp; appendices</b>	<b>69</b>

# List of figures

Figure 1: Relative volume of submissions to each Unit of Assessment (UoA) compared to relative volume of submissions for that UoA from the rest of the UK .....	25
Figure 2: Number of case studies coded to a Field of Research (FOR) allowing for up to three codes per case study (top 75% of all codes assigned for both Wales and UK) .....	26
Figure 3: ‘Impact wheels’ that show distribution of case studies from each UoA for select impact topics: Informing Government Policy, Parliamentary Scrutiny, Technology Commercialisation and Media .....	28
Figure 4: Disciplinary ‘hot spots’ that underpinned the 60 impact topics from Wales’s REF 2014 impact submissions (n=273) .....	29
Figure 5: Alluvial connectivity linking UoA to Impact Topic .....	30
Figure 6: Global reach of research from universities in Wales.....	31
Figure 7: Regions in Wales where activities that led to impact or the impact itself occurred (number refers to the number of case studies).....	34
Figure 8: Sectors impacted by research from Wales across all locations .....	39
Figure 9: Impact sectors and types from research in Wales HEIs .....	40
Figure 10: Impact mechanism categories and types. ....	47
Figure 11: Impact activities and mechanisms, ordered by frequency .....	48
Figure 12: Type of dissemination activity arranged by academic panel.....	51
Figure 13: Main beneficiary categories of research impact from Wales .....	54
Figure 14 Distribution of beneficiary types across different regions .....	56
Figure 15: Nature of beneficiary engagement with research .....	57
Figure 16: Proportion of case studies submitted by HEIs in Wales that include an impact on Wales, organised by UoA .....	61
Figure 17: Most common impact types within Wales .....	63
Figure 18: Proportion of impacts reported within Wales vs elsewhere.....	64



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# Executive summary

This report was commissioned as an independent review by the Learned Society of Wales (LSW) to capture evidence that can be used to better understand, promote and communicate the contribution that research from Wales made to wider society and the economy. As such the focus of this report is on the impact of Wales's research beyond academia identified in the submissions HEIs from Wales made to the 2014 Research Excellence Framework (REF).

REF 2014 was the first time that impact was included as one of the criteria all higher education institutions (HEIs) in the UK were assessed on. Impact was defined as 'any effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia'. To demonstrate impact, all HEIs in the UK submitted 'impact case studies', which were then made available as an online searchable database by the Higher Education Funding Council for England (HEFCE).

In 2015, researchers from the Policy Institute and Digital Humanities at King's College London, in collaboration with Digital Science, analysed the full set of 6,679 REF 2014 impact case studies available for analysis, using a combination of text mining and qualitative analysis to describe the nature, scale and beneficiaries of impact from UK HEIs.

The present report is unique in providing two different but complementary forms of analyses. The first involves comparing the 273 case studies submitted by Welsh HEIs against the original data underpinning the 2015 UK-wide study that had been generated through topic modelling. The second form of analysis provides a more in-depth, qualitative insight into the different types of impacts produced from Wales.

The detailed analysis of the 273 impact case studies makes for an impressive and inspiring summary of how research from a small country can produce changes and benefits both internationally and regionally, impacting on culture, industry, on the preservation of languages, and local policy.

As with previous research, this study makes no judgement about whether the information presented was accurate or authoritative, but instead seeks to capture the information as supplied by HEIs and researchers.

Key findings include:

**1) The report covers for the first time, all the case studies submitted by a single country, and provides an in-depth insight into the impact produced by universities in Wales.**

In REF 2014, universities in Wales submitted 273 case studies, amounting to some 4% of the UK total. Across all submissions for Wales, 49% of impacts were judged as 4\* (outstanding), compared to a UK average of 44%; and a further 37% of impacts in Wales were judged as 3\* (very considerable). Given this strong performance it was considered important to understand the collective Welsh submission in more detail.

The analyses presented in this report are unique in that they cover, for the first time, all of the case studies submitted by a devolved country, and provide an in-depth insight into the types of research impacts arising within it. The report also differs from previous studies in that it was possible to analyse every case study originating from Wales qualitatively, and not rely on a subset of the sample of case studies as employed in previous reports.

**2) Compared to the rest of the UK, Welsh HEIs submitted relatively more case studies in Modern Languages and Linguistics and Allied Health Professions.**

There was a relatively even distribution of case studies from universities in Wales submitted across the four main REF disciplinary panels (Life Sciences, Engineering and Physical Sciences Social Sciences, and Arts and Humanities). Disciplines where Welsh HEIs submitted relatively more case studies compared to the rest of the UK included Modern Languages and Linguistics, Allied Health Professions, Health Services and Primary Care, and General Engineering. Disciplines with relatively less case studies submitted included Clinical Medicine, Education and Biological Sciences.

**3) The areas in which research influences society emerging from submissions from Wales were largely similar to those of the rest of the UK.**

Many of the common impact topics prominent in the submissions from Wales (topics identified through data mining, where research influences society) were also seen in the full set of UK impact case studies. These included 'Informing government policy', 'Parliamentary scrutiny', 'Media' and 'Technology commercialisation'. However, the topic 'Languages of the British Isles' appeared salient for Wales specifically.

**4) The impact of Welsh research showed considerable interdisciplinarity.**

While there were clear associations between specific research disciplines and corresponding impact topics, the report also found considerable interdisciplinarity – a pattern reflected in the full set of UK REF 2014 impact case studies. For example, case studies from 20 out of a possible 36 disciplinary areas ('Units of Assessment' [UoAs], in REF terms) contributed to the topic 'Informing government policy', and 12 different research disciplines to 'Business and industry'. 300 unique pathways were found linking UoAs to the three most prominent impact topics for each case study, and accounting for just over half of all pathways drawn in the detailed alluvial diagram on page 30.

Impact topics with the greatest diversity of research disciplines included:

- ‘Informing Government Policy’
- ‘Parliamentary Scrutiny’
- ‘Media’
- ‘Community and Local Government’
- ‘Business and Industry’

5) In addition to considerable international reach, a significant number of case studies from Wales showed local impact, particularly in the sectors of policy, society, culture, heritage, and education.

Locations mentioned in the impact case studies from Wales involved 102 countries covering six continents. Research from Wales has considerable international reach, particularly in the life sciences, advanced materials and manufacturing, and energy and the environment. The three disciplinary areas that saw the most submissions from Wales HEIs showed comparatively greater international levels of impact, these being: Allied Health Professions, Dentistry, Nursing and Pharmacy; Business and Management; and Psychology, Psychiatry and Neuroscience.

37% of the case studies reported impacts specifically in Wales and these showed a remarkably distinct profile. Within this sample, impacts on policy and society were prominent, as they were in the sample overall, mainly describing contributions to policy reform. However, the contribution of academic research to the country’s culture and heritage, to its economy, to public education and social cohesion are distinctively foregrounded by researchers as a *direct benefit to Wales*. These impacts originated more from research in the Arts and Humanities and Social Sciences than from the Life Sciences, and Engineering and Physical Sciences.

6) Local beneficiaries of research in Wales included SMEs, policymakers, the third sector, education and creative industries.

Research from Wales impacted on a wide array of beneficiaries. These ranged from adopters of research findings to those who benefited indirectly from the resulting products or services, and from people who directly collaborated with researchers to those who have been exposed to research through the dissemination of findings.

Analysis of the location of the beneficiaries of research impact further illustrates the regional spread of research from Wales. Policymakers, who were the most common beneficiary group across all case studies, were spread across Wales, the UK and globally. The European Union, European Commission and United Nations also emerged as key international beneficiaries, whereas beneficiaries in the UK notably included the UK government and Welsh Assembly government.

Beneficiary communities within the third sector, education and creative industries were also distributed across Wales, the UK and globally. Predominantly global beneficiaries were found in the ‘food and agriculture’, ‘technology’ and ‘banking and finance’ sectors, whereas those inclined more towards the UK were seen within ‘emergency services and defence’, ‘legal’, and ‘health and social care’.



A notable beneficiary for Wales were small and medium-sized enterprises (SMEs), with 63% of all references to SMEs relating to companies located in Wales. SMEs were the subject of complementary research and policy initiatives to support start-ups and small businesses, and encourage industry within Wales. This was followed by impact beneficiaries in 'creative industries and heritage', the 'public', and 'education'. Examples of impacts that benefitted 'creative industries and heritage' included the preservation and conservation of heritage sites, and building local audiences for cultural activities.

The less generic 'public' beneficiary types cited by researchers, such as the elderly, parents, local communities, disabled and young people, were largely resident in Wales. This reflected initiatives among researchers in Wales to empower, connect and make provisions for local – and especially rural – communities.

### 7) Researchers in Wales employed a wide range of activities to translate the impact from their research.

36 different mechanism types appeared in the case studies submitted from Wales in REF 2014. These can be broadly classified into six areas:

1. Disseminating research findings to non-academic audiences
2. Engaging with an 'adopter' community
3. Interacting with policymakers
4. Offering training
5. Developing a product or service
6. Interventions (for example, clinical)

Research impact was commonly the product of multiple activities working in conjunction, with three different mechanisms or activities appearing as the average cited in each case study. In 19% of the case studies, only one mechanism type was identified.

Over two-thirds of case studies produced examples where a research impact beneficiary had directly adopted their research in practice. This was especially so in the case of 'policymakers and local governments', or in relation to professionals working within 'health and social care', and 'science, engineering, manufacturing and industry'. Engagement with the 'public' and with those involved in 'education' was more inclined towards dissemination, or benefitting as a third party through the consumption of services informed by the research.

\*

As with all previous reports that have used the REF 2014 case studies for analysis purposes, more nuanced and detailed information can be found if one employs qualitative analyses. In this study, it was possible to read and code all the case studies using the original raw data. Further insights could also be drawn by interviewing the researchers themselves, who have contributed to this diverse and fascinating set of impacts, which are only an illustrative sample of wider impacts that are occurring as a result of research in higher education in Wales and the UK more widely.



# 1 | Background

# 1 | Background

The United Kingdom's 2014 Research Excellence Framework (REF 2014) was the first nationwide assessment of academic research that formally evaluated non-academic impact. This section provides a brief overview of the REF, the assessment of impact, and the remit of this report, which highlights the impact of research from Wales.

## Overview of the Research Excellence Framework 2014

Conducted in 2014, the REF was the first attempt to assess the range and quality of research impact undertaken across all UK higher education institutions (HEIs). The subsequent allocation of research funding – based in part on the assessment of non-academic impact – was a significant feature, and the largest such evaluation of impact carried out across research in any country in the world (Morgan Jones and Grant, 2013).

The REF involved the four UK higher education funding bodies – the Higher Education Funding Council for England (HEFCE), the Scottish Funding Council (SFC), the Higher Education Funding Council for Wales (HEFCW), and the Department for Employment and Learning, Northern Ireland (DEL) – and was managed by the REF team based at HEFCE.

154 UK HEIs made submissions to 36 Units of Assessment (UoAs) in REF 2014. These submissions were assessed by expert sub-panels within each UoA, working under the guidance of four main panels, labelled A to D (Table 1). Research was assessed on the basis of the quality of research outputs (which counted for 65% of the assessment), the vitality of the research environment (15%), and the wider impact of research (20%). (See Appendix A for more information about REF 2014.)

Impact was defined in REF 2014 as 'any effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia' (REF, 2011).

Institutions were required to report on their best research impact in the form of narrative 'impact case studies' outlining the non-academic changes and benefits arising from academic research. A total of 6,975 impact case studies were submitted to the REF 2014 assessment exercise. Institutions were required to select their strongest examples of impact, underpinned by the submitted unit's 'excellent research', defined as being at least internationally recognised ('2\*'). They were assessed on the reach and significance of the impact (REF, 2011) (see Table 2 for definitions of these in each panel).

Each case study comprised five sections: 'summary', 'underpinning research', 'references to the research', 'details of the impact', and 'sources to corroborate the

impact'. Impact had to have occurred between 1 January 2008 and 31 July 2013, and the underpinning research between 1 January 1993 and 31 December 2013.

**Table 1:** Units of Assessment (UoAs) and respective main panels for REF 2014

<b>Panel A: Life Sciences</b>	<b>UoA 1</b>	Clinical Medicine
	<b>UoA 2</b>	Public Health, Health Services and Primary Care
	<b>UoA 3</b>	Allied Health Professions, Dentistry, Nursing, Pharmacy
	<b>UoA 4</b>	Psychology, Psychiatry, Neuroscience
	<b>UoA 5</b>	Biological Sciences
	<b>UoA 6</b>	Agriculture, Veterinary and Food Science
<b>Panel B: Engineering and Physical Sciences</b>	<b>UoA 7</b>	Earth Systems and Environmental Sciences
	<b>UoA 8</b>	Chemistry
	<b>UoA 9</b>	Physics
	<b>UoA 10</b>	Mathematical Sciences
	<b>UoA 11</b>	Computer Science And Informatics
	<b>UoA 12</b>	Aeronautical, Mechanical, Chemical and Manufacturing Engineering
	<b>UoA 13</b>	Electrical And Electronic Engineering, Metallurgy and Materials
	<b>UoA 14</b>	Civil And Construction Engineering
	<b>UoA 15</b>	General Engineering
<b>Panel C: Social Sciences</b>	<b>UoA 16</b>	Architecture, Built Environment and Planning
	<b>UoA 17</b>	Geography, Environmental Studies and Archaeology
	<b>UoA 18</b>	Economics and Econometrics
	<b>UoA 19</b>	Business and Management Studies
	<b>UoA 20</b>	Law
	<b>UoA 21</b>	Politics and International Studies
	<b>UoA 22</b>	Social Work and Social Policy
	<b>UoA 23</b>	Sociology
	<b>UoA 24</b>	Anthropology and Development Studies
	<b>UoA 25</b>	Education
	<b>UoA 26</b>	Sport and Exercise Sciences, Leisure and Tourism
<b>Panel D: Arts and Humanities</b>	<b>UoA 27</b>	Area Studies
	<b>UoA 28</b>	Modern Languages and Linguistics
	<b>UoA 29</b>	English Language and Literature
	<b>UoA 30</b>	History
	<b>UoA 31</b>	Classics
	<b>UoA 32</b>	Philosophy
	<b>UoA 33</b>	Theology and Religious Studies
	<b>UoA 34</b>	Art and Design: History, Practice and Theory
	<b>UoA 35</b>	Music, Drama, Dance and Performing Arts
	<b>UoA 36</b>	Communication, Cultural and Media Studies, Library And Information Management

## 1 | Background

**Table 2:** Definition of ‘Reach’ and ‘Significance’ in REF 2014 (HEFCE, 2012)

	<b>Reach</b>	<b>Significance</b>
<b>Panel A: Life Sciences</b>	<i>‘The spread or breadth of influence or effect on the relevant constituencies.’</i>	<i>‘The intensity of the influence or effect.’</i>
<b>Panel B: Engineering and Physical Sciences</b>	<i>‘Reach is the extent and breadth of the beneficiaries of the impact.’</i>	<i>‘Significance is the degree to which the impact has enabled, enriched, influenced, informed or changed the products, services, performance, practices, policies or understanding of commerce, industry or other organisations, governments, communities or individuals.’</i>
<b>Panel C: Social Sciences</b>	<i>‘Reach will be understood in terms of the extent and diversity of the communities, environments, individuals, organisations or any other beneficiaries that have benefited or been affected.’</i>	<i>‘Significance will be understood in terms of the degree to which the impact has enriched, influenced, informed or changed policies, opportunities, perspectives or practices of communities, individuals or organisations.’</i>
<b>Panel D: Arts and Humanities</b>	<i>‘The extent and/or diversity of the organisations, communities and/or individuals who have benefited from the impact.’</i>	<i>‘The degree to which the impact enriched, influenced, informed or changed the policies, practices, understanding or awareness of organisations, communities or individuals.’</i>

### Researching research impact

All of the impact case studies submitted to REF 2014 that are available for analysis were made available as a searchable database developed by Digital Science.<sup>1</sup> This repository provides a rich resource of text showcasing research that led to benefits to society beyond academia over the past 20 years (Hinrichs and Grant, 2015).

Following the submission of the impact case studies, HEFCE and partners (the UK higher education funding bodies, Research Councils UK and the Wellcome Trust) commissioned a detailed formal analysis of the full set of 6,679 non-redacted impact case studies. This analysis was carried out by the Policy Institute and the Department of Digital Humanities at King’s College London, in conjunction with Digital Science, a division of Macmillan Science & Education. The subsequent report, hereafter referred to as the King’s and Digital Science 2015 study, employed novel text mining and qualitative analysis techniques to produce a synthetic review of the case studies, identifying general patterns and thematic structures across the sector (King’s College London and Digital Science, 2015).

One of the striking observations of this original study was the diverse range of contributions that UK HEIs made to society. As part of this analysis the 156

<sup>1</sup> Impact case study database. Available at: <http://impact.ref.ac.uk/CaseStudies/>

fields of research within 36 UoAs were linked to 60 'impact topics', resulting in 3,709 unique 'pathways to impact'. Although the impacts described in the case studies represent only a selection of impacts from HE research, they were incredibly revealing. The research impact narratives have since been used to provide evidence of the societal and economic difference that research can make to society.

Although REF 2014 was the first national assessment exercise of its kind to include research impact, the interest in non-academic research impact was not new. Governments have been increasingly seeking greater accountability for public investment in university-funded research by asking for more demonstrable evidence of impact (Nature Editorial, 2010). The National Science Foundation, European Commission, and the UK government's research funding bodies have all called for measures of research impact as an important way of looking at how research delivers beyond academia.

The REF impact case studies have also been widely used by individual universities and funding agencies. For example, the Engineering and Physical Sciences Research Council (EPSRC) used relevant case studies to demonstrate the sustained economic and social impact of their investments in engineering and physical sciences research (EPSRC, 2015). The UK Collaborative on Development Sciences (UKCDS) commissioned the Policy Institute at King's to describe the non-academic impact of development research in UK universities (Hinrichs-Krapels et al., 2015). A subsequent study reported on the impact of research funded by the National Institute of Health Research (Kamenetzky et al., 2016).

In 2016, the Policy Institute at King's also helped Universities Scotland produce a brief report to demonstrate how the REF impact case studies provided a useful resource to better understand the beneficiaries of research and impact pathways delivered by Scottish institutions. Although this report provided only a snapshot of research from across 795 case studies, it was used to show that research at Scottish HEIs has produced impact on a wide range of often unexpected beneficiaries (Universities Scotland, 2016).

### Impact from research in Wales

In REF 2014, Wales submitted 273 case studies, 4% of the UK total. A number of these case studies were featured by Universities Wales, HEFCW and individual universities, but no formal analysis of the country's collective sector impact was previously undertaken (see Box A for further information on the research performance in Wales).

As can be seen from Table 3, Wales impressively secured 49% at 4\* (outstanding) in the impact sub-profile, which exceeded the UK average of 44%. A further 37% of the submitted impact for Wales was judged to be 3\* (very considerable impact [see Table 4]).

This report was commissioned as an independent review by the Learned Society of Wales to capture evidence to better understand, promote and communicate the contribution made by academic research originating from Wales's universities. It builds on the prior King's and Digital Science 2015 study of the full set of 6,679 REF 2014 non-redacted impact case studies, and the subsequent sub-analyses of individual points of interest, of impact in the international devel-

## 1 | Background

opment sector (Hinrichs-Krapels et al. 2015), and the impact of research funded by the National Institute of Health Research (Kamenetzky et al. 2016).

The analyses reported in this study remain unique in that they cover, for the first time, all case studies submitted by a single devolved UK country, and provide in-depth insights into the types of impacts arising within it. Given the number of case studies involved, this report is also distinctive in that it was possible to analyse each case study originating from research in Wales qualitatively, whereas previous studies have had to rely on a subset of samples due to the range, scope and objectives of the reports.

**Table 3:** REF 2014 impact sub-profiles for UK country and UK

	% of the submission meeting the standard for				
	4*	3*	2*	1*	u/c
<b>Wales</b>	49%	37%	10%	3%	1%
<b>England</b>	44%	39%	14%	2%	1%
<b>Scotland</b>	46%	40%	11%	3%	0%
<b>Northern Ireland</b>	42%	45%	10%	3%	0%
<b>UK</b>	44%	40%	13%	2%	1%

**Table 4:** REF 2014 impact sub-profile: criteria and definitions of starred levels

<b>The criteria for assessing impacts were ‘reach and significance’:</b>	
<ul style="list-style-type: none"> <li>• In assessing the impact described within a case study, the expert panels were directed to form an overall view about its reach and significance taken as a whole, rather than assessing reach and significance separately.</li> <li>• In assessing the impact template, the panels considered the extent to which the unit’s approach described in the template was conducive to achieving impacts of reach and significance.</li> </ul>	
<b>Four star</b>	Outstanding impacts in terms of their reach and significance
<b>Three star</b>	Very considerable impacts in terms of their reach and significance
<b>Two star</b>	Considerable impacts in terms of their reach and significance
<b>One star</b>	Recognised but modest impacts in terms of their reach and significance
<b>Unclassified</b>	The impact is of little or no reach and significance; or the impact was not eligible; or the impact was not underpinned by excellent research produced by the submitted unit

**Box 1: Wales's Research Performance**

Over the past decade, Wales's universities have demonstrated strong growth in many areas of research, such as renewable energy, environmental sciences, social and bio-sciences.

In 2013 an independent bibliometric report by Elsevier showed that the impact (measured by field weighted citations) of Welsh research had grown significantly over the previous 16 years, outperforming many similar-sized countries, and making a real contribution to the UK's world-leading research base (Elsevier, 2013). It also showed that research inputs from Wales were highly productive and efficient, despite comparatively low levels of funding and a relatively small Science, Technology, Engineering, Maths and Medicine (STEMM) research base.

In REF 2014, Welsh universities significantly boosted their performance from the 2008 Research Assessment Exercise, with more than three-quarters of the research submitted assessed as internationally excellent (3\*), and almost a third rated 'world-leading' (4\*). Wales saw strong performances over a range of subjects, with world-class achievements in fields including: Psychology/Neuroscience, Allied Health Professions, General Engineering, Geography/Environmental Studies/Archaeology, Sport and Exercise Sciences/Leisure and Tourism, and English Language and Literature.

In 2015, the Leadership Foundation for Higher Education (LFHE) published a report by Halligan and Bright that provided a comprehensive review and explanation for Wales's relatively less competitive overall research council income. In the report, Halligan and Bright (2015) showed that the critical problem lay not in the quality of the research but rather the inadequate size of the science base and the number of researchers working in STEMM. Using Wales's population share of total UK academics engaged in research, they concluded that the academic research workforce was some 0.5% below Wales's population standard share.

The Welsh government set up two phases of 'Sêr Cymru' (Stars Wales), an investment programme designed to deliver an ambitious strategy aimed at increasing capacity in research, particularly science, to produce greater economic growth. The first phase saw a £50-million commitment to bring prestigious research chairs to Welsh universities, and to support national research networks in three 'grand challenge' areas: life sciences and health; low carbon, energy, and environment; and advanced engineering and materials. In December 2015, a second £60-million phase of Sêr Cymru was launched by the Chief Scientific Advisor (CSA), aimed at further boosting research capacity by offering support for 120 fellowships to mid- or early-career scientists, and those currently on a career break. Like all large, complex change projects, it will take several years to fully capture the impact of these Sêr Cymru planned initiatives.



# 2 | Methods

## 2 | Methods

### Sampling

The sample used in this report included all case studies submitted by HEIs in Wales, totalling 273 case studies,<sup>2</sup> some of which were submitted jointly by two HEIs. The breakdown was as follows:

- Aberystwyth University (55 case studies)
- Bangor University (44 case studies)
- Cardiff Metropolitan University (8 case studies)
- Cardiff University (90 case studies)
- Glyndŵr University (8 case studies)
- Swansea University (54 case studies)
- University of South Wales (23 case studies)
- University of Wales (2 case studies)
- University of Wales, Trinity Saint David (12 case studies)<sup>3</sup>

A full list of the case studies submitted by Wales can be found in **Appendix C**.

### Analytical approach

In the previous King's College and Digital Science 2015 study, several high-level themes were identified using topic modelling (King's College London and Digital Science, 2015). With more than 6 million words in the 'details of the impact' sections alone, topic modelling was used to uncover common 'topics' that occurred throughout all 6,679 non-redacted impact case studies submitted to REF 2014. 60 impact topics, or areas where research influences society, were identified.

In the present report, two different but complementary types of analyses were performed. The first involved comparing the 273 case studies submitted by Welsh HEIs with the original data underpinning the 2015 UK-wide study that had been generated through topic modelling.

The second type of analysis provided a more in-depth, qualitative insight into the different types of impacts produced from Wales.

The UK-based comparative analysis drew from the original 60 impact topics (of which 58 were present in our Welsh sample), linking them to the underlying academic disciplines of the underpinning research. In Chapter 3, 'Comparative

<sup>2</sup> There is a discrepancy between the number of case studies contained in the online database of non-redacted case studies submitted to REF 2014 (<http://impact.ref.ac.uk/CaseStudies/>), which displays 272 case studies from HEIs in Wales, and data held at the Policy Institute, which identifies 273 unique case studies. Our sample has been derived from the latter dataset.

<sup>3</sup> The summary page for the online database of REF case studies lists 11 case studies for Cardiff Metropolitan University (see <http://impact.ref.ac.uk/CaseStudies/Search1.aspx>); however, both the online database and the data held by the Policy Institute at King's show only 8 case studies. Likewise, for the University of South Wales, the summary page shows 26 case studies, whereas only 23 case studies are accessible for this HEI (as stated in footnote 2, the data held by the Policy Institute at King's also shows one more case study for this UoA than the online database).

overview of research impact from Welsh universities', this approach is used to compare the types of impacts reported by researchers in Wales against the rest of the UK. These findings were predominantly based on automated text-mined analysis including topic modelling.

This automated analysis is contextualised by a manual, qualitative analysis for all the case studies submitted by HEIs in Wales, and is presented in more detail in the second set of findings in Chapter 4, 'Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities'. For this analysis, each case study was read and analysed with a view to addressing the following questions:

- Who are the beneficiaries of the research?
- What is the nature of beneficiary engagement with research?
- What were the activities or mechanisms that enabled impact to take place?
- What was the geographical reach of the activities that enabled the impact?
- What was the nature of the impact, and in which sector did the impact occur?
- To what extent did researchers describe the income generated in their research in terms of the indicators used in the Higher Education Business and Community Interaction survey (HEBCIS)?
- What were the specific benefits to Wales?

This qualitative analysis draws primarily on information in the penultimate section of the impact case study reports, the 'details of the impact'. Within this section, the impact types cited in each case study, the activities and mechanisms that enabled them, and beneficiaries reached were captured and analysed using NVivo.<sup>4</sup> The coding and framework for analysis were defined iteratively. The top-level categories relating to each of the guiding questions above were generated from a pilot analysis of 20 case studies. Subcategories were then generated by the content of the case studies during the process of reading and analysing the sample, being consolidated or subcategorised as patterns emerged. Two iterations of these groupings took place during the analysis process, with a comprehensive review after the analysis of all 273 case studies was complete. The types and categorisations of activities presented in Chapter 4 are thus largely derived from the content of the case studies rather than adhering to existing models or frameworks.

As with previous reports, no judgements are made about whether the information presented was accurate or authoritative. The analysis instead seeks to capture the information supplied by HEIs and researchers objectively. Individual case studies are also not linked to how they were ranked by the expert panels, as the ranking of individual impact case studies is not in the public domain.

### Caveats and limitations

Using the database of case studies submitted to REF 2014 as source material for analysis comes with at least three important caveats. None of these undermine the analysis, but help to frame the context for its interpretation.

1. The impact case studies submitted to REF 2014 were written for assessment, not analysis. The impacts reported were therefore selective, compiled

<sup>4</sup> NVivo is a qualitative data analysis software that allows for the coding of text-based information. For more information about this software, see: <http://www.qsrinternational.com/nvivo-product> (accessed 24 March 2017).



## 2 | Methods

according to requirements and guidelines published by the REF team to assist in preparing impact case studies. It should not, therefore, be assumed that they provide a comprehensive account of how all research has had impact beyond academia.

2. Impact was reported in a free-text format. As a result, much of the information captured is freely described, resulting in variable levels of quantitative and geographic information that when measured using metrics can differ substantially from one case study to the next. There were also no mandatory fields of information, which may have also led to omissions of certain types of information, such as the level of income from commercialisation activities.
3. The design of the case study template may have influenced how impact was reported, as suggested by other analyses of these case studies (Greenhalgh and Fahy, 2015), encouraging authors to trace a direct and causal pathway from originating research to activity beyond academia. However, it is likely that such a focus on forward trajectories within a prescribed timeframe does not fully represent the nuances of how academic research actually had an impact beyond academia. There may be numerous engagement, collaborative and co-design activities that take place during the research process that had already enabled some impact to occur.



# 3 | Findings: Comparative overview of research impact from Welsh universities



### 3 | Findings: Comparative overview of research impact from Welsh universities

The 273 case studies submitted by Welsh HEIs were matched with the database of the full set of case studies from all UK HEIs underlying the King's College London and Digital Science 2015 study. This enabled identification of the disciplinary areas underpinning the impact case studies for Wales, and the impact topics that had arisen from this research, described in this chapter. Comparisons are also drawn between the types of impacts reported by researchers in Wales and those reported in the rest of the UK.

#### Disciplinary areas underpinning the REF 2014 impact case studies for HEIs in Wales

The number of case studies submitted to REF 2014 by HEIs in Wales across the panels and UoAs is shown in Table 5. Overall there was a relatively even distribution of case studies submitted across panels. The largest number of case study submissions originated from research in the Social Sciences (Panel C, n=79, 29% of 273) followed by Engineering and Physical Sciences (Panel B, n=66, 24%), Arts and Humanities (Panel D, n=65, 24%), and Life Sciences (Panel A, n=63, 23%).

Disciplinary areas receiving most case study submissions were:

- UoA 3: Allied Health Professions, Health Services and Primary Care (n=21)
- UoA 19: Business and Management Studies (n=21)
- UoA 4: Psychology, Psychiatry, Neuroscience (n=17)
- UoA 15: General Engineering (n=16)
- UoA 28: Modern Languages and Linguistics (n=15)

There were four UoAs that received no submissions from Wales (see Table 5): Aeronautical, Mechanical, Chemical and Manufacturing Engineering (UoA 12), Economics and Econometrics (UoA 18), Anthropology and Development Studies (UoA 24), and Area Studies (UoA 27).



### 3 | Findings: Comparative overview of research impact from Welsh universities

**Table 5:** Number of case studies submitted to REF 2014 by HEIs in Wales. The disciplines with the relatively greatest submissions within each panel have been highlighted in bold

Panel	Unit of Assessment	No. Case Studies	% Total
<b>A</b>	1 Clinical medicine	7	2.56%
	2 Public health, health services and primary care	3	1.10%
	3 Allied health professions, dentistry, nursing and pharmacy	21	<b>7.69%</b>
	4 Psychology, psychiatry and neuroscience	17	<b>6.23%</b>
	5 Biological sciences	5	1.83%
	6 Agriculture, veterinary and food science	10	3.66%
<b>B</b>	7 Earth systems and environmental sciences	9	3.30%
	8 Chemistry	4	1.47%
	9 Physics	8	2.93%
	10 Mathematical sciences	9	3.30%
	11 Computer science and informatics	14	<b>5.13%</b>
	12 Aeronautical, mechanical, chemical and manufacturing engineering	0	0.00%
	13 Electrical and electronic engineering, metallurgy and materials	4	1.47%
	14 Civil and construction engineering	2	0.73%
15 General engineering	16	<b>5.86%</b>	
<b>C</b>	16 Architecture, built environment and planning	6	2.20%
	17 Geography, environmental studies and archaeology	13	<b>4.76%</b>
	18 Economics and econometrics	0	0.00%
	19 Business and management studies	21	<b>7.69%</b>
	20 Law	11	4.03%
	21 Politics and international studies	8	2.93%
	22 Social work and social policy	4	1.47%
	23 Sociology	4	1.47%
	24 Anthropology and development studies	0	0.00%
	25 Education	3	1.10%
	26 Sport and exercise sciences, leisure and tourism	9	3.30%
<b>D</b>	27 Area studies	0	0.00%
	28 Modern languages and linguistics	15	<b>5.49%</b>
	29 English language and literature	12	<b>4.40%</b>
	30 History	11	4.03%
	31 Classics	2	0.73%
	32 Philosophy	2	0.73%
	33 Theology and religious studies	1	0.37%
	34 Art and design: history, practice and theory	5	1.83%
	35 Music, drama, dance and performing arts	11	4.03%
	36 Communication, cultural and media studies, library and information management	6	2.20%
			<b>273</b>

### 3 | Findings: Comparative overview of research impact from Welsh universities

Figure 1 compares the proportion of case studies submitted to different disciplines by HEIs in Wales compared to those of HEIs in the rest of the UK. Each circle represents the total number of submissions by HEIs in Wales for that UoA, with size of the circle indicating the absolute number of case studies submitted. The location of circles to the right or left shows the difference between the percentage of case studies for that UoA for Wales compared to the rest of the UK. Circles to the right of the mid-point indicate that Wales submitted proportionally more case studies (as a proportion of the total number of submissions from Wales) for that UoA, compared to the rest of the UK.

Compared to the rest of the UK, the number of case studies submitted to Modern Languages and Linguistics was 2.65% higher. Other areas where Wales submitted above average for the rest of the UK included Allied Health Professions, Health Services and Primary Care (+2.5%), and General Engineering (+2.24%).

UoAs where Wales submitted below the average compared to the rest of the UK (in addition to those that received no submissions from Wales) included Clinical Medicine (-3.1%), Education (-2.11%) and Biological Sciences (-2.02%).

In the previous, larger King's and Digital Science 2015 study covering the full set of available UK case studies, 15,963 field of research (FOR) codes were assigned to the 6,679 non-redacted case studies. Just under two-thirds of these case studies had two or more two-digit codes (out of a possible 22), providing an indication of the high degree of interdisciplinarity in the research underpinning many of the impact case studies (King's College London and Digital Science, 2015). This was also reflected in the case studies from Wales. As can be seen from Figure 2, the most common fields of research in Wales using this approach were Public Health and Health Services (accounting for some 63 assigned codes), followed by Historical Studies, Literary and Cultural Studies and Policy and Administration.

#### The nature of impacts reported by HEIs in Wales

Using the topic modelling employed in the King's College and Digital Science 2015 study, 60 high-level themes were identified from the full set of impact case studies. These were referred to as 'impact topics'.

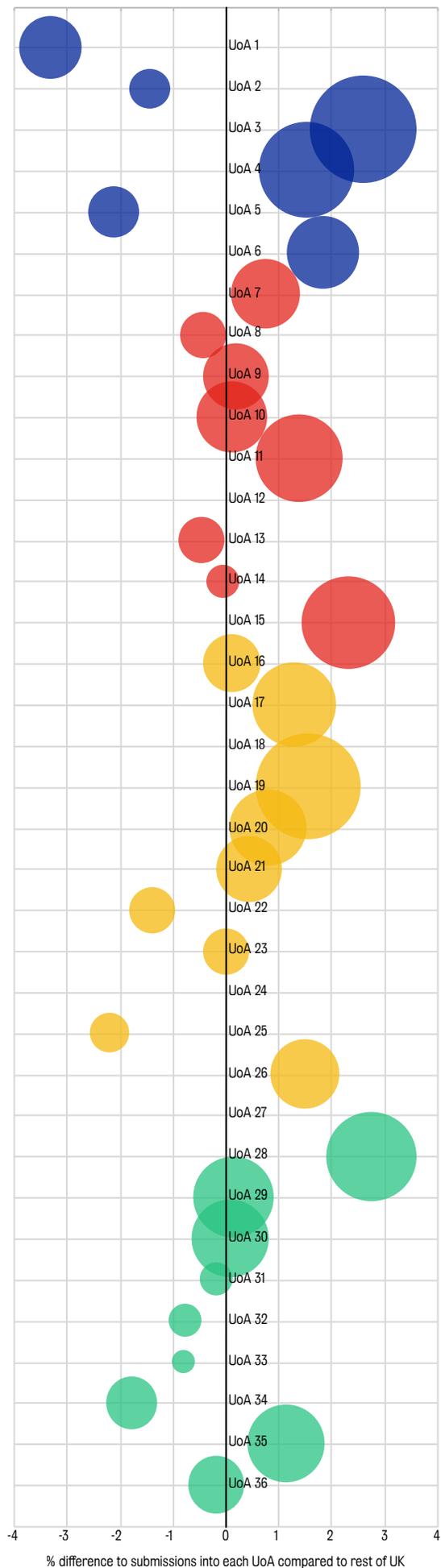
For the 273 submitted case studies from Wales, the most common impact topic areas were:

- ♦ 'Informing government policy' (n=56)
- ♦ 'Parliamentary scrutiny' (n=45)
- ♦ 'Technology commercialization' (n=39)
- ♦ 'Media' (n=35)
- ♦ 'Regional languages of British Isles' (n=23)
- ♦ 'Health care services' (n=19)

### 3 | Findings: Comparative overview of research impact from Welsh universities

**Figure 1:** Relative volume of submissions to each Unit of Assessment compared to relative volume of submissions for that UoA from the rest of the UK. The size of the circles represents the absolute number of case studies submitted by HEIs in Wales

- Life sciences
- Social sciences
- Engineering and physical sciences
- Arts and humanities



### 3 | Findings: Comparative overview of research impact from Welsh universities

**Figure 2:** Number of case studies coded to a Field of Research (FOR) allowing for up to three codes per case study (top 75% of all codes assigned for both Wales and UK)



### 3 | Findings: Comparative overview of research impact from Welsh universities

With the exception of ‘Regional languages of British Isles’, these topics also appear in the top 10 most common impact topics for the full set of UK impact case studies. There were clear associations between *specific research disciplines* and *corresponding impact topics*, as seen with the full set of UK case studies. Case studies submitted to General Engineering (UoA 15), for example, led to impacts in the topics ‘Technology Commercialisation’ (n=12) and ‘Engineering, Design and Manufacturing’ (n=9), whereas those from Modern Languages and Linguistics (UoA 28) produced impacts in the topic ‘Regional Languages of the British Isles’ (n=10).

Most case studies also involved considerable interdisciplinary activity. This is illustrated in Figure 3, which shows the distribution of four select impact topics across the four main panels (distinguished by colour) and 26 UoAs. These four impact topics help show the detail of the distribution for those topics across disciplines.

Similarly, the disciplinary ‘hot spots’ that led to these impact topics for Wales HEIs are shown in Figure 4. This complex figure shows the relationship between impact topic UoA and panel. To aid understanding, impact topics were ordered by the panel in which they frequently occurred, as well as alphabetically within that panel. Within each cell, the size of the circle illustrates the number of case studies relevant to a topic for the corresponding UoA. For example, the circle in the top left-hand corner shows that the content in three of the 15 case studies submitted for UoA 1 (Clinical Medicine) captured subjects that were germane to the ‘Clinical Guidance’ topic (fourth from left).

As noted previously in the original King’s and Digital Science 2015 study and shown in Figure 4, there is a clear relationship between the type of impact and the UoA. However, some topics are more distributed across all panels, illustrating the input from many different disciplines to one particular topic. ‘Technology Commercialisation’, which stems from research in Panels A and B, is one example of this, as is ‘Informing Government Policy’, which cuts across all four panels.

In fact, there was no single prominent route to research impact. The detailed ‘alluvial diagram’ presented in Figure 5 links the pathways from 36 UoAs to the 60 impact topics. Up to three lines connect the originating academic discipline for each case study with the three most relevant topics; the colour coding is generated by the panel grouping of the academic discipline.

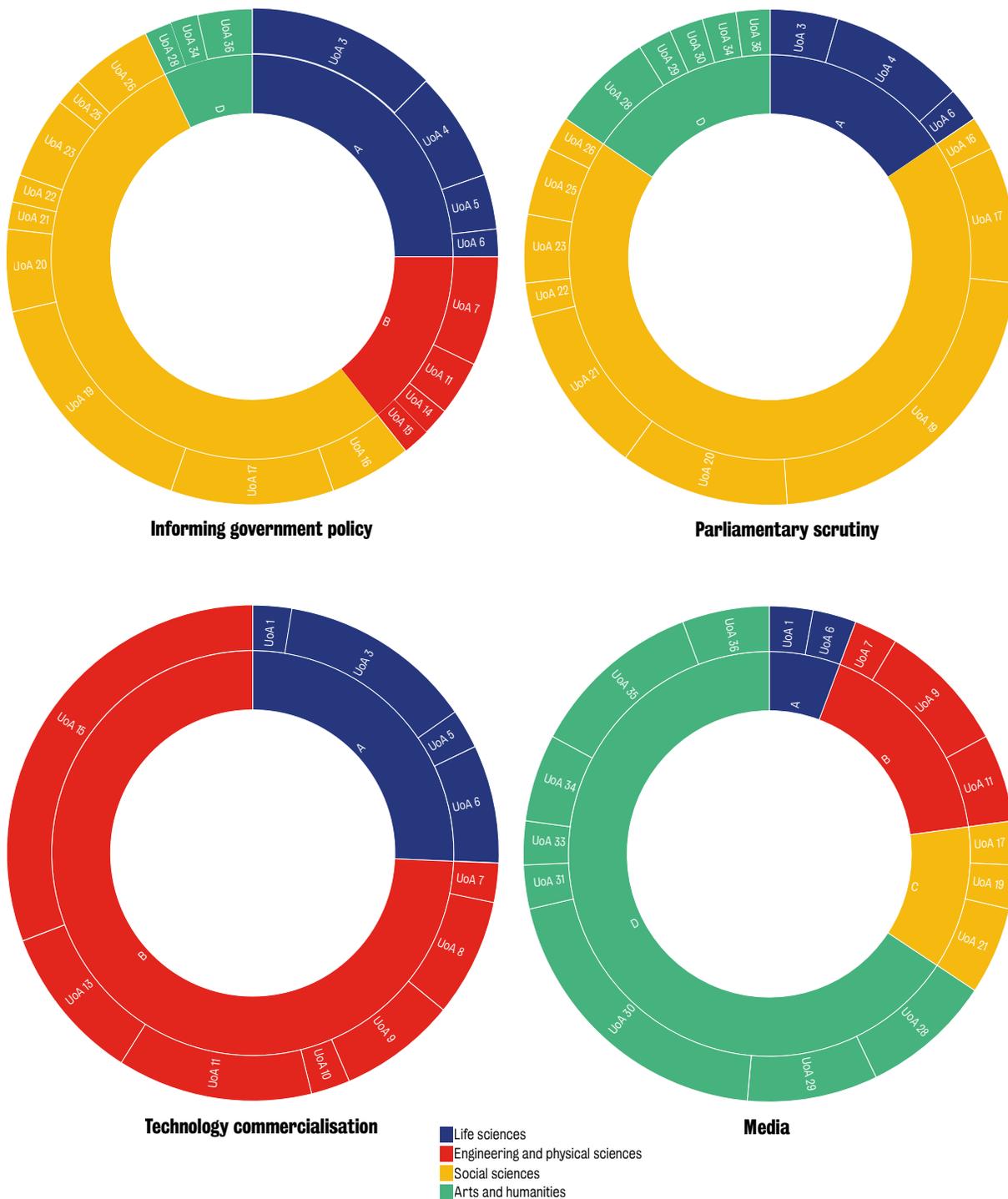
Interdisciplinarity can clearly be seen in the combination of red, green, blue and yellow lines filtering into all four disciplinary groupings on the right-hand axis. Impact topics originating from the greatest diversity of research disciplines included:

- ‘Informing Government Policy’ (submissions from 20 different UoAs)
- ‘Parliamentary Scrutiny’ (17 UoAs)
- ‘Media’ (16 UoAs)
- ‘Community and Local Government’ (14 UoAs)
- ‘Business and Industry’ (12 UoAs)

### 3 | Findings: Comparative overview of research impact from Welsh universities

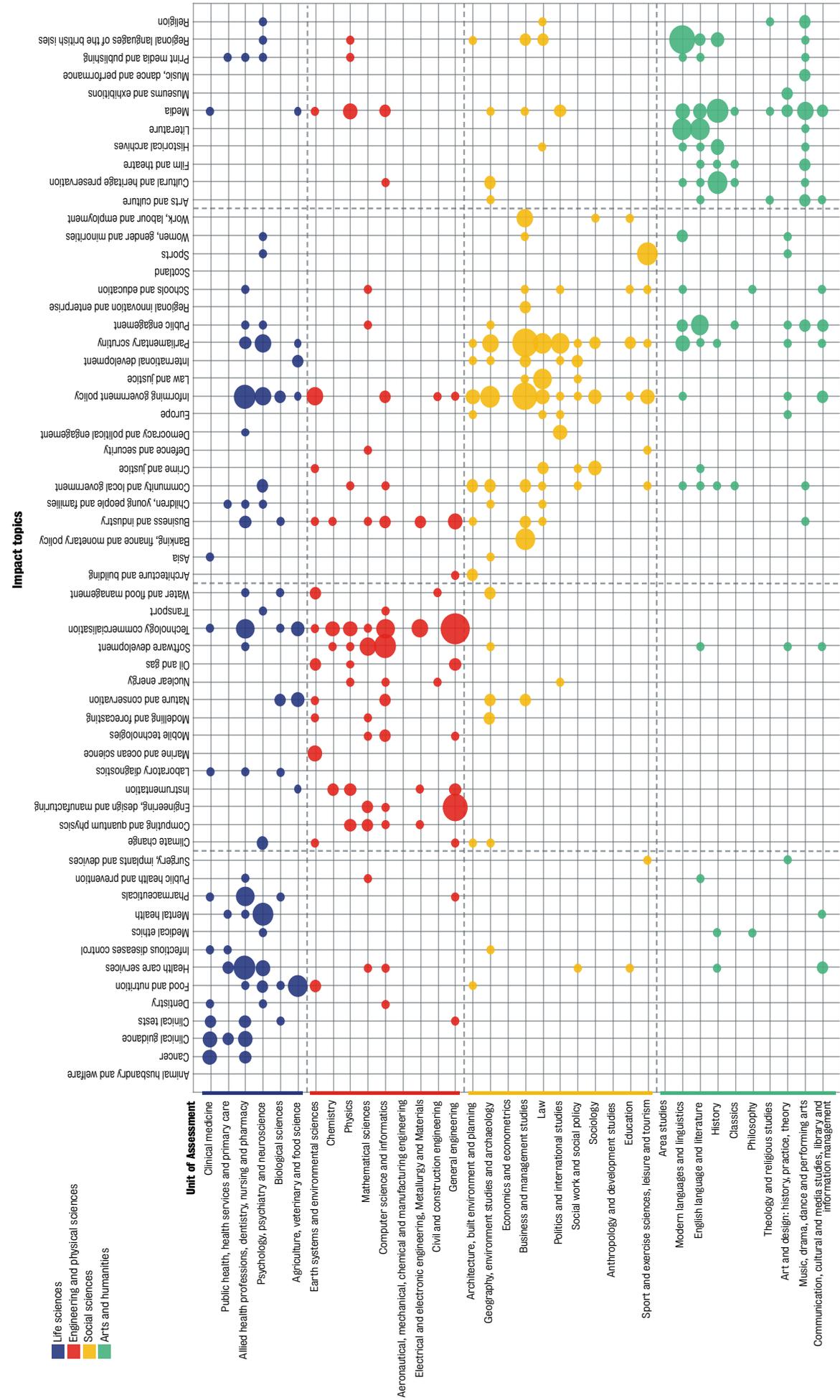
There were 300 unique pathways that linked UoAs to the three most prominent topics described in the impact narrative (see Figure 5). This accounted for 53% of all pathways drawn in the alluvial diagram, suggesting that just over half of the pathways represent research that, while arising from a single discipline, in fact led to multiple and varied impact topics. The other half had at least one more discipline (represented by a different UoA) contributing to the impact.

**Figure 3:** 'Impact wheels' that show distribution of case studies, from each UoA for select impact topics: 'informing government policy', 'parliamentary scrutiny', 'technology commercialisation' and 'media'



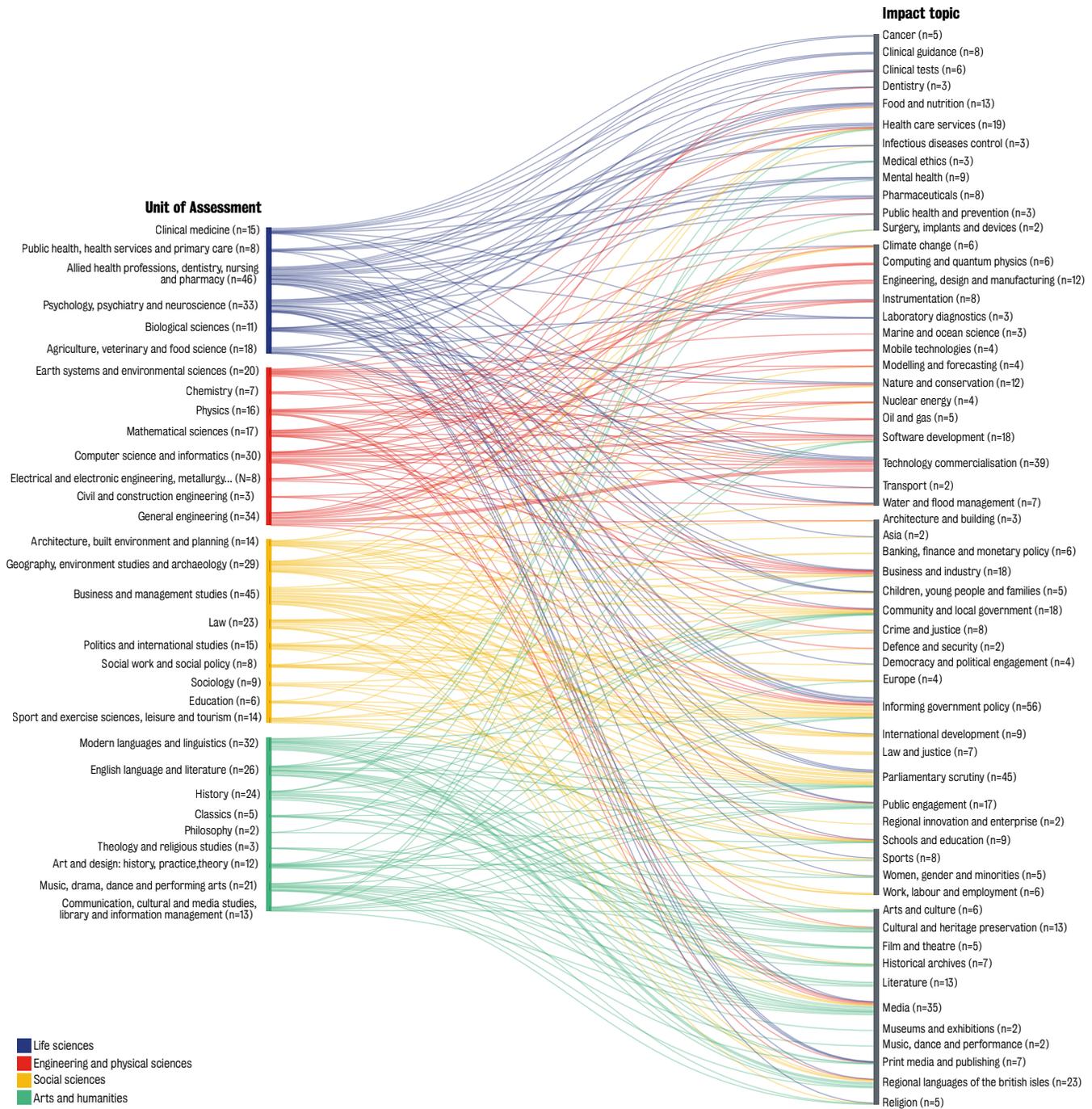


**Figure 4: Disciplinary 'hot spots' that underpinned the 60 impact submissions from Wales's REF 2014 impact submissions (n=273)**



### 3 | Findings: Comparative overview of research impact from Welsh universities

**Figure 5:** Alluvial connectivity linking UoA to impact topic



#### Geographical reach of the research and impact activities

Locations mentioned in the impact case studies from Wales involved 102 countries covering six continents (Figure 6a). The information presented in Figure 6 was generated by combining information extraction of location names with a third-party database of geolocations (known as 'geotagging'). Locations were tagged as either city, region or country, and form part of the searchable online database of case studies developed by Digital Science in the original King's College and Digital Science 2015 study. One caveat regarding geotagging is that it cannot discern whether a location mentioned is part of the research process (e.g. in relation to a collaborator), or where the actual impact occurred. Through further qualitative analysis described in this chapter, however, it was possible to show where the impact actually occurred.

The case study reach tended to cluster around Europe (45% case studies, see also Figure 6b) and North America (37%). However, Wales's research impact also showed considerable reach in countries within Asia (27%), Oceania (19%), South America (9%) and Africa (9%). Many case studies mentioned more than one location. See Case Study 1 below for an example of collaborative research taking place in South Africa.

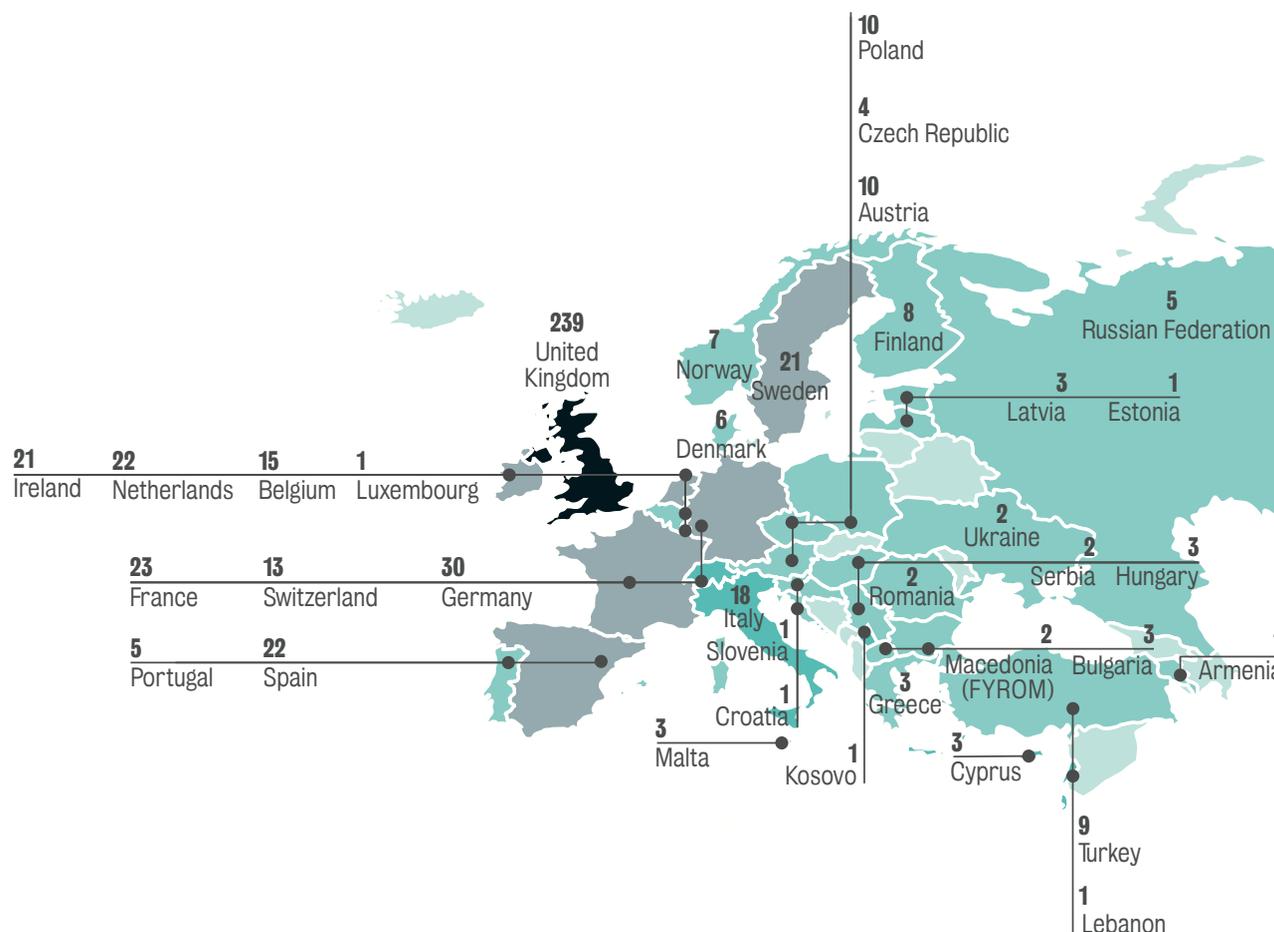
#### **Case Study 1:** Improving HIV/AIDS education and support in KwaZulu-Natal through comics drawing

Research at Cardiff University brought together two studies: research on autobiographical comics, visual metaphor and teenagers' responses to cartoons, combined with research into communicating HIV risk. This led to the development of comics drawing workshops for teenagers who had, or were at risk of, HIV/AIDS. The workshops were run at the Whizzkids United Health Academy in South Africa, helping teenagers to create their own comics stories as a way of expressing their feelings and exploring different possible solutions to scenarios from their life experiences. Teenagers who were HIV-positive spoke for the first time about their problems, sharing their concerns with each other and with Health Academy counsellors. A booklet of the best comics was distributed to teenagers in Edendale and via the Whizzkids United website. The workshops have made an impact on the health and quality of life of teenagers with, or at grave risk of, HIV – in particular their attitudes, awareness and behaviour.



### 3 | Findings: Comparative overview of research impact from Welsh universities

**Figure 6b:** Copy of Figure 6a focusing on Europe



Impacts or activities specifically involving Wales were noted in 48% of case studies submitted.<sup>5</sup> This included both the locations where the activities that led to the impacts took place, as well as the impacts themselves. However, it was also observed that there was a significant proportion of case studies in which the impact benefit was to Wales.

Of the 230 case studies that described impacts and activities in the UK, 130 (57%) specifically referred to research and impact activities occurring within Wales, followed by England (n=60), Scotland (n=25) and Northern Ireland (n=5).

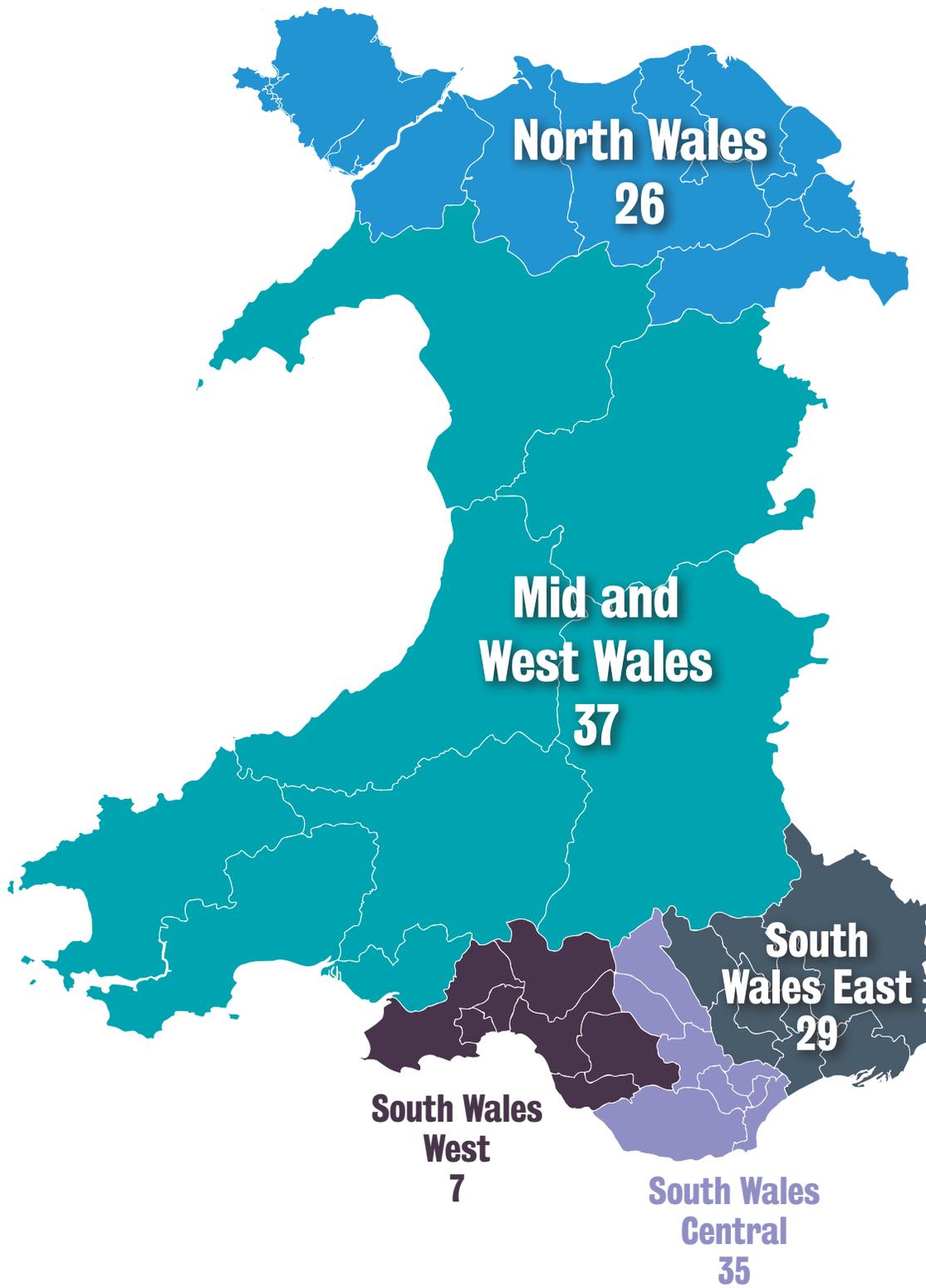
Within Wales, activities described with a specific location were most commonly reported in the areas surrounding Wales's nine HEIs. Not surprisingly, given the location of Welsh universities, most of these were spread more towards the south. Tagging qualitatively within Wales identified 134 locations, with over half based in the southern regions<sup>6</sup> (see Figure 7). The distribution across the regions in Wales and their corresponding originating discipline (the UoA) is shown in Table 6.

<sup>5</sup> Sub-regions in the UK and within Wales were tagged qualitatively specifically for this study.

<sup>6</sup> This sub-regional tagging does not include any mention of impact on Wales as a whole.

3 | Findings: Comparative overview of research impact from Welsh universities

**Figure 7:** Regions in Wales where activities that led to impact or the impact itself occurred (number refers to the number of case studies)



### 3 | Findings: Comparative overview of research impact from Welsh universities

**Table 6:** Regions in Wales where activities that led to impact, or the impact itself occurred, broken down by UoA

	Unit of Assessment	Mid and West Wales	North Wales	South Wales Central	South Wales East	South Wales West	Total case studies
UoA 1	Clinical medicine						0
UoA 2	Public health health services and primary care						0
UoA 3	Allied health professions dentistry nursing and pharmacy			2	1	1	4
UoA 4	Psychology psychiatry and neuroscience		2	1	1		4
UoA 5	Biological sciences			1	1	1	3
UoA 6	Agriculture veterinary and food science	2	2	1	1		6
UoA 7	Earth systems and environmental sciences	1	1				2
UoA 8	Chemistry	1		1			2
UoA 9	Physics	3	1	2		1	7
UoA 10	Mathematical sciences	1	1	1	1		4
UoA 11	Computer science and informatics	1	1				2
UoA 12	Aeronautical mechanical chemical and manufacturing engineering						0
UoA 13	Electrical and electronic engineering metallurgy and materials						0
UoA 14	Civil and construction engineering						0
UoA 15	General engineering	2		1	5	1	9
UoA 16	Architecture built environment and planning				1		1
UoA 17	Geography environmental studies and archaeology		1		2		3
UoA 18	Economics and econometrics						0
UoA 19	Business and management studies	1	2	2	2		7
UoA 20	Law	2	1	2	1		6
UoA 21	Politics and international studies	1		1			2
UoA 22	Social work and social policy		1	1	1		3
UoA 23	Sociology			1	1	1	3
UoA 24	Anthropology and development studies						0
UoA 25	Education						0
UoA 26	Sport and exercise sciences leisure and tourism	1		1			2
UoA 27	Area studies						0
UoA 28	Modern languages and linguistics	7	4	4	5	1	21
UoA 29	English language and literature	4	4	2	2	1	13
UoA 30	History	3	2	4	4		13
UoA 31	Classics						0
UoA 32	Philosophy	1					1
UoA 33	Theology and religious studies						0
UoA 34	Art and design: history practice and theory	1	1				2
UoA 35	Music drama dance and performing arts	5	1	7			13
UoA 36	Communication cultural and media studies library and information management		1				1





# 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities



## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

This chapter provides a further detailed qualitative analysis of all the individual impact case studies submitted to REF 2014 by HEIs in Wales. For this analysis, each case study was read and analysed with a view to addressing the following questions:

- What are the most common types of impact, and in which sectors do they occur?
- What are the activities or mechanisms that enable impact?
- Who benefits from the research? To what extent do these beneficiaries engage with the research, and are they located within Wales, the UK or internationally?
- How does Wales specifically benefit from the research undertaken in its universities?

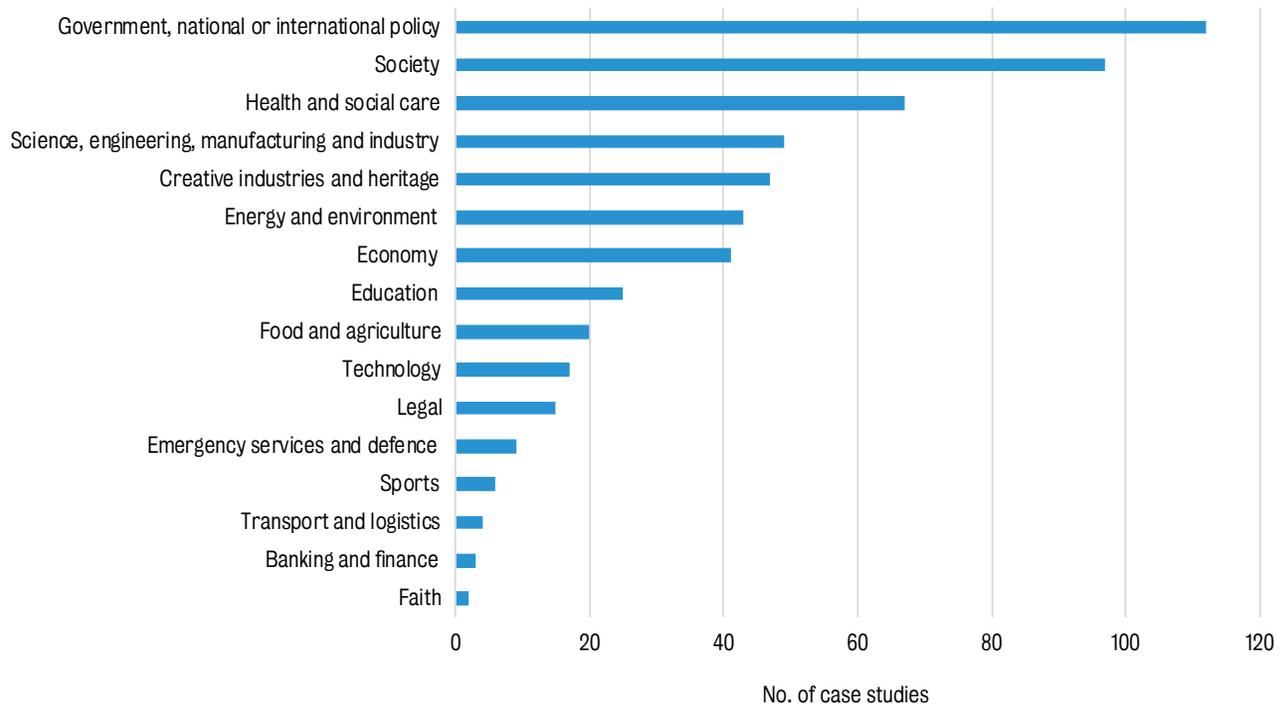
The following sections seek to answer these questions based on a close reading of all 273 case studies. As noted in Chapter 2, the process of analysis was iterative, with themes identified and grouped based on the initial identification of each type at a granular level. The analysis and categorisations of activities presented in the following sections are unique, being derived from the content of the case studies themselves rather than mapping previous or existing models or frameworks.

### Areas of impact for Wales's research

The types of impact reported by researchers in Wales fall into 16 different sectors or areas, as shown in Figure 8. The most prominent area was 'government, national and international policy', impacts from which featured in 41% of case studies submitted by HEIs in Wales in REF 2014. 'Society' was the next most common area of impact, occurring in 36% of all submissions, followed by impacts on 'health and social care' (25%), 'science, engineering, manufacturing and industry' (18%), 'creative industries and heritage' (17%), and 'energy and environment' (16%).



**Figure 8:** Sectors impacted by research from Wales across all locations



There was considerable overlap between national and global impacts, with 66% of case studies describing activities taking place within the UK and 57% abroad. This is compared to 37% of case studies that specifically described impacts only within Wales.

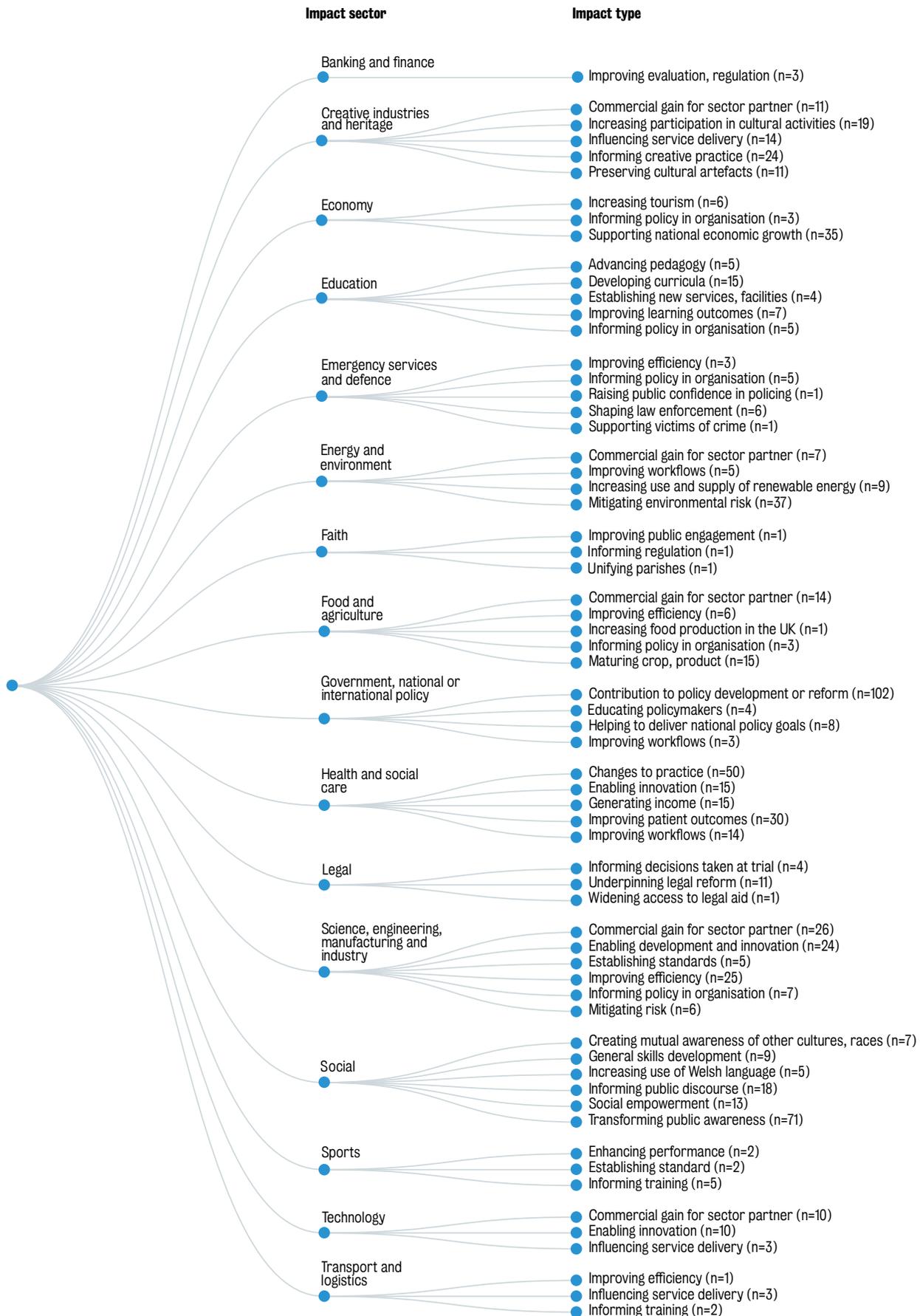
Impacts reported for the two most prominent sectors, ‘government, national or international policy’ and ‘society’, appear to have occurred equally in Wales, the UK and internationally. ‘Science, engineering, manufacturing and industry’ saw the highest concentration of activity outside of Wales, with 42% of all references to impacts on the sector situated in the UK and 45% internationally. Similarly, over half of all activity reported within ‘health and social care’ referred to the UK. Impacts on ‘energy and environment’ had the highest proportion of international reach, with over two-thirds of references to impacts occurring overseas.

Relative to the number of times that each impact sector was cited, the ‘creative industries and heritage’ were the most dominant beneficiary of research impact within Wales, with 52% of impact types within the sector situated locally or nationally within Wales. The next most prominent areas were the ‘economy’, 44% of references to which referred to Wales, and ‘education’ (36%).

Examining each case study further revealed details of how the research generated change in each of these 16 sector areas. These were captured as ‘impact types’ under each respective sector area, as outlined in Figure 9. Certain impact types such as ‘commercial gain for a sector partner’ or ‘influencing service delivery’ were common among multiple sectors. Others, however, were unique to the sector.

## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

**Figure 9:** Impact sectors and types from research in Wales HEIs



## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

For example, research undertaken by Cardiff University on targeting policing interventions to more effectively address how the public perceive their safety demonstrated impact types shared by multiple sectors in addition to those specific to ‘emergency services and defence’. One particular way in which this research delivered impact was through ‘informing policy’, with South Wales Police’s Neighbourhood Policing Teams gradually rolling out across South Wales methods developed at Cardiff University for improving neighbourhood policing. This led to impacts unique to the sector, such as ‘raising public confidence in policing’, evidenced through a growing number of residents in South Wales who felt confident in the ability of the police to deal with local concerns. The work also ‘shaped law enforcement’ in generating community intelligence that increased the number of arrests relating to Class A drug supply, increasing seizures of narcotics, reducing antisocial behaviour, and in so doing reducing public concerns about safety.<sup>7</sup>

### Cross-sector impact types

There were 6 types of impact that occurred commonly across multiple sectors:

#### A. Commercial gain for sector partner

Examples of researchers generating income for a collaborator occurred most prominently among case studies where the impact came from within ‘science, engineering, manufacturing and industry’ (44% of references to this impact type). This was not only framed in terms of direct income generation for a company or individual, but also included enabling business growth through building a client base, reducing costs, or the research establishing a unique selling point for a company – examples of which ranged from providing scientific support for omega-3 supplements produced by Seven Seas<sup>8</sup> to mathematical algorithms funded and adopted by Hewlett Packard to enable greater data security.<sup>9</sup>

Comparable examples of commercial gain also occurred for impacts on ‘food and agriculture’ (18% references to commercial gain), ‘creative industries and heritage’ (16%), ‘technology’ (13%), and ‘energy and the environment’ (9%). Among all these four sectors, direct income generation and business growth were common indicators of commercial gain. This included strengthening relationships with clients, providing a company with an edge over its competitors, or reducing costs by optimising resources. The protection of intellectual property also emerged as a form of commercial benefit for both the creative industries and agriculture, with examples including developing watermarks for use in the film industry<sup>10</sup> or establishing mutually beneficial agreements to share genetic resources.<sup>11</sup>

A separate, focused analysis was also conducted on commercialisation activities as an area of particular interest in relation to commercial gain. Specifically, this analysis identified commercialisation activities used by HEFCE in the ‘Higher

<sup>7</sup> ‘Improving Community Policing’, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3484>

<sup>8</sup> ‘Cardiff research supports the commercial use of ‘omega-3s’ in pet foods and dietary supplements’, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3144>

<sup>9</sup> ‘Meeting the Challenges of Data Security’, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3389>

<sup>10</sup> ‘Benefits to the business and medical sectors through the application of geometric convexity-based methods to image and data processing’, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=29357>

<sup>11</sup> ‘Industry investment in a Miscanthus breeding programme for UK and global sustainable energy, and the fair and equitable use of natural resources’, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=42084>

Education – Business and Community Interaction Survey’ (HEBCIS) within the same reporting period (2013-14). This included standard indicators of commercialisation, such as spin-out companies, patents, royalties or licenses, but also extended to collaboratively funded research, CPD and income generated from leasing facilities.

A third of case studies submitted to REF 2014 by HEIs in Wales described some form of commercialisation. 70% of these case studies measured this through commercial income (discounting where money had been granted by an award or government), and 60% by the commercialisation of research via an output. 43% of references to outputs exclusively involved spin-off companies and 30% patents granted or applied for; 28% described both spin-offs and patents. Most of these commercialisation activities arose from panels A and B. This was also the case in the King’s College London and Digital Science 2015 study.<sup>12</sup>

### B. Improving efficiency and workflows

Improving efficiency and workflows was the most common impact type to cross sectors, with clusters of examples occurring across seven different sector areas. Examples ranged from reducing staff turnover in ‘emergency services and defence’ (n=3) to optimising resources, reducing waste and streamlining supply chains within ‘food and agriculture’ (n=6). For example, researchers at Bangor University improved the efficiency of sourcing and distribution for major producers and retailers of vegetables in the UK via a carbon footprint model that provides an evidence base for modifying sourcing policy and production chains.<sup>13</sup>

In the context of ‘science, engineering, manufacturing and industry’, improving efficiency and workflows related more to shortening production and development timescales (n=8), reducing waste (n=2), optimising the use of resources (n=15) and automating processes (n=1); in ‘government, national or international policy’, examples included streamlining the rollout of new policies, while improved efficiency and workflows in ‘health and social care’ are typically described in terms of improving logistics and administration, delivering more efficient treatments, and standardising processes (n=12). For example, in collaboration with the Royal College of Physicians, researchers at Swansea University have developed – and are beginning to embed in practice – national standards for the structure and content of patient records. The new standards overhaul a system in which the lack of uniformity in the data collected precludes its potential use in monitoring the quality of care, be it within an institution or nationally.<sup>14</sup>

### C. Enabling innovation

Research-enabled innovation was a common impact type from the sciences, with just over half of explicit references to enabling innovation related to impacts in ‘science, engineering, manufacturing and industry’. The remainder was made up of 31% from ‘health and social care’, and 17% from computational ‘technology’.

<sup>12</sup> Only instances where researchers explicitly described commercialisation activities that generated income for their institution were used in this analysis. Instances where partnerships with industry were described without an explicit statement about whether income was generated for their institution were not included, neither were instances where the income gained was described solely in terms of the benefit to the sector. Moreover, references to grants, studentships or fellowships awarded specifically for research were not captured. It is likely, therefore, that what is reported only constitutes a partial account of the actual commercialisation activities resulting from research in Wales.

<sup>13</sup> ‘Enhanced carbon footprinting of food products’, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=25249>

<sup>14</sup> ‘Developing and implementing national standards to improve the structure and content of patient records’, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=35208>

## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

Innovation took various forms specific to each field. Depending on the sector, this meant improving or implementing product development and design processes, informing clinical trials, contributing to the development of pharmaceuticals or scientific instruments, or embedding new programming languages in practice.

For example, research developed at Swansea University that led to the invention, trialling and adoption of technology for the early detection of abnormal blood clots has had additional impact through its use by Haemair Ltd, a medical device company, as ‘a key underpinning and enabling technology in the development, testing, trialling and sale’ of its products. The importance of the research for development has led the company to operate within Swansea, considering it ‘a vital part of our ability to attract ongoing investment’.<sup>15</sup>

### D. Mitigating risk

The use of research to manage risk was most prominently reported within the context of ‘energy and environment’ (n=37) and ‘science, engineering, manufacturing and industry’ (n=6). Yet further examples can also be found embedded within other contexts, such as in ‘health and social care’, where managing risk formed part of improving patient outcomes through reducing the failure rates of treatments or managing risks to health in clinical practice (n=12).

In the context of ‘energy and environment’, mitigating risk include:

- ♦ protecting habitats and endangered species (n=14)
- ♦ improving forecasting and environmental management (n=11)
- ♦ lowering emissions and fuel consumption (n=12)
- ♦ reducing waste (n=5)
- ♦ managing hazardous elements (n=4)

All five areas relate to the mitigation of threats to the environment, be that in facilitating interventions from environmental managers, changing consumption behaviours among the public, or influencing design processes to be more energy efficient. Mitigating risk in the context of ‘science, engineering, manufacturing and industry’, however, occurred more commonly in relation to health and safety in the workplace, or controlling risk to prevent hazardous or defective products, either through predictive modelling in design phases (n=3) or testing components (n=3).

For example, automotive design analysis software developed at Aberystwyth University in collaboration with companies such as Ford are now deployed at over 200 automotive and aeronautic assembly lines and component suppliers across the world. In addition to related benefits in shortening product time-to-market and reducing costs, this method of automating design analysis and producing diagnostics for automotive systems has been shown to improve vehicle safety by providing feedback early on potential problems with the design of automotive systems.<sup>16</sup>

### E. Influencing service delivery

The ways in which research influenced service delivery included a range of activities. In the ‘creative industries and heritage’ this included implementing

<sup>15</sup> ‘Use of new diagnostic medical technology to improve detection of abnormal blood clotting: the health and economic benefits’, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=29295>

<sup>16</sup> ‘Automated Design Analysis and Generation of Diagnostics’, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=44051>

## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

digital methods (n=2), improving management of organisations or of heritage sites (n=6), or informing commissioning (n=4), examples in ‘technology’ included growing service capacity (n=2) and strengthening data security (n=1). For example, researchers at the University of South Wales have contributed to the development of ‘High Performance Computing Wales (HPC Wales) by providing “test” problems from the life sciences (bioinformatics), defining key software packages, and brought on-board collaborative partners to instigate project areas’.<sup>17</sup>

### F. Informing organisational policy

Impacts on policy within organisations occurred across many different fields, spanning ‘science, engineering, manufacturing and industry’ (n=7), ‘education’ (n=5), ‘emergency services and defence’ (n=5), ‘economy’ (n=3) and ‘food and agriculture’ (n=3).

Within ‘food and agriculture’, examples of informing policy related to establishing standards, simplifying regulation and improving hygiene management. For example, through the development of a Knowledge, Innovation and Technology Exchange programme, researchers at Cardiff Metropolitan University worked with 31 food manufacturing businesses in Wales to improve their food production and food safety management systems.<sup>18</sup> By contrast, impacts on informing organisational policy in relation to the ‘economy’ focused more on informing forecasting and strategy. The UK Tourism Satellite Account feasibility study produced by the Cardiff Business School has, for example, provided the ‘fundamental basis for subsequent Office for National Statistics’ (ONS) estimates and was ‘critical to the formation of the Tourism Intelligence Unit (TIU) at ONS’.<sup>19</sup>

### Examples of sector-specific impact types

#### Government Policy

While the above six impact types were common among various sectors, others were specific to certain sectors. One such area was government policy, an impact topic that was also prominent in the King’s and Digital Science 2015 study. Research from the Social Sciences was dominant this area, with 77% of case studies from this panel describing impacts on policy.

The impacts that researchers reported in REF 2014 were typically on policy itself, even though a small number did describe *raising awareness of specific issues* among government officials or improving workflows within government. Such contributions to policymaking appeared to cross four discrete stages:

1. Shaping policy debate (30% case studies with policy impact)
2. Influencing policy recommendations (43%)
3. Informing strategy or allocation of funds (47%)
4. Implementation or delivery of policy (54%)

<sup>17</sup> ‘Using genomics to shape high performance computing’, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=27041>

<sup>18</sup> ‘The impact of food safety research on knowledge exchange, food safety practice and economic prosperity in the Welsh food industry’, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=42079>

<sup>19</sup> ‘Understanding the economic and environmental impacts of tourism’, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3515>

## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

All four could occur in conjunction to illustrate the evolution of the impact on policy. In some cases, shaping policy debate led to recommendations informed by the research, whereas in others the research might feed directly into a new strategy.

Significantly, however, over half of the instances describing a policy impact concerned the implementation of a policy informed by the research, be it as a pilot or nationally. Research from Cardiff University saw a number of high level impacts in policy, such as the introduction of national and international policies to support victims of sexual or domestic abuse, using the research 'to inform their decision-making about the development, implementation and funding of services for these victims of crime'.<sup>20</sup> Research from another group at Cardiff University led directly to the development of a pioneering multi-agency data-sharing model for violence prevention using hospital data, which has encouraged both international adoption and a UK government national commitment to implement the approach UK-wide.<sup>21</sup>

Similarly unique impact types also appear in relation to 'health and social care', in which changes to practice (n=50) and improving patient outcomes (n=30) were the most dominant impact types reported. With the former, the adoption of research findings in clinical practice (n=20), informing clinical guidelines (n=17) and training (n=13), and increasing the efficacy of treatments (n=6) were all key measures of impact. Patient outcomes were framed in similar terms, such as improving wellbeing (n=13), increasing participation in preventative scheme (n=9) and reducing risk to patients (n=9).

### Activities and mechanisms that enabled impact

The activities or 'mechanisms' that enabled an impact to take place ranged from direct products of the research to translating research findings into new mediums that engaged a wider public.

36 different mechanism types were identified in the case studies submitted from Wales in REF 2014 (see Figure 10). These broadly fell into six areas:

- ♦ *Disseminating research findings* (present in 79% of case studies), where researchers actively disseminated their findings through activities such as publishing reports or articles, engaging in public speaking, or gaining coverage of their work in the media.
- ♦ *Engagement with adopter community* (45%), where the 'adopter' is effectively the beneficiary of the impact. These types of activities included contributing to a working group, knowledge transfer partnerships, engaging in projects in the creative industries, and producing guidelines for best practice or models.
- ♦ *Interacting with policy makers* (25%), ranging from briefing policy makers and supplying evidence to government committees, to drafting legislation and serving on select committees as an invited expert.

20 'Improving the response to victims of violence', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3482>

21 'Shaping government policy on violence prevention'. REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3669>

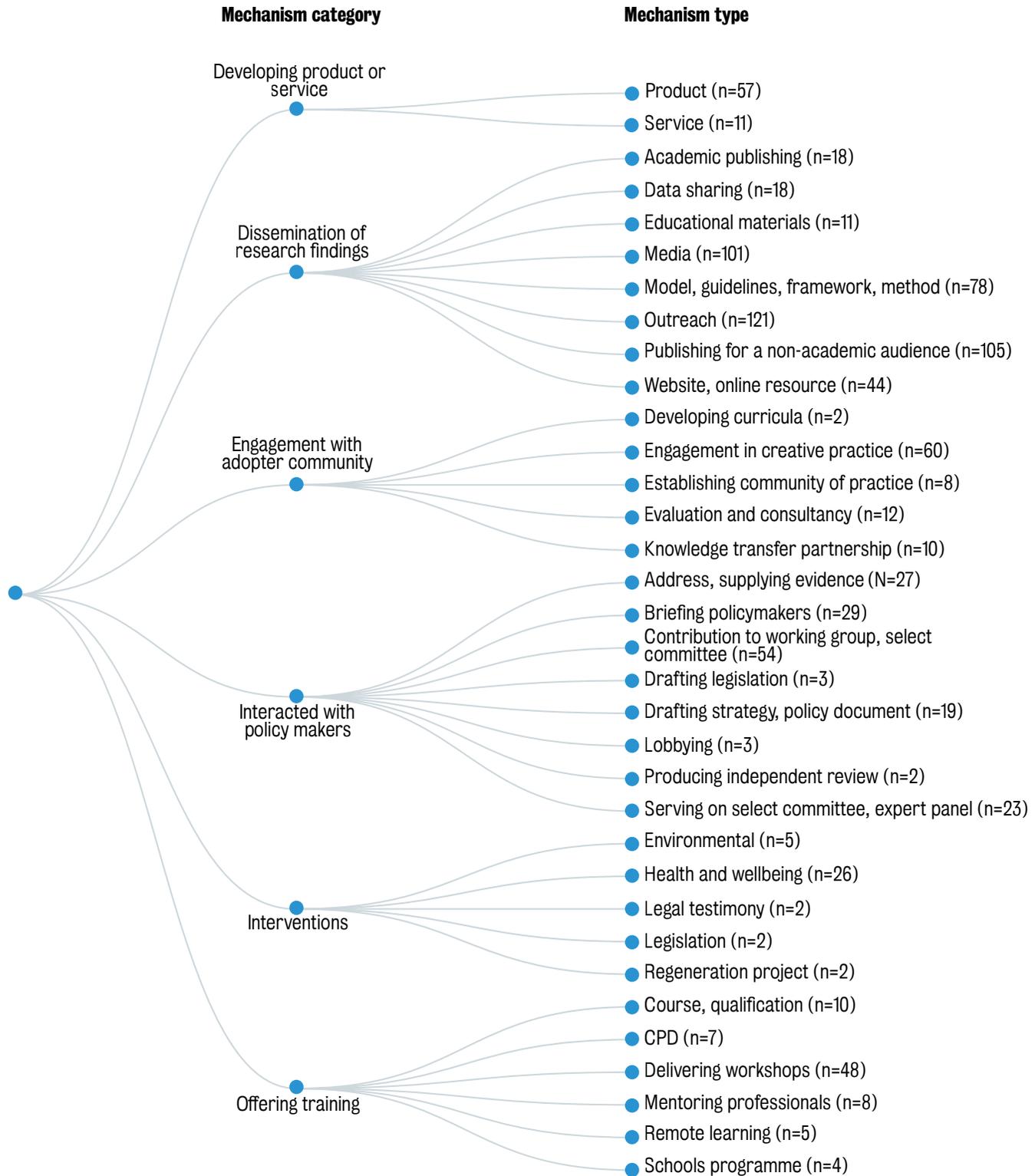
#### 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

- ♦ *Offering training* (24%) to practitioners or beneficiaries of the research.
- ♦ *Developing a product or service* (24%), such as software, pharmaceuticals or tools for communication.
- ♦ *Interventions* (14%), especially clinical interventions where researchers developed a public health programme or provided a screening tool to enable diagnosis.

The majority of impacts reported by researchers from Wales were the product of multiple activities. Just 19% of case studies reported one mechanism type. Instead, these activities typically worked in conjunction: an average of three individual mechanisms appear per case study, belonging to an average of two of the above categories.

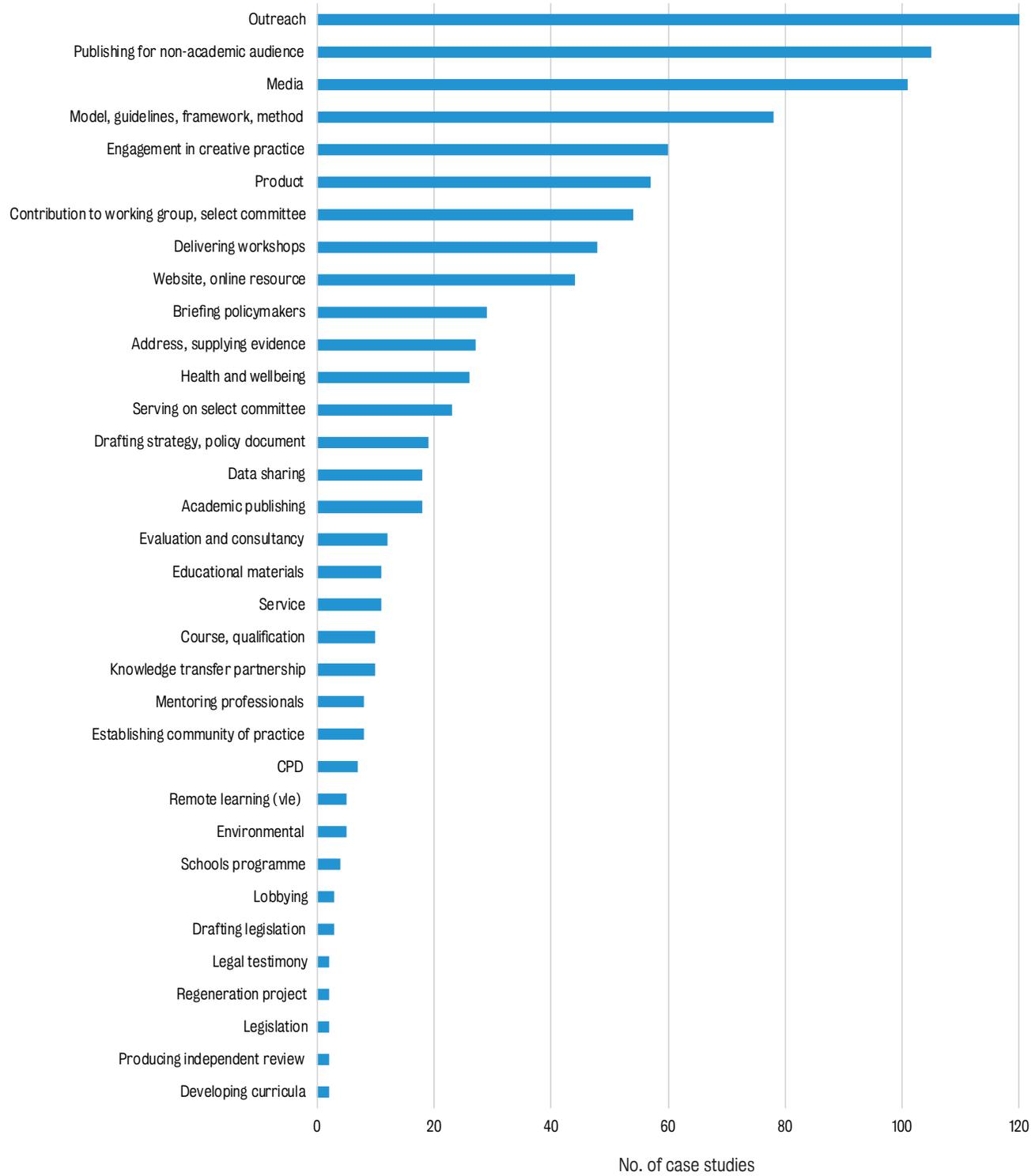
The following sections describe the types of activities and mechanisms reported under each of the above 6 categories, considering how these activities established pathways to impact for researchers within Wales. Given the prominence of 'dissemination', a larger emphasis is given to this section, with shorter descriptions of the other mechanisms.

**Figure 10:** Impact mechanisms: categories and types



## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

**Figure 11:** Impact activities and mechanisms, ordered by frequency



### Disseminating research findings

The most commonly reported activity that led to impact was the dissemination of research findings or knowledge transfer, which occurred in 79% of case studies submitted to REF 2014 by HEIs in Wales. This encompasses all forms of outputs that took original research and presented it in a format that would be accessible to a non-academic audience, including:

- ♦ *Outreach* (occurring in 44% of case studies), delivered via public speaking, social media or organising conferences and seminars based on themes generated by the research.
- ♦ *Publishing for a non-academic audience* (39% of case studies), through mediums such as reports, books, articles, blogs, newsletters, pamphlets and reference texts such as dictionaries and encyclopaedias.
- ♦ *Media* (37% of case studies), via coverage in broadcast and print media, in addition to a small number of instances where mobile apps, videos and games were developed.
- ♦ *Models, guidelines and frameworks* (29% of case studies) for direct implementation in industry or practice, ranging from tourism and heritage to engineering, agriculture, environment management, health and social care.
- ♦ *Website or online resource* (16% of case studies), including general reference websites, online toolkits and downloadable materials.
- ♦ *Data sharing* (7% of case studies), examples of which include the publication of datasets derived from environmental and archaeological field data, genome composition and collections of digitised historical sources.
- ♦ *Academic publishing* (7% of case studies) of journals and journal articles that directly led to impact.<sup>22</sup>
- ♦ *Educational materials* (4% of case studies), such as teaching resources and study guides.

As shown in Figure 12, researchers from all academic panels engaged in dissemination as a pathway to impact. This was, however, especially prominent in case studies from the Social Sciences (Panel C), 91% of which describe dissemination activities (n=72).

The Arts and Humanities (Panel D) were the next most prominent (88%, n=57), followed by Life Sciences (Panel A, 68%, n=43), and Engineering and Physical Sciences (Panel B, 67%, n=44).

Each of the 4 REF panel groups produced distinct patterns of dissemination. In the Life Sciences (Panel A), dissemination was more inclined towards publication. Here, models, guidelines and frameworks were the most common, featuring in 32% of the case studies submitted to this panel. For example, research developed at Cardiff University underpinned new evidence-based treatment guidelines for the diagnosis and treatment of acquired haemophilia A (AHA), which have

<sup>22</sup> Note that REF 2014 included a separate assessment for quality of academic outputs. Not all researchers may have included academic papers in their impact case studies as a mechanism toward impact.

#### 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

been adopted both in the UK and worldwide.<sup>23</sup> The next most prominent type of dissemination was *publishing for a non-academic audience*, occurring in 29% of case studies in Panel A. Submissions to Panel A also included the highest number of case studies that present *academic publishing* as a direct pathway to impact, particularly in relation to research from Clinical Medicine and Allied Health Professions, Dentistry, Nursing and Pharmacy.

By contrast, dissemination in Engineering and Physical Sciences (Panel B) had a greater focus on verbal communication. While *models, guidelines and frameworks* were still a common catalyst for impact (29% of Panel B case studies), with examples including the incorporation of new techniques for measuring turbulence in established and widely used oceanographic models,<sup>24</sup> a third of case studies arising from research in Panel B included forms of *outreach*, or work in the *media*. For example, through talks and demonstrations aimed largely at children of secondary school age, modelling of soap bubbles and soap films undertaken at Aberystwyth University has led to increased public engagement in mathematics.<sup>25</sup> Similarly, *Great Migrations*, a seven-part television series for National Geographic was informed by field data gathered by researchers at Swansea University via an innovative device carried by animals to track remotely their movements, energy expenditure and behaviour.<sup>26</sup>

*Outreach* was also a prominent type of dissemination within the Social Sciences, occurring in 62% of case studies submitted to Panel C, and 58% of those from the Arts and Humanities (Panel D). In the latter, this was especially focused around History, and Music, Drama, Dance and Performing Arts, 91% and 73% of which counted outreach among the activities that enabled an impact.

Publishing for a non-academic audience was most relevant to research from Panels C and D. The University of Wales has, for example, led work since 1921 on the Geiriadur Prifysgol Cymru (GPC), a historical dictionary that today is considered an authority on the spelling, derivation and meaning of Welsh words.<sup>27</sup> Further examples range from articles or regular columns published in national newspapers and specialist magazines to reports commissioned by clients such as the BBC Trust on audience satisfaction levels, or on the provision of live music in Wales.<sup>28</sup>

*Media* was also an important form of dissemination for all four panels. However, relative to the number of submissions to each UoA, its use was most prominent in the Arts and Humanities, particularly History (occurring in 82% of case studies). Half of the references to media related to interviews or coverage in broadcast media, and 40% to the printed press; the remaining 10% new media such as mobile applications, videos and games. Particularly in relation to broadcast media, researchers were typically invited as featured experts rather than initiating the project. 57% of references to TV or radio broadcasts described the

23 'Cardiff-led research underpins new UK and International clinical treatment guidelines for the management of acquired haemophilia A', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=2728>

24 'Turbulence research improves ocean forecasting and marine energy infrastructure', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=17646>

25 'Optimal geometry of soap films', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42095>

26 'Public understanding of long-distance animal movements: Great Migrations', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5733>

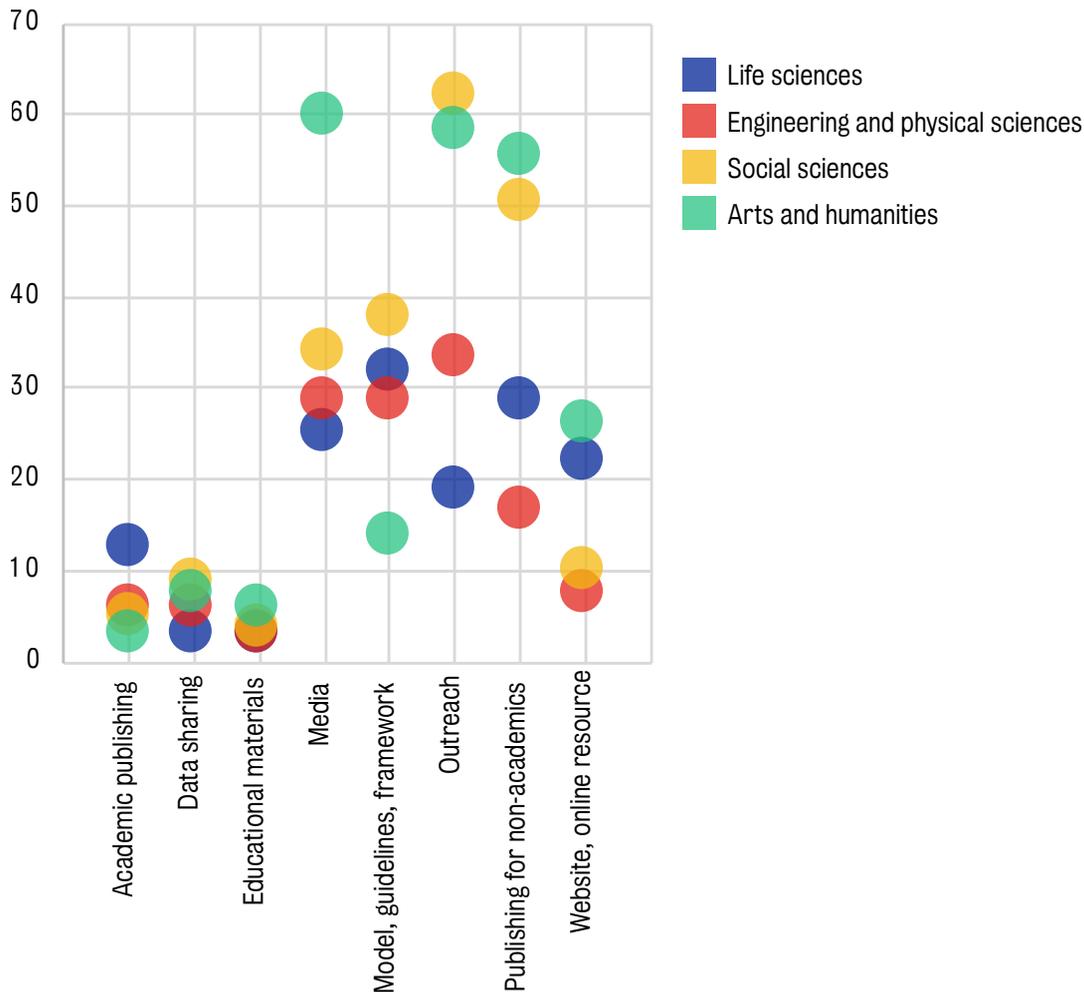
27 'Geiriadur Prifysgol Cymru / A Dictionary of the Welsh Language', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=37244>

28 'Analysing and Developing Creative Industries in Small Nations', REF 2014 Case Study. Available at <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27760>

#### 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

researcher's role as a featured expert or as an advisor; in 22%, their involvement was unclear; and in 15%, the researcher described having no direct involvement, with the research gaining coverage of its own accord. Just 6% of references to broadcast media described dissemination as a proactive collaboration with a media partner, or a project led by the research team.

**Figure 12:** Type of dissemination activity arranged by academic panel



#### Engagement with adopter community

Engagement with a community of practitioners or beneficiaries has grown increasingly common for many academic disciplines. Within Wales, this has not only been achieved through formal arrangements such as Knowledge Transfer Partnerships (n=10), but researchers are also engaging with adopters directly through a variety of channels. Those reported in REF 2014 included:

- ♦ *Engagement in creative practice* (featured in 22% of case studies from HEIs in Wales), most prominently in curating exhibitions (n=29), writing fiction and poetry (n=13), assisting in the curation of festivals (n=12), or contributing to documentaries (n=11) and theatre productions (n=8).

#### 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

- ♦ *Participation in a working group or select committee* (20% case studies.)
- ♦ *Providing independent evaluation* (4% case studies), especially in assessing the delivery of medial processes and treatments, product testing, or the evaluation of services such as training schemes and transportation services.
- ♦ *Establishing a community of practice or professional network* (3% case studies), notably among the health, science and technology, energy and environmental sectors, and policing.
- ♦ *Developing curricula* (1% case studies) for formal education programmes.

The impact case studies produced by universities in Wales produced several excellent examples of how such engagement worked in practice. As shown in Case Study 1, (below) part of the Biosciences, Environment and Agriculture Alliance between Bangor and Aberystwyth Universities, Bangor has led the development and dissemination of rice varieties that are improving the livelihoods of over 5 million households in India and Nepal.<sup>29</sup>

##### **Case Study 2:** New rice varieties improve livelihoods of millions of households in India and Nepal

Since 1996, research led by Professor John Witcombe at Bangor University resulted in the production and adoption of ten new varieties of rice in India and Nepal. This development was enabled through client-orientated breeding, a concept developed by Witcombe based on participatory varietal selection (PVS).

The new varieties were implemented in farm-based PVS trials in 20 lowland districts in Nepal. The trials have helped to 'improve knowledge of, and access to, suitable rice varieties for resource-poor farmers'. The spread of varieties developed specifically for use in India started in 2001. By 2012 more than 900 tonnes of seed had been distributed to over 226,000 farmers in villages throughout northern and central India. Little intervention was needed to sustain use of the seed, which had a multiplier effect, with seed being distributed to neighbours and people in nearby cities. Seven years after its release, the seed variety Ashoka was 'grown on 40-76% of the available land of adopting farmers in the five study districts in four states'.

The varieties have grown in popularity among farmers due to their high yield, their suitability to grow during the fallow season, and their superior taste and grain quality. Grown on at least 500,000 HA in India and Nepal, the new rice varieties provide higher yields of better quality crop to some of the poorest farmers across a wide range of environments.

<sup>29</sup> 'New rice varieties improve livelihoods of 5 million households', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=42086>

## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

### Interactions with policymakers

Interactions with policymakers ranged from supplying evidence to select committees (n=27) and briefing policymakers (n=29), to drafting policies and strategies (n=21), lobbying (n=3) and producing independent reviews (n=2).

An example of successful interaction and collaboration with policymakers came from Swansea University, where a study of underage test purchasing of alcohol was conducted for the Home Office. This led directly to legislation in England and Wales, and later in Scotland and Northern Ireland, permitting underage test purchasing of alcohol under official supervision. The method is now used routinely by every UK police force and local authority trading standards department, as well as internationally. Sales of alcohol to minors has since fallen by over 60%.<sup>30</sup>

### Offering training

Training delivered by researchers in Wales spanned a variety of platforms. Just under a fifth of all case studies submitted by Wales mentioned workshops among the activities that led to impact, with audiences ranging from professionals, volunteers and the general public to school pupils, students and young people.

Further types of training include:

- Formal courses, qualifications or CPD provision (n=16)
- Mentoring professionals (n=8)
- Remote learning (n=5)
- Schools programmes (n=4)

### Development of a product or service

Software was by far the most dominant product described by researchers as a pathway to impact (n=22). Yet other products developed by researchers in Wales also spanned a variety of areas from pharmaceuticals (n=6), seed and crop varieties (n=6) to food and supplements (n=5), lasers (n=3) and construction materials (n=2). Services, too, were wide reaching, including research and training centres (n=6), the establishment of health clinics (n=2) and the provision of laboratory spaces for those outside of academia (n=2). The underpinning research mostly occurred in case studies from Panel B, particularly General Engineering, and Computer Science and Informatics.

For example, Molpro, a software package originating from research in quantum-mechanical methods at Cardiff University, calculated the properties of molecular matter, yielding far greater accuracy in computations for larger molecules and for screening new materials than most other programmes on the market. The software has been used by over 650 organisations worldwide during the assessment period, informing the development and production of products marketed to industries ranging from agriculture, aerospace and construction to pharmaceuticals and personal care products.<sup>31</sup>

30 'The impact of alcohol test purchasing by underage adolescents on the availability of alcohol to minors', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=5731>

31 'Transforming quantitative prediction of molecular properties through software – Molpro', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3462>

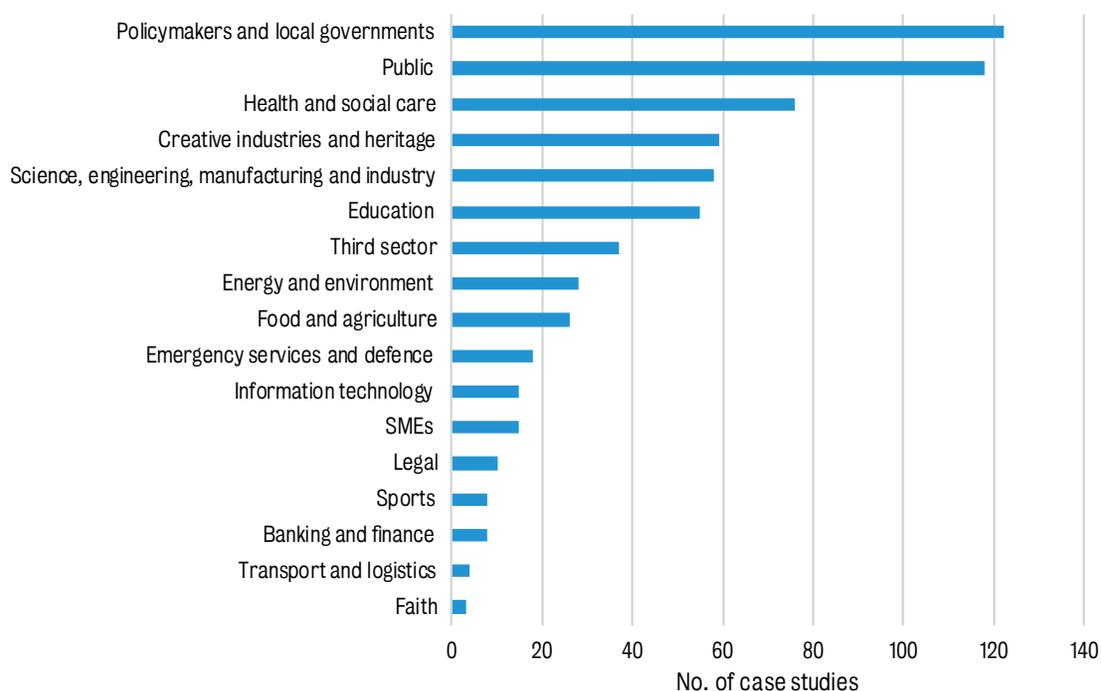
## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

### Beneficiaries of research from HEIs in Wales

Research from Wales impacted on a wide array of beneficiaries. These ranged from adopters of research findings to those who benefited indirectly from the resulting products or services; from people who have directly collaborated with researchers to those who have been exposed to research through the dissemination of findings.

104 different beneficiary types appear in the case studies submitted to REF 2014 from Wales. These can be grouped into 17 wider sector groups (see Table 7). Of these, ‘policymakers and local governments’ were the most common group, followed closely by members of the ‘public’, and practitioners and recipients of ‘health and social care’ (see Figure 13).

**Figure 13:** Main beneficiary categories of research impact from Wales



The location of these beneficiaries further illustrates the even regional spread of research impact from Wales, with 24% of beneficiaries described as located in Wales, 34% in the UK (which may include Wales, but the region not specified), and 31% international. (In the remaining 12% of cases, it was not possible to identify the location of the beneficiary.)

As shown in Figure 14, beneficiary communities within ‘policy’, the ‘third sector’ and ‘education’ were distributed evenly across Wales, the UK and internationally. Farmers and food manufacturers were more commonly located internationally, as were beneficiaries within ‘technology’ and ‘banking and finance’. Those located in the UK, however, included national ‘emergency services and defence’, ‘legal’, and ‘health and social care’. One notable beneficiary for Wales were ‘SMEs’, which, will be discussed in more detail below, have been the subject of complementary research and policy initiatives to support start-ups and small businesses, and to encourage industry within Wales.

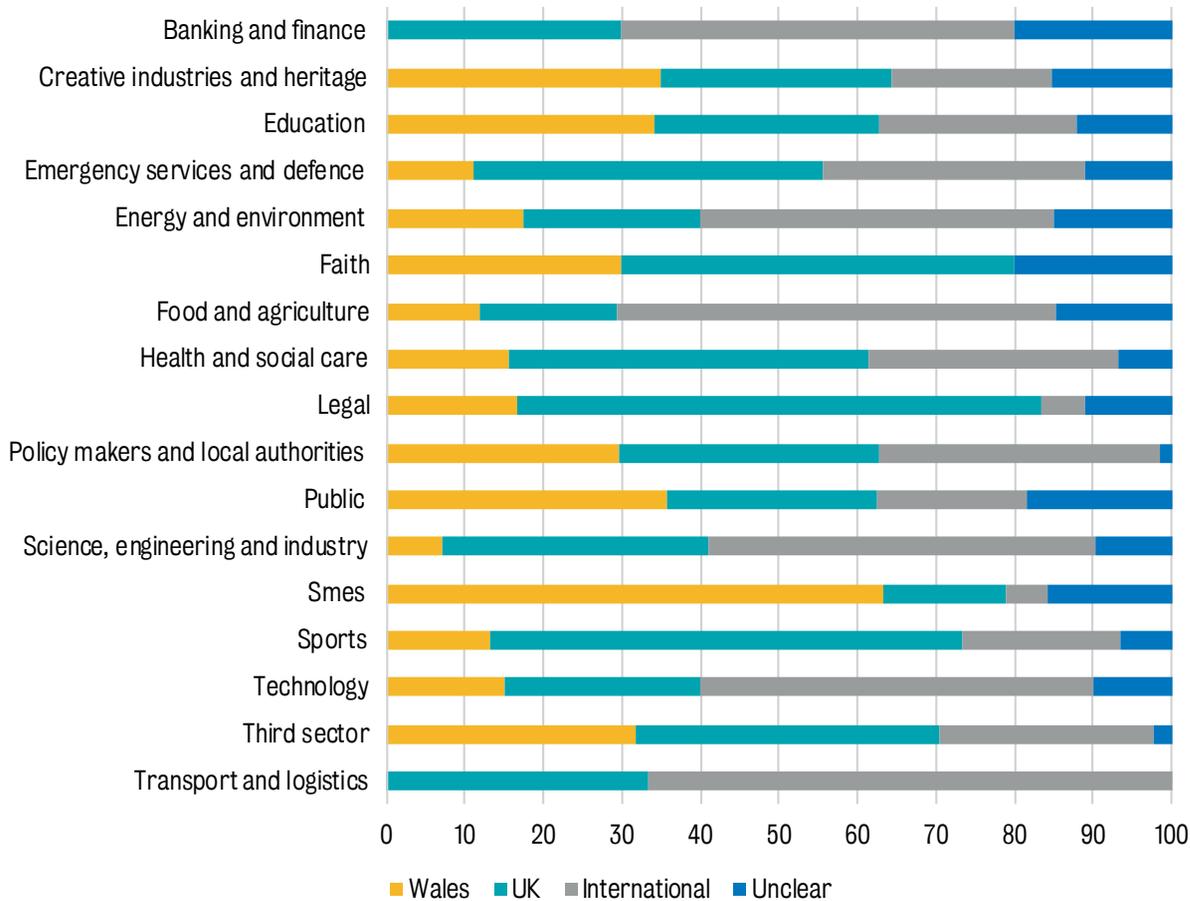
## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

**Table 7:** Beneficiaries of research from HEIs in Wales

	No. of case studies		No. of case studies			
<b>Banking and finance</b>	Banks	7		Paramedics	1	
	Economists	1		Patients	36	
	Tax authorities	1		Pharmaceuticals companies	14	
<b>Creative industries and heritage</b>	Actors, playwrights	4	<b>Health and social care (cont.)</b>	Regulators	11	
	Artists	4		Social workers	6	
	Arts organisations	9		Surgeons	4	
	Broadcasters, journalists	26		Unions	1	
	Choreographers	1		Victims of abuse	2	
	Crafts practitioners	2				
	Curators	6		<b>Legal</b>	Clients	1
	Designers	1	Courts		3	
	Filmmakers	2	Judges		2	
	Heritage practitioners	9		Lawyers	9	
	Museums and galleries	12	<b>Policymakers and local governments</b>	EU, EC, United Nations	34	
	Musicians	6		Governments and politicians	96	
	Publishers	10		Lobbyists, think tanks	7	
	Writers, translators	14		Local governments	18	
		Ministers		12		
<b>Education</b>	Academics	17		Non-governmental policymakers	18	
	Adult education	1		Regulators	6	
	Examination boards	3	<b>Public</b>	Children	17	
	Libraries and archivists	6		Citizens	88	
	School pupils	17		Communities	15	
	Schools	15		Disabled people	6	
	Teachers	10		Elderly	6	
	Universities	10		Local historians	5	
	University students	10		Minority communities	3	
<b>Emergency services and defence</b>	Ambulance services	2			Parents	2
	Intelligence agencies	3			Refugees	3
	Military	3		Women	5	
	Offenders	1		Young people	10	
	Peacekeeping organisations	2	<b>Science, engineering, manufacturing and industry</b>	Construction professionals	2	
	Police	10		Engineers	14	
<b>Energy and environment</b>	Animals	3		Manufacturers	28	
	Conservationists	3		Mining companies	4	
	Energy providers	11		Scientists	16	
	Environmental agencies	18		Unions and professional bodies	3	
	Foresters	1	<b>SMEs</b>	SMEs	15	
	Recycling services	1	<b>Sports</b>	Athletes	5	
<b>Faith</b>	Church of England	1		Coaches	3	
	Churches, cathedrals	2		Physiotherapists	1	
	Clergy	2		Professional bodies	4	
	<b>Food and agriculture</b>	Farmers	11	<b>Technology</b>	Communications companies	4
Food manufacturers		17	Software providers		5	
Food retailers		1	Technology manufacturers		9	
<b>Health and social care</b>	Carers	4	<b>Third sector</b>	Charities, non-profits	18	
	Clinicians	21		NGOs	20	
	Donors	1		Volunteers	3	
	Health trusts	2	<b>Transport and logistics</b>	Airlines	1	
	Healthcare professionals	20		Distribution centres	1	
	Hospitals	13		Regulators, unions	2	
	National healthcare providers	27		Transport providers	2	
	Nurses	4		Workers	3	

#### 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

**Figure 14:** Distribution of beneficiary types across different regions

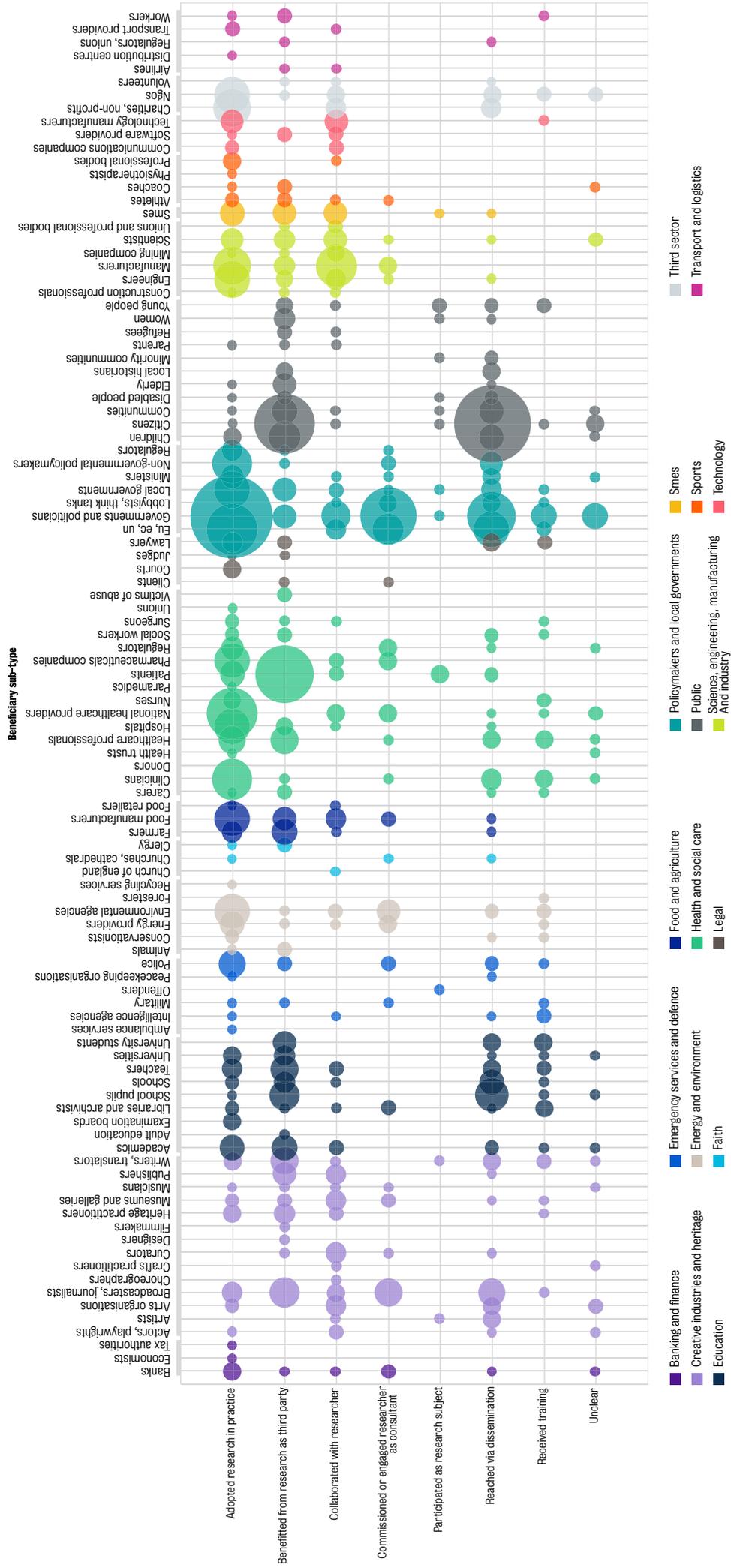


From the information presented in the impact case studies, it was also possible to loosely trace how respective beneficiary communities engaged with this research. The bubble chart in Figure 15 illustrates the clusters of engagement activity for all 17 beneficiary groups.

Over two-thirds of the case studies contained examples where a beneficiary had directly adopted their research in practice. As this figure shows, these were clustered around ‘policymakers and local governments’, or beneficiaries within ‘health and social care’ and ‘science, engineering, manufacturing and industry’. Engagement with the ‘public’, and with those involved in ‘education’, by contrast, is more inclined towards dissemination or benefitting as a third party through the consumption or adoption of services.

The following provides three ‘deep dive’ sections that present contrasting examples of these types of engagement with research from Wales.

**Figure 15:** Nature of beneficiary engagement with research



To get a sense of scale: the largest bubble where 'governments and politicians' intersects with 'adopted in practice', represents 65 instances of this mentioned across the case studies. The smallest bubble where the same beneficiary 'governments and politicians' intersects with 'participated as research subject', represents 1 instance.

## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

### Deep Dive 1: Policymakers and local governments

The policymakers who benefited from research originating from Wales were spread across Wales, the UK and globally. Of all 17 beneficiary groups identified in the above analysis, *policy makers and local governments* saw one of the highest rates of adoption of research from Wales.

36% of references to policymakers were international, with the *European Union*, *European Commission* and *United Nations* emerging as key types of beneficiary. For example, water quality thresholds derived from research at Aberystwyth into microbial concentrations in sea water were implemented throughout the EU after their inclusion in recommendations issued by the World Health Organization. The resulting bathing water quality regulations issued by the EU now affect over 24,000 bathing water sites across all EU member states.<sup>32</sup>

Comparable examples of officials from the European Union, European Commission and United Nations utilising research from Wales feature in over a quarter of case studies that number policymakers and government officials among the beneficiaries of the research.

The use of research by *governments and politicians*, however, was more localised within the UK, with 42% of references relating to the UK government, and 34% relating specifically to government officials in Wales. Research conducted by the Cardiff Business School into the assessment of councils and local services has, for example, simplified and streamlined how governments in England and Scotland now assess the performance of local authorities, engaging beneficiaries such as senior civil servants, auditors and local government officers throughout the process of research.<sup>33</sup>

Links between Wales-based researchers and the Welsh Assembly Government were also strongly apparent in Wales's submissions to REF 2014. For example, commissioned as part of the Welsh Government's 2005 Climbing Higher strategy, which aimed to increase participation in sport and physical activity, researchers from Bangor and Cardiff Metropolitan Universities have informed the rollout of two public health initiatives – the pan-Wales 5x60 physical activity programme for schools and the Free Swimming Initiative. The findings have influenced how data linked to physical activity provision is captured and managed by government officials and policymakers in Wales, and transformed the nature of that provision for residents over the age of 60 and under the age of 16.<sup>34</sup>

### Deep Dive 2: Public

The range of 'public' beneficiaries of research from Wales were largely situated within the UK: 36% of references specifically referred to the Welsh population, and 27% to the UK more broadly. Just 19% of references to the public were global, leaving 18% of instances where it was not possible to identify the location.

What distinguished this beneficiary group was its indirect engagement with research, be this reached via dissemination or through the consumption of products or services that have been derived from the research as a third party.

32 'Setting quality standards for recreational waters', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=42103>

33 'Improving local government performance assessments', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3518>

34 'Sport and physical activity policy in Wales: The impact of evaluation research on "roll-out" and revised implementation', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=32320>

## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

Compared with direct adopters of research findings, limited information is reported about this group, with many researchers referring to the public as a generic group of citizens. (This was the most commonly cited ‘public’ beneficiary, particularly in relation to audiences reached via dissemination.)

Descriptions of the public audiences reached within Wales were, however, more nuanced, with over half of the references to less generic types, such as the elderly, parents, communities, disabled and young people, relating to residents of Wales. This reflects initiatives among researchers in Wales to empower, connect and make provisions for local – and especially rural – communities.

An interesting anomaly, however, occurs with regards to women, where the majority of references were international. This reflected a small number of instances where researchers had engaged with communities in countries where there have been efforts to tackle gender issues. One example was the ‘Zanzibar Soccer Queens’ (2007) and its impact on civil society and cultural life in Africa and Europe – a joint submission from Cardiff Metropolitan University and the University of Wales, Trinity Saint David. This case study built on a body of work that used documentary film as a means of investigating alternative representations of images, particularly of girls and women in Africa. This resulted in the emancipation of the players, improved respect and understanding of Muslim women internationally, improvements in the health and wellbeing of women and girls in Zanzibar as a result of their increased involvement in sports, and a change in government policy to allow girls in Zanzibar to play football in schools.<sup>35</sup>

### Deep Dive 3: SMEs

SMEs were the subject of complementary research and policy initiatives led by researchers in Wales in support of start-ups and small businesses. Just under two-thirds of all references to SMEs (15 case studies) related to companies located in Wales, making SMEs proportionally the most prominent beneficiary of research from Wales.

Examples of SME engagement with Welsh research included, in equal measure, collaborations with researchers, instances of companies adopting research in practice, and more indirect examples of companies benefitting by using services and schemes derived from research. For example, strategies for developing innovation and growth within individual SMEs were developed at Bangor University through involving user groups – be it the Welsh government or local SME owners or managers – from the beginning of the research, to identify the actual needs of SMEs in the region. This led to impacts in the form of company growth, successful bidding and grant acquisition, and improved marketing and customer management.<sup>36</sup>

Bangor University has also pioneered research into the legal and risk barriers that inhibit SMEs from participating in public procurement. This has had a transformational impact on companies who have benefitted from improved access to public contract opportunities. Following the launch of the Supplier Qualification Information Database (SQUiD) tool, developed by the Welsh Government in

<sup>35</sup> ‘Zanzibar Soccer Queens’ and its Impact on Civil Society and Cultural Life in Africa and Europe, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=42391>

<sup>36</sup> ‘SME Research in a European Union Convergence Region’, REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=25256>

## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

2010 and informed by research from the Bangor Institute for Competition & Procurement Studies, the number of major Welsh public sector contracts being won by Welsh businesses has increased by a third over three years.<sup>37</sup>

SMEs also benefitted from research by using services or products derived from findings of the research: the Welsh Enterprise Institute at the University of South Wales has helped to improve small businesses' access to finance<sup>38</sup>; the Welsh Centre for Printing and Coating (WCPC) at Swansea University has led knowledge transfer activities with small-to-medium-sized partner companies to support their long-term viability in relation to the 'printing and coating of novel inks at high speed'<sup>39</sup>; and the *The Welsh Academy English-Welsh Dictionary: Geiriadur yr Academi*, led by scholars in Modern Languages and Linguistics at Bangor University, has impacted the daily use and vocabulary of standard literary Welsh within SMEs in Caernarfon, Cardiff and Carmarthen (as well as among several other stakeholders).<sup>40</sup>

### The benefit of academic research to Wales

While research from Wales has considerable international influence, particularly in areas such as science, manufacturing, computing and the environment, research impact within Wales itself has a remarkably distinct profile.

37% of the case studies submitted to REF 2014 by Welsh HEIs reported specifically on impacts to the country. While, among this sample, impacts on policy and society remain prominent, the contribution of academic research to the country's culture and heritage, its economy, and to public education and social cohesion, were distinctively foregrounded by researchers as a *direct benefit to Wales*.

### Research disciplines that had an impact within Wales

Compared to the number of case studies submitted by Wales to REF 2014 overall, the proportion of case studies from Panel D describing an impact within Wales was 10% higher than in the sample overall; case studies from Panel C, by contrast, are proportionally just 2% higher, and Panels A and B 7% and 4% lower, respectively.<sup>41</sup>

The areas that had the most mentions of research that led to impact within Wales were:

- ♦ Modern Languages and Linguistics (12 case studies)
- ♦ Business and Management Studies (8 case studies)
- ♦ General Engineering (8 case studies)
- ♦ Music, Drama, Dance and Performing Arts (8 case studies)
- ♦ Allied Health Professions, Dentistry, Nursing and Pharmacy (7 case studies)
- ♦ History (6 case studies)
- ♦ Law (6 case studies)

37 'Removing SME Public Procurement Participation Barriers in Wales', REF 2014 Case Study. Available at: <http://impactref.ac.uk/CaseStudies/CaseStudy.aspx?id=27756>

38 'Entrepreneurship Promotion: Federation of Small Business Bi-Annual Survey (2007-2008)', REF 2014 Case Study Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=36214>

39 'The Benefits to Business and Practitioners of Advanced manufacturing by printing of Complex Inks', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=29300>

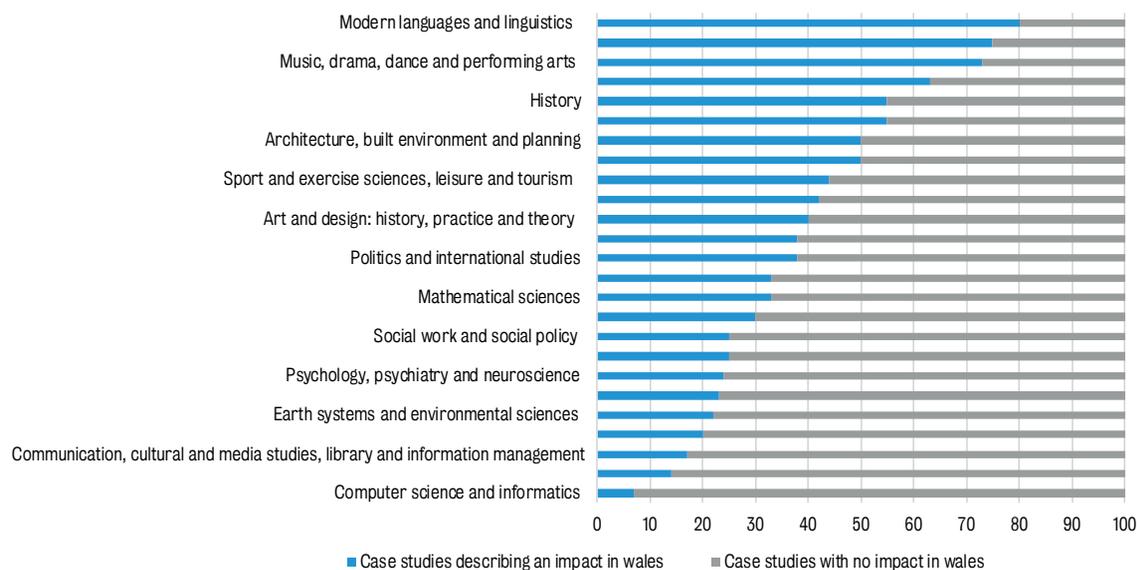
40 'Welsh Lexicography and Terminology', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=28025>

41 Research in the Arts and Humanities (Panel D, n=34) and Social Sciences (Panel C, n=31) had a greater impact within Wales than Engineering and Physical Sciences (Panel B, n=20) and the Life Sciences (Panel A, n=16).

## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

As shown in Figure 16, relative to the number of submissions to each UoA, research from Modern Languages and Linguistics had the greatest focus on Wales, with 80% of submissions reporting an impact within Wales. Sociology, albeit based on a much small number of submissions, also emerged as a disciplinary area of relevance to Wales, with three of four submissions to this UoA describing impact within Wales.

**Figure 16:** Proportion of case studies submitted by HEIs in Wales that include an impact on Wales, organised by UoA<sup>42</sup>



### Impact benefit to Wales

In terms of absolute numbers of case studies, the most prominent sectors or areas in which research from Welsh HEIs had impact within Wales reveal similar patterns to Wales's submission to REF overall.

As shown in Figure 17, the most commonly reported impacts were those on policy, which occurred in 44% of the case studies that describe an impact on Wales. Over 90% of references to policymaking in Wales spoke to a 'contribution to policy reform': just under half described the implementation of research-informed policy, roughly a quarter illustrate how the research has informed new government strategies or influenced the allocation of funds (n=17), 12% related to informing policy recommendations, and 11% spoke to informing debate.

The policy areas in Wales that were mentioned by the greatest number of case studies were health care (n=10), environment (n=10), food and agriculture (n=7), and culture (n=6). However, there are also specific areas of policymaking that stand out as unique concerns for researchers in Wales during the assessment period.

The devolution of law-making in Wales following the 2011 referendum, where 63.49% of Welsh citizens voted to empower the National Assembly for Wales

<sup>42</sup> Note that the absence of some disciplines does not necessarily mean there was no impact on Wales, as their impact may have been generic, having an effect on the UK as a whole or globally, with no specific mention of local benefit to Wales

## 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

to make its own laws independent of the UK Parliament, emerged as a hot topic for some researchers in REF 2014 (n=5), with related areas of policymaking also being the reallocation of power to local governments (n=5).

As shown in Case Study 3, researchers from the Institute for Welsh Politics at Aberystwyth University provided independent analysis of Welsh politics, feeding evidence-based recommendations into public and policy debates about democracy in Wales.<sup>43</sup>

Relative to the total number of references to each impact sector, the creative industries and heritage were also an important area for impact within Wales. The preservation of language through creative and cultural activities was a conspicuous theme. Initiatives ranged from practice-led creative writing projects intended to encourage resurgence and rejuvenation in the use of the Welsh language, such as those from Bangor University's School of Welsh<sup>44</sup> and the department of Celtic Studies at Swansea University<sup>45</sup>, to policy-led initiatives to normalise the use of Welsh among young people.<sup>46</sup>

Initiatives to preserve Welsh heritage also extended beyond language. Historians from Swansea University have prompted the regeneration of the Hafod-Morfa copperworks in the Lower Swansea Valley, a site that was once a hub of industry and innovation but has laid derelict since the 1980s. Following extensive public engagement, Swansea researchers generated significant investment to preserve and present the site's cultural heritage, transforming public perceptions of the copperworks as a scar of industrialism to a relic that was once a hub of scientific innovation, commerce and social aspiration.<sup>47</sup>

Further impacts within Wales also surfaced where universities have helped to build audiences for cultural activities locally. Through collaborations with National Theatre Wales, practice-led researchers at Aberystwyth University have pioneered innovative forms of artistic expression and theatrical performance in site-specific performances of *The Persians* and *Coriolanus*, which were respectively staged at an army training facility in the Brecon Beacons and in a large hanger at RAF St Athan in South Wales. As one reviewer for *The Telegraph* wrote, *The Persians* turned 'Aeschylus's anti-war tragedy into one of the most thrilling events of the year by staging it in an army village high in the Brecon Beacons where soldiers are trained to fight in built-up areas. The result was sinister, ghostly and dramatically stunning'. The work demonstrated the viability of developing a new national theatre that staged ambitious and challenging projects in rural locations, drawing on the expertise of local organisations and operatives.<sup>48</sup>

43 'Public Opinion and Welsh Devolution', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3001>

44 'Extending the Reach of Welsh-language Creative Writing', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=26215>

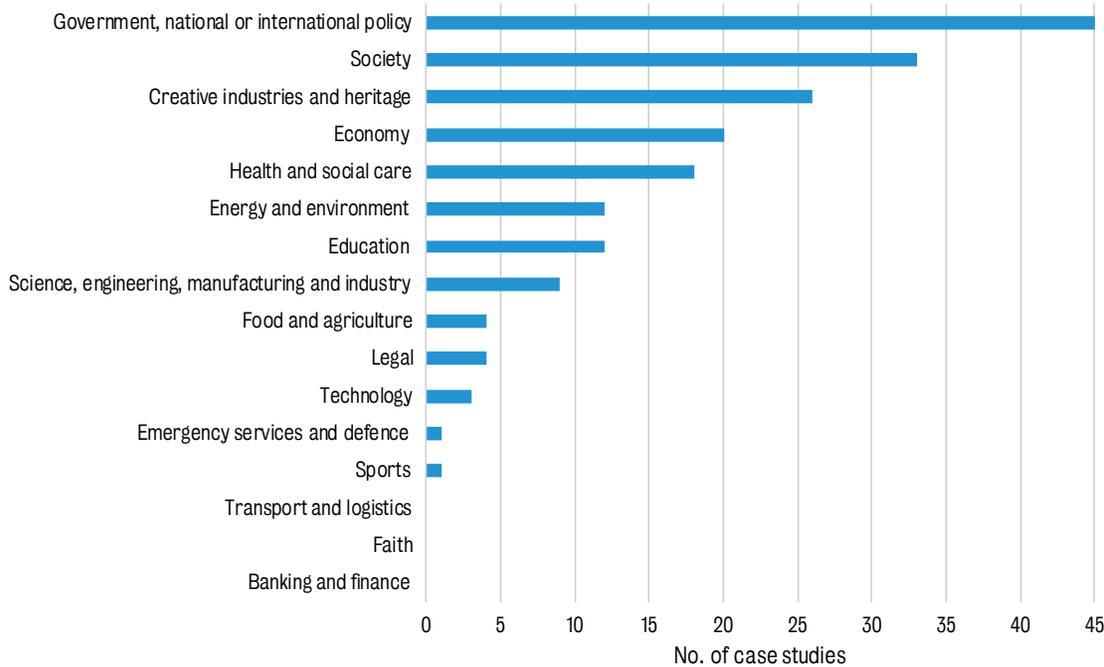
45 'Using creative writing to engage the public in Welsh language culture and enrich the cultural life of Wales', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=5906>

46 'Informing and influencing the creation of language policies and strategies at local and national government levels to promote the use of Welsh amongst young people', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=26758>

47 'Copperopolis: Regenerating and Transforming an Industrial Landscape in the Lower Swansea Valley', REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=5913>

48 *The Persians, Coriolanus* and ...: a series of site-specific performances created for, and produced by, National Theatre Wales (NTW). REF 2014 Case Study. Available at: <http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=42126>

**Figure 17:** Most common impact types within Wales



**Case Study 3:** Public opinion and devolution in Wales

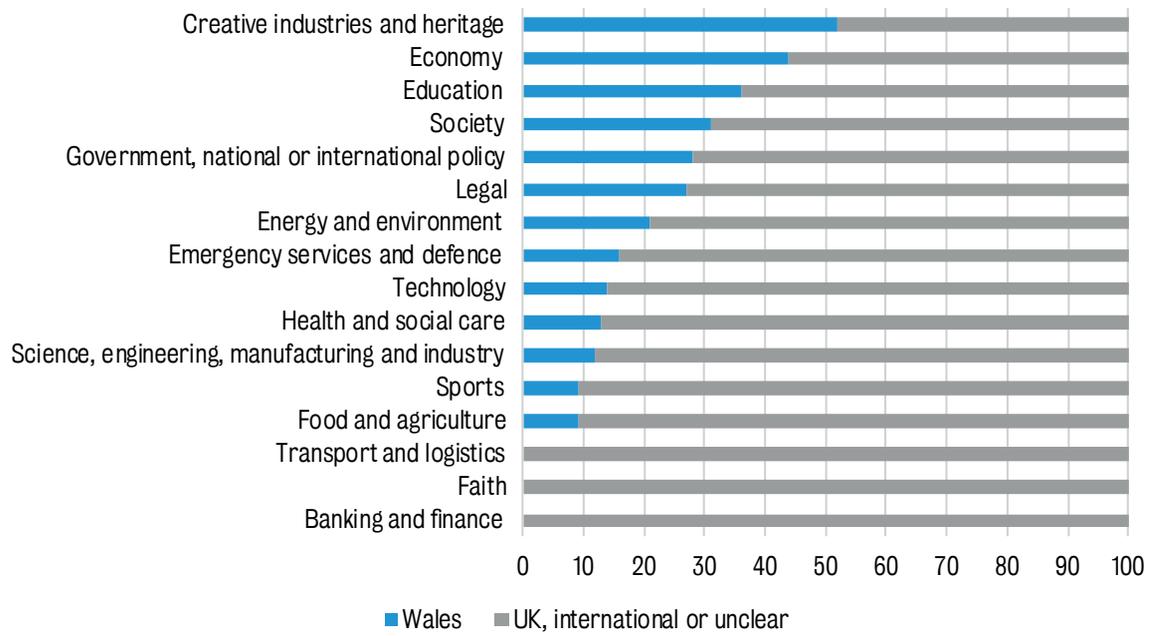
Established in 1997, the Institute for Welsh Politics at Aberystwyth University provides independent analysis of Welsh politics, feeding evidence-based recommendations into public and policy debates about democracy in Wales.

Conducted between 2001 and 2009, the Institute pioneered the first opinion surveys since the creation of the National Assembly for Wales to gather data specifically on the evolution of public opinion and electoral behavior in Wales. The first phase of this research looked at the feasibility of a devolution settlement, which in the 1997 referendum received marginal public support. Finding that the opposition to devolution had since fallen, Aberystwyth researchers provided evidence to the All Wales Convention (AWC), a public enquiry launched in 2008 to assess public attitudes to devolution. After the intention to call a referendum was formally announced in February 2010, the Institute launched a follow-up Welsh Referendum Study which used rolling samples throughout the campaign period to enable real-time tracking of changes in attitude.

The research has since informed public policy processes relating to the Welsh devolution settlement, particularly in the UK government’s Commission on Devolution and the Welsh Office green paper proposals on the reform of electoral arrangements in Wales. The work has also informed and shaped public debate through a range of channels: findings were disseminated through both Welsh- and English-language media outlets; they influenced the work of YouGov, a major national polling organisation that is now developing surveys specific for Wales; and, through the delivery of workshops, reached A-level and Welsh Baccalaureate students, and students on the ‘Understanding Contemporary Wales’ Open University course.

#### 4 | Findings: Focus on the nature, mechanisms, and beneficiaries of impact from Welsh universities

**Figure 18:** Proportion of impacts reported within Wales vs elsewhere





# 5 | Concluding reflections





## 5 | Concluding reflections

Wales submitted 4% of all the case studies for REF 2014. Despite the strong performance by Wales on impact in the REF, no formal analysis of impact originating from the Welsh higher education sector had previously been produced. This report is the first of its kind, using this dataset to reveal a fascinating and diverse set of impacts from Welsh HEIs. This chapter concludes with some general reflections and wider policy observations on the nature of impact from research in Wales.

### Reflections on the nature of impact from research in Wales

Many of the trends observed for the 273 case studies from Welsh HEIs were similar to those more general trends seen in the UK database. For example, the most common impact topics identified in the submissions from Wales were also common to the UK, with the exception of 'Regional languages of the British Isles', which in proportional terms appeared more frequently for Wales. The impact case studies from Wales were also frequently embedded within interdisciplinary activity, as they were in the rest of the UK.

Areas in which there were more significant differences included topics that are of more regional interest, such as impacts on local policy, society, education, and culture and heritage. Most of the references to policymaking within Wales refer to a contribution to policy reform. Wales as a region also specifically benefitted from academic research impacting on culture and heritage, the economy, and on public education and social cohesion. These originated more from research in the Arts and Humanities and Social Sciences than from Engineering and Physical Sciences and the Life Sciences, despite a higher volume of submissions from Wales in health-related subjects and business and management.

The beneficiaries of Welsh research identified as having more impact within Wales compared to elsewhere included SMEs, policymakers, the third sector, education and the creative industries.

This qualitative analysis allows for further interpretation of the mechanisms and processes that underpinned research and impact activities, as well as a closer look at how beneficiaries adopted outputs from research.

The analysis found that researchers in Wales adopted a wide range of activities to enable the impact from their research to occur, from direct products to translating findings into new media to engage a wider public. As found with other reports analysing such impact activity, most of the impact claims reported by researchers in Wales were the product of multiple activities. Beneficiaries of research were often part of these activities. They may have adopted the research findings or products and services, or have directly worked with researchers through a collaborative or co-design process. Examples of a number of these activities were observed in the diverse collection of case studies from Welsh HEIs showing that,





while the types of impacts or sectors in which impact had occurred may have been focussed on specific areas, the mechanisms adopted for impact were as diverse as those observed elsewhere.

### Reflections for future research

The REF 2014 impact case study dataset provides a unique opportunity to characterise the contribution made by academic research originating from universities in Wales. However, as with previous reports using the REF 2014 impact case studies, there are caveats which should be kept in mind. Case studies reflect a highly selective set of descriptions of impact from higher education researchers submitted for assessment purposes. In other words, where impact has not been reported, this should not be seen as reflecting an absence of activity – it is simply that those activities were not selected for the impact case studies submitted as part of REF 2014.

Consequently, there may well be a wealth of further activities taking place that deserve more attention or communication but were simply not available or sufficiently far along the impact timeline. There may be many more impacts to come from work that is taking place in Welsh universities and these might well appear in the next REF. This analysis may spark an interest in investigating the impact of wider research activity being undertaken in Wales.

As with previous reports, it is clear that much more nuanced and detailed information can only be found through reading and qualitatively analysing the case studies themselves. Much more could be found, however, by interviewing researchers and understanding the wider barriers and facilitators that enabled impact to occur.

The observation that research in Wales had an influence locally and regionally has implications for ongoing support for research. It is an illustration of how proximity to research institutions can enable direct local benefits, in addition to impacts further afield. Finally, analysis that identifies the interdisciplinary and cross-sector activity that occurs within Wales and in partnership with global institutions may also shed light on where collaborative investments lead to both academic excellence and impacts beyond academia.





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# References & appendices

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# Appendix A: Impact in REF 2014

Research assessment in the UK occurs on a nearly five-year basis since 1986. The Research Excellence Framework (REF) is the current system for assessing the quality of research in UK higher education institutions (HEIs). The results inform allocation of research funding to HEIs, providing accountability for public investment in research and contributing to the reputational excellence of HEIs.

In REF 2014, HEIs were assessed by:

- the *quality* of research outputs, through a list of publications, weighted at 65% of the total assessment;
- the *vitality* of the research environment, through a form outlining the research strategy, current staff and research students, levels of income, infrastructure and facilities, and degree of collaboration and contribution to the discipline or research base, weighted at 15%; and
- the *wider impact* of research, through forms of narrative case studies, weighted at 20%.

HEIs made submissions to 36 Units of Assessment (UoAs), which were evaluated by expert panels working under the guidance of four panels: Biological Sciences and Medicine, Physical Sciences and Engineering, Social Sciences, and Arts and Humanities.

Impact was defined in the REF as ‘any effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia’ (REF, 2011). An impact case study, which formed the basis of the previous work and the analysis conducted in this report, is a short four-page document with five sections:

1. a summary of the impact;
2. a description of the underpinning research;
3. references to the research;
4. details of the impact; and
5. sources to corroborate the impact.



## Appendix B: Glossary of terms used in this report

**Alluvial diagram** = Type of flow diagram originally developed to represent changes in network structure over time. In allusion to both their visual appearance and their emphasis on flow, alluvial diagrams are named after alluvial fans that are naturally formed by the soil deposited from streaming water.

**Beneficiaries of research** = Individuals, groups, or organisations that have benefited from research, either through adopting findings in practice or engaging with the outputs of research before, during or after the research process.

**Impact topics** = Topics identified through data mining, demonstrated as areas where research influences society, as previously identified in the King's and Digital Science 2015 report from 60 topics identified via topic modelling.

**Impact types** = Types of impacts or areas where research influences society, as identified through qualitative coding of case studies specifically for the purposes of this study.

**Research disciplines** = Branch of knowledge or academic discipline.

**Interdisciplinarity** = Involving or drawing on two or more branches of knowledge or research disciplines.

**UOA** = Unit of Assessment, the disciplinary research units to which universities could make a submission for REF 2014.

**Mechanism of impact** = Activities that enabled an impact to take place from research. For example, disseminating findings in non-academic media sources to reach a wider, non-academic audience for future update of research.

# Appendix C: REF 2014 submissions from HEIs in Wales

Aberystwyth University		
UoA 6	Agriculture, Veterinary and Food Science	Improvements in biomass measurement have changed practitioner approaches and improved profitability in commercial brewing and biotechnology [joint submission with Bangor University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42082">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42082</a>
		Improving the environmental and economic sustainability of upland grazing systems [joint submission with Bangor University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42083">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42083</a>
		Industry investment in a Miscanthus breeding programme for UK and global sustainable energy, and the fair and equitable use of natural resources [joint submission with Bangor University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42084">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42084</a>
		Maize variety GM-6 brings £55 million of benefits to more than 300,000 resource-poor farmers in Western India [joint submission with Bangor University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42085">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42085</a>
		New rice varieties improve livelihoods of 5 million households [joint submission with Bangor University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42086">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42086</a>
		Novel applications for fractionation of plant biomass in the food ingredients industry [joint submission with Bangor University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42087">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42087</a>
		Novel genetic marker-assisted breeding produced a pearl millet hybrid grown on 700,000 ha of drought-prone areas in Northern India which has improved food security of three million people [joint submission with Bangor University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42088">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42088</a>
		The breeding of high sugar grasses (HSG) has had a positive effect on UK greenhouse gas mitigation and on livestock production [joint submission with Bangor University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42089">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42089</a>
		The breeding of novel types of oat with improved grain composition has changed retail and consumers' habits to the benefit of the UK oat crop as a healthy human food and as a high value livestock feed. [joint submission with Bangor University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42090">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42090</a>
		The conservation and protection of grassland fungi [joint submission with Bangor University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42091">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42091</a>
UoA 7	Earth Systems and Environmental Sciences	Enhanced carbon footprinting of food products <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25249">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25249</a>



		<p>International conservation and restoration of peatland and improved drinking water quality through peatland carbon sequestration research  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=23148">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=23148</a></p> <p>New DNA forensics tools improve sustainable fisheries management and reduce wildlife crime  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=21483">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=21483</a></p> <p>Quantification of ecosystem effects of fishing underpins the policy and practice of government, industry and retailers in relation to sustainable fisheries  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=23140">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=23140</a></p> <p>Turbulence research improves ocean forecasting and marine energy infrastructure  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=17646">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=17646</a></p>
UoA 9	Physics	<p>Impact of research on coloured glass on the social enterprise Ten Green Bottles  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42092">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42092</a></p> <p>Impact of physics and astronomy research on the work of the Urdd National Eisteddfod  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42093">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42093</a></p>
UoA 10	Mathematical Sciences	<p>Improved parametric resonance of a vibrating screen  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42094">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42094</a></p> <p>Optimal geometry of soap films  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42095">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42095</a></p>
UoA 11	Computer Science and Informatics	<p>Automated Design Analysis and Generation of Diagnostics  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44051">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44051</a></p> <p>Planetary Exploration Based Camera Technology for Precision Agriculture Applications  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44052">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44052</a></p> <p>The Robot Scientist  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44053">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44053</a></p>
UoA 17	Geography, Environmental Studies and Archaeology	<p>Development and provision of resources to improve professional practice in satellite-based observation for mapping land cover and forest structure  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42099">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42099</a></p> <p>Enhancing the capacity to act and democratic accountability of parish, town and community councils  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42100">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42100</a></p> <p>Eradication of child and adult mortality from lead poisoning following community resettlement: Mitrovica, Kosovo  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42101">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42101</a></p> <p>Informing public perception of the influence of climate change on Earth's ice masses  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42102">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42102</a></p> <p>Setting quality standards for recreational waters  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42103">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42103</a></p>
UoA 19	Business and Management Studies	<p>Application of a systems approach to hill and upland development policies in Wales  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=43999">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=43999</a></p>





		Economic value of ecosystem services and biodiversity <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44000">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44000</a>
		Understanding the impact of the housing market on consumer spending levels <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44001">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44001</a>
UoA 20	Law	Human Rights and Older People <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42107">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42107</a>
		Trafficking in Human Beings <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42108">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42108</a>
		Welsh Legal History: Outreach to Communities <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42110">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42110</a>
UoA 21	Politics and International Studies	Conceptions of Democracy in Democracy Promotion <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42111">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42111</a>
		Global Health and Foreign and Security Policy <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42112">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42112</a>
		Nuclear Non-proliferation <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42113">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42113</a>
		Public Opinion and Devolution in Wales <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42114">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42114</a>
UoA 26	Sport and Exercise Sciences, Leisure and Tourism	Development of a performance-enhancing warm-up procedure for athletic events <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42115">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42115</a>
		Community exercise schemes for rural populations <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42116">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42116</a>
UoA 28	Modern Languages and Linguistics	Rewriting the Welsh literary landscape: Welsh literary postmodernism in the poetry and fiction of Mihangel Morgan <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44017">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44017</a>
		Shaping the growth, development and impact of Celtic Studies by editing and publishing, within the Department, a journal, Cambrian Medieval Celtic Studies (1993-) <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44018">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44018</a>
		Anglo-Norman Dictionary <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44021">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44021</a>
		The Kindertransport to Britain 1938/39: New Perspectives <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44022">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44022</a>
UoA 29	English Language and Literature	Contempo: Critically informed Contemporary Poetry in the Public Domain <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42119">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42119</a>
		Remembering the Land: Food Supply, Literature and Ecology <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42120">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42120</a>
UoA 30	History	Influencing Policy and Public Discourse in Medicine and Public Health in Modern Wales <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42121">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42121</a>
		Seals in the Medieval World: a case-study of impact on cultural life, the heritage professions and education <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42122">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42122</a>
UoA 34	Art and Design: History, Practice and Theory	British art and artists 1840-1960: exploring identities, practices and contexts <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42123">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42123</a>





		On the Rediscovery, Re-evaluation and Re-presentation of Artistic Reputation <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42124">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42124</a>
UoA 35	Music, Drama, Dance and Performing Arts	<p>Capel: The Lights are On: Generating New Ways of Thinking That Influence Creative Practice. A public, site-specific performance forming part of a practice led AHRC funded research project with CSSD London. <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42125">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42125</a></p> <p>The Persians (2010) and Coriolanus (2012): site-specific performances created for, and produced by, National Theatre Wales (NTW). <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42126">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42126</a></p> <p>Tween Audiences and Welsh-language Television Production: Impacts on Economic Prosperity and Cultural Life <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42127">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42127</a></p>
		What's Welsh for Performance? Beth yw 'Performance' yn Gymraeg?: Enhancing the creation, presentation and conservation of performance and live art in Wales <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42128">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42128</a>
UoA 36	Communication, Cultural and Media Studies, Library and Information Management	<p>Ensuring Professionalism: knowledge, competencies and skills for the global information profession <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42129">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42129</a></p> <p>Managing Digital Assets <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42130">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42130</a></p>

### Bangor University

UoA 3	Allied Health Professions, Dentistry, Nursing and Pharmacy	<p>Evidence-based policies for new medicines <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=21005">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=21005</a></p> <p>Evidence-based primary care interventions to improve health benefits in cancer care <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=22137">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=22137</a></p>
UoA 4	Psychology, Psychiatry and Neuroscience	<p>Cognitive stimulation - an effective intervention to improve quality of life and cognition in people with mild to moderate dementia <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=21480">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=21480</a></p> <p>Encouraging Healthy Eating in Children with the Food Dudes Programme <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=23095">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=23095</a></p> <p>Mindfulness-based interventions enhance wellbeing: development and implementation <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=23542">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=23542</a></p>
UoA 6	Agriculture, Veterinary and Food Science	<p>Improvements in biomass measurement have changed practitioner approaches and improved profitability in commercial brewing and biotechnology [joint submission with Aberystwyth University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42082">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42082</a></p> <p>Improving the environmental and economic sustainability of upland grazing systems [joint submission with Aberystwyth University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42083">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42083</a></p>



		<p>Industry investment in a Miscanthus breeding programme for UK and global sustainable energy, and the fair and equitable use of natural resources [joint submission with Aberystwyth University]  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42084">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42084</a></p> <p>Maize variety GM-6 brings £55 million of benefits to more than 300,000 resource-poor farmers in Western India [joint submission with Aberystwyth University]  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42085">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42085</a></p> <p>New rice varieties improve livelihoods of 5 million households [joint submission with Aberystwyth University]  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42086">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42086</a></p> <p>Novel applications for fractionation of plant biomass in the food ingredients industry [joint submission with Aberystwyth University]  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42087">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42087</a></p>
		<p>Novel genetic marker-assisted breeding produced a pearl millet hybrid grown on 700,000 ha of drought-prone areas in Northern India which has improved food security of three million people [joint submission with Aberystwyth University]  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42088">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42088</a></p> <p>The breeding of high sugar grasses (HSG) has had a positive effect on UK greenhouse gas mitigation and on livestock production [joint submission with Aberystwyth University]  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42089">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42089</a></p> <p>The breeding of novel types of oat with improved grain composition has changed retail and consumers' habits to the benefit of the UK oat crop as a healthy human food and as a high value livestock feed. [joint submission with Aberystwyth University]  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42090">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42090</a></p> <p>The conservation and protection of grassland fungi [joint submission with Aberystwyth University]  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42091">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42091</a></p>
UoA 7	Earth Systems and Environmental Sciences	<p>Turbulence research improves ocean forecasting and marine energy infrastructure [joint submission with Aberystwyth University]  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=17646">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=17646</a></p> <p>New DNA forensics tools improve sustainable fisheries management and reduce wildlife crime [joint submission with Aberystwyth University]  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=21483">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=21483</a></p> <p>Quantification of ecosystem effects of fishing underpins the policy and practice of government, industry and retailers in relation to sustainable fisheries [joint submission with Aberystwyth University]  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=23140">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=23140</a></p> <p>International conservation and restoration of peatland and improved drinking water quality through peatland carbon sequestration research [joint submission with Aberystwyth University]  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=23148">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=23148</a></p> <p>Enhanced carbon footprinting of food products [joint submission with Aberystwyth University]  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25249">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25249</a></p>





UoA 8	Chemistry	Dye-Sensitised Solar Cells <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29359">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29359</a>
		Cervical Cancer Diagnostics <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=31377">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=31377</a>
UoA 11	Computer Science and Informatics	Minimally invasive procedural training for clinicians using virtual patients <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=24880">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=24880</a>
		Enhancing of National Grid Stability via optimisation of 'Dinor-wig Hydro Power Station' <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25250">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25250</a>
UoA 13	Electrical and Electronic Engineering, Metallurgy and Materials	Laser Micromachining Limited (LML) <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=24700">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=24700</a>
		Optical OFDM Transceiver Development and Commercialisation <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25251">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25251</a>
UoA 19	Business and Management Studies	Market Power & Efficiency in Banking <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25253">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25253</a>
		Competition, Governance and Bank Stability <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25254">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25254</a>
		Bank Securitization and Monetary Policy <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25255">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25255</a>
		SME Research in a European Union Convergence Region <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25256">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25256</a>
UoA 20	Law	The Regionalisation of Public Law <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25451">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25451</a>
		Removing SME Public Procurement Participation Barriers in Wales <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27756">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27756</a>
UoA 26	Sport and Exercise Sciences, Leisure and Tourism	Developing best practice: Bangor and Cardiff research underpins the professional training, development and support provided by sport coaches and sport science practitioners [joint submission with Cardiff Metropolitan University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=32232">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=32232</a>
		'Train in, not select out': Bangor leadership training model decreased the high wastage rates in British army recruits and improved training practices [joint submission with Cardiff Metropolitan University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=32269">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=32269</a>
		Sport and physical activity policy in Wales: The impact of evaluation research on 'roll-out' and revised implementation [joint submission with Cardiff Metropolitan University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=32320">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=32320</a>
UoA 28	Modern Languages and Linguistics	Language policy, diversity and usage <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26214">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26214</a>
		Extending the Reach of Welsh-language Creative Writing <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26215">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26215</a>
		Welsh Lexicography and Terminology <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=28025">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=28025</a>
UoA 29	English Language and Literature	Poetry and audiences: Wales, UK and Worldwide <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=17645">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=17645</a>





UoA 30	History	King Arthur from the Medieval to the Modern Periods <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25252">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=25252</a>
		Archaeological Heritage Management in Austria <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26122">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26122</a>
		Inscribed Stones and Stone Sculpture in Wales c.AD400-1150 <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26123">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26123</a>
UoA 35	Music, Drama, Dance and Performing Arts	Exploring Jews, Jewishness and Judaism in Contemporary Global Media, 1990-present <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26124">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26124</a>
		The Experience of Worship in late medieval Cathedral and Parish Church <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26126">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26126</a>

### Cardiff Metropolitan University

UoA 3	Allied Health Professions, Dentistry, Nursing and Pharmacy	The impact of food safety research on knowledge exchange, food safety practice and economic prosperity in the Welsh food industry <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42079">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42079</a>
		The impact on the organic waste industry from research on workers' exposure to bioaerosols: Adoption of technical guidance <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42080">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42080</a>
UoA 26	Sport and Exercise Sciences, Leisure and Tourism	Developing best practice: Bangor and Cardiff research underpins the professional training, development and support provided by sport coaches and sport science practitioners [joint submission with Bangor University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=32232">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=32232</a>
		'Train in, not select out': Bangor leadership training model decreased the high wastage rates in British army recruits and improved training practices [joint submission with Bangor University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=32269">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=32269</a>
		Sport and physical activity policy in Wales: The impact of evaluation research on 'roll-out' and revised implementation [joint submission with Bangor University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=32320">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=32320</a>
UoA 34	Art and Design: History, Practice and Theory	Using Product Design Techniques to Improve the Lives of Reconstructive Surgery Patients while Reducing the Cost to the NHS and Tax Payer [joint submission with University of Wales, Trinity Saint David] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42385">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42385</a>
		The Influence of WIRAD's Design Policy Unit on the Design Innovation Policies of Wales, the UK and the European Union [joint submission with University of Wales, Trinity Saint David] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42388">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42388</a>
		'Zanzibar Soccer Queens' (2007) and its Impact on Civil Society and Cultural Life in Africa and Europe [joint submission with University of Wales, Trinity Saint David] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42391">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42391</a>



**Cardiff University**

UoA 1	Clinical Medicine	Cardiff-led research underpins new UK and International clinical treatment guidelines for the management of acquired haemophilia A <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=2728">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=2728</a>
		The Dermatology Life Quality Index: the leading patient-orientated dermatology outcome measure used worldwide. <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=2933">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=2933</a>
		A New Standard of Care for Locally Advanced Prostate Cancer <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=2999">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=2999</a>
		Identification of MUTYH, the first recessive colorectal cancer gene, improves management of familial bowel cancer <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3416">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3416</a>
		Cardiff research yields evidence for benefits of sentinel node biopsy and spearheads training in the technique as a standard of care in breast cancer surgery <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3417">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3417</a>
		Identification of a novel drug resistance determinant resulting in global change of attitude and policy <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3418">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3418</a>
		Discovery and exploitation of fluorescent dyes in healthcare, drug discovery and life sciences <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3419">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3419</a>
UoA 2	Public Health, Health Services and Primary Care	A scientific foundation for the first national clinical standards in the assessment of child abuse <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3408">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3408</a>
		Motivational interviewing in health care - worldwide uptake <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3409">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3409</a>
		Safely reducing antibiotic prescriptions to help contain antibiotic resistance <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3410">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3410</a>
UoA 3	Allied Health Professions, Dentistry, Nursing and Pharmacy	ProTide Technology: Transforming drug discovery of nucleoside-based anti-viral and anti-cancer agents <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=1929">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=1929</a>
		Discovery and development of the world's most powerful antiviral agent against shingles <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=2708">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=2708</a>
		Inhaled medicines: Leveraging benefits to global pharma and international development <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3665">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3665</a>
		Cardiff chemiluminescent technology underpinning global adoption of nucleic acid-based clinical diagnostic assays <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3666">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3666</a>
		Research drives development and use of biocompatible dialysis solutions, and better patient outcomes in peritoneal dialysis <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3667">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3667</a>
		Improving eye care and learning potential for children with Down's syndrome <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3668">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3668</a>





		<p>Shaping government policy on violence prevention <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3669">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3669</a></p> <p>Wound care management and disease-specific quality of life measures <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3670">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3670</a></p>
UoA 4	Psychology, Psychiatry and Neuroscience	<p>Informing and transforming the international policy and debate on cannabis use and psychosis <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3473">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3473</a></p> <p>Stopping ineffective (and possibly harmful) resource-intensive psychological debriefing for trauma patients <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3475">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3475</a></p> <p>Influencing international legislation, policy and management strategy to improve maritime safety by reducing seafarers' fatigue <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3476">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3476</a></p> <p>New tools support citizens, governments and health professionals to address effects of infertility <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3477">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3477</a></p> <p>Cardiff research leads Welsh Government and England's Department of Health to implement systematic health check for ~250,000 adults with learning disabilities across England and Wales <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3478">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3478</a></p> <p>A programme developed and delivered by Cardiff University transforms access to psycho-education for bipolar disorder <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3479">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3479</a></p> <p>Cardiff University research on values changes focus of charitable campaigns <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3481">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3481</a></p>
UoA 5	Biological Sciences	<p>Genetic data optimises conservation of endangered species <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3140">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3140</a></p> <p>Delivering UK policy for river conservation and management <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3141">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3141</a></p> <p>New data analysis methods drive transgenic research to raise yield in oil crops <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3143">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3143</a></p> <p>Cardiff research supports the commercial use of 'omega-3s' in pet foods and dietary supplements <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3144">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3144</a></p> <p>Improved Diagnostic Technology with the first genome standard for Pathogenic Human Cytomegalovirus. <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3145">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3145</a></p>
UoA 7	Earth Systems and Environmental Sciences	<p>Understanding the properties of caprocks to improve hydrocarbon exploration and CO2 sequestration <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3659">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3659</a></p> <p>Platinum-Group Element mineral deposits: exploration, evaluation and beneficiation <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3660">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3660</a></p>





UoA 8	Chemistry	Enabling the cost-effective and environmentally friendly production of Perspex <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3461">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3461</a>
		Transforming quantitative prediction of molecular properties through software – Molpro <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3462">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3462</a>
UoA 9	Physics	The Antikythera Mechanism: seeing inside a two-thousand-year-old computer <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3465">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3465</a>
		THz detection from the distant universe to the international market. <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3466">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3466</a>
		The Herschel Space Observatory: scientific and technical outreach <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3467">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3467</a>
UoA 10	Mathematical Sciences	Mathematics and Healthcare: Saving Lives and Reducing Costs <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3387">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3387</a>
		Meeting the Challenges of Data Security <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3389">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3389</a>
		Growing Businesses: Robust Models for Understanding Consumer Buying Behaviour <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3390">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3390</a>
UoA 11	Computer Science and Informatics	Enabling the Catalogue of Life to index the world's species <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3414">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3414</a>
		Realising the potential of 3D scanners through reverse engineering and digital shape reconstruction <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3415">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3415</a>
UoA 14	Civil and Construction Engineering	Improved Flood Hydrodynamic, Hazard and Water Quality Model Predictions <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3663">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3663</a>
		Engineering Solutions for High Level Nuclear Waste Disposal <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3664">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3664</a>
UoA 15	General Engineering	Q Chip Ltd - Micro Technology for Injectable Therapeutics <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3407">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3407</a>
		Acoustic Emission Monitoring - Transforming the Inspection of Bridges Worldwide <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3451">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3451</a>
		Practical Waveform Engineering - Reshaping Today's Communication Systems <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3452">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3452</a>
		Low-Carbon Engine Design Through Integrated Simulation-Validation <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3453">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3453</a>
UoA 16	Architecture, Built Environment and Planning	Regional Competitiveness and Uneven Development: Transforming the Strategies of Policymakers <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3454">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3454</a>
		Creating evidence-based integrated rural policy in Wales <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3469">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3469</a>
		Reforming School Food <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3470">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3470</a>





		<p>Spatial Design Network Analysis (sDNA) – a network analysis tool for evidence-based urban planning.  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3474">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3474</a></p> <p>Energy and Environmental Modelling at Building and Urban Scale  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3656">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3656</a></p> <p>Achieving Greener Building Services in Practice for Europe  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3658">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3658</a></p>
UoA 17	Geography, Environmental Studies and Archaeology	<p>Evidence based management strategies for Heritage iron  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3404">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3404</a></p> <p>Changing people’s perceptions of the human:animal relationship  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3405">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3405</a></p>
UoA 19	Business and Management Studies	<p>Influencing British macroeconomic policy and the relationship with the European Union in the aftermath of a global economic crisis  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3514">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3514</a></p> <p>Understanding the economic and environmental impacts of tourism  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3515">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3515</a></p> <p>Ensuring fair compensation for accident victims in court  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3516">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3516</a></p> <p>Improving labour relations in the world’s ports through social dialogue  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3517">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3517</a></p> <p>Improving local government performance assessments  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3518">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3518</a></p> <p>Sustaining lean business improvements through the delivery of structured training and tailored lean solutions  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3519">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3519</a></p> <p>Addressing issues of social vulnerability and environmental degradation in Ibero-America  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3520">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3520</a></p> <p>Informing local government reorganisation in England and Wales  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3521">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3521</a></p>
UoA 20	Law	<p>Canon Law and Covenant: Transformation in Global Anglicanism  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3550">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3550</a></p> <p>Putting carers on the legal map  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3551">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3551</a></p> <p>Regulating nanotechnology: shaping government strategy and industry standards  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3553">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3553</a></p>
UoA 21	Politics and International Studies	<p>Delineating England  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3000">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3000</a></p> <p>Public Opinion and Welsh Devolution  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3001">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3001</a></p>
UoA 23	Sociology	<p>Improving the response to victims of violence  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3482">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3482</a></p> <p>Policies for Better Treatment for Employees with Disabilities and Long-term Health Problems  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3483">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3483</a></p> <p>Improving Community Policing  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3484">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?id=3484</a></p>





		Improving control over illicit money flows and recovering the proceeds of crime <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3485">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3485</a>
UoA 25	Education	Campaigning for equal opportunities in learning outside the classroom <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3486">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3486</a> DECIPHer-Assist: the UK's most effective school-based smoking prevention programme <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3487">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3487</a>
UoA 28	Modern Languages and Linguistics	Challenging the International Policy Consensus on Skills, Knowledge and Human Capital in the Global Economy <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3488">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3488</a> Devolution and the Creation of a New Language Law Regime in Wales <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3471">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3471</a> Transforming the Mabinogion <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3472">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3472</a>
UoA 29	English Language and Literature	Creating a Searchable Database of Victorian Images for Multiple Use <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3580">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3580</a> Improving the effectiveness of police communication with the public in South Wales <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3581">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3581</a> Improving HIV/AIDS education and support in KwaZulu-Natal through comics drawing <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3582">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3582</a>
UoA 30	History	Shaping Public Understanding of the Knights Templar <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3464">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3464</a> Transforming professional and public understanding of the Welsh overseas <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3468">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3468</a>
UoA 32	Philosophy	Enabling critical engagement with academic research in A-level Philosophy <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3585">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3585</a> Transforming practices and influencing debate in genetics research <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=18762">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=18762</a>
UoA 35	Music, Drama, Dance and Performing Arts	Transforming performances of music of the 'long 18th century' worldwide <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3392">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3392</a> More than Messiaen: Reinterpreting 20th-Century French Musical Traditions for UK Audiences <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3423">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3423</a>
UoA 36	Communication, Cultural and Media Studies, Library and Information Management	Improving decision-making about treatment for people in vegetative and minimally conscious states <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3653">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=3653</a> Improving the quality of news coverage across the BBC in a devolved UK <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=17644">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=17644</a>



**Glyndŵr University**

UoA 4	Psychology, Psychiatry and Neuroscience	The psychology of prayer <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44501">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44501</a>
		A refereeing performance model for training talent <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44502">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44502</a>
UoA 11	Computer Science and Informatics	EASYLINE+: Low Cost Advanced White Goods for a Longer Independent Life of Elderly People <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=1488">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=1488</a>
		Software Integration and Visualisation for Complex Electrical Motor Design Programming, Simulation and Modelling <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44550">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44550</a>
UoA 13	Electrical and Electronic Engineering, Metallurgy and Materials	Economic impacts of computer controlled polishing and metrology of ultra-precision surfaces <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44551">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44551</a>
		Modification of hydrocolloids to produce novel and enhanced food products <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44552">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44552</a>
UoA 36	Communication, Cultural and Media Studies, Library and Information Management	Using art to capture the changes to the self during antidepressant treatment <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44576">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44576</a>
		Impact of network radio broadcasts on the audience and critical peer environment <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44579">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=44579</a>

**Swansea University**

UoA 3	Allied Health Professions, Dentistry, Nursing and Pharmacy	Improved breastfeeding rates through evidence-based guideline changes <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5729">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5729</a>
		Economics of pain and pain management: impact on policy, practice and patients <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5730">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5730</a>
		Developing and implementing national standards to improve the structure and content of patient records <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=35208">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=35208</a>
		Influencing national policy to improve service delivery and patient care in gastroenterology <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=35233">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=35233</a>
		Reducing unnecessary attendance at hospital emergency departments by improving care out of hospital <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=35234">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=35234</a>
		The concept of genotoxicity thresholds benefits patients and the pharmaceutical industry <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=35236">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=35236</a>
		Economic and health benefits of novel light therapies for the treatment of skin conditions. <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=41600">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=41600</a>
UoA 4	Psychology, Psychiatry and Neuroscience	The impact of alcohol test purchasing by underage adolescents on the availability of alcohol to minors <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5731">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5731</a>





		The development of food items to benefit cognition and mood <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5732">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5732</a>
UoA 7	Earth Systems and Environmental Sciences	Public understanding of long-distance animal movements: Great Migrations <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5733">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5733</a> Enabling the widespread use of an insect-killing fungus to control crop pests; from lab to regulator to commercial success <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29358">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29358</a>
UoA 9	Physics	Applications of laser spectroscopy techniques to the nuclear, defence and aerospace industries <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5792">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5792</a> Antimatter: From Hollywood to CERN <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5793">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5793</a> A benchmark tool for high performance computing <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5794">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5794</a>
UoA 10	Mathematical Sciences	Techniques for Improved Electromagnetic Design in the Aerospace Industry <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29356">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29356</a> Benefits to the business and medical sectors through the application of geometric convexity-based methods to image and data processing <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29357">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29357</a>
UoA 11	Computer Science and Informatics	Improving Processes and Policies in the UK Railway Industry <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5798">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5798</a> Safer Human-Computer Interaction for Healthcare <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5800">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5800</a> Empowering rural digital communities in the developing world and the UK <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5801">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5801</a>
UoA 15	General Engineering	Advanced Simulation Technology to Optimise the Recovery of High Value Metals Through Heap Leaching <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29293">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29293</a> Optimisation of membrane systems and its benefit to water treatment, food processing and medicine – from characterisation and fabrication to control <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29294">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29294</a> Use of new diagnostic medical technology to improve detection of abnormal blood clotting: the health and economic benefits <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29295">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29295</a> The economic benefits of finite element/discrete element analysis when applied to industrial problems involving coupled field and multi-fracturing phenomena <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29296">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29296</a> Improved Aerodynamic Design Process for the Aerospace Industry through Application of Unstructured Mesh Technology <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29297">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29297</a> Rolls-Royce Gas Turbine Engines – Materials Characterisation to Underpin Design, Efficiency and Safe Service <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29298">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29298</a>





		<p>The development of new coatings for Tata Steel Europe through collaborative research  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29299">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29299</a></p> <p>The benefits to business and practitioners of advanced manufacturing by printing of complex inks  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29300">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=29300</a></p>
UoA 17	Geography, Environmental Studies and Archaeology	<p>Using land-surface satellite data to improve weather forecasts and climate predictions  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5838">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5838</a></p> <p>Improved land management and rainforest conservation in South East Asia  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27715">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27715</a></p> <p>Reducing age disputes and improving the process of age assessment for separated asylum-seeking children in the UK, Europe and beyond  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27731">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27731</a></p> <p>Improved post-wildfire hazard assessment and risk reduction policy and practice  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27746">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27746</a></p>
UoA 19	Business and Management Studies	<p>Informing Policies to Reduce Labour Market Inequalities  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5842">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5842</a></p> <p>Promoting positive employment relations in the civil aviation industry  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5843">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5843</a></p> <p>Improving conflict resolution and mediation in UK workplaces  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5844">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5844</a></p> <p>Influencing policy in the areas of Employment and Public Sector Pay  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5845">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5845</a></p>
UoA 20	Law	<p>The international impact of probation research from Jersey: risk/need measurement and supervision skills  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5846">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5846</a></p> <p>Shaping new law on human rights of children and young people in Wales  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5847">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5847</a></p> <p>Reshaping the youth justice framework in England and Wales through a research-led critique of the Risk Factor Prevention Paradigm  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5848">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5848</a></p>
UoA 21	Politics and International Studies	<p>Reframing drug policy discourse: Impacting high-level debates on international drug control  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5849">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5849</a></p> <p>Military literacy in an age of terror: influencing educational organisations and publishing stakeholders in the provision of curricula and texts for children on global politics  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5850">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5850</a></p>
UoA 22	Social Work and Social Policy	<p>How research on Thailand's healthcare reforms changed perceptions, influenced policy and impacted on the resource allocation mechanism  <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5899">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5899</a></p>





		How research on supported living environments for older people changed Welsh Policy and Practice <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5900">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5900</a>
UoA 26	Sport and Exercise Sciences, Leisure and Tourism	The ethics of enhancement in elite sport: improving anti-doping education and policy development <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5901">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5901</a> Pre-competition strategies for enhanced performance in elite athletes <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5902">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5902</a>
UoA 28	Modern Languages and Linguistics	Hafan Books: Transforming Refugee Awareness and Integration in South Wales <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5903">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5903</a> Mrs Peabody Investigates: Enhancing Public Understanding of German, European and International Crime Fiction <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5904">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5904</a> Using creative writing to engage the public in Welsh language culture and enrich the cultural life of Wales <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5906">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5906</a> Informing and influencing the creation of language policies and strategies at local and national government levels to promote the use of Welsh amongst young people <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26758">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26758</a>
UoA 29	English Language and Literature	Mapping Medieval Chester: driving heritage policy, expanding heritage audiences and creating new cultural and economic opportunities <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5908">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5908</a> Father knows Lloyd George. Now so do thousands of others: expanding theatre audiences and enriching history in post-devolution Wales <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5909">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5909</a> The Library of Wales: influencing Government Policy to benefit the Creative Industries, Cultural Tourism, Education and General Readers <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26733">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26733</a>
UoA 30	History	Re-discovering Richard Burton: generating new creative representations and commemorations of a cultural icon <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5912">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5912</a> Copperopolis: Regenerating and Transforming an Industrial Landscape in the Lower Swansea Valley <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5913">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=5913</a> Revealing Disability's Hidden Past: Enriching public discourses and empowering disabled people <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26562">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26562</a>





University of South Wales		
UoA 3	Allied Health Professions, Dentistry, Nursing and Pharmacy	Engaging the public and professionals with genetics: the impact of the Genomics Policy Unit on exploring a new age of genetic healthcare <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27125">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27125</a>
		Safety in numbers: towards reducing global medication dosage calculation problem-solving (MDC-PS) error through the design and application of virtual authentic learning and assessment environments [not online]
UoA 4	Psychology, Psychiatry and Neuroscience	The development of the first adult screening tool for Developmental Coordination Disorder: the Adult Developmental coordination disorder Checklist (ADC) <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27324">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27324</a>
		Autism Spectrum Disorder in Later Life <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27330">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27330</a>
UoA 10	Mathematical Sciences	Developing frequency assignment techniques for British military communication systems <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26674">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=26674</a>
		Using genomics to shape high performance computing <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27041">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27041</a>
UoA 11	Computer Science and Informatics	Linking Archaeological Data – enabling semantic infrastructure in the digital archaeology domain <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27425">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27425</a>
		Mobile applications and technologies making economic impact <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27426">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27426</a>
UoA 15	General Engineering	Optimisation of Anaerobic Process Technology <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=28518">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=28518</a>
		Industrial modelling and monitoring <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=28519">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=28519</a>
UoA 19	Business and Management Studies	Entrepreneurship Promotion: Federation of Small Business Bi-Annual Survey (2007–2008) <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=36214">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=36214</a>
		The Enterprising University / Enterprise Education <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=36221">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=36221</a>
UoA 22	Social Work and Social Policy	Contribution to New Methods of Homicide Investigation <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27454">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27454</a>
		A New Hybrid Model of the Justice System in Afghanistan <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27455">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27455</a>
UoA 26	Sport and Exercise Sciences, Leisure and Tourism	Free radicals and vascular ageing; move your muscles, move your mind! <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27762">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27762</a>
		Intermittent hypoxia and its impact on human health: on mountains, medals and medicine! <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27763">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27763</a>
UoA 29	English Language and Literature	Re-creating Creativity: Promoting the study and articulation of creative process <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27459">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27459</a>
		Republishing Welsh Women's Classics <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27460">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27460</a>





UoA 30	History	Slave Wales – the Welsh and Atlantic Slavery <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27578">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27578</a>
		The Material Culture of Late Medieval Religion in Wales <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27579">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27579</a>
UoA 35	Music, Drama, Dance and Performing Arts	Grand-Guignol and Popular Horror Performance <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27759">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27759</a>
		Analysing and Developing Creative Industries in Small Nations <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27760">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27760</a>
		Storytelling and Community <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27761">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27761</a>

#### University of Wales

UoA 28	Modern Languages and Linguistics	Geiriadur Prifysgol Cymru / A Dictionary of the Welsh Language [joint submission with University of Wales, Trinity Saint David] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=37244">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=37244</a>
		The Poetry of Guto'r Glyn [joint submission with University of Wales, Trinity Saint David] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=37330">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=37330</a>

#### University of Wales, Trinity Saint David

UoA 15	General Engineering	Knowledge Transfer Centre in NDT <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=41129">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=41129</a>
		Scientific Advice to Belron Technical Ltd on Windscreen Impact Damage <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=41489">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=41489</a>
UoA 17	Geography, Environmental Studies and Archaeology	The Newport Medieval Ship Project <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=21488">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=21488</a>
		Global Forum on Oceans, Coasts, and Islands <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=21489">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=21489</a>
UoA 28	Modern Languages and Linguistics	Geiriadur Prifysgol Cymru / A Dictionary of the Welsh Language [joint submission with University of Wales] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=37244">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=37244</a>
		The Poetry of Guto'r Glyn [joint submission with University of Wales] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=37330">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=37330</a>
UoA 31	Classics	Arediou-Vouppes: Exploring a Rural Community in Late Bronze Age Cyprus <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=17020">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=17020</a>
		IMAGINES: Antiquity in the Visual & Performing Arts <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27111">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=27111</a>
UoA 33	Theology and Religious Studies	Theology, Art and Religion in Contemporary European Avant-Garde Culture <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=19864">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=19864</a>
UoA 34	Art and Design: History, Practice and Theory	Using Product Design Techniques to Improve the Lives of Reconstructive Surgery Patients while Reducing the Cost to the NHS and Tax Payer [joint submission with Cardiff Metropolitan University] <a href="http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42385">http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42385</a>





The Influence of WIRAD's Design Policy Unit on the Design Innovation Policies of Wales, the UK and the European Union [joint submission with Cardiff Metropolitan University]

<http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42388>

'Zanzibar Soccer Queens' (2007) and its Impact on Civil Society and Cultural Life in Africa and Europe [joint submission with Cardiff Metropolitan University]

<http://impact.ref.ac.uk/CaseStudies/CaseStudy.aspx?Id=42391>





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