

# WALES AND THE WORLD



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## SMALL, SMART COUNTRY



# Croeso Welcome

With its rugged coastline, mountainous national parks, friendly cities, pleasant maritime climate and affordable quality of life, Wales is part of the south-west region of the UK with extensive research, cultural and commercial relationships with the rest of the UK, Europe and the world.

Wales is a vibrant nation with its own devolved government and a multicultural society that is open to the world. Known perhaps more for its poets, artists, language, sport and UNESCO world heritage sites, Wales also boasts a growing research profile characterised by excellence, impact, talent, collaboration and international engagement. International awareness and recognition of this excellence however, is less well known. Recognising that a country's intellectual vitality remains one of its most valuable assets and a geo-political marker of a nation's intrinsic quality and future economic potential, this supplement showcases some of Wales's international research, connections and innovative national profile.

A small country of 3 million people, Wales has a proud tradition of achievement in many areas of research, science and innovation. From its recent past, as one of the first industrialised nations based on natural resources to the present knowledge based economy where Airbus, one of the world's leading aeroplane manufacturer makes its wings, and where IQE is a global leader in the design and manufacture of advanced semiconductor wafer products, Wales has produced an impressive list of achievements, many of which are among the first of their kind.

The theory of natural selection, the early development of crystallography, the ideas of Richard Price, the Renaissance philosopher and mathematician who influenced America's founding fathers, and Aneurin Bevan, architect of the world's first National Health Service are just some examples of Wales's innovative contribution. The discovery of free radicals and meson decay, the invention of the microphone, the fuel cell and the teleprinter, ground-breaking research into embryonic stem cells and more recently establishing unique legislation requiring all public bodies to consider the impact on future generations, are all further tangible evidence of Wales' proud intellectual tradition.

Today, Wales's eight universities contribute significantly to the world-leading UK research base, second only to the US in its share of global citations. Several of Wales's universities boast examples of outstanding science research – from Nobel Laureates in the Life Sciences research at Cardiff University, to the award-winning Institute of Biological, Environmental and Rural Sciences at Aberystwyth, Swansea's innovative advances in materials research and testing, and Bangor's impressive work in the fields of environmental protection.



## Growing Science Research in Wales: Sêr Cymru Programme

Committed to ensuring a strong, sustainable, world-class higher education system, the Welsh government in 2012 launched an ambitious new science strategy, which set out a compelling case to build a stronger research base for Wales in support of the country's economic and national development. The first phase of Sêr Cymru (Star Wales) was launched in 2013 with the aim of attracting the brightest and best scientific researchers and their teams from around the world to Wales. This was initially backed by £50 million of public funding and collaboration from the Higher Education Funding Council Wales and Universities.

The initiative paved the way for the Government and Universities to work together to support three 'Grand Challenge' areas: Life Sciences and Health; Low Carbon, Energy, and Environment; and Advanced Engineering and Materials. The first phase secured five world-class academics as Sêr Cymru Research Chairs, (two from the US, one from UK, and one from Switzerland) and supported the development of three national research networks in each of the three 'Grand Challenge' areas and funding for large scale doctoral training schemes.

2015 saw the launch of the second phase of Sêr Cymru when £57 million, much from European Union Funding, was secured for growing greater capacity for Wales' leading university research groups by attracting over 160 rising stars (early-mid career scientists) and promising research leaders, together with support for scientists (particularly with women in mind) returning after a long absence. In addition to appointing another prestigious chair from Australia, Sêr Cymru II has to-date appointed competitive fellowships to researchers from 28 countries including Austria, Australia, Bulgaria, Canada, Chile, China, Denmark, France, Georgia, Germany, Greece, India, Iran, Ireland, Italy, Korea, Mexico, New Zealand, Netherlands, Pakistan, Poland, Portugal, Romania, Spain, Sweden, UK, Ukraine and USA.

The Sêr Cymru initiative has already begun to make significant progress into building Wales's future research capacity, an essential element for growing a successful, sustainable national economy.

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## WALES HAS 4 UNIVERSITIES IN THE WORLD TOP 500

QS WORLD UNIVERSITY RANKINGS (2016/17)



## Global Standing

International university rankings provide an influential indicator of comparative institutional and national higher education systems standing. With over 26,000 universities worldwide, being ranked in the top 500 of the QS World University Rankings is recognition for both Wales's universities and for the country as a whole.

While it comes as no surprise that leading countries on most league tables tend to be the largest, rankings that rely on size-dependent indicators such as wealth or population inevitably overlook smaller, efficient nations.

When the ranking playing field is leveled by controlling for population or economic resources, the achievement of several well performing but smaller countries such as **Wales, Denmark, Ireland, Scotland and New Zealand** come to the fore.

Figures 1 and 2 (page 4) provide a snapshot of national performance for countries with three or more universities ranked in the top-500 ranked in the **QS World University Rankings 2016-17 league table**. With four universities ranked in the top-500, Wales has one of the highest concentrations of top ranked universities both in terms of population and GDP per capita.

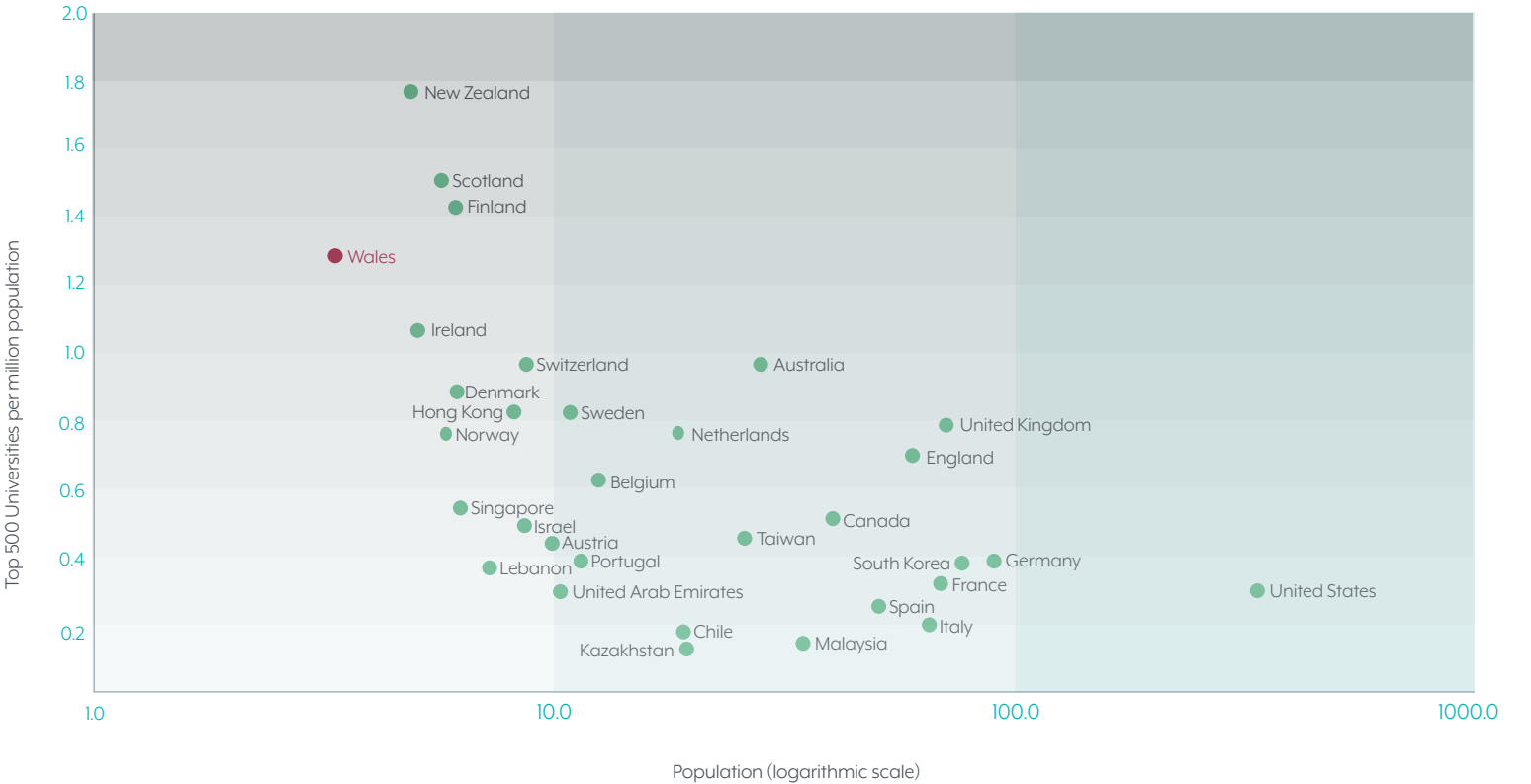
The results on page 4 confirm that for a small country, **Wales punches above its demographic weight**, securing

more universities positioned in the top-500 per million of population than many larger countries.

In addition, Welsh universities also perform well by subject discipline. In the **QS Subject rankings (2017)**, Wales's universities secured 21 top 200 rankings and 13 top-100 ranked positions covering 46 different subject areas.

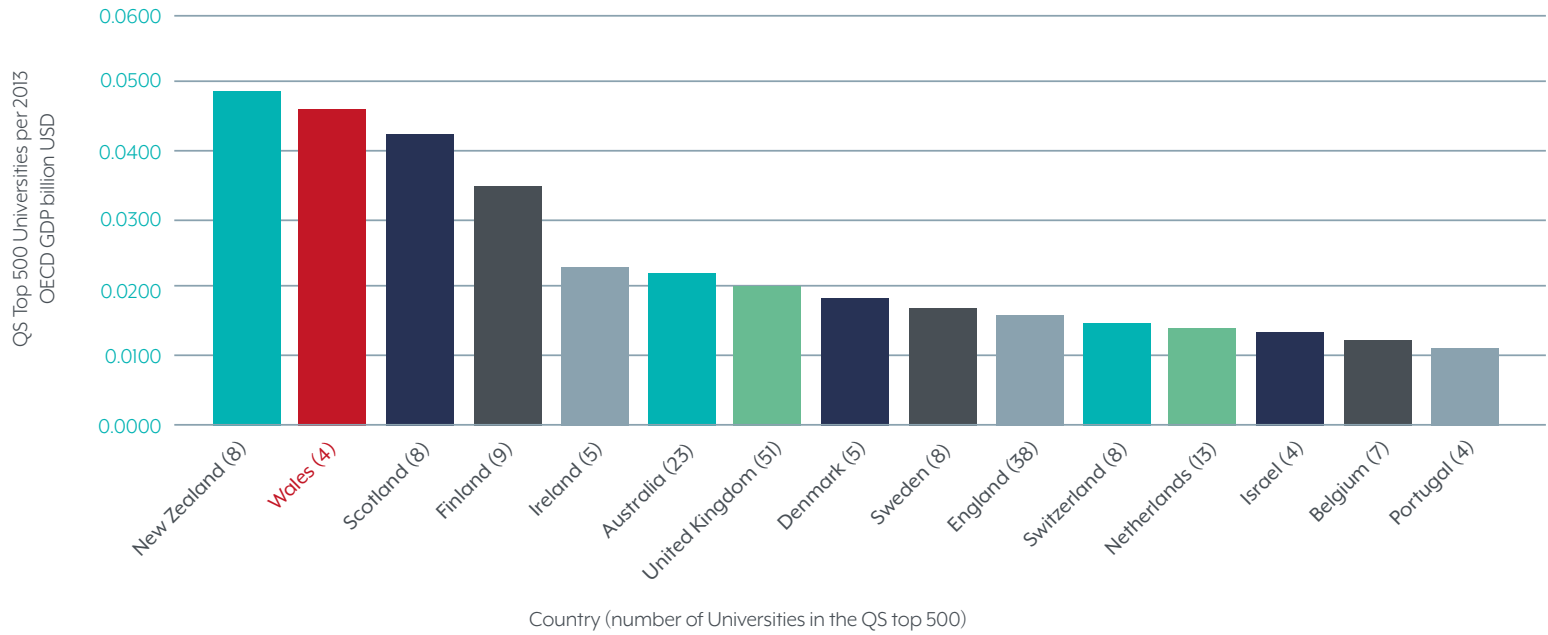
**Fig. 1 QS Top 500 Universities per million population, 2016 (only top 30)**

(only countries with 3 or more universities in the top 500 included)



**Fig. 2 Universities in the QS 2016 top 500 World University Rankings per billion USD GDP (top 15 only)**

(only countries with 3 or more universities in the top 500; OECD 2013; current prices, current PPP)



**Sources:** Figure 1 QS Quacquarelli Symonds Limited QS World University Rankings 2016-17 <https://www.topuniversities.com/university-rankings/world-university-rankings/2016> [accessed 07 March 2017] United Nations World Population Prospects 2015 <https://esa.un.org/unpd/wpp/Download/Standard/Population/> [accessed 07 March 2017]; UK Office for National Statistics Population Estimates 2015 <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates> [accessed 07 March 2017] Figure 2 QS Quacquarelli Symonds Limited QS World University Rankings 2016-17 <https://www.topuniversities.com/university-rankings/world-university-rankings/2016> [accessed 07 March 2017]; OECD GDP Dataset: Regional Accounts <http://stats.oecd.org/> [Accessed 15 March 2017]. **Note:** 20 countries with universities in the QS top 500 were omitted because they were not included in the OECD Regional Accounts data. The Regional Accounts dataset was used because it provided comparable data for the UK Regions and other countries.

# Research Quality

In 2014, **46%** of Welsh publications were internationally co-authored.

**A nation's research base is only as good as the people who work within it.** In 2014, the Research Excellence Framework (REF), the UK Government's five yearly assessment of the quality of research at the UK's 154 universities showed that Wales had significantly boosted its performance with more than three-quarters of all research submitted to the REF panels assessed as being world-leading or internationally excellent, and almost a third rated as world-leading.

In 2013 and 2016, Elsevier produced 2 independent reports (International Comparative Performance of the Welsh Research Base) showing how academic researchers from Wales compared internationally on a series of established bibliometric measures, compared to other parts of the UK and countries of a similar size.


## Key findings included:


 With just 0.14% of the world's researchers, Wales accounted for 0.24% of the world's published papers and 0.47% of global citations.

Wales's share of the top 1% highest cited papers was over twice that expected based on its overall publication share.

Wales's field weighted citation impact exceeded that of England, Finland, Norway, New Zealand and Ireland.

By 2014, Welsh publications were being cited 68% more often than the world average, compared to 59% back in 2011.

 1 in 10 research papers from Wales were ranked in the top 5% of most cited publications worldwide.

 Wales receives more citations per one million dollar equivalent of research investment than any other comparator country.

Wales is one of the most efficient countries at translating its relative low levels of research income into high impact research for countries of a comparable size.

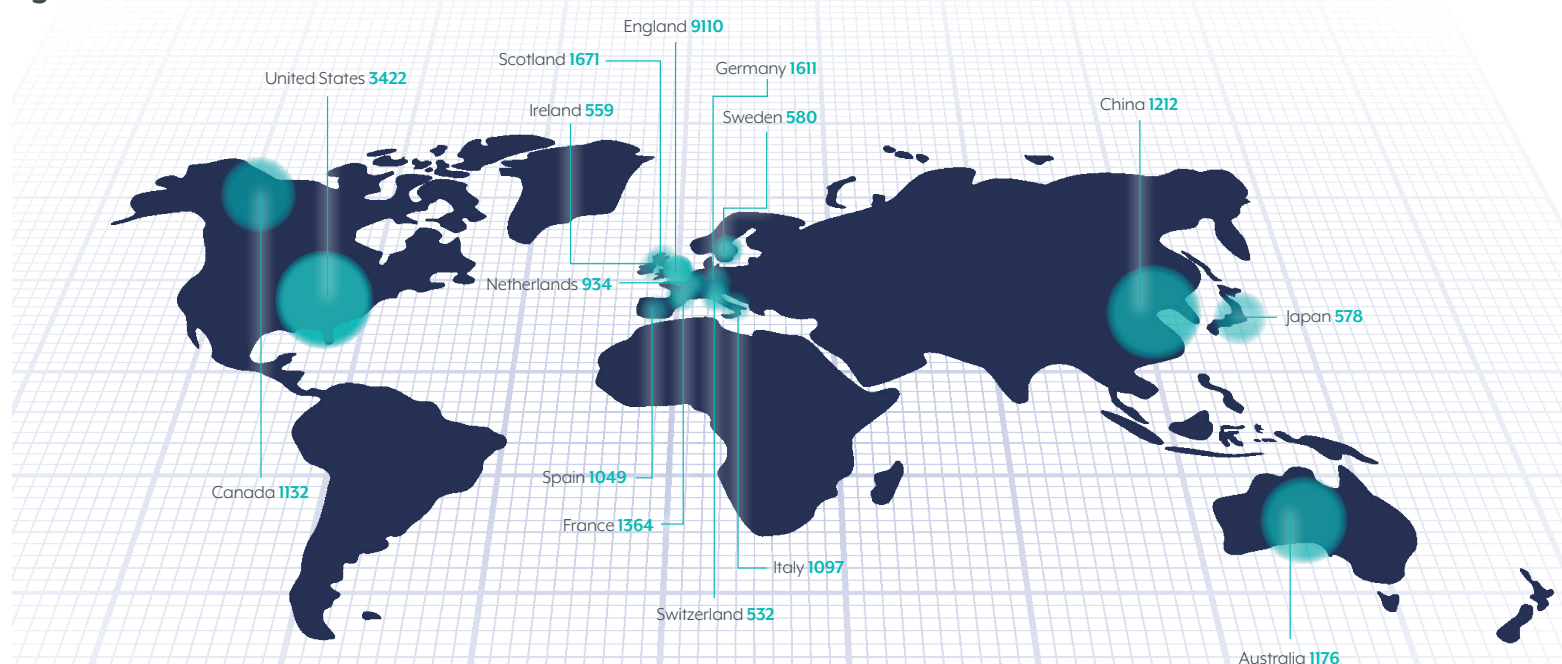
# INTERNATIONAL COLLABORATION

**Many of the challenges that the world faces requires global responses. Research excellence also depends on international collaboration. A key contributor to Wales's impressive research performance has been growing its level of international research, demonstrating the productive outcome of years of international networking.**

International collaboration not only accounts for the growing number of the Welsh articles, it also results in the highest field-weighted citation impact. The increase in international collaboration is striking for a small country moving from 25% in 1997-2001 to nearly 46% by 2014.

This collaborative partnership forms part of a virtuous circle of economic growth that benefits Wales while also attracting international researchers. Figure 3 provides a snapshot of Wales's research publication collaborations with other countries 2007-2011.

**Fig. 3 Wales's International Research Publications**





# SOCIO-ECONOMIC IMPACT OF WELSH RESEARCH

In 2014, the UK Research Excellence Framework (REF), required universities for the first time to select and submit their best case studies demonstrating the societal, cultural and economic impact of their research.

A report commissioned by the Learned Society of Wales (Impacts of Academic research from Welsh universities 2017) prepared by the Policy Unit at Kings College London highlighted the impressive research impact of Welsh universities to Wales, the UK and wider society. Despite comprising only 4% of the total UK submissions, Wales's REF impact results showed that almost half of the research submitted was evaluated as world-leading, with Wales securing the highest proportion of 4 Star impact for any the UK countries.

This authoritative report showed that universities in Wales carry out research into a wide range of areas including bilingualism, policing, flooding, dementia, childcare, mental health, public housing, renewable energy, community violence, poverty, transport management, cancer and agriculture. Research from Wales impacted on a wide number of beneficiaries including:

- ▶ Small and medium-sized enterprises (SMEs)
- ▶ Commercial sector - a third of case studies submitted by HEIs described some form of commercialisation
- ▶ Policymakers.

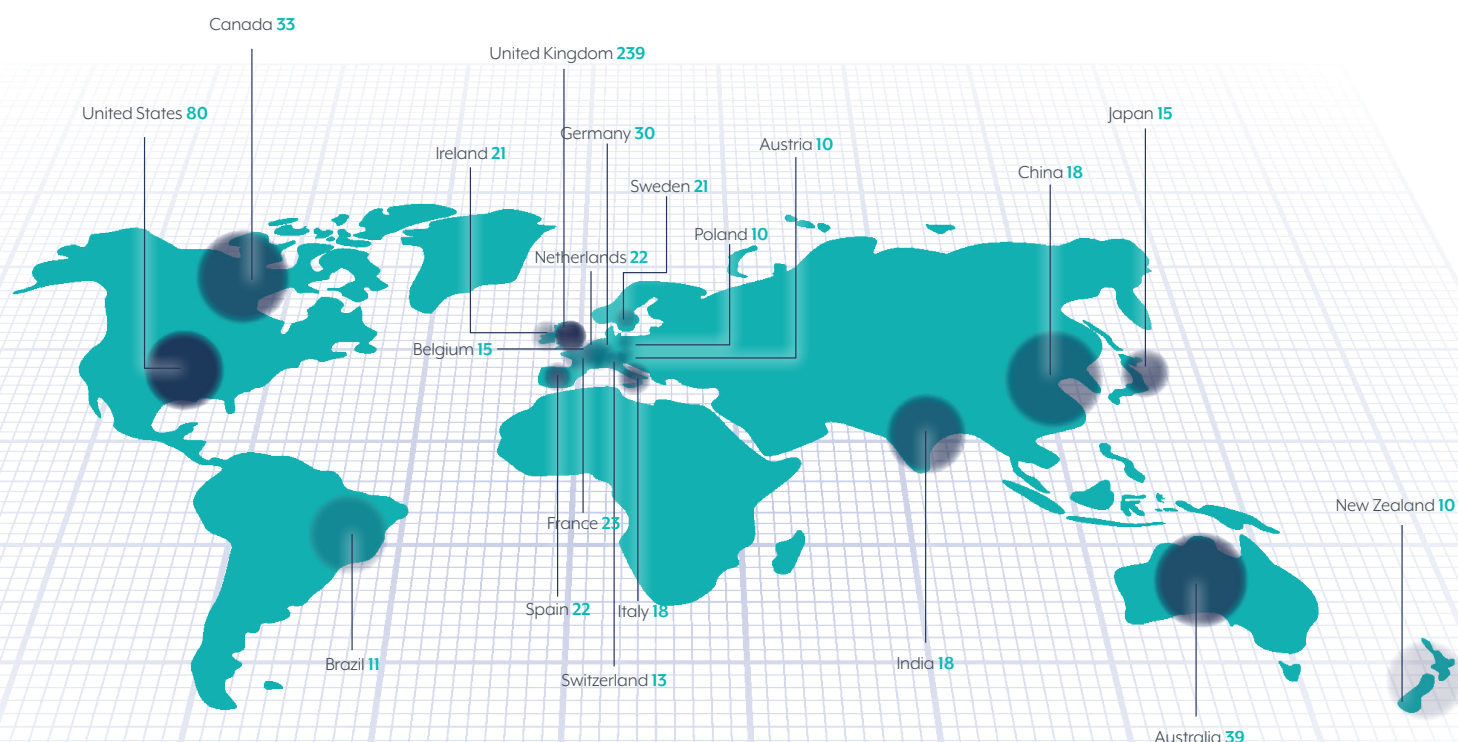
**The study found that the research impacts from Welsh universities covered 102 countries across six continents**, with the Life Sciences and selected disciplines from Engineering and Physical Sciences having the greatest tendency to translate into impacts abroad. Small and medium-sized enterprises (SMEs) in Wales were a key beneficiary with many of the impacts relating to economic growth in Wales highlighting complementary research and policy initiatives to support the growth of start-ups and small businesses, and to encourage industry, enterprise and entrepreneurship within Wales.

Figure 4 provides a summary of the top 20 countries where case studies from Wales had a research-related impact.



**With only 2% of the total UK spend on research and development (R&D), Wales's research base is a national asset, delivering economic, social, cultural and health benefits for the nation and for others around the world.**

**Fig. 4 Wales International Research Related Impact**



# Higher Education

Universities play a crucial role in the Welsh economy by conducting world-class research and innovation, and developing graduate skills that support local and national economic growth. In addition, universities employ tens of thousands of people in Wales creating an industry in its own right. In 2013, Welsh universities and their students contributed £2.4 billion of GVA to the Welsh economy and supported 46,000 jobs.

A sector with a proud history, Wales's eight universities and the Open University educate more than 140,000 students every year, ranging from undergraduate and postgraduate degrees to lifelong or work-based learning modules.

**Over 30% of the Welsh population aged 21 to 64 are college graduates.**

With academic provision spanning all major areas including Arts and Humanities, Creative Industries, Science and Technology, Business, Education, Social Sciences, Medicine and Healthcare, around half of the university courses are vocational or professional, providing training for teachers, lawyers, doctors, nurses, and social workers, as well as the public servants of the future.

In 2016, 92% of graduates from full time first degree courses in Wales were employed or

in further study six months after leaving. Three and a half years after graduation, the vast majority are in full-time employment.

Welsh universities are also successful in recruiting **international students**. In 2013-14, Wales welcomed over 25,000 international students from over 145 countries comprising 19% of the total student population. Figure 5 shows a breakdown of students from across the globe.

International students contribute significantly to Wales's economic and cultural prosperity. In 2014, universities generated £530 million of export earnings equivalent to 4% of all Welsh exports. Encouraging domestic students to develop an international outlook is also important. Universities encourage Welsh students and staff to participate in international exchange and research collaborations.

## Research, Innovation & Business Ecosystem

Strong links between industry and Wales's tertiary education ensures a skilled workforce with a broad range of technical and research expertise. The **automotive industry in Wales** features around 150 companies and employs 18,000 people generating £3 billion each year. Wales has around 10% of the UK's **aerospace industry** involving 160 aerospace and defence companies employing 20,000 people and a combined turnover of more than £5 billion.

Wales has particular strengths in several key industries that collectively contribute to its national research innovation profile. Many connect closely to areas of significant university expertise including:

### Advanced Engineering, Materials & Manufacturing

Wales has a 165,000-strong skilled workforce in this sector. Welsh universities produce over 2,000 engineering graduates every year.

### ICT & the Digital Economy

There are some 3,000 tech businesses in Wales, including over 400 electronics businesses and more than 250 telecoms-related companies.

### Low Carbon, Energy and Environment

Around 58,000 people work in the energy and environment sectors in Wales, generating over £4.8 billion in revenue.

### Life Sciences and Health

This sector is recognised internationally for its research and development excellence and is home to 12,000 Life Sciences university students.

### Creative Industries

The creative industries in Wales, range from architecture to software design to TV and film production, employing around 50,000 people and generating a £1.6 billion annual turnover.

### Financial Services

There are over 150,000 skilled people working in financial and professional business services across Wales, engaged in key operational areas such as banking, insurance, legal services, accountancy, financial technology and shared service centre operations.

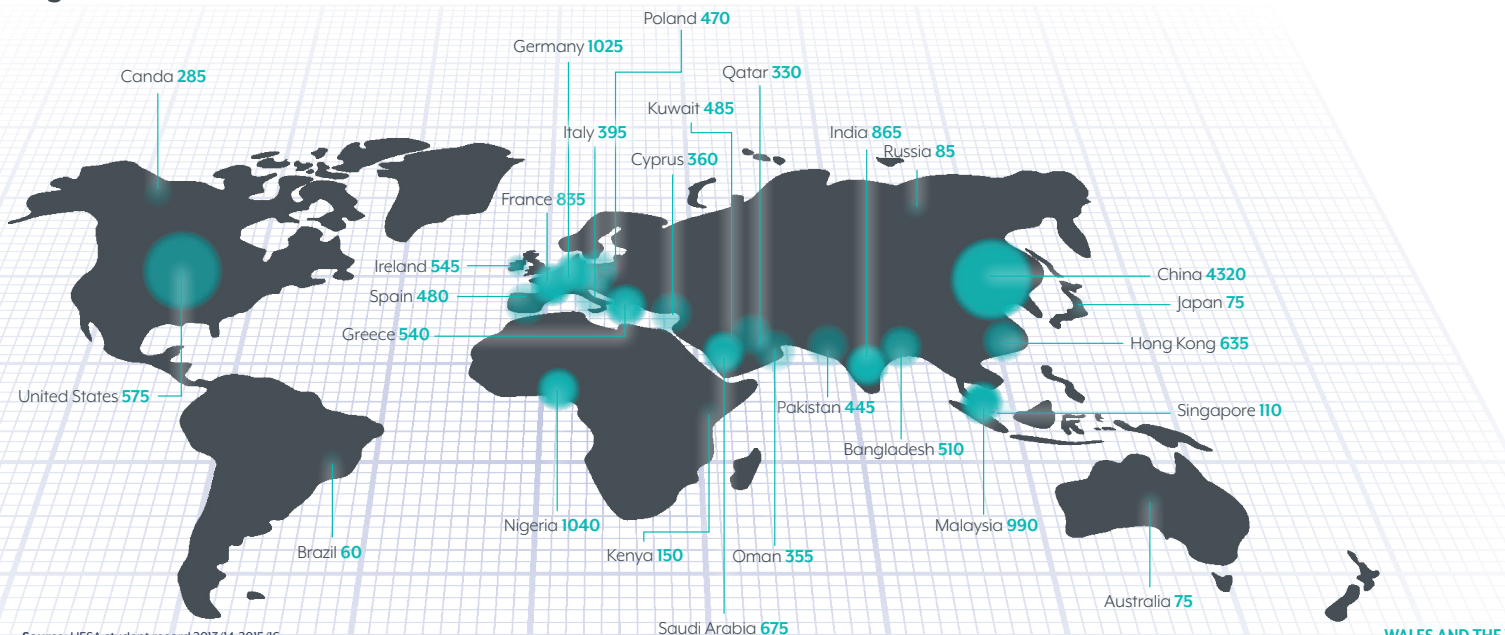
### Food and Drink

Around 170,000 people work in the food and drink industry, generating £17.3 billion to the economy.

### Tourism

With three National Parks, three UNESCO World Heritage Sites, five Areas of Outstanding Natural Beauty and an award-winning 1,400 km Wales Coast Path, Welsh Tourism is a £5 billion industry drawing visitors from all over the world.

Fig. 5 Wales's International students come from all over the Globe



Source: HESA student record 2013/14-2015/16



# Wales: globally connected by research, business, education and innovation

Following a shift from an industrial economy based on natural resources to a knowledge based manufacturing and services economy, Wales has over the past 2 decades begun to develop a more diverse technologically advanced open economy, involving partnership between its universities, small industries and anchor companies.

### Intellectual Property Office (IPO)

The official UK government body responsible for intellectual property rights in the UK located at Newport in Wales.

### Driver and Vehicle Licensing Agency (DVLA)

A UK government organisation located in Swansea responsible for maintaining a database of drivers in Great Britain and a database of vehicles for the entire United Kingdom. The agency issues driving licences, organises collection of vehicle excise duty road tax and road fund licence.

### The Royal Mint

A UK government owned mint located in Llantrisant that under an exclusive contract supplies all the UK's coinage. The mint exports to an average of 60 countries a year, making up 70% of its total sales. The Royal Mint supplies over 40 countries 9 in Europe, 9 Asia and Oceania, 10 Americas and Caribbean, 12 Africa and Middle East.

### Office for National Statistics (ONS)

A UK department located in Newport which reports directly to the UK Parliament and is charged with the collection and publication of statistics related to the economy, population and society of the UK.

### National Museum Wales

Dedicated to preserving, presenting and promoting the culture of Wales at 7 sites across the country.

### The National Library of Wales

The largest library in Wales, holding over 6.5 million books and periodicals. The library holds the largest collections of archives, portraits, maps, paintings and topographical prints and images in Wales.

### National Botanic Garden of Wales

Houses an amazing collection of over 8000 different plant varieties, spread across 560 acres of beautiful countryside.

## Anchor Companies

The Welsh Governments 'Anchor Company' programme recognises the strategic economic importance of large, global or international companies that work with in Wales to create jobs, growth and wealth within the Welsh economy. These include:

- Admiral Group Plc

Airbus Operations Ltd

Biomet UK Ltd

British Airways Engineering South Wales

British Telecommunications (BT) Plc

Celsa Manufacturing (UK) Ltd

Centrica

Dawnus Group

Deloitte

Dŵr Cymru Welsh Water

Ford Motor Company Ltd

GE Aircraft Engine Services Ltd

GE Healthcare

General Dynamics UK
- IQE Plc

JCB

Legal & General Assurance Society Ltd

Lloyds Banking Group

Norgine Ltd

Nuair Ltd

Penn Pharmaceutical Services Ltd

Pinewood Studios Wales

Principality Building Society Ltd

Qioptiq Ltd

Redrow Plc

Royal Bank of Scotland

Sharp Manufacturing Company

- Siemens Healthcare Diagnostics Products

SIMEC/Liberty House

Sony UK Technology Centre

SPTS Technologies Ltd

Tata Steel Europe

Tinopolis Plc

Toyota Motor Manufacturing (UK) Ltd
- UPM-Kymmene (UK) Ltd

UPM Shotton

Valero

Wales and West Utilities Ltd

Western Power Distribution (South Wales) Plc

Zodiac Seats (UK) Ltd

Sources: Diamond Review Interm report 2015. Study in Wales Brochure (2015). Universities Wales web site (http://www.uniswales.ac.uk/). The Economic Impact of Higher Education in Wales 2015. The Economic impact on Wales of International students (2015). Business wales (https://businesswales.gov.wales). Trade and Invest Web site (https://tradeandinvest.wales/ Wales in the World: The Welsh Government's International Agenda (2015). Welsh Crucible : http://www.welshcrucible.org.uk/

## THE RESEARCH, INNOVATION & INDUSTRY LANDSCAPE

Figure 6 provides a selective overview of the rich landscape of current and emerging research, educational, innovation and business activities in Wales.



### Life Sciences and Health

1. Life Sciences Hub Wales

2. Jellagen

3. Magstim

4. Bionema

5. Swansea University

6. Cardiff University Brain Research Imaging Centre (CUBRIC)

7. Proton Partners International, Rutherford Cancer Centre

8. BBI Group

9. Cotton Mouton Diagnostics Ltd

10. PCI Pharma

11. Siemens Healthcare Diagnostics Ltd

12. ConvaTec

13. ReNeuron

14. TrackCel

15. GE Healthcare Innovation Village

16. Cardiff Medicentre

17. Aberystwyth University
- Institute of Life Sciences

► Centre for NanoHealth

► AgorIP

► EHealth Industries Innovation centre

► Institute of Biological, Environmental and Rural Sciences (IBERS)

► Aberystwyth Innovation and Enterprise Campus (AIEC)
18. ARCH: A regional collaboration for Health (Swansea University and Health Boards)

19. International Centre for Product Design and Research (IPDR) (Cardiff Met)

20. GE Healthcare

21. Cardiff University
- Welsh Wound Innovation Centre (WWIC)

► MRC Centre for Neuropsychiatric Genetics and Genomics

► Dementia Research Institute

5. Flexible Integrated Energy Systems (FLEXIS) (Cardiff University and others)

6. BEACON Biorefining Centre of Excellence (Aberystwyth University and others)

7. Horizon Nuclear Power Station at Wylfa Newydd (Hitachi)

8. Bangor University

9. SEACAMS (Bangor University and others)

10. Sustainable Product Engineering Centre for Innovative Functional Industrial Coatings (SPECIFIC) (Swansea University)
- UK National Nuclear Thermal Hydraulic Facility (with Imperial College London)

► Boiling Water Reactor Research Hub and Network

- Information Security Research Group

► Centre for Financial and Professional Services

5. Compound Semiconductors

6. Cardiff University
- Endeavr Wales (Airbus & Cardiff University)

► Centre of Excellence in Cyber Security Analytics (Cardiff University)

► IQE

► Microsemi Corporation

► SPTS Technologies

► Institute for Compound Semiconductor Technology;

► The Compound Semiconductor Centre with IQE

► The Compound Semiconductor Applications Catapult (UK Government)

► The Futures Compound Semiconductors Manufacturing Hub (EPSRC)

### Advanced Engineering, Materials and Manufacturing

1. Advanced Manufacturing & Research Institute (AMRI)

2. Airbus UK, Broughton

3. Snowdonia Aerospace Centre

4. GE Aviation Wales

5. University of South Wales Aerospace Centre

6. Cardiff University

7. Advanced Engineering Materials Research Institute (AEMRI)

8. Automotive Design Non-Destructive Testing (University of Wales Trinity St David)

9. Astute 2020 (Swansea University)

10. Advanced Composite Training and Development centre (Wrexham Glyndŵr University)

11. Catalysis Institute (Cardiff University)

12. Zienkiewicz Centre for Computational Engineering (ZCCE) (Swansea University)
- Morgan Botti Research Centre

► Gas Turbine Research Centre

### Arts, Humanities and Social Sciences

1. Welsh Institute of Social and Economic Research and Data methods (WISERD)

2. Centre for Advanced Welsh and Celtic Studies (CAWCS) (Aberystwyth)

3. CREW Centre for Research into the English Literature and Language of Wales (Swansea University)

4. SPARK: Cardiff University Social Science Research Park

5. The Wales Governance Centre (Cardiff University)

6. Pontio Innovation (Bangor University)

7. Mercator Institute (Aberystwyth University)

8. Creative Industries Research and Innovation Centre (University of Wales Trinity St David)

- National Museum Cardiff

► St Fagans National Museum of History

► National Waterfront Museum

► Big Pit National Coal Museum

► National Slate Museum

► National Roman Legion Museum

► National Wool Museum

### ICT and Digital Economy

1. The National Software Academy (Cardiff University)

2. University of South Wales
- National Cyber Security Research Group

Fig. 6: An Overview of some of Wales's Educational, Research, Innovation and Industry Activities





# FROM KING COAL TO SMART ENERGY

The Welsh economy is rooted in the natural resources of the landscape. Agriculture was Wales's first industry, and it remains important today. But Wales has also been shaped by what lies under ground.

Although renowned for its breath-taking views, the earliest surviving illustrations of the Welsh landscape are of two lead mines, from 1670. The mineral resources of the land saw the development of the copper, iron and coal industries, and by the mid-nineteenth century Wales was one of the world's first industrial societies.

By the eighteenth and nineteenth centuries, Wales was transformed from a primarily pastoral economy into one of the world's powerhouses of the industrial revolution. Its resources of copper, slate, manganese, gold, iron ore and especially coal were key to industrial expansion, but also brought very distinctive health problems for the workpeople of this country.

By the late 1800s, a quarter of the global trade in coal came from Wales; it was exported around the world, from Singapore to Valparaiso and fuelled global economic development.

The world's first million-pound business deal was agreed at Cardiff's Coal Exchange in 1907.

Wales remains a world-leading energy pioneer today, but has shifted focus to low carbon, renewable and sustainable energy solutions.

Recent developments include:

## SPECIFIC

A research-led and industry-inspired innovation centre delivered by Swansea University with Tata Steel, BASF, NSG Pilkington and Cardiff University. The Sustainable Product Engineering Centre for Innovative Functional Industrial Coatings (SPECIFIC) is one of seven Innovation and Knowledge Centres set up to foster emerging industries and close the gap between scientific research and its commercial exploitation.

Set up in 2011 with a £20million commitment over five years comprising grants from the Engineering and Physical

Sciences Research Council (EPSRC), Innovate UK and the Welsh Government together with investment from Swansea University and strategic industrial partners, the project will progress the commercialisation of technologies to transform 'buildings into power stations' by enabling them to generate, store and release their own solar energy.

The project brings together thematic areas of research including photovoltaics, battery technology and heating coatings that will revolutionise the construction sector – with the strategic ambitions to generate over one third of the UK's total target renewable energy by 2020; reduce CO<sub>2</sub> output by six million tonnes per year and create new jobs in high-value manufacturing.

SPECIFIC has brought together a wide range of industrial partners to share expertise in functional coatings, energy storage, technology scale-up, business

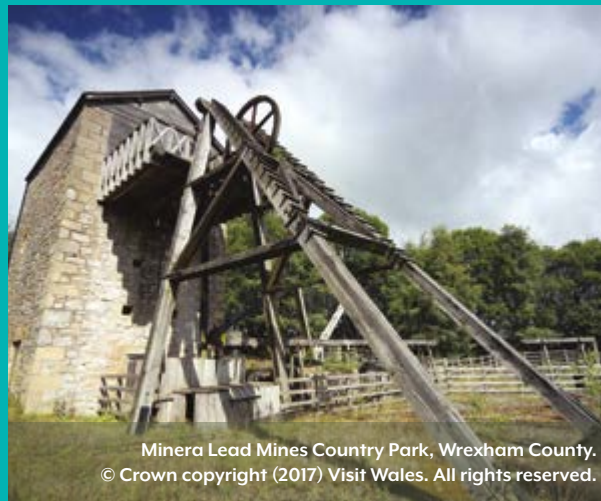
development and commercial know-how. The long term vision is the development of a new £1 billion industry with thousands of jobs created and enhanced value in the construction supply chain, addressing one of the biggest global challenges by providing secure, affordable, sustainable energy.

“

**The long-term vision is the development of a new £1 billion industry with thousands of jobs**

”

In 2016, SPECIFIC began phase two with £26 million in funding from EPSRC, Innovate UK and the European Regional Development Fund through the Welsh Government, as well as further investment from Swansea University, the industrial partners and matched funding from Cardiff University.



Minera Lead Mines Country Park, Wrexham County.  
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## Public Health and Industry

**The history of public health in Wales is inextricably linked with its changing economic and social conditions.**

Studies of the mining communities of south Wales carried out by Professor Archie Cochrane in the 1950s helped pioneer randomised control trials; Cochrane argued that since resources will always be limited, only health care proven to be effective should be implemented.

In 2008, Cardiff University established the world's first Chair in Public Health, named in his honour. The Cochrane Collaboration is now a global network of 37,000 contributors from 130 countries working together to produce accessible high-quality information that inform healthcare decisions.

Recent research projects have considered the legacies of heavy industry in Wales. The Disability and Industrial History project looked at how understandings and experiences of disability were affected by industrial development from the late eighteenth century until the end of the Second World War.



[www.dis-ind-soc.org.uk/en/index](http://www.dis-ind-soc.org.uk/en/index)

### FLEXIS

Cardiff University's FLEXIS project brings together world-leading expertise from Welsh universities to tackle some of the most pressing issues currently facing society, such as climate change, rising energy prices and fuel poverty. FLEXIS is designed to meet the diverse, complex and inter-dependent challenges that arise when new sources of energy are integrated into the grid by suppliers.

Leading researchers from the UK and Europe are being recruited to Welsh universities as part of the project, helping to strengthen Wales' position as a leader in research and innovation within the energy industry. This will address the challenges of: accommodating power supply from multiple places; storing energy when it is not needed; coping with extreme flows of energy into the system; accommodating an ailing infrastructure; and making sure all challenges are met in a socially acceptable, affordable way.

The project aims to prepare for the development of new technologies and job creation in the energy sector, and attract new companies to locate themselves in Wales.

By 2020, over £20 million of additional competitive research income is expected to be secured. FLEXIS aims to establish Wales as a pioneer in energy systems and deliver significant benefits to the nation as a whole, attracting new businesses, creating jobs and training the research engineers of the future.

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**£20m** competitive research income expected

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In north Wales, Bangor University is leading **M-Sparc, the Menai Science Park**, which will build on Wales's tradition of energy and innovation. As one of Wales's first science parks, it aims to drive growth in knowledge-based

science, with an early focus on low carbon energy, the environment and ICT sectors.

Anglesey is also home to the Energy Island Programme, a collective effort between several stakeholders within the public and private sector working in partnership to put Anglesey at the forefront of energy research and development, production and servicing. Harnessing a rich mix of energy streams, including nuclear, wind, tidal, biomass and solar; and with associated

servicing projects, Energy Island provides major potential to achieve economic, social and environmental gains for Anglesey and the wider north Wales region. More information can be found on the Energy Island website: [www.anglesey.gov.uk/business/energy-island-isle-of-anglesey-north-wales](http://www.anglesey.gov.uk/business/energy-island-isle-of-anglesey-north-wales)



# SUSTAINABILITY, EQUALITY AND QUALITY OF LIFE

Wales is on a journey to become a place of global significance. The Well-being of Future Generations (Wales) Act 2015 created a unique framework and opportunity for the development of a low carbon, resource efficient, healthy, well-educated, culturally engaged, and enterprising society, thriving within environment limits.

“

What a wonderful thing: to walk the entire length of a country's coastline, to trace its every nook, cranny, cliff-face, indent and estuary. How better to truly appreciate the shape – and soul – of a nation?

Lonely Planet

”

The Green Bridge of Wales off the Pembrokeshire Coast.



26%

of Wales's land surface is designated as either a **National Park** or as an **Area of Outstanding Natural Beauty**.

Betws y Coed, North Wales.

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## The seven well-being goals of the Well-being of Future Generations (Wales) Act 2015 are:

A prosperous Wales

A resilient Wales

A healthier Wales

A more equal Wales

A Wales of cohesive communities

A Wales of vibrant culture and Welsh language

A globally responsible Wales

The goals seek to create a more equal society that enables people to fulfil their potential no matter what their background or circumstances. This builds on a long tradition of equality in Wales.

[futuregenerations.wales/about-us/future-generations-act](http://futuregenerations.wales/about-us/future-generations-act)

The Welsh laws of Hywel Dda (Hywel the Good), of the tenth century included **elements of mercy, common sense and respect for women and children**, unlike the Anglo-Saxon laws of the time.

Welsh universities were amongst the **first institutions in the UK to admit female students**.



Cardiff and Swansea Universities were amongst the first to **appoint female professors** in the early twentieth century.



In 2003, the National Assembly for Wales became the **first legislature in the world** to achieve **50:50 GENDER BALANCE**.

The first Welsh universities were funded by 'crowd-sourced' donations from communities within Wales, signalling the nation's commitment to education and opportunity. **The universities in Wales remain rooted in Welsh society, whilst engaging with the rest of the world.**



In 2008 Wales became the **FIRST FAIR TRADE NATION IN THE WORLD**.



The Welsh Government's Environment (Wales) Act 2016 aims to deliver at least an **80% reduction** in emissions by 2050.

The Welsh word '**cynefin**' captures the sense of community in place – a sense of habitat and belonging. **Cynefin** is that place to which one belongs, and how it is understood as a place in time. The landscape, environment and communities are key to the Welsh experience.



A Welshman was the driving force behind the establishment of the **world's first free at point of access national health service** in 1948. **Aneurin Bevan**, as the UK's Minister for Health, was inspired by community health projects he saw in Tredegar, South Wales.

**Wales is currently the only country in the world to have a continuous coastal path stretching its entire length.** The Wales Coast Path travels through some of the most beautiful countryside anywhere, and there are 870 miles of public path to explore. It joins with the 177 mile long Offa's Dyke Path national trail along the Welsh-English border, to create a complete circuit of Wales.

Aberystwyth University established the **world's first Chair in International Politics** in 1919 named in honour of the American President Woodrow Wilson.



# CULTURE AND COMMUNITY

Wales has a vibrant, outward looking, distinctive and welcoming cultural identity, rooted in its traditions. The people of Wales have hundreds of stories which over the centuries have shaped the collective identity of the country today.

Wales has a lively, bilingual culture. Cymraeg (Welsh) is one of Europe's oldest living languages used every day by thousands. It can be seen and heard throughout Wales, and is part of what makes Wales distinctive.

The annual **Eisteddfod Genedlaethol** (National Eisteddfod) is the biggest Welsh language cultural event, and one of Europe's largest roaming, cultural festivals. With a history dating to the twelfth century, it encompasses aspects of the arts, literature culture and science. An inclusive and welcoming festival, it attracts thousands of visitors: Welsh learners, Welsh speakers

from Wales and the world, as well as those who do not speak Welsh. The two literatures of Wales are a central part of Welsh culture. One of Wales's most iconic buildings, the **Wales Millennium Centre**, features two poetic inscriptions by Gwyneth Lewis, in six-foot tall letters of stained glass. Dylan Thomas and Roald Dahl are arguably the best-known Welsh literary figures, but there are many more writers to explore. Wales is also home to the internationally renowned **Hay Festival of Literature and Arts**.

Art in Wales dates back to the prehistoric era, and the Mold Cape (1900-1600BC) is one of the most well-known artefacts.

The National Museum of Wales in Cardiff houses one of the world's most remarkable collections of French Impressionist and Post-Impressionist painting. Since 2003, the Venice Biennale has featured a Welsh pavilion, and in the same year the **Artes Mundi** prize was established. This Cardiff-based award is held every two years and is one of the largest visual art prizes in the world.

With its reputation as the 'land of song', Wales has a strong musical heritage. The nation boasts a constantly evolving music scene. The **Cardiff Singer of the World** has been recognising excellent opera singers since 1983, and

since 1947 Wales has staged the **Llangollen International Musical Eisteddfod**, one of the world's most inspirational music festivals.

Sport is another important part of the Welsh way of life. Rugby remains popular, but Wales excels at other sports too. Cardiff was the European Capital of Sport in 2014, and the nation has established itself as a leading venue for major sporting events including Ryder Cup and the UEFA Champions League Final. The magnificent Welsh coastline and landscape also provide the perfect playground for sporting activities.



## The future of Wales is as exciting as its past

To learn more about Wales from a variety of perspectives, visit the Open University in Wales's Hafan website: [www2.open.ac.uk/openlearn/hafan](http://www2.open.ac.uk/openlearn/hafan)





# DIRECTORY

## Universities and Related organisations

**Aberystwyth University**  
[www.aber.ac.uk](http://www.aber.ac.uk)

**Bangor University**  
[www.bangor.ac.uk](http://www.bangor.ac.uk)

**Cardiff University**  
[www.cardiff.ac.uk](http://www.cardiff.ac.uk)

**Cardiff Metropolitan University**  
[www.cardiffmet.ac.uk](http://www.cardiffmet.ac.uk)

**Glyndŵr University**  
[www.glyndwr.ac.uk](http://www.glyndwr.ac.uk)

**Open University in Wales**  
[www.open.ac.uk/wales](http://www.open.ac.uk/wales)

**Swansea University**  
[www.swansea.ac.uk](http://www.swansea.ac.uk)

**University of South Wales**  
[www.southwales.ac.uk](http://www.southwales.ac.uk)

**University of Wales Trinity Saint David** [www.uwtsd.ac.uk](http://www.uwtsd.ac.uk)

**Global Wales**  
[wales.britishcouncil.org/en/global-wales-welsh-higher-education-partnership](http://wales.britishcouncil.org/en/global-wales-welsh-higher-education-partnership)

**Study in Wales**  
[www.studyinwales.ac.uk](http://www.studyinwales.ac.uk)

**Universities Wales**  
[www.uniswales.ac.uk](http://www.uniswales.ac.uk)

**Welsh Crucible**  
[www.welshcrucible.org.uk](http://www.welshcrucible.org.uk)

**Welsh Higher Education Brussels**  
[www.wheb.ac.uk/en](http://www.wheb.ac.uk/en)

**Higher Education Funding Council for Wales ( HEFCW)**  
[www.hefcw.ac.uk](http://www.hefcw.ac.uk)

**University of Wales Press**  
[www.uwp.co.uk](http://www.uwp.co.uk)

## Welsh Government and the National Assembly

**National Assembly for Wales**  
[www.assembly.wales](http://www.assembly.wales)

**Sêr Cymru**  
[businesswales.gov.wales/expertisewales](http://businesswales.gov.wales/expertisewales)

**VisitWales**  
[www.visitwales.com](http://www.visitwales.com)

**Welsh Government**  
[www.futuregenerations.wales](http://www.futuregenerations.wales)  
[www.wales.com](http://www.wales.com)  
[www.tradeandinvest.wales](http://www.tradeandinvest.wales)

## Culture and Heritage

**Arts Council of Wales**  
[www.arts.wales](http://www.arts.wales)

**British Council Wales**  
[wales.britishcouncil.org](http://wales.britishcouncil.org)

**CADW**  
[www.cadw.wales](http://www.cadw.wales)

**Eisteddfod Genedlaethol**  
[www.eisteddfod.wales](http://www.eisteddfod.wales)

**Hay Festival**  
[www.hayfestival.com](http://www.hayfestival.com)

**Literature Wales**  
[www.literaturewales.org](http://www.literaturewales.org)

**National Botanic Garden of Wales**  
[www.botanicgarden.wales](http://www.botanicgarden.wales)

**National Museum Wales**  
[www.museum.wales](http://www.museum.wales)

**National Library of Wales**  
[www.llgc.org.uk](http://www.llgc.org.uk)

The **Learned Society of Wales (LSW)** is an independent, all-Wales, self-governing, pan-discipline educational charity.

The Society is Wales's first national academy of science and letters and was established in 2010. The Society draws upon the considerable strengths of over 400 distinguished Fellows based in Wales, the UK and beyond. It provides public benefit including expert scholarly advice on a variety of public policy issues related to science, engineering, medicine, arts, humanities and social sciences.

 [www.learnedsociety.wales](http://www.learnedsociety.wales)

## Reports and further information

**Science for Wales – Welsh government science strategy (2012)**  
[gov.wales/topics/science-and-technology/science/?lang=en](http://gov.wales/topics/science-and-technology/science/?lang=en)

**International Comparative Performance of the Welsh Research Base 2010-2014, 2016 update**

[www.elsevier.com/research-intelligence/research-initiatives/wales2013](http://www.elsevier.com/research-intelligence/research-initiatives/wales2013)

[www.elsevier.com/research-intelligence/research-initiatives/international-comparative-performance-of-the-welsh-research-base-2016](http://www.elsevier.com/research-intelligence/research-initiatives/international-comparative-performance-of-the-welsh-research-base-2016)

**The Economic Impact of International Students in Wales (2015)**

[www.uniswales.ac.uk/new-report-launched-the-economic-impact-of-international-students-in-wales](http://www.uniswales.ac.uk/new-report-launched-the-economic-impact-of-international-students-in-wales)

**The Economic Impact of Higher Education in Wales (2015)**

[www.uniswales.ac.uk/wp/media/The-Economic-Impact-of-Higher-Education-in-Wales.pdf](http://www.uniswales.ac.uk/wp/media/The-Economic-Impact-of-Higher-Education-in-Wales.pdf)

**Science in Wales (2012)**

[www.sciencemag.org/careers/features/2013/04/science-wales](http://www.sciencemag.org/careers/features/2013/04/science-wales)

**Wales wants more Scientists (2016)**

[www.sciencemag.org/careers/features/2016/10/wales-wants-more-scientists](http://www.sciencemag.org/careers/features/2016/10/wales-wants-more-scientists)

**The Case for Growing STEM Research Capacity in Wales (2015)**

[www.learnedsociety.wales/growing-stemm-research-capacity-in-wales](http://www.learnedsociety.wales/growing-stemm-research-capacity-in-wales)

**Impact of academic research from Welsh Universities, by the Policy Unit Kings College London (2017)**

[www.learnedsociety.wales/societal-economic-impact-welsh-universities](http://www.learnedsociety.wales/societal-economic-impact-welsh-universities)



