A Bio Refining Centre of Excellence for Wales

BEACON

From plants to products
O blanhigion i gynhyrchion

Collaborative Research, Innovation & Benefits to Society

Selwyn Owen, Business Development Manager

Prifysgol Aberystwyth University

Prifysgol Bangor University

Swansea University
Prifysgol Abertawe

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Overview

- **Part 1:** The BEACON Project
- **Part 2:** Collaborative Research
- **Part 3:** Innovation
- **Part 4:** Benefits to Society
- **Part 5:** Going Forward…

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My Background

- **Business Development Manager** at Aberystwyth University for the BEACON bio-refinery project
- Facilitate successful 'collaborative R&D projects' between academia and industry

Past Experience

- **International Business Development** at Trade Cleantech
- **Research Associate** at Copenhagen Business School, Denmark
- **Business Incubation Developer** at Optic Glyndŵr (Glyndŵr University), Wales

Interests

- Strategic alliances and developing new green business models that can positively impact the environment.

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Part 1

The BEACON Project

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PRIFYSGOL BANGOR UNIVERSITY

Swansea University
Prifysgol Abertawe

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What is BEACON?

A **£21.2 million, 5 year** partnership between three Welsh universities at **Aberystwyth, Bangor,** and **Swansea,** developed to establish a Biorefining Centre of Excellence and collaborate with SMEs across a range of industry sectors.

Supported by the European Regional Development Fund through the Welsh European Funding Office (WEFO)

BEACON is seeking to:

- Establish links between the business community and academia within Wales
- Develop new products and processes that will support economic growth
- Create highly skilled jobs in the area of green biotechnology
- Support inward investment
- Promote science excellence in Wales

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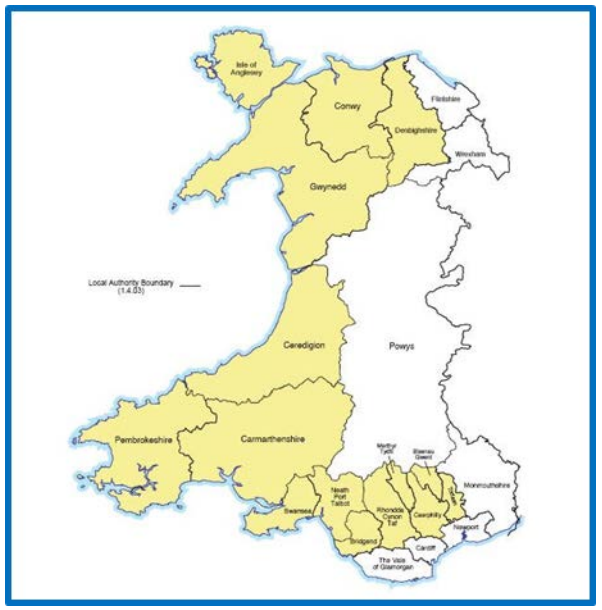
Wales



ERDF Region
West Wales & the Valleys

'This region is under-preforming (economically), with low employment rates'

Funding made available 'to make West Wales a vibrant, entrepreneurial region at the cutting edge of sustainable development'

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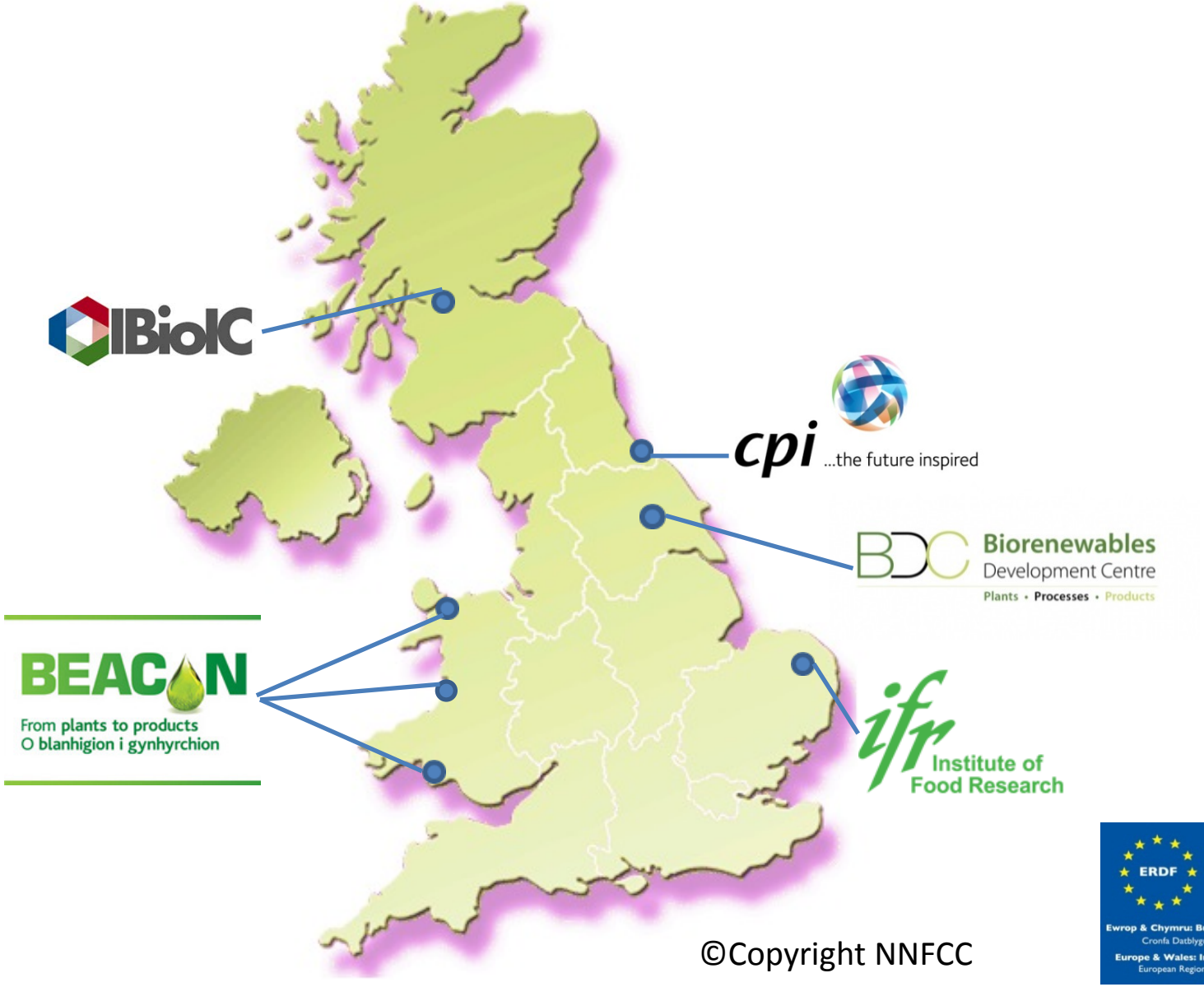
UK Biorefining Initiatives



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Key Performance Indicators

Outputs

- 202 Enterprise Assists
- 25 R&D Collaborations

Results

- 67 Jobs created (over 3 sites)
- 3 Enterprises Created
- Research investment induced £3,360,000
- 7 Products , process & services registered
- 16 New & improved products, processes or services launched

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The Bio-based economy

EU Bio Economy Sectors

- €2 Trillion in annual turnover
- 22 Million jobs
- 9% of the Workforce

It is estimated that **Direct Research Funding** associated to the bio economy strategy under **Horizon 2020** could generate approximately **130,000 jobs** and **€45 Billion** through value added in the bio economy sectors by 2025*

(*EC- Innovating for Sustainable Growth: A Bio Economy for Europe-2012)

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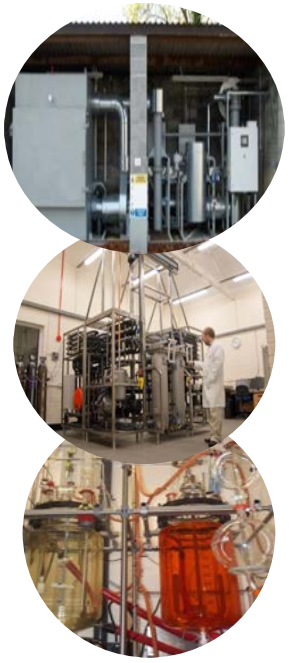
Biorefining: From Plants to Multiple Products

Biomass → **Conversion** → **Products**

- Ryegrass
- Miscanthus
- Willow
- Oats
- Macroalgae



- Chemicals
- Fuels
- Materials
- Natural Products
- Bio actives

Life Cycle Assessment / Financial & Carbon Accounting / Socio Economic Effects

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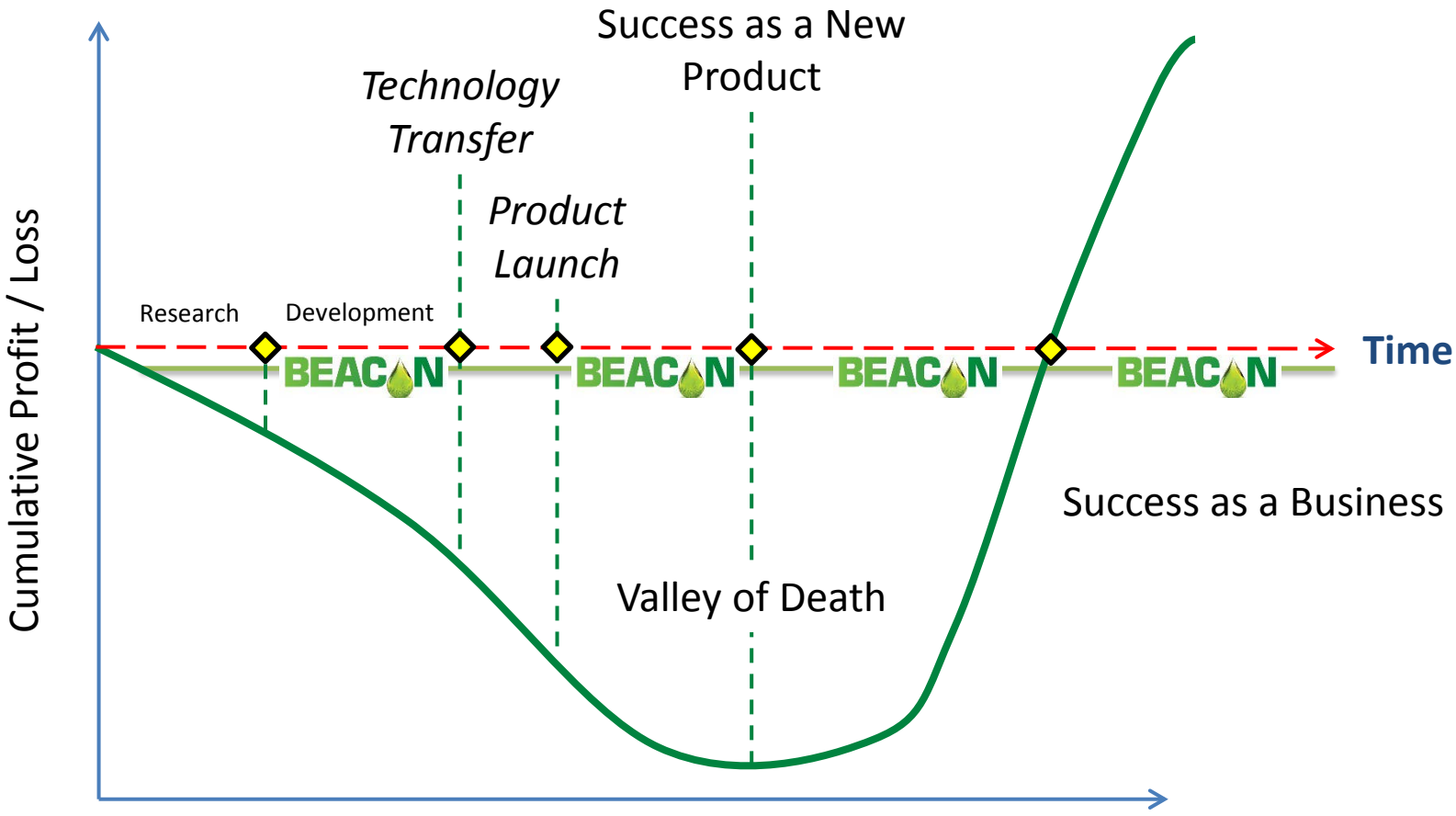
How does BEACON help companies?



BEACON provide companies with scale-up equipment and research scientists to help commercialize their concepts.

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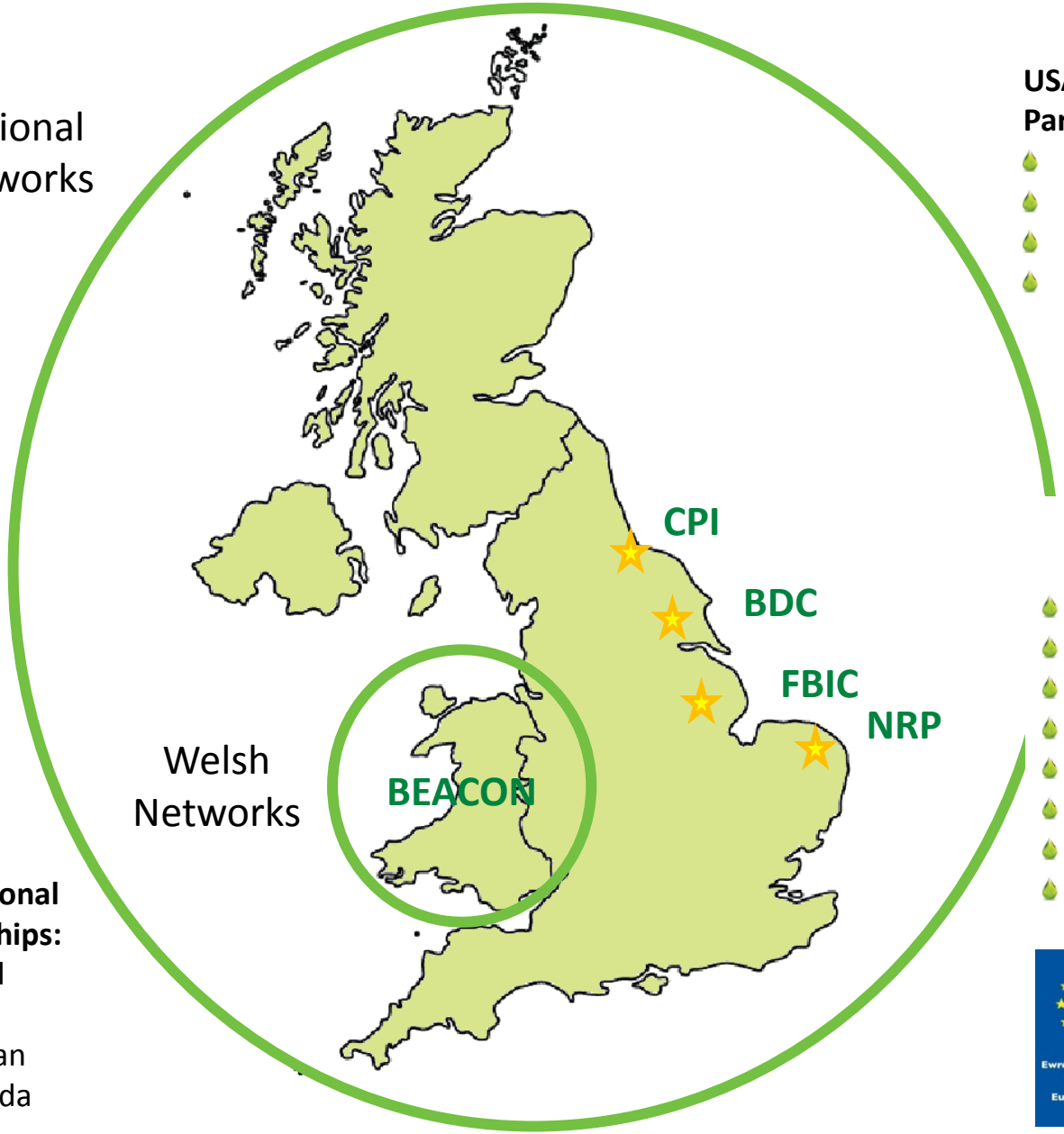
National & International Outreach



USA Partnerships:

- NREL
- GU Athens
- Univ Florida
- PNNL, INL

EU Academic & Business Links:

- Climate KIC
- Imperial
- INRA
- Wageningen
- Kassel
- Wroclaw
- DSM
- Reverdia

Other International Partnerships:

- Brazil
- India
- Taiwan
- Canada

Our Capability

Aberystwyth University

Plant Microbiology, Bio Technology, Economic Modelling

Bangor University

Biomass processing and extraction, bio composite materials, plant chemistry, life cycle assessment

Swansea University

Microbial genetics, enzymology, fermentation, molecular modelling

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Aberystwyth University

Areas of Research Expertise and Capabilities

IBERS
Athrofa y Gwyddorau Biolegol, Amgylcheddol a Gwledig
Institute of Biological, Environmental and Rural Sciences

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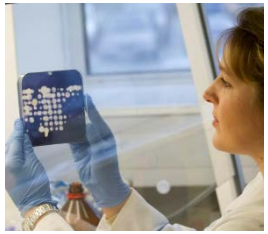
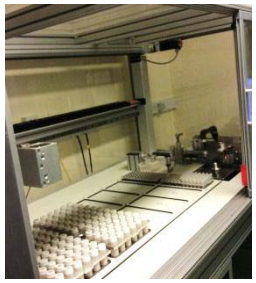
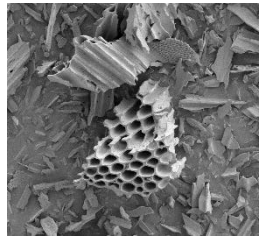
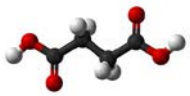
Aberystwyth University: Research Areas









Biomass Characterisation

Enzyme/Microbial Discovery

High Throughput processing (robotics)

Feedstocks processing & conversion

Industrial Biotechnology: Platform Chemicals

Thermochemical (Biochar)

Macro algae and plant extracts

Feedstock Development

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Aberystwyth

Primary Processing

Secondary Processing

- Integrated Wet Processing Line (Top Left)
- Dry Processing Mill (Bottom Left)
- Secondary Processing Lab (Top Right)

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Primary Processing, Aberystwyth

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Secondary Processing

- Expertise with biomass pre-treatment, fermentation and extraction
- Plant microbiology
- Plug and play biorefining facility
- Steam explosion pre-treatment of biomass
- Pilot scale prototype slow pyrolysis rig

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Feedstock Processing

Screw Press Dewatering:

Crude fractionation

Densification – Pelletisation

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Pre-Treatment & Biomass Processing

Steam Explosion & Pasteurisation

Centrifugation Solid/Liquid Separation

Biochar/Torrefaction

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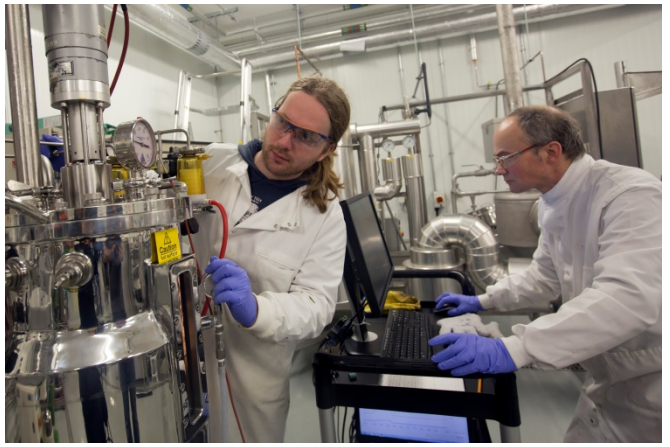
Membrane Fractionation & Conversion

Cross-Flow Filtration

Fermentation/Bioreactors



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Bangor University

Areas of Research Expertise and Capabilities

BioComposites Centre
Innovation in biomaterials for industry

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Bangor

BioComposites Centre

- Production of BioComposites materials
- Fibre based packaging
- Bio Based plastics and packaging

Chemistry Department

- Isolation of bio actives and bio-based additives
- Organic synthesis
- Chemical structure elucidation by using 1H-NMR, 13C-NMR and 31-P NMR.

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Bangor University: Research Areas

Mycology / Compositional Analysis

Bio-Catalysis – Enzymatic fractionation, food ingredients

Pre Treatment

Green Solvents – Plant Extracts for cosmetics, personal care, medical

Biomass

Life Cycle Assessment

Bio-based polymers & fibre packaging

Bio-Composite Materials & Bio-resins (construction)

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Bangor University: Biomass Pretreatment and Extraction

Thermo – Mechanical/ milling/ sieving

Conventional/ Green Solvents

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Bangor Facilities

Bio Plastics Research

Twin screw extruder and film forming line

Wet chemistry laboratory

50 Litre jacketed glass reactor

20 Litre rotary evaporator

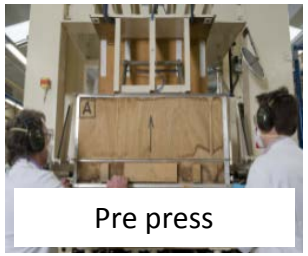
Pressurised Refining of Biomass

Two deck vibrating sieve

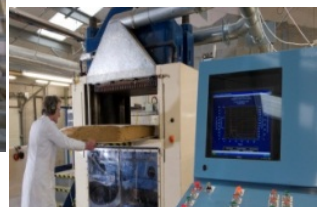
1000 litre drum blender

Pressurised refiner

Tech Transfer Centre
Total floor space: 615m²



Pre press



Hot press for bio composites production

Fibre collection and mattress forming station

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Biomass Conversion

Bio Composites Production: Construction

Wet Fractionation Line: Functional foods

Extrusion: Wood Plastic Composites

Pulp moulding/ thermoforming: Packaging

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Bio Composites Centre, Mona

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Swansea University

Areas of Research Expertise and Capabilities

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Swansea University

- Institute of Life Science.
- Over 30 years of experience in industrial biotechnology.
- Leading international pharmaceutical companies as well as SME.
- Agrochemical, chemical and food industries.
- Generating a new cluster of life science and healthcare companies.

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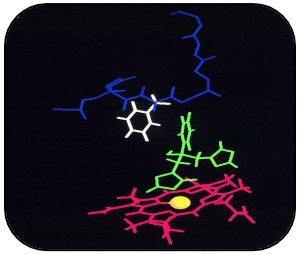
Institute of Life Sciences

Protein Biochemistry & Enzymology

Biofuels / Fermentation

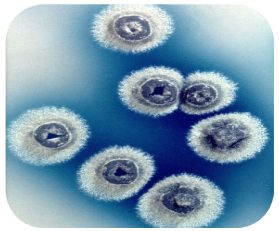
Microbial Genomes and Bioinformatics



Synthetic Biology & Metabolic Engineering

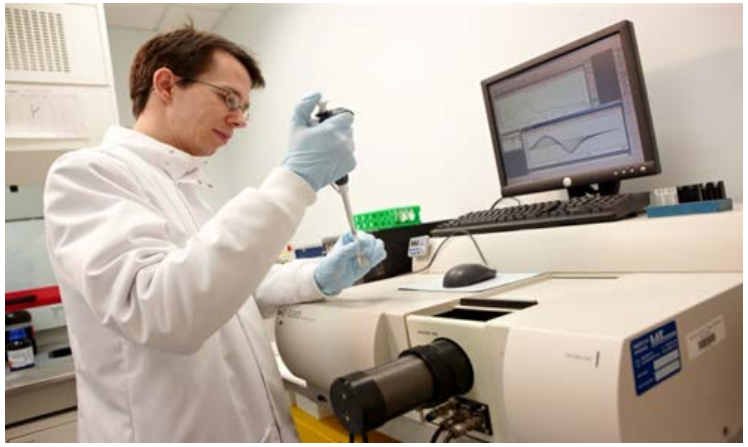
ILS Swansea

Microbial Natural Products



Bio transformations

Expertise



- Filamentous fungi and bacteria
- Enzymology and protein studies, including modelling & crystallography
- Analytical chemistry
- Mass spectrometry

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BEACON LCA Capability

- A method to calculate the environmental footprint of a product
- Identifies hotspots within the material composition / production chain
- Local energy monitoring of equipment (at >30 individual machine points)
- Market-leading LCA analysis software

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Part 2

Collaborative Research

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PRIFYSGOL BANGOR UNIVERSITY

Swansea University
Prifysgol Abertawe

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Collaborative Research

- What is Collaborative Research?
- Who are the Collaborators?
- Key Barriers
- What makes a successful collaboration?
- How do Universities and Business differ?
- How do we measure collaborative success? (academic/business perspective)
- How does BEACON Collaborate?
- Key Points

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What is Collaborative Research?

Working together in a joint intellectual effort in the production of “knowledge” and “innovation” for a common purpose or benefit.

The aim of collaborative research is to understand the complex problems facing our global communities and how to design and implement research-based responses and solutions to those problems - such as climate change or health challenges.

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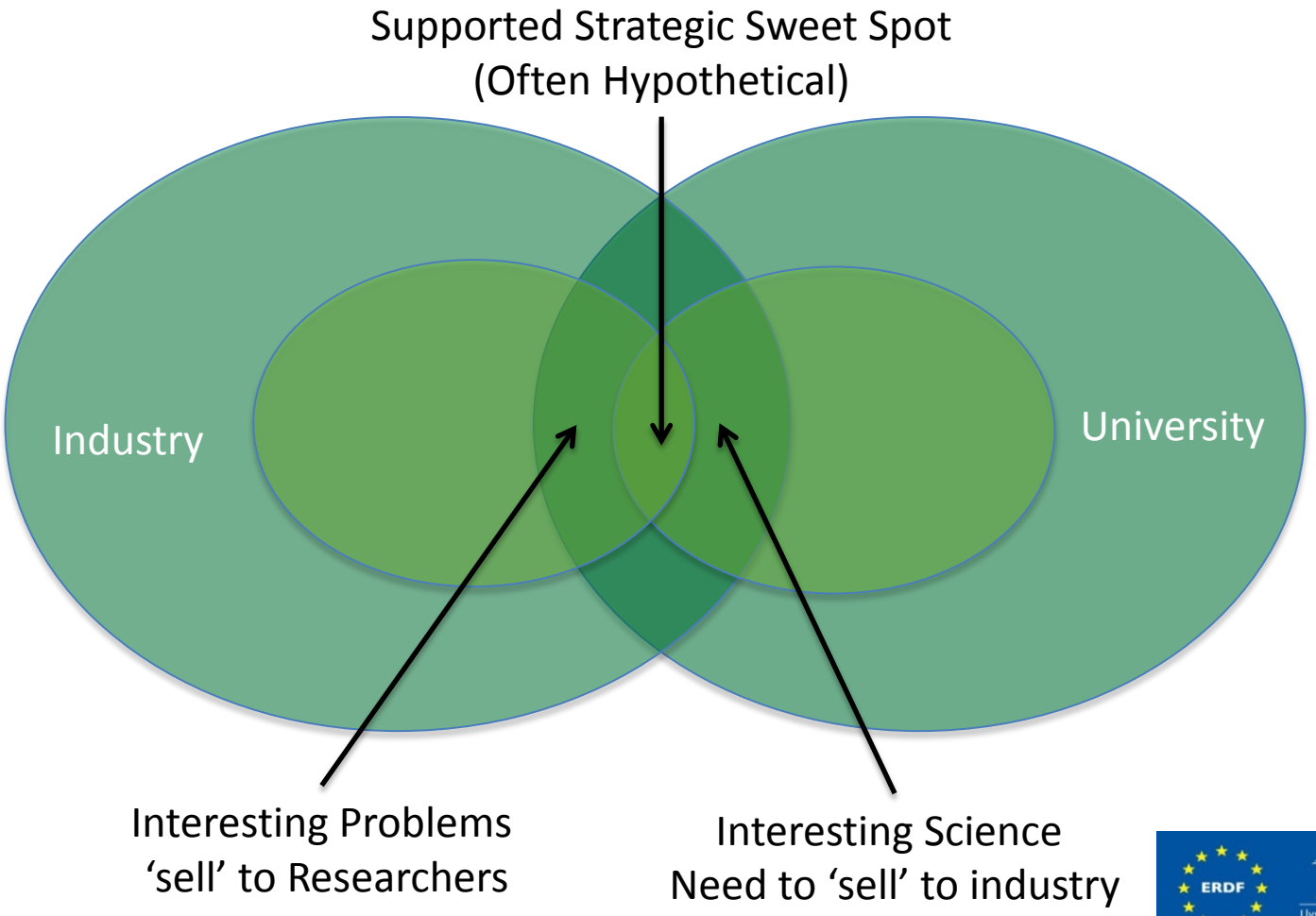
Who are the Research Collaborators?

	Intra	*Inter*
Individual	-	*Between individuals*
Group	*Individuals in the same research group*	*Between groups (e.g. in the same department)*
Department	*Individuals or groups in the same department*	*Between departments (in the same institution)*
Institution	*Individual or departments in the same institution*	*Between institutions*
Sector	*Institutions within the same sector*	*Between institutions in different sectors*
Nation	*Institutions in the same country*	*Between institutions in different countries*

Industry and University in Collaboration



Universities and Business

Universities are essentially “ideas factories” that can create innovation and value; however…..

- Complex and large organisations, risk averse
- Slow, bureaucratic process with many rules to follow…
- Limited resources
- Encourage innovation and help business to identify appropriate funding; help with grant applications/programme administration and project delivery

Businesses take on more risk, require quicker results, flexible to adapt to the changing economic landscape. Culture and organisational structure is different.

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What are the the Key Barriers?

Intellectual Property (IP)

- Protecting and Licensing IP can be challenging and costly
- How is the background and foreground IP delineated?
- Who are the inventors – staff, students, third party?
- Is there freedom to use results for academic research?
- When can academics publish?
- Setting up a spin-out company (ownership - who's involved? vast documentation, timeline etc)

Contractual Issues

- Are the aims of the contract clearly defined? i.e. terms and project duration
- Are the obligations in the contract reasonable – can they be delivered on time?
- Several forms to complete and sign

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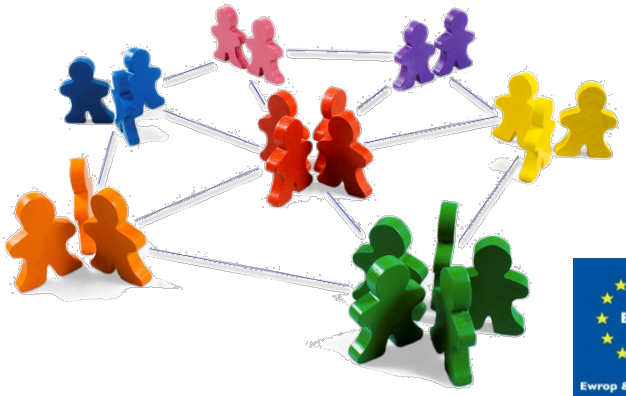
What are the Key Barriers?

Confidentiality Issues

- Academics want to publish… a commercial partner may not if a patent application is to be filed
- Are research groups working for competing industrial partners – how are conflicts handled? What if research staff move institutions?

Managing the Relationship

- Managing the imbalances of various interest/players
- Complexities that can emerge once in the relationship
- Cross-border contracts… jurisdiction? County law, language etc?



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Key Points

- Determine project ownership – business, academia, variety of funders (state, industry etc.)
- Agree the aims of the collaboration , i.e. milestones, outputs and deliverables are realistic
- Keep business informed and engaged throughout the process: (regular communication between PI, academics, company and other partners involved in the project)
- Collaborations are essential to help deliver “impact” from investment in the research base through to commercial deployment.
- “Fast-track collaboration agreement” for business engagement

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Key Points

- Dealing with Universities is more complex and time consuming than dealing with business.
- Understand the political and cultural differences between the academic and the private sector
- Understand the strategic role that business-university relationships have in an increasingly competitive global economy.
- Capture and manage IP fairly; “Fair” builds up trust!
- Collaboration research requires input and dialogue between both sides to have a successful outcome
- People and teamwork are key to making it happen – focus on building and maintaining relationships towards a common goal; aim for “**win-win**” outcomes in all stakeholder engagement

Note: project delivery is crucial to maintaining expectations and relationship ; no empty promises

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How can we Measure Collaborative Success?

Business Perspective

- Access to university graduates from various disciplines to support research, development, and commercialisation of new or improved products, process and services.
- Access to funding to scale-up of new concept
- Development of know-how and/or novel IP
- Creation of jobs
- Attract investment

Academic Perspective

- Identification of new leading-edge research areas
- Increased publications and citations – opportunity
- Ability to evidence translation of academic research into enterprise, innovation and commercialisation i.e. know-how, patents, and license agreements
- Increased capture of research funding e.g. TSB, EPSRC, NERC, BBSRC and FP7, Horizon 2020

How does BEACON Collaborate?

- Assistance companies on a no charge basis under de-minimise European rules
- Work is undertaken on to resolve scientific or technological challenge aimed at achieving an advance in science or technology.
- Evidence requirement - letter of agreement of collaboration/ memorandum of understanding, which states what each partner is going to put in/receive from the collaboration

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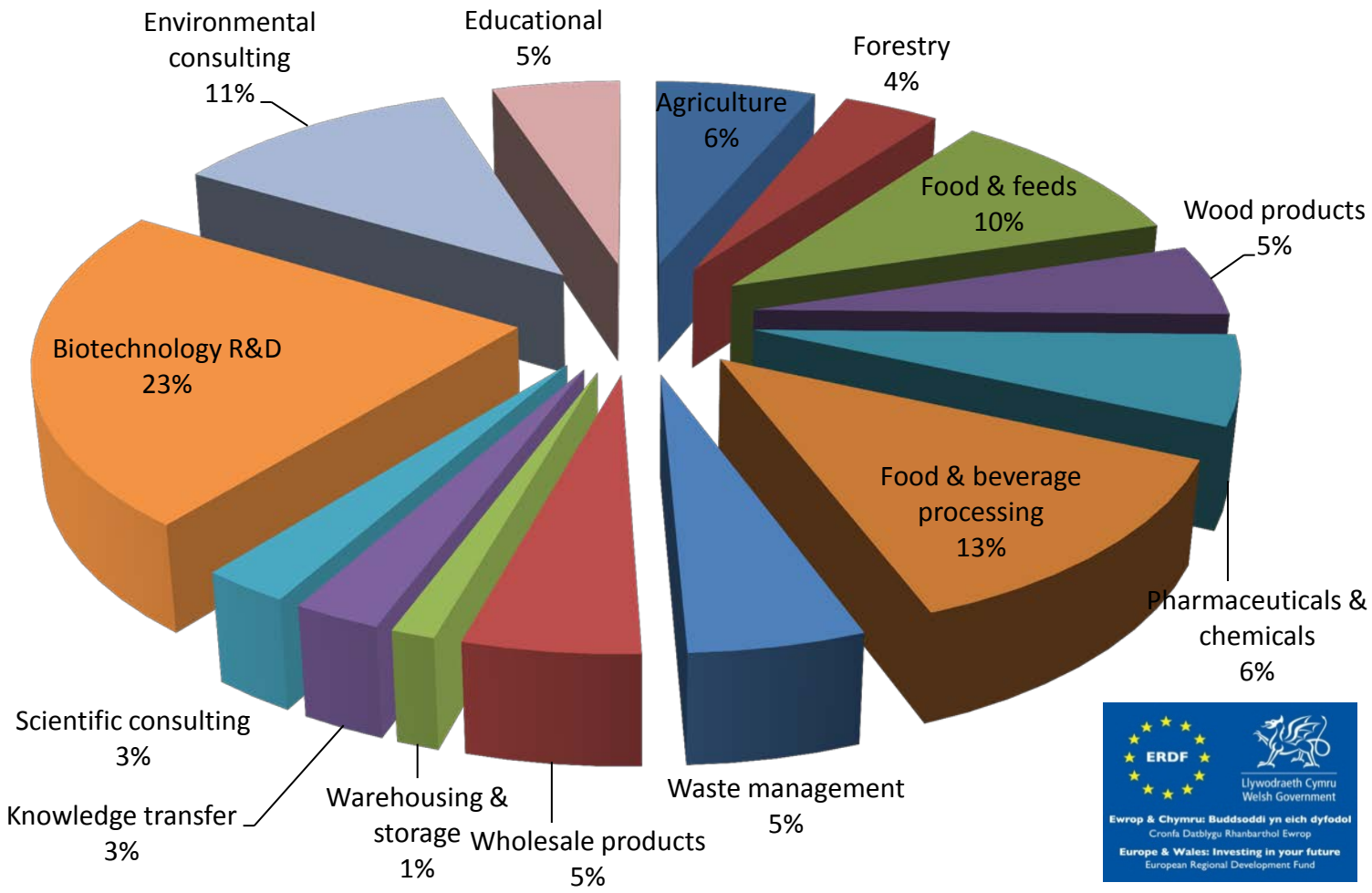
BEACON Collaborations

Distribution of companies interacting with BEACON based on their SIC codes



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BEACON R&D Collaborations

- Characterisation of apple/pear pomace (waste residue from the pips/pulp/skin from the cider making process)
- Plant fibre products and packaging
- Pelletisation of recovered MDF fibre for incorporation into wood plastic composites
- Use of Steam explosion/pressurised refining for the pre-treatment of agricultural residues
- Medical devices from bio-plastics

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Part 3

Innovation

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Innovation

- What is Innovation?
- How does collaboration impact innovation?
- Why is innovation important?
- Innovation Drivers
- The right ingredients for innovation
- Brazil – UK perspective
- BEACON and innovation?

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What is Innovation?

- Innovation is the successful exploitation of new ideas
- It can happen in many ways and in any sector
- Sometimes it is the result of the application of brand new knowledge, but more often it is the result of incremental changes, or new combinations of existing ideas and experience

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How does Collaboration impact Innovation?

- Increased sharing of knowledge
- Transfer of knowledge skills and know how
- Source of stimulation or creativity
- Can lead to wider network of contacts
- Increased efficiency in undertaking research

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Why is Innovation Important?

- Reduces waste and environmental damage
- Creates growth, increases productivity, and economic wealth (avoids stagnation)
- Provides better goods and services at a cheaper price – higher standard of living

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Innovation Drivers

- Excellent education and research system
- Skills Mix – engineers, scientists & entrepreneurs
- Multi stakeholder approach – dynamic relationship between government, industry and universities
- Political commitment to innovation, sustainability and resource efficiency
- Supportive government policy, i.e. R&D tax credits for companies & favorable regulations
- University and industry collaboration, i.e. Public / Private partnerships

Innovation Drivers

- Leading edge technology innovation, technical know-how
- Culture of innovation in the private and public sector,
- Cluster development, incubators and science parks Cluster programs & initiatives
- Entrepreneurship Culture
- Modern national infrastructure – transport and ICT communication networks
- Funding and Investment Opportunities, i.e. Grants from early stage start-ups

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The right Ingredients for Innovation?

Much of what fosters innovation involves processes and organization-wide support.

61% *…of CEO's say that innovation is a priority or a primary focus within their business*

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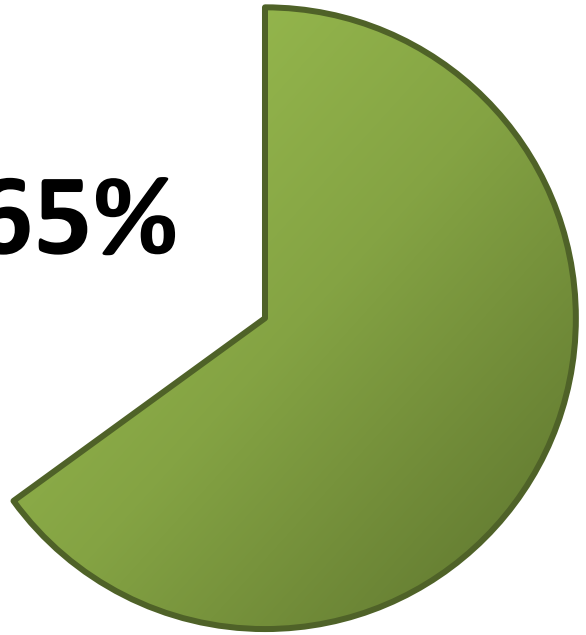
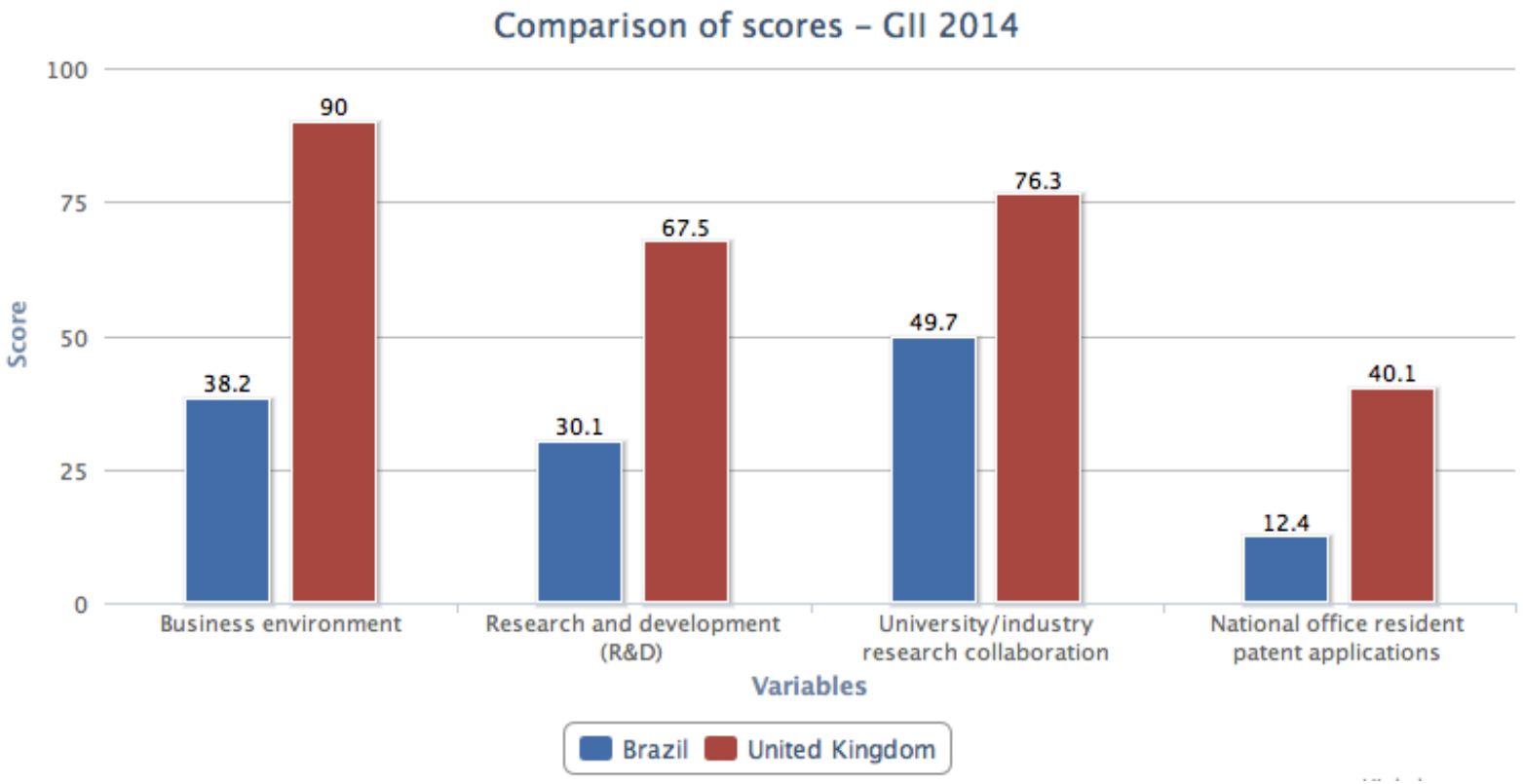
Brazil Innovation

- Brazil is a world science power house
- **$31 billion** (USD) spend on Science, Technology & Innovation (2013)
- 33,989 patents applied, 3326 successful
- Newton Fund = £375 million
- Institutional Partnership



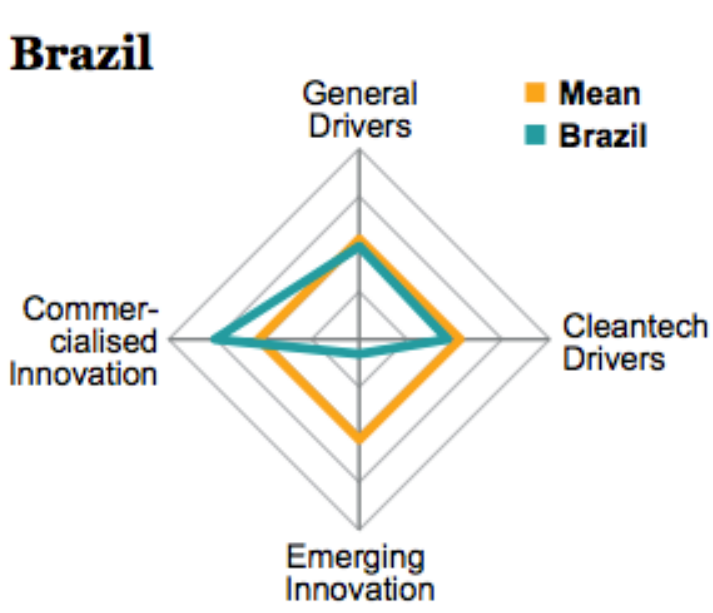
of Brazilian companies report a shortage on technical expertise

Brazil vs. UK Innovation Output

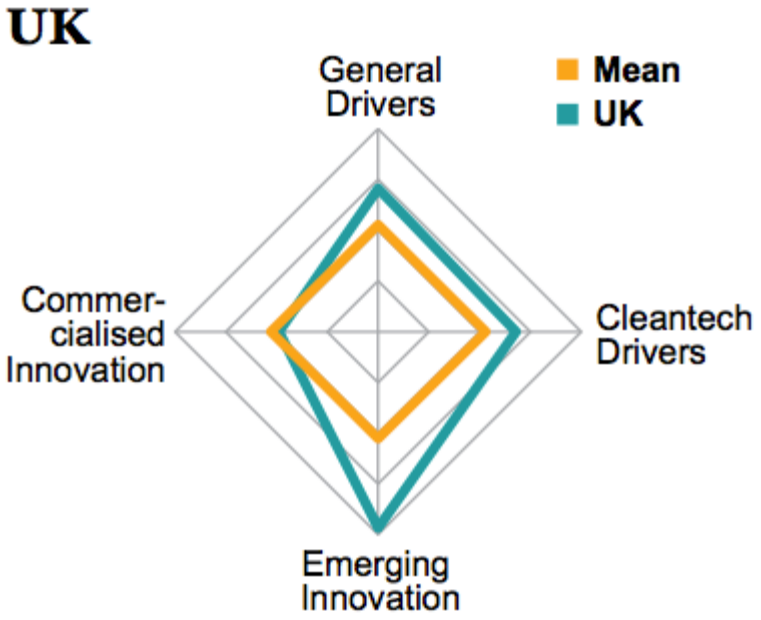


Country Innovation Profile

Brazil



United Kingdom



BEACON and Innovation

- 135 Enterprises Assisted
- 35 Collaborative R&D Projects
- 7 Products, process or services registered
- 10 New or improved products, processes or services launched
- £6.5 million funding induced

*** Figures correct as of October 2014**

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BEACON Funding Induced

Project	Value (£ 000's)
'STARS' project (A4B)	550
International Relations Programme	60
UK-US Bio-refining collaboration	30
Optimising energy output and bio-refining	1,900
Matching cell-wall composition with conversion processes	620
LICENSE (A4B)	225
iCRAB (TSB) Chitin production from shell waste	125
Biogas2Market (Climate KIC)	45
ADMIT Bio-Succinovate (Climate KIC)	1,600
Supercritical CO2 extraction	320
Isolation & modification of fructans (rye-grass biorefinery)	110
DeepDock - 'Novel Functional Ingredients from Seaweed'	280
Ivy for Ruminants (TSB)	340
HiPLExSON (A4B)	255
Additional "STARS" funding	30
QWV-waste stream valorisation (Quorn) PoC with P2P NIBB	50

Part 4

Benefits to Society

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How does Innovation benefit Society?

- Creation of new and viable organizations
- Jobs, economic prosperity & growth
- New collaborative networks
- Promotes healthy competition
- Improved supply chains
- Creates multi-skilled, flexible workforces
- Leads to patents & publications
- Creates novel products and processes

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How does BEACON Benefit Society?

- 45 Gross Jobs Created
- £6.5 Millions Funding Induced
- Creation of new organizations i.e. Pennotec
- 100+ New Research papers
- Dissemination
- Moving away from oil based materials and fossil fuels to a low carbon and sustainable society

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BEACON Dissemination

Past Events

- Lifecycle Analysis & Process Optimisation Seminar
- Intellectual Property Seminar
- Bio-based Materials and Construction Seminar
- BioComposites 25th Anniversary Lectures

Upcoming Events

- Enhanced Utilisation of Alcoholic Beverage By-products Seminar
- Natural Cosmetics Seminar
- BEACON 3rd Annual Conference

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Regio Stars Awards

- Held as part of the EC's "Regions for Economic Change" initiative, which aims to highlight good practice in urban and regional development
- Over 80 nominations in four categories were received for the 2013/14 session from funding regions throughout the EU member states
- BEACON won the 'Sustainable growth- Green growth and jobs through Bio-economy' category

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Regio Stars Winners 2014

RegioStars 2014 Winners

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Case Studies

- Agroceutical Products
- Compton Group
- DTR Medical
- MDF Recovery
- Pennotec (iCRAB)
- Phytoquest
- Plant Fibre Technology

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Agroceutical Products

- Developers of cost-effective Galanthamine
- Galanthamine naturally found in daffodils
- Aim of collaboration to increase quality and quantity of Galanthamine extracted
- Collaboration has led to consortium membership of HiPLExSon project

Galanthamine has been found to be effective in the treatment of Alzheimer's disease

Agroceutical Products

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Agroceutical Products

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Compton Group

- Compton group aims to commercialise the output of successful research in the commercial exploitation of IP around biotech
- Looking for an improved means of separating the individual components in frankincense
- Achieved a 99.9% purity through the use of automated chromatography

compton group

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DTR Medical

- Medical device manufacturer, specialising in single-use sterile surgical instruments
- Committed to providing sustainable products
- R&D to compare the sustainable PLA material to ABS using tga (thermogravimetric analysis)

DTR Medical

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MDF Recovery

- Technology developer focussed on developing novel and proprietary processes to recover fibre from waste MDF

Projects Include:

- Up-scale equipment used at Mona facilities to characterise and process recovered fibres
- Investigate the use of screw press technology at Aberystwyth to regulate moisture content

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Pennotec

Cynhyrchion a phrosesau cynaliadwy
Pennotec
Sustainable products & processes

- Industrial bio-technologists who aim to advise and provide technology to assist businesses and operators in the conversion of manufacturing waste into marketable resources.
- Collaboration to investigate alternative techniques for the fermentation of crab waste
- BEACON has demonstrated the capability to incorporate waste crab shell material into grass sugar biorefining.
- Collaboration has led to a successful TSB (Technology Strategy Board) grant for a feasibility study – iCRAB.

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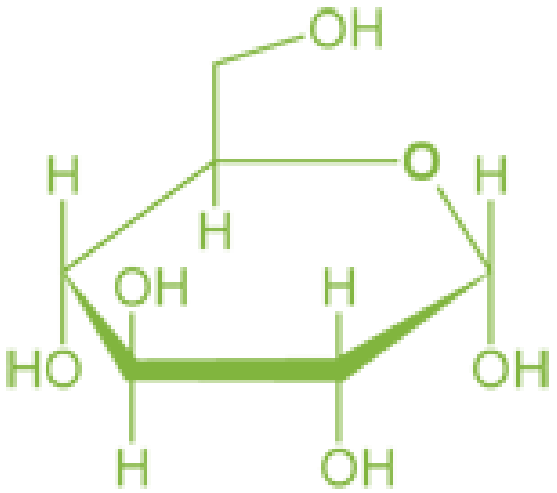
Phyto Quest

- Scientific research to identify natural ingredients and compounds targeting high margin healthy living products emerging from food, pharma & cosmetics sectors.
- R&D with BEACON to investigate compounds in a clients waste stream using centrifugation and cross-flow filtration.



PhytoQuest
unlocking iminosugars

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Plant Fibre Technology

Plant Fibre
Technology Ltd.

- Developers of new commercial opportunities and products made from plant fibres
- R&D to investigate the insulation potential of straw & grass materials
- Collaboration has led to the production of raw fibre materials for the development of natural sustainable insulation.

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Part 5

Going Forward…

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Keys to the Future

- Demographic shifts
- Technology evolution
- Urbanization
- Shifts in global economic power
- Resource scarcity and climate change

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AEIC Innovation Campus

IBERS research is evolving from a major focus on agricultural primary production to drive innovation in ‘downstream’ sectors that have more direct impact on the UK population:

- Functional Foods
- Personalised Nutrition
- Human Health

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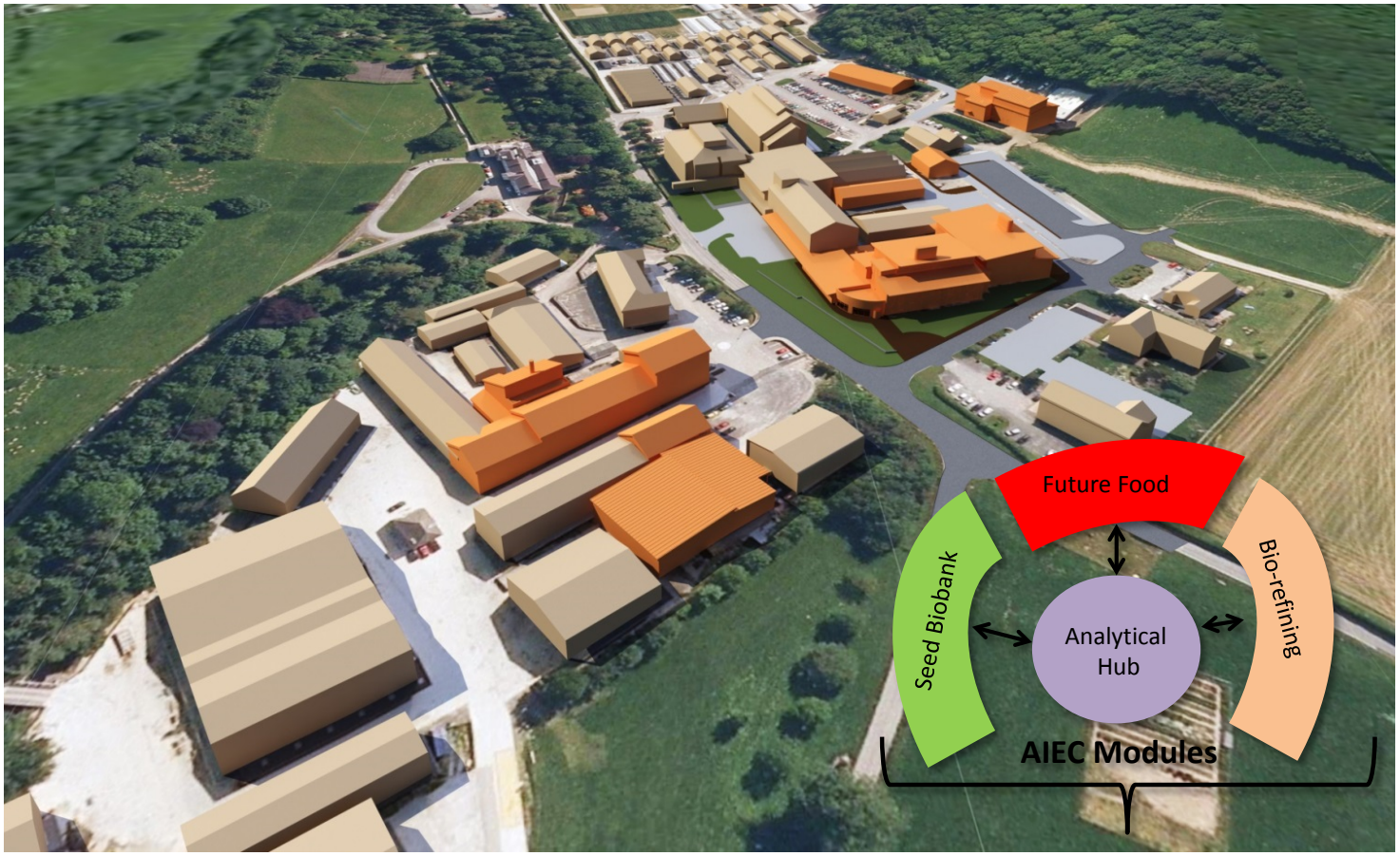
Aberystwyth Innovation & Enterprise Campus (AIEC)



Collaboration between 3 funding partners: AU, BBSRC, WEFO following successful BBSRC Innovation Campus bid in mid-2013

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Impact of AIEC

DISCOVERY FACILITIES

Genomics
Metabolomics
Phenotyping
Informatics

TRANSLATION

Pastoral Agriculture

Biofuels

Enter New Research Sectors

Breeding new crop species

Food Product Development

Bioactives Discovery & Personalised Nutrition

Bio-refining

Enhance Capability & Capacity

- Expand specialised equipment base
- Recruit & train further specialised support staff
- Provide flexible access to industry

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Aligning AIEC to impact on government policy?

- New facilities will allow UK commercial sector to understand food composition and add value to existing and develop both new varieties/breeds and food products

- By engaging with breeders, farmers, food processers, retailers, health boards and government agencies AIEC will have scope for tremendous ‘reach’ in sectors of immediate relevance to the general public – improve visibility and boost funding streams

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Funding Opportunities

- BBSRC-Brazil (FAPESP) joint funding of research
- RCUK-CONFAP Research Partnerships
- Newton Fund
- FAPERJ
- Horizon 2020

FAPESP

FAPERJ
Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro

European Commission

BBSRC
bioscience for the future

RESEARCH COUNCILS UK

Newton Fund

CONFAP
CONSELHO NACIONAL DAS FUNDAÇÕES ESTADUAIS DE AMPARO À PESQUISA

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Collaborative Opportunities

Nós gostaríamos de conversar sobre oportunidades de colaboração nas seguintes áreas:

- Ciências agrícolas e tecnologia aplicada à agricultura;
- Ciência das plantas;
- Biologia e bioquímica
- Biotecnologia
- Meio ambiente e ecologia
- Silvicultura
- Alimentação e saúde

BEACON
From plants to products
O blanhigion i gynhyrchion

Prifysgol Aberystwyth University

Swansea University
Prifysgol Abertawe

BioComposites Centre
Innovation in biomaterials for industry

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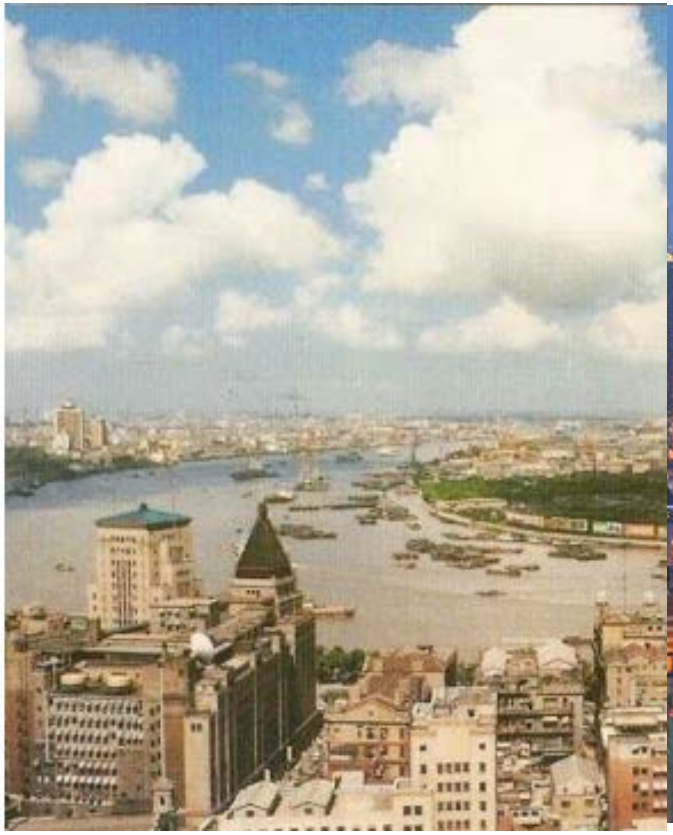
Shanghai 1980 vs. 2008



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Obrigado pela presença!

"In the future we will not be able to compete on the world stage with low labour costs or by exploiting vast reserves of mineral resources. We will have to compete with our brains and with our science."

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