Sustainable Development through Innovation & Investment

RegioStars 2014 Winners

BEACON
From plants to products
O blanhigion i gynhyrchion

PRIFYSGOL
ABERYSTWYTH UNIVERSITY
PRIFYSGOL
BANGOR UNIVERSITY
Swansea University
Prifysgol Abertawe

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BEACON Primary Processing Facilities, IBERS, Gogerddan, Aberystwyth
Introduction

What is BEACON?

BEACON is a biorefining initiative led by Aberystwyth University’s Institute of Biological Environmental and Rural Sciences (IBERS), in collaboration with partners at Bangor and Swansea Universities.

Backed with £10.6 million from the European Regional Development Fund (ERDF) through the Welsh Government, BEACON aims to establish Wales as a biorefining centre of excellence and make vital contributions to tackling climate change.

The BEACON initiative uses pioneering techniques, known as biorefining to assist companies in developing new low carbon technologies and innovative ways to enhance the utilisation of current by-products and waste streams through the extraction and commercialisation of high value chemicals.

BEACON assists Welsh SME’s through...

- Technology transfer between academia and business through collaborative projects for the benefit of Welsh SME’s
- Promoting inward investment opportunities for companies wanting to relocate into Wales and access its scientific expertise.
- Promoting Welsh scientific expertise within Europe.
- Commercialisation of intellectual property (IP) from scientific advances in Wales.

Sustainable Development through Innovation and Investment

Throughout the duration of the BEACON project, we have built and developed a network of contacts from business and academia, which have created a number of networking opportunities for Welsh SME’s. Many of these opportunities have led to collaborations and successful applications for further funding. This booklet presents a small selection of the funding opportunities that have been assisted through the BEACON project to date.

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The Sustainable Ryegrass Products (STARS) project, led by the BioComposites Centre at Bangor University and the Institute of Biological Environmental and Rural Sciences (IBERS) at Aberystwyth University, and informed by industry partners including Waitrose, has been researching the use of Welsh grass for food packaging.

Funding from the Welsh Government’s Academic Expertise for Business (A4B) programme is supporting the project, which is utilising the biorefining process used to isolate and extract sugars and other components from ryegrass and convert them into low carbon products.

Some of these products include biofuels, platform chemicals and pulp-moulded packaging for retail applications such as food packaging. The project is currently collaborating with six industrial partners, representing all links in the SME supply chain – from biomass cultivation and harvesting to processing and commercial end use – and will demonstrate the production of these materials at pilot scale.

To inform the process, Waitrose is researching public engagement in the bio-economy and the adoption of
The idea behind the grass packaging is that the material fibre can go into the same compost bin as the food it was used to display, giving an environmental alternative to the tons of plastics being used today, reducing landfill and in turn the environmental impact on our planet. The Waitrose store hosted a display of the range of products that have been produced as a result of this collaboration, and the group were canvassing the opinions of the general public during the day in order to feed back into their research and development.

In November 2014 the project showcased some of its prototypes to the public for the first time at Waitrose, Menai Bridge store on Anglesey.
Innoture Ltd

Knowledge Transfer Partnership

Biopolymers are polymers that occur in nature; they are large molecules that have many uses as materials in plastic packaging and adhesive applications.

In a Welsh Government Knowledge Transfer Partnership (sKTP) with Innoture Ltd research is seeking to develop these biopolymers for medical products such as micro-needles.

Innoture has assembled a team of commercial and academic expertise to deliver next generation transdermal devices for use in multiple applications within drug delivery and diagnostics. It holds worldwide patents enabling the company to adopt a unique position in the manufacture, development and commercialisation of microneedle technologies.

Research and Development is based at the Institute of Life Sciences at Swansea University, bringing together the multidisciplinary expertise to create and analyse microneedle enhanced devices based on Innoture’s patents.

Microneedles have been clinically proven to effectively transport large molecule drugs or active pharmaceutical ingredients (APIs) and vaccines via, but not restricted to, transdermal delivery.

Chris Williams, Director presenting at BEACON Climate Change Breakfast 2015
Innoture’s patented microneedles offer extreme flexibility compared with standard and traditional microneedle technologies and processes, allowing layering of compounds, flexibility of substrates and dynamic mass manufacture that is cost effective.

Microneedles are patches of tiny pillars, which deliver therapies via the dermis of the skin. They are very effective and can speed up the delivery of drugs, and often are able to avoid many of the side effects of intravenous injections.

The 12 month sKTP project has enabled the BioComposites Centre at Bangor University to collaborate with Innoture and continue their research in the application of biopolymers in medical products.

To help with the research, mature graduate Alan Hughes has been employed on the project based at the BioComposites Centre. The sKTP funding has given Alan his first real science position following his graduation in 2014 with a PhD in Chemistry at Bangor University.
Pennotec, a new venture established under Pennog Ltd, are industrial biotechnologists who aim to advise and provide technology to assist businesses and operators in the conversion of manufacturing waste into a marketable resource.

Initially learning of the BEACON project via the BioComposites Centre at Bangor, Director Jonathan Hughes met with Business Development Manager (BDM), Selwyn Owen and Senior Scientist Joe Gallagher at the BEACON 2013 Annual Conference held in Llandudno in June, and later set up a formal meeting to discuss alternative techniques for the fermentation of crab waste. Discussions with the BEACON team during the Summer of 2013, resulted in the formation of a one month collaborative research and development project to identify innovative processing solutions. Pennotec approached BEACON with the initial idea of utilizing the products of grass sugar biorefining as a means of removing specific compounds from waste crab shell material.

Through the collaboration, BEACON positively demonstrated the capability to incorporate waste crab shell material into grass sugar biorefining. The results of the collaboration led to the successful application for a nine month feasibility study funded by the technology strategy board worth £126,003.

The feasibility study named iCRAB (integrated Crab Rye grass Acid Biorefinery), investigates a biorefinery process which involves co-fermenting a readily available, agricultural biomass (high sugar forage grass), with food processing by-products to manufacture a combination of platform chemicals, such as those used in the production of bioplastics, and high value biological actives.

The innovative iCRAB project is looking to improve the economics of
both chitin extraction and lactic acid production by combining the two in a single biorefinery process. In the future, Pennotec hopes to market the waste valorisation expertise to other bio-waste producers through an expansion of the biorefinery technology developed during the iCRAB project to include the production of produce of other organic solvents. The iCRAB process could potentially act as a pre-digestion and extraction step for the recovery of high value actives prior to conventional biogas production.

Summary

Project Lead:
Dr Joe Gallagher
jbg@aber.ac.uk

Lead Institution:
Aberystwyth University

Company:
Pennotec

Sponsors:
Technology Strategy Board

Project Value:
Grant £126,003
Company Contribution £22,158

Total Project Value:
£148,161
+2 Employed

Project Duration:
9 months
ADMIT Bio-SuccInnovate is a Climate KIC funded project which aims to develop a range of technologies and processes that will contribute to bringing advanced biorefining to the market, most notably focusing on the production of fermentable sugars from non-food lignocellulosic resources and processes that can be used to make valuable chemicals and polymer building blocks.

The project encompasses a holistic, integrative approach to drive innovations that enable dedicated nonfood crops and agricultural residues to be refined into a range of sustainable added-value products and markets. In order to maximise the economic and environmental sustainability of the lignocellulosic sugar platform, the majority of the biomass components need to be utilised and commercially exploited. A key project objective is to demonstrate the production of bio-succinic acid from the C6 sugar fraction and assess the impact on GHG emissions against current processes using techno-economic analysis and life cycle assessments. Furthermore, development of novel, multifunctional enzymes will be conducted to simplify the biorefining of complex (toxic) C5 streams derived from hemicellulose processing, thus provide commercial uplift for SME’s and a lignocellulose driven supply chain.

For the valorisation of the C5 stream, biotechnological tools will be developed to produce natural sweeteners e.g. xylitol at a commercially relevant scale.
The lignin stream will be purified to enhance its value added application (e.g. polymer building blocks, green chemicals, fibre) thus ensuring the complete utilisation of biomass.

In addition to the technical and commercial outputs, the project findings will be of strategic importance to the bio-economy platform, industrial biorefineries and policy makers.
BioGas2Market was a 12 month pathfinder project funded through the Climate KIC initiative with the aim to explore relevant climate arenas to identify and prioritise innovation opportunities for sustainable production.

Currently the biogas production chain leads to the emission of both strong greenhouse gases (N₂O, CH₄) and related-CO₂ from energy-use biogas upgrading/conditioning.

The climate relevance of biogas production was assessed through Life-Cycle-Analysis; and other sustainability issues through a critical Sustainability Analysis. Currently running digester facilities both at small, medium and industrial scale were used as reference-cases. From new innovative processes designed, expected GHG emissions and other sustainability issues were calculated and compared to the reference cases.

The results of the project were used to upgrade existing facilities to improve their overall sustainability (economy and ecology), and to develop sustainable biogas-driven biorefinery platforms for new conversion capacity to be built.

The BioGas2Market approach is innovative and adds to sustainable development whilst offering great business opportunities at the same time. The project collaborated with eight partners from academia and business with Dr Sreenivas Ravella, BEACON fermentation scientist co-leading from Aberystwyth University.

Summary

Project Lead: René van Ree, Wageningen University and Research Centre (DLO)

Lead Institute: Wageningen University

Project Partners:
- Utrecht University
- Province of Utrecht
- Imperial College London
- Aberystwyth University
- Ceredigion County Council
- Farm Renewable Environmental Energy Ltd
- University of Debrecen
- Aachen University of Technology and Economics

Sponsors: Climate KIC

Project Value: £45,383 (GBP) / €56,500 €267,000 (total project value)
Deep Dock

Novel Functional Ingredients from Seaweeds

The Deep Dock project was an 18 month, £279,344 funded project through the Welsh Government’s Academic Expertise for Business (A4B) funding programme. Aimed at creating a sustainable supply chain in Wales to exploit seaweed as a source of high value products for use in the food and cosmetics industries, the project facilitates the use of Welsh native seaweeds, produced using marine-culture, associated with existing mussel production. The project aims to isolate fractionated feedstocks for subsequent downstream conversion into high value products for the food and cosmetics industry. Initial research was undertaken through the utilization of Bangor University’s expertise in marine aquaculture and the BEACON capabilities to extract plant chemicals from biomass.

The expertise and knowledge gained will assist the three Welsh SME’s involved in the production, preprocessing, and use of seaweed based fractions to deliver a range of products as part of an integrated supply chain. Input from several multinational companies has also provided additional market pull for the uptake of seaweed derived functional additives across the food and cosmetics sectors.

Summary

Project Lead:
Dr Rob Elias
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Lead Institution:
Bangor University

Project Partners:
• Unilever
• Deep Dock Ltd
• Beaumaris Technologies Ltd
• Biocatalysts Ltd
• Novel Food Ingredients Ltd
• Lisk Associates
• Chrysalis Ltd
• Leslie Parsons and Sons Ltd
• Marlow Foods (Quorn)
• Nandi Protein

Sponsors:
Academic Expertise for Business (Welsh Government)

Total Project Value:
£279,344 + partner contributions = £569,344
During 2010, the BEACON project was awarded funding for travel from the international Funding Relations program (for Wales), with the assistance of the British Consulate in Houston and San Francisco. As a result members of the BEACON team attended a two-week trade mission to the US, visiting:

- The University of Georgia, Athens
- Natureworks LLC
- Idaho National Laboratory (INL)
- National Renewable Energy Laboratories, Golden Colorado

As a result of the trade mission, links were made with NREL, which led to the successful application of a BBSRC research grant. BEACON was awarded an international partnering award worth £30,659.04 to enable a US/UK biorefining collaboration between Aberystwyth and Bangor Universities with the National Renewable Energy Laboratories in Golden Colorado.

In July 2013, the award enabled two BEACON scientists specialising in Life Cycle Assessment to visit the NREL laboratories in Colorado. The two week placement gave the BEACON visitors an opportunity to work alongside NREL’s Strategic Energy and Analysis Centre as they developed a key new global land use change model, BioLUC.

The model, which is just one of those developed by the NREL team, uses a systems dynamics approach to model land use change associated with different global biofuel production scenarios. The placement allowed the visitors to meet and exchange ideas with modellers working in different areas of NREL’s sustainability analysis group and to explore opportunities for future collaborations.

In September 2014, Daniel Inman and Ethan Warner from NREL visited Aberystwyth and Bangor Universities as part of the partnering award. During their 10-day visit to Wales, the NREL visitors spent three days at Bangor University where they visited some of the high tech equipment, including the CO2 laboratory and the BioComposites centre. After spending three days at Bangor University, our
visitors travelled to Aberystwyth, where they delivered the first UK seminar on their newly developed BioLUC (Bio Land Use Change) and BSM (Biomass Scenario Model) system dynamics models, to a group of specialists in economic and environmental modelling from around the UK. Whilst at Aberystwyth Daniel and Ethan also had the opportunity to tour the internationally recognised facilities at IBERS, including the Phenomic’s Lab and the BEACON upscale facilities.

During their visit, they met with a range of staff from IBERS and the School of Management and Business (SMB) to hear about the range of projects and research currently being undertaken at Aberystwyth.
HiPLeXSon

High Performance Liquid Extraction and Sonobioprocessing

HiPLeXSon is a research project funded by the European Regional Development Fund (ERDF) through the Welsh Government Academic Expertise for Business (A4B) funding programme.

Based at the Institute of Biological Environmental and Rural Sciences (IBERS) at Aberystwyth University, the project aims to twin the processing and separation technologies of sonobioprocessing and High Performance Counter Current Chromatography (HPCCC).

Counter Current Chromatography (CCC) is a liquid chromatography technique that uses two immiscible liquid phases (rather than a liquid/solid system as in conventional liquid chromatography). One liquid acts as the stationary phase and the other as the mobile phase with the liquid stationary phase held in place either by gravity or by centrifugal force.

While the technology is complementary to liquid chromatography, it can have significant advantages for preparative separations.
through higher throughput and process efficiencies provided by the lack of a solid matrix. Compounds separate according to differences in their partition coefficients between the two liquids.

High Performance Counter Current Chromatography (HPCCC) uses high centrifugal forces together with a planetary rotation of an open coiled tubular column to achieve rapid separations.

The technology allowing for much higher centrifugal forces to be used was developed by Brunel University, a partner on this project. The project led by Aberystwyth University is a diverse consortium including two other academic institutions and six industrial partners.
**LCEE-Innovation**

**Low Carbon Energy and Environment**

LCEE-Innovation is the Low Carbon Energy and Environment Network for Wales. It is a Welsh Government A4B (Academic Expertise for Business) funded knowledge exchange project, aimed at meeting one of the Welsh Government’s Grand Challenges (the others being Life Sciences and Advanced Engineering & Materials).

LCEE-Innovation is aligned with NRN-LCEE (National Research Network-LCEE) which is a major new initiative for research into the interactions between land, water, the provision of food and energy production. Because of the interdisciplinary and boundary-crossing structure of the Network, it will directly feed policy development and implementation and will increase commercial opportunities for businesses in Wales. The aim is to identify gaps, barriers and opportunities associated with developing a low carbon economy in Wales and to bring people together to carry out necessary applied research in order to achieve this.

Through the work at LCEE-Innovation, we have been collecting information and opinion as to what are the major barriers and opportunities for the low carbon energy and environment sector in Wales. This has been carried out through workshops, surveys and research of the many initiatives that are already in place.

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**Summary**

**Project Lead:**
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**Lead Institution:**
Aberystwyth University

**Sponsors:**
Academic Expertise for Business (A4B), Welsh Government

**Project Value:**
£225,616  
2 x jobs created

**Project Duration:**
24 months  
October 2012 - November 2014
Funding Programmes

**Academic Expertise for Business (A4B)**

A4B was a 6 year programme (2008 - 2014) of supported funding by the Welsh Government and European Structural Funds aimed at providing a simplified, integrated package of support for knowledge transfer from academic and business.

The aim of the overall programme was to promote a high value-added economy and to maximise the economic impact of academia and business through knowledge transfer and the creation of a stronger science, engineering and technology base with clear commercial potential. This will be achieved by the adoption of new processes, systems and services, or by improving substantially those already produced or installed. In turn, this will lead to the creation of high value jobs and ultimately, a value-added economy.

**Climate KIC Innovation and Pathfinder Projects**

As the central instrument of Climate-KIC, the Innovation and Pathfinder Projects Programme funds for the initiation of projects and efforts inspired by the goals of Climate-KIC.

**Pathfinder Projects**

Pathfinder Projects are funded research projects by Climate KIC, which address the conditions required for a low-carbon society. The projects use feasibility studies, market analysis, and other scoping studies to tear down obstacles and forge the way for systematic innovation.

Furthermore, Pathfinder Projects show how subsequent projects can support climate change mitigation. In their development, they also estimate the market potential of innovations, leading to subsequent innovation projects.

**Innovation Projects**

Innovation Projects forge new collaborations and lay the ground for new value chains. They are evaluated on:

- Existing strengths of the applicant
- Accordance with the fundamental I&P goals
- Potential for immediate results
- Accordance with the goals of Climate-KIC.
Funding Programmes

Technology Strategy Board
Feasibility Study

Now known as Innovate UK, the Technology Strategy Board supported the development of innovative technologies and products.

In 2013, the Technology Strategy Board invested up to £2.5m into feasibility and collaborative R&D projects to encourage the development and commercialisation of innovative processes that would generate high-value chemical products through industrial biotechnology and bio refining.

BBSRC
International Partering Award

The Biotechnology and Biological Sciences Research Council (BBSRC) is the leading funding agency for academic research and training in the biosciences at universities and institutes throughout the UK. The BBSRC offers grants, studentships, awards, bursaries and funding opportunities.

The BBSRC offers a selection of funding schemes to enable international collaboration; this includes the United States Partnering Awards. The aim of the BBSRC Partnering Awards is to assist in the creating partnership links between the UK and overseas laboratories. The funds can be used for travel, subsistence and other activities such as workshops or exchanges.

Want to know more?
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