

# Progress through Partnerships

A Selection of industrial companies collaborating with BEACON

# BEACON

From plants to products  
O blanhigion i gynhyrchion



**FINALISTS**





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# What is BEACON?

BEACON is led by Aberystwyth University in collaboration with partners at Bangor and Swansea Universities. We are backed with £10.6 million from the European Regional Development Fund through the Welsh Government.

BEACON will build on research already underway at Aberystwyth University's Institute of Biological Environmental and Rural Sciences (IBERS) to produce fuels from energy crops such as high-sugar grasses like rye.

Bangor University will build on work to develop new materials and chemicals from plants which can be used to develop innovative products.

BEACON will also enable Swansea University to focus on developing their expertise in using bacteria and fungi to digest, or ferment, plant matter within the biorefining process.

BEACON aims to contribute to developing renewable energy and assist in the transition to a low carbon economy with an overall objective of mitigating the impact of climate change.

## 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 from Wales.



*BEACON has been part funded by the European Regional Development Fund through the Welsh Government.*

*It focuses on the development of a viable Welsh bio-economy through the expansion of green supply chains.*



# Core Activities

**BEACON has a number of core strategic research activities and these include initiatives focused on:**

- ◆ Understanding how to efficiently process wet biomass using mechanical and physicochemical technologies
- ◆ Conversion of lignocellulose biomass into biofuels
- ◆ Conversion of wet biomass into platform chemicals and fine chemicals
- ◆ Developing and enhancing enzymes and microbial systems for the production of products such as fine chemicals and transport fuels
- ◆ Isolating commercially important molecules using membrane technologies and supercritical fluids
- ◆ Production of bioplastics from biomass
- ◆ Production of biobased packaging from biomass
- ◆ Developing 'End of Life' methodologies associated with pyrolysis and the production of biochar and bio-oil
- ◆ Evaluation of processing routes from biomass to products and developing the associated economic modelling

## Biomass

This is material derived from living organisms. In our case the main sources of biomass are from plants. Examples are perennial rye grass, clover, miscanthus, oats and Jerusalem artichoke. Plants convert sunlight into a variety of molecules such as cellulose, lignin and simple sugars. Our project aims to isolate these molecules and convert them into higher value products.



# Capabilities

## Primary Processing

In many cases we cannot use the plants directly, so to improve our ability to access those key molecules and compounds, a number of processes must be used. The initial phase include mechanical and physicochemical approaches such as: chopping, hammering, pelleting, pyrolysis and steam explosion.

## Secondary Processing

Once the initial processing has taken place we can use biological and chemical methods to convert the raw material into high value end products. In many cases enzymes and microorganisms will be used to help reduce complex molecules from the plants into simple building blocks such as sugars.

These are then converted into chemicals using microorganisms such as bacteria, yeasts and fungi etc. Methods then need to be developed to isolate these molecules. This is where technologies such as super critical fluid extraction, centrifugation and membrane systems are used to help purify the desired products.

## Conversion to:

Bioethanol, biobutanol, plant oils, antioxidants, sorbitol, etc...

## Product Range

Many of the products that we see around us can be made from compounds originating from plants including:

- 💧 Biocomposites
- 💧 Bio-oil
- 💧 Charcoal, activated charcoal
- 💧 Emulsifiers
- 💧 Plastics
- 💧 Proteins
- 💧 Surfactants (detergents)
- 💧 Transport fuels



# Aberystwyth

## Pilot Plant Facilities

The BEACON Biorefining facility built on the Gogerddan campus at Aberystwyth University (AU) features a flexible plug and play, multi-feedstock pilot processing plant. The unit houses a range of key equipment facilities and associated expertise to



enable academic and industrial partners to develop and demonstrate scale-up processes, taking laboratory research to economically viable industrial applications.

The facility includes a primary processing area and a secondary processing pilot laboratory situated within the IBERS AU Gogerddan campus. It is within a short walk of the new IBERS Phenomics centre and main laboratory and breeding research facilities.



## Aberystwyth Capabilities

- ◆ Preparative and analytical capabilities
- ◆ Pre-treatment equipment
- ◆ Secondary separation systems
- ◆ Integrated wet biomass processing line
- ◆ Dual Duty Pasteuriser
- ◆ Biotage Flash 75 Radial Compression
- ◆ Nano Filtration/Reverse Osmosis Pilot Plant
- ◆ Secondary separation systems
- ◆ Sharples P600 Decanter Centrifuge
- ◆ Steam in Place Fermenters
- ◆ Static Forage Chopper
- ◆ Ultra/Micro Filtration Pilot Plant

# Bangor

## Pilot Plant Facilities

The BEACON capability based at Bangor University is separated over two sites: the main university campus and the BioProducts and BioRefining Technology Transfer Centre based at Mona on Anglesey. These facilities house a range of key equipment and associated expertise to enable academic and industrial partners to develop and demonstrate scale-up processes, taking laboratory research to economically viable industrial applications. A variety of technologies are available to develop commercial opportunities.

### Core Capabilities Available at Bangor

- Pressurised refining line for the production of plant fibre based biocomposite materials for the construction industry
- Pilot-scale extrusion/ film forming equipment for evaluating biobased plastics for the packaging sector
- Pilot-scale extraction equipment for isolation of botanical extracts for the cosmetics and healthcare sectors
- Organic synthesis / chemical modification of a range of plant chemicals
- Pulp moulding equipment for the preparation of plant fibre based packaging
- Pilot-scale wet biomass fractionation line for the production of functional food ingredients.



### Analytical Capabilities

The analytical capabilities involve full chemical-physical characterization and biological screening of a wide range of complex matrices. The research activities currently ongoing are focused on the determination of elemental composition and secondary metabolites such as volatiles and phenolics.

- Compound separation and identification via a wide range of chromatographic techniques such as HPLC, LC-SPE, GC-MS, LC-MS and Flash Chromatography
- Anion and cation composition using Ion Exchange Chromatography.
- Biological screening (large molecular weight and proteins) using MALDI-TOF
- Chemical structure elucidation by using  $^1\text{H-NMR}$ ,  $^{13}\text{C-NMR}$  and  $^{31}\text{P-NMR}$ .
- Elemental analysis and sample characterisation by using ICP-OES, GFAAS and XRF
- Mineral composition via XRD



# Swansea

## Facilities and Capabilities

The BEACON capability at Swansea University is centred on the microbiology facilities in the Institute of Life Science (ILS), the research arm of the College of Medicine at Swansea University.

Completed in 2007, with support from the Welsh Government and the European Union, the ILS laboratories house state of the art facilities and equipment. The highly trained personnel have a history of industrial biotechnology experience going back 30 years. The team have a wealth of experience working with a range of industries, including pharmaceutical, agrochemical, chemical and food industries as well as international companies and local SMEs.



## Applications

- Opportunities exist to develop collaborative research and development and company advice on processes involving microbes and proteins.
- Microbial natural product discovery and novel chemical entities for medicine.
- Metabolic engineering in microbes.
- Monooxygenase biotransformation of lipophilic chemicals in biorefinery.



# Intellectual Property

Whilst collaborating with BEACON it is possible that we may develop a novel method, process, microbe or marker. If this occurs then there is the potential to generate Intellectual Property (IP).

BEACON has the capabilities alongside the technology transfer team to help you protect and commercialise your ideas. At the beginning of a collaboration with BEACON, companies are required to jointly sign a Confidentiality Disclosure Agreement (CDA). This will help ensure the protection of any novel ideas or processes developed during the collaboration.



Currently two applications for patents have recently been submitted for intellectual property in the area of grass biorefining:

## **1. Extracts from grass for use as pre-biotics and their use in combination with a novel bacterium as a syn-biotic.**

*Research has demonstrated that components isolated from grass show strong pre-biotic activity, comparable and exceeding current market products. These components can be coupled with a novel bacterium which enhances the health benefit by outcompeting harmful bacteria.*

## **2. Biorefining of grass for the extraction and production of both fine and platform chemicals including biofuels.**

*Processes have been developed for the production of a range of chemicals from grasses in combination with bioconversion of sugars to platform chemicals.*

*BEACON has been granted the intellectual property for squalene and bioethanol in a biorefinery approach and the application of fructanase.*

# Generating Intellectual Property

## Squalene and Bioethanol in a Biorefinery Approach

Maximising the value of products in a biorefinery approach can produce stand alone or combined products from the same fermentation of plant biomass. At BEACON we are also interested to explore microbial biotechnology towards the use of Wales-relevant biomass such as rye grass.



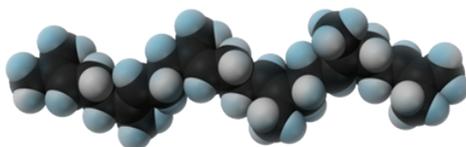
Squalene is used in a range of industrial sectors including beauty/cosmetics, nutraceuticals and pharmaceuticals - particularly skin treatments. However, current sources of squalene are unsustainable as most are derived from the livers of deep sea shark.

In this exemplar project at Swansea University we explored the potential of using yeast biotechnology to produce both bioethanol and squalene as a commodity product.

Squalene is normally present in trace amounts in Brewer's yeast (*Saccharomyces cerevisiae*) as part of a multi-step process leading to sterol synthesis.

Extensive research carried out at Swansea University on a modified strain of Brewers yeast (as part of a grass based biorefining project), found that this pathway could be blocked leading to significant higher yields of squalene in the yeast.

Through careful management of the fermentative process it is possible for the same organism to produce both bulk liquid biofuel and significant quantities of high value squalene.

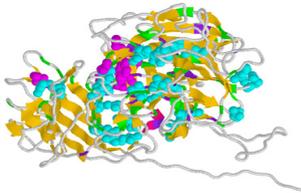


This unique method of producing squalene has been successfully patented through Swansea University.

# Generating Intellectual Property

## Fructanase

Grasses produce storage carbohydrates (sugars) called fructan (or graminan) that have the same function as starch in other plants. Fructans from rye grass consist of multiple (polymeric) and branched fructose units (~50 units) that are very water soluble. Fructans can also exhibit prebiotic activity i.e. support the growth of probiotic bacteria such as *lactobacilli*. Microbes capable of utilising fructan break down the polymer using a specific enzyme (fructanase).



Dr Jonathan Mullins at Swansea University in collaboration with Dr Roberto Togawa at the agricultural research centre Embrapa in Brasilia have developed a novel modelling platform that has enabled the prediction of the core structure of the soluble domain, *L.paracasei fructanase*. Enzymologists and microbial biotechnologists together with Professors Diane and Steve Kelly at Swansea University have used this knowledge to develop methods to produce the novel protein at very high levels in the

workhorse bacterium *Escherichia coli*. Results showed it was indeed active in breaking down a range of fructans, including those from a high sugar perennial ryegrass variety bred at Aberystwyth University.

“ We are delighted to include this technology within our portfolio, as the use of non-crop feedstocks for the production of bioethanol is essential in meeting the demands associated with global population growth. ”

James Dimitriou  
CEO of AltEnergis

Brewing or Bakers Yeast called *Saccharomyces cerevisiae* does not utilise fructan and this obstacle to bioethanol production from grass with yeast was overcome using the novel enzyme added to grass juice fractions. Not only could bioethanol be produced by this route but another yeast used as a probiotic called *Saccharomyces boulardii* produced equivalent yields and may then be used to treat humans and animals together with biofuel production

Intellectual property has been licensed to AltEnergis and as a result Dr Jonathan Mullins has developed a spin-out company Moleculomics to utilise the protein structure prediction platform for studies on other biocatalysts and for drug discovery.

# Life Cycle Assessment

*The increased awareness and importance of the environmental impact associated with products has led to the development of methods to better understand these impacts. One technique that has been developed for this purpose is the Life Cycle Assessment (LCA).*

## What is LCA?

LCA is a systematic approach to identifying, measuring, documenting and interpreting the environmental consequences of a product. An LCA can look at the entire life-cycle of a product from raw material extraction through to end of life disposal, and all of the stages in between, including transportation. This type of LCA gives the most complete analysis, and considers the environmental implications of the whole supply chain of products, both goods and services, their use, and waste management from 'cradle to grave'.

At BEACON we have experience in conducting both full and partial LCAs, enabling the identification of hot spots either in the whole product life cycle or specific parts, such as manufacturing or product assembly. BEACON has expertise in LCA using current market leading software SimaPro®, which gives us access to data sets applicable to modelling products and processes worldwide.



## How can LCA help my Company?

Using the expertise within BEACON, we have the ability to design targeted biotechnology solutions, utilise life cycle design, computer modelling, economic analysis, laboratory facilities, and custom built pilot facilities.

Life cycle assessment allows us to use an integrated approach which can add value to research projects by ensuring that the systems used and products produced are not only technologically achievable but also environmentally and economically viable.



**BEACON**  
**Progress through Partnership**

A Selection of Industrial Companies  
Collaborating with BEACON

# Aber Instruments

## Company Profile

Founded in 1988, Aber Instruments (AI) was developed around the research activities of Aberystwyth University and the Centre for Alternative Technology (CAT), based in Machynlleth. AI devised and patented a radio-frequency impedance method to assess live biomass in fermentations through the measurement of the inherent capacitance of living cells (dielectric spectroscopy). In a matter of only three years, systems were sold to major biopharma and brewing companies. AI are currently the global leader in online biomass measurement.



## Collaborating with BEACON

AI, having previously collaborated with IBERS through the Grassohol project in 2009, was keen to be involved once more with the IBERS department.

BEACON had been investigating dielectric spectroscopy (DS) applied to Distillers Dried Grains with Solubles (DDGS) and was interested in establishing the change, if any, in DS following pre-treatment from the pilot-scale steam explosion equipment. BEACON had identified AI as having the best biomass probes for this work, and a collaboration began. The company provided BEACON scientists access to their biomass probes and continued the collaboration with particular focus on the development of appropriate algorithms for data interpretation.

The biomass probes and software used allowed the enzymatic degradation of the plant cell material to be followed in real time - with the critical end point to be determined for the addition of yeast and the start of the fermentation process and production of bioethanol.

The results of the collaboration demonstrated that DDGS had a significant and measurable inherent capacitance and that the subsequent decay of this capacitance following the addition of specific enzymes for breaking the cellular structure could be followed in real time and modelled accurately. The results of the collaboration were subsequently published in the *Bioresource Technology Journal* (Bryant *et al.*, 2012).

*“The effective collaboration has enabled Aber Instruments to explore new market potential and gain an early foothold in the new and growing worldwide production of biofuels and bioproducts.”*

*Dr John Carvell, Sales and Marketing Director*

AI have benefited from the opportunity of testing their technology in the field providing invaluable results for their research work and attracting high calibre research scientists and fermentation experts. Working with the BEACON team has further enhanced the company's reputation as the leader in online biomass measurement. AI have since been involved in a second collaboration with BEACON investigating the capabilities of their new mini probes compared to their conventional probes for the determination of yeast growth in cultures.

**ABER**  
TRUSTED TECHNOLOGY

For more information: [www.aber-instruments.co.uk/](http://www.aber-instruments.co.uk/)

# Agroceutical Products Limited

## Company Profile

Agroceutical Products Limited (APL) was established in 2012 to commercialise over 8 years of research by Professor Trevor Walker and colleagues whose aims were to develop a cost-effective and scalable method of producing Galanthamine from daffodils.

Galanthamine has been found to be effective in the treatment of Alzheimer's disease, and has currently been approved in several countries for the symptomatic treatment of senile dementia. However a natural source of Galanthamine is not readily available on the market.



*Director, Kevin Stephens and Professor Trevor Walker at APL's daffodil fields*

## Collaborating with BEACON

The aim of the collaboration with BEACON was to increase the quantity and quality of alkaloid rich material and Galanthamine extracted from different parts of the daffodil. Galanthamine is extracted from the daffodils through a complex process. However this has resulted in a reduced volume of end product. It was due to these circumstances that director Kevin Stephens approached BEACON. Having collaborated with BEACON in the past, Kevin was already aware of the extensive pilot-scale facilities, equipment and skills available.

Although Galanthamine extraction is a difficult process; with APL providing a large quantity of daffodil bulbs and BEACON utilising their equipment and expertise a challenging project was undertaken. With the use of a pilot-scale screw press, filtration equipment, and analytical monitoring (HPLC, high performance liquid chromatography) positive results soon became evident. The research investigations undertaken by BEACON has resulted in a dramatic increase in the quantity of extract.

“ We began working with BEACON because of their reputation, skills and equipment they offer. No other organization could match it! ”

**Kevin Stephens, Director**

Daffodil compound extraction is APL's core business; the collaborative work with BEACON has seen direct benefits to the business and identified future research opportunities for Kevin and his company.

Through the interaction with BEACON, APL is now a consortium member of a new IBERS based ERDF funded project (HiPLExSon). The project will look at developing high throughput downstream purification of Galanthamine and other daffodil alkaloids using high performance countercurrent chromatography (HPCCC).



**Agroceutical Products**

For more information: [www.agroceutical.com/](http://www.agroceutical.com/)

# Axium Process

## Company Profile

Axium Process specialises in the design, fabrication, testing and commissioning of customised manual and automatic membrane filtration systems. The company is also a specialist in the supply of custom built processing equipment, components, tube and pipe fittings that meet their customers individual requirements. Axium is committed to providing the best possible value for money in terms of design, fabrication, product quality and consistency, delivery and traceability.

Axium engineers have over 150 man years of hygienic stainless steel and filtration expertise and whilst they operate across a diverse range of industries, investment in the very latest technologies, training, systems and procedures allow them to meet the rigorous standards set by pharmaceutical and biotech companies for hygienic design, manufacturing quality, surface finish, testing and certification.



## Collaborating with BEACON

BEACON is a £20m research initiative to build integrated 'Green Supply Chains' with a focus on developing new routes to market and cost competitive products using biomass rather than oil. The BEACON intention is to understand and engage with businesses to cultivate and deliver 'Green Technology Solutions' to benefit industry across a range of sectors. To facilitate this BEACON have a network of scientific expertise based at Aberystwyth, Bangor and Swansea Universities with the capacity to provide solutions from bench to scale demonstration.

In order to maximise the Biorefining facility at Aberystwyth, BEACON sought specialist pilot-scale equipment, including ultrafiltration and reverse osmosis filtration systems. Axium is a market leader in the manufacturing of multi-stage filtration systems with proven experience in meeting the requirements of pharmaceutical and biotech organizations. BEACON supplied Axium with data on the fractionation and concentration of grass juice (obtained through experimental research for Axium) to calculate the requirements of a scaled-up system for a biorefinery scenario. Axium provided expert advice, modelling and feedback on the feasibility and associated costing for a filtration system for the biorefining of grass juice.

In accordance with the results of the study, BEACON proceeded with the purchase of an integrated wet feedstock processing line, pasteuriser and membrane filtration pilot-plant, utilising ultrafiltration and reverse osmosis technologies for processes. These included fractionation, concentration, clarification and water conservation.

As a result of their collaboration with BEACON, Axium is now one of the partners involved in the Welsh Government's A4B research project. This initiative involves academic Universities Aberystwyth and Bangor, and industrial partners including a supermarket chain. The aim of the project is to demonstrate the possibility of producing meat, packaging and transport fuel from the same biomass feedstock in an environmentally sustainable manner. The project "STARS" will look to generate a range of products from a readily available UK biomass source, such as rye grass.



For more information on the work Axium Process visit:  
[www.axiumprocess.com](http://www.axiumprocess.com)

# Clifford Jones Timber Group

## Company Profile

Clifford Jones Timber Group (CJ Timber) is the UK's largest manufacturer of timber fence posts. Established in 1948, CJ Timber is a Forestry Stewardship Council (FSC) certified company based at its eco-friendly 13 acre headquarters site in Ruthin, North Wales.

They provide their customers with innovative, high quality timber products sourced from local sustainable forests, for an increasingly wide range of end uses. These include fence posts, laminated timber for the construction and leisure industries, bedding for horses, cat litter, and a range of wood fuels - from dried logs and wood briquettes to wood pellets for biomass boilers.



With over 100,000 tons of timber processed on the Ruthin site every year, the company 'green' ethos is to use every piece of timber that comes through their gates. Their commitment to sustainability has led to the development of its new TimberSol range of wooden frames for solar panel installations that benefit from a lower carbon footprint, compared to the conventional steel frame.

## Collaborating with BEACON

CJ Timber has been collaborating with the BioComposites Centre at Bangor University for several years. Recently the company have been involved in a number of diverse collaborations with the BEACON initiative. Projects range from the de-watering of wood chips to investigating volatile aroma compounds in coniferous saw mills, with the aim to maximise the value in their current waste streams.

The R&D projects are led by BEACON scientist Dr Dave Preskett at the unique pilot-scale facilities at Mona, Anglesey. CJ Timber contribute to the projects in terms of biomass material and market knowledge. BEACON has assisted the company in sourcing an innovative, durable and environmentally friendly coating product which protects timber from rotting. As a result, the company have invested in equipment to apply the coating technology to their products leading to new market opportunities.

“*BEACON has been an invaluable resource to our company. At Clifford Jones Timber we always try to be imaginative and diverse whilst adding value to our product range and processes. Without BEACON's scientific knowledge and research facilities we would not have been able to explore such wide-ranging and innovative concepts.*”

**Alan Jones, Chairman of  
Clifford Jones Timber**

CJ Timber continues to diversify and expand into new markets with the opening of the first laminating plant in Wales. In testimony to their innovative product development, the firm recently won the Welsh Government sponsored "Growth through Innovation" title at the Daily Post Achievement Wales Business Awards in 2013.

*Clifford Jones*  
Timber Group Est.1948 

For more information: [www.cjtimber.com/](http://www.cjtimber.com/)

# Farmaceutical Innovations

## Company Profile

Farmaceutical Innovations is a new business venture business based in Caergybi, Anglesey. A limited company formed in August 2011, they target three areas of the phytochemical sector including: process development, supply, and toll extraction.



Farmaceutical Innovations have undertaken studies in economic optimization and process improvements to enhance the environmental impact and overall economic performance of their business. They aim to provide their clients with the skills and resources required to rapidly improve their production line, adding value to the entire process.

## Collaborating with BEACON

Kevin Wall, director of Pharmaceutical Innovations, initially learnt of the BEACON project through a previous A4B collaboration at Bangor University.

Kevin's primary concern for one project was to establish the potential for using screwpress equipment to pre-treat daffodil biomass as part of a process to extract alkaloids including Galanthamine - which is known for its treatment of Alzheimer's disease. Having previously considered a wide range of solutions, Kevin approached BEACON to develop a collaboration focussed primarily around the process optimization of daffodil bulbs.

During trials using the pilot-scale process equipment, BEACON was able to identify suitable solutions to the current daffodil processing problems. The trials conducted demonstrated that the equipment and systems used, will be more than suitable for the processing of daffodil biomass. As a result, the company are in a better position to correctly specify their equipment and technical specification when they next consider their procurement requirements.

*“ The project is well equipped and has a wide range of specialists who are able to bring a wide range of knowledge and experience to help solve the problem ”*

**Kevin Wall - Director**

Ultimately the trials undertaken at BEACON have saved the business time and money by eliminating the high costs associated with major scientific development work. Pharmaceutical Innovations are currently discussing with BEACON the prospect of further collaborations for some of their new projects.



For more information: [www.farmaceuticals.biz/](http://www.farmaceuticals.biz/)

# Fruiting Bodies

## Company Profile

Fruiting Bodies based in Bethlehem, Llandeilo is part of the Red Pig Farm group. Red Pig Farm have thirty hectares of land located on the western fringes of the Brecon Beacons National Park. Since 2004 the land has been developed to accommodate a unique cluster of rural businesses that would demonstrate the value of native broad leaved woodland in the UK.

“*BEACON have saved us time, costs, and added value to our business.*”

**Richard Edwards**  
CEO at Fruiting Bodies

Fruiting Bodies has been developing simple mushroom extracts for over ten years. They grow a variety of mushrooms on hardwood logs and sawdust, which are then dried for harvest. The dried mushrooms are then slowly simmered in filtered water. The resulting broth is concentrated and added to organic grain alcohol. The final product is a tincture, which is used as a food supplement.

## Collaborating with BEACON

Recent changes in regulations by the MHRA (Medicines and Healthcare products Regulatory Agency) caused difficulty for Fruiting Bodies and CEO Richard Edwards resulting in a negative impact on the business. Richard considered a variety of possible solutions but did not have the resources to implement them at the time.



A selection of mushrooms grown at Fruiting Bodies ©

Richard initially contacted BEACON having seen content on the professional social media platform, LinkedIn and soon after underwent meetings with Business Development Manager, Dr Mike Morris. Following numerous discussions over possible solutions, Fruiting Bodies began a collaboration with BEACON. Mushroom extracts and dried preparations were then brought back to the BEACON scale-up and laboratory facilities in Aberystwyth for unique profiling and activity assessment.

The results have shown some interesting findings. As a result, Fruiting Bodies is now in the process of proceeding into a new project collaboration with BEACON which will involve further analyses in the hope of discovering various new health benefits not previously discovered in mushrooms.



For more information on the Fruiting Bodies enterprise visit [www.fruiting-bodies.co.uk](http://www.fruiting-bodies.co.uk)

# MDF Recovery

## Company Profile

MDF Recovery is a technology developer, which is focused on developing a novel and proprietary process to recover fibre from waste Medium Density Fibreboard (MDF). Over 200,000 tons of MDF waste is generated in the UK alone, with it being incinerated or sent to landfill after a single user life.

MDF Recovery aims to solve this problem through establishing the UK's first commercial scale MDF recycling facility alongside the licensing of its technology worldwide. The fibres recovered from their novel process can then be re-integrated back into MDF production, or used as feedstock for a variety of high value industrial applications. MDF Recovery offer a better ecological solution for the disposal of MDF which generates a new source of raw materials for the wood and natural fibre industry, in turn reducing the demand on virgin fibre produced from standing forests.

## Collaborating with BEACON

MDF Recovery has collaborated with BEACON through Aberystwyth and Bangor Universities. The pilot-scale equipment at the BioComposites Centre, Mona in Anglesey has helped the company to characterise and process their recovered fibres. BEACON has also assisted in numerous practical trials to establish the effectiveness of fibres as a raw material for new innovative products.



BEACON's latest collaboration with MDF Recovery has been at Aberystwyth University to investigate the application of some of the pilot-scale equipment available at the BEACON facility to regulate the moisture content of fibres recovered by MDRF's process.

“BEACON has assisted MDF Recovery to test and optimise our novel technologies in such a short time frame, something no other organization could offer. MDRF is a start-up company attempting to introduce closed loop recycling opportunities into mature and established manufacturing and retail supply chains. The involvement of the universities enhances MDRF's credibility with these commercial partners.”

Craig Bartlett, Director

BEACON's aim was to investigate whether, through the use of screw-press technology, an optimum output moisture content for the feedstock could be achieved, at a level appropriate for further processing within particular industrial market applications. Optimization of moisture content in the processed materials can reduce energy costs and thus decrease the carbon footprint of the whole recycling process.



For more information: [www.mdfrecovery.co.uk/](http://www.mdfrecovery.co.uk/)

# Pennotec

## Company Profile

Pennotec, a new venture established under Pennog Ltd, are industrial bio-technologists who aim to advise and provide technology to assist businesses and operators in the conversion of manufacturing waste into marketable resources.

Waste biomass typically accumulates as a result of numerous manufacturing activities from a variety of industries including: agriculture; food & beverage; chemicals & pharmaceuticals; and fuels & biofuels. Establishing new markets as an alternative to landfill and incineration disposal methods is a priority for Pennotec. Currently, Managing Director Dr Jonathan Hughes is focussing on the waste streams associated with crustacean meat processing.



Washed, dried and milled crab shell

## Collaborating with BEACON

Initially learning of the BEACON project via the BioComposites Centre at Bangor, Jonathan 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.

BEACON's existing biorefining research and pilot-scale facilities, alongside the possibility of conducting a techno-economic analysis of the results obtained were factors that influenced Jonathan's decision to collaborate. 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.

“*BEACON has provided considerable support to Pennotec, including providing network support for the future development of the business and a compelling Technology Strategy Board grant application.*”

Jonathan Hughes - Director

The handling and preprocess of waste crab shells proved to be a challenging task. However, this was overcome through the use of BEACON's upscale autoclave equipment at Aberystwyth, with drying and milling undertaken BioComposites Tech Transfer Centre in Mona, Anglesey.

BEACON has positively demonstrated their capability to incorporate waste crab shell material into grass sugar biorefining. The results of the collaboration have allowed Pennog Ltd to apply and successfully be granted the opportunity of Technology Strategy Board funding for a nine month technical feasibility project in 2014.



For more information: [www.pennotec.com/about-us/](http://www.pennotec.com/about-us/)

# PhytoQuest

## Company Profile

PhytoQuest traces its history back to 1999 when Professor Robert Nash founded Molecular Nature Limited (MNL) a spin-off from the UK's Institute of Grassland and Environmental Research (IGER). In 2006, MNL was bought by Summit Plc., and in 2009 a MBO (Management Buyout) allowed for the formation of PhytoQuest Ltd. PhytoQuest has since developed scientific research to identify natural ingredients and compounds targeting high margin healthy living products emerging from the food, pharmaceuticals and cosmetics sectors.



PhytoQuest Director Robert Nash at BEACON's Aberystwyth Facilities

## Collaborating with BEACON

PhytoQuest are currently carrying out a number of investigative contracts for a large UK food producer. One project undertaken was to profile compounds in their current waste stream.

With the requirement for pilot-scale processing equipment, including continuous centrifugation and ultrafiltration, PhytoQuest approached BEACON to develop a synergistic collaboration.

Robert provided BEACON with their clients waste stream, and requested BEACON to fractionate the liquor based on weight and molecular size. This was carried out using CEPA continuous centrifugation and serial size exclusion crossflow filtration (Sartoflow- $\alpha$ ). The fractions produced were profiled using a range of analytical techniques by both PhytoQuest and BEACON for a variety of compound types.

The results confirmed that 'sugar alcohols' were a major component of the materials provided, whilst a potential high value peptide fraction was also identified.

*“ BEACON have added value to our company through the use of pilot-scale equipment which is not currently available at any other organization we know about ”*

**Robert Nash - Director**

The collaboration with BEACON has assisted PhytoQuest in the continuation of their research and development work with the UK food producer and continue to add value to their waste streams. In autumn 2013 PhytoQuest began a second collaboration with BEACON. This involved the company utilizing scale-up assistance for the development of a new extraction process.



For more information on the work carried out by Phyto Quest visit: [www.phytoquest.co.uk](http://www.phytoquest.co.uk)

# Plant Fibre Technology

## Company Profile

Plant Fibre Technology (PFT), established in 2005 by company director Gary Newman, was launched with the aim to make natural insulation “the norm and not the exception”. PFT play a central and pioneering role in the development of new commercial opportunities and products made from plant fibres. PFT develops and market a range of construction products made from biomass. These include fibre based insulation, strawboard-chipboard and hemp particle board.

“*Nobody else in Europe could do this job for Plant Fibre Technology*”  
Gary Newman.  
Company Director

## Collaborating with BEACON

Working to develop new and innovative natural insulation products, PFT approached BEACON with an interest to investigate the insulation potential of straw and grass materials.



Company Director Gary Newman on site installing plant fibre insulation on a low carbon Williams Homes timber frame housing project



Natural Fibre insulation from Plant Fibre Technology

Influenced by the availability of the pilot-scale equipment and expertise available at BEACON, Gary began the collaboration. After explaining the specifications and requirements for the fibre, BEACON then utilized the unique biorefining facility at Mona, Anglesey, together with the expertise of staff at the BioComposites Centre, Bangor University to undertake the trials on approx. 200kg of biomass material.

The collaboration with BEACON has led to the production of raw fibre materials for the development of natural sustainable insulation. The results of the BEACON R&D project have enabled PFT to develop a prototype insulation material which has since been fully developed into a marketable product - currently in the early stages of commercialisation.



Plant Fibre  
Technology Ltd.

For more information: [www.plantfibretechnology.com/](http://www.plantfibretechnology.com/)

# Spencer ECA

## Company Profile

Established in 1991, initially trading as Spencer Environmental Care and Construction, Spencer ECA has evolved over the years to become one of the most respected operators in land maintenance and ground works sectors, building itself a reputation which has seen them working with many multinational companies.

Spencer ECA currently operates from three strategically based locations within Wales: Llandysul, Newtown, and Swansea. Spencer ECA undertake a wide range of services including all aspects of construction industry support and environmental management, ranging from site clearance in advance building projects, to pipe and cable installations. Spencer ECA adopts rigid health and safety and environmental policies, minimising the risk to personnel and the effect of its ecological footprint. Consequently, they use sustainable resources wherever possible.



## Collaborating with BEACON

Spencer ECA have always considered the sustainability and environmental impact of their goods and services, and with the biomass division expanding this was something they were keen to pursue further. When approached by BEACON, Spencer ECA had not previously worked with a university and was keen to investigate such links. Due to their market expansion Jamie Jukes, Managing Director, was keen to increase his level of research and development in this area.

LCA is a systematic approach to assess the environmental impacts associated with all the stages of a products life cycle - 'from cradle to grave'. Spencer ECA worked alongside BEACON to establish the environmental impact of the production of wood chip from forest derived biomass and its delivery to customers in Wales. The company supplied BEACON with wood chip for analysis and collated data with the help from the BEACON team and historical company records.

*“ BEACON has identified hot spots in our supply chain and allowed us to make changes which has saved Spencer ECA time and money. ”*

**Jamie Jukes - MD**

The collaboration with BEACON has given Spencer ECA a better understanding of their supply chain whilst identifying hotspots; thus enabling the company to reduce the re-handling of the product, which saves them time and money, thereby increasing the profitability in this area of their business.

Spencer ECA's collaboration with BEACON was carried out with the BEACON life-cycle analysts and Master's student James Nash, from Aberystwyth University. James has since been employed on a full-time basis as the companies Biomass and Renewables Manager, since October 2013. Spencer ECA are currently in discussions with BEACON to begin a new collaboration in Spring 2014, focusing on another area of their company.



For more information: [www.spencereca.com](http://www.spencereca.com)

# Partner in BEACON

## How is BEACON Funded?

BEACON is funded through the European Regional Development Fund (ERDF) through the Welsh European Funding Office (WEFO), as part of the Welsh Government under the Convergence programme for West Wales and the Valleys.

## What does it cost to collaborate with BEACON ?

Collaborating with BEACON does not require your company to make any financial commitment. Companies need only contribute 'in-kind' to R&D collaborations.

## Who can collaborate with BEACON?

Both new and existing small and medium enterprises (SME's) in the Convergence region of Wales can collaborate with BEACON.



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*The convergence region in Wales includes 15 local authorities in West Wales and the Valleys.*

*Businesses outside Wales can also collaborate with BEACON but the work undertaken must benefit the Convergence region in order to qualify for support.*

## BEACON has collaborated with...

- 💧 Companies in the construction, packaging and manufacturing industries by developing new biocomposite materials.
- 💧 The bioscience industry - for example, developing new microbial or enzyme systems and technologies for the processing of biomass.
- 💧 The chemical industry by providing new sources of green chemicals.
- 💧 Fuel producers by offering 'green' fuels, impacting on the Renewable Transport Fuel Obligation (RFTO) and reducing carbon emissions.
- 💧 Rural communities by applying biorefinery technology to the processing of non-food crops.

# Regio Stars Awards 2014

**BEACON has been short listed for the European Commission's Regio Stars Awards 2014.**

Researchers at BEACON work with industry, including small and medium sized enterprises (SME's) to develop renewable materials, fuels and chemicals, as well as modified and new processes which are more sustainable from an environmental and economic perspective.

BEACON is one of four projects to be short listed in the "Sustainable Growth: Green Growth and Jobs through Bio-economy" category.

The other three are EcoPonto em casa from Portugal, ORGANEXT from Belgium, Germany and the Netherlands, and ARBOR which has partners from the UK, Ireland, Germany, Luxembourg, Netherlands and Belgium.



Based on four key criteria - innovation, impact, sustainability, and partnership - BEACON is one of 19 finalists to have been short listed for the 2014 awards from a total of 80 projects supported by European Union Cohesion Funds.

Seventeen member states are represented by the finalists: Belgium, Czech Republic, Denmark, France, Germany, Greece, Hungary, Italy, Ireland, Luxembourg, Netherlands, Poland, Portugal, Romania, Spain, Sweden, and the United Kingdom.

*The finalists showcased their work on October 8th during the 11th Annual European Week of Regions and Cities.*

**Winners will be announced at an awards ceremony in Brussels on March 31st 2014**

The Regio Stars Awards recognize Europe's most inspirational and innovative regional projects. The awards aim to identify good practices in regional development and to highlight original and innovative projects which could be attractive and inspiring to other regions. The awards form part of the Commission's which aim to highlight good practices in urban and regional development.

## Who will I be Working with?

Within BEACON you may work with Aberystwyth, Bangor, or Swansea Universities or a combination of all three institutions.

Initial contact should be made via our Business Development Managers who will assess what skills and facilities are suited and which institute(s) best meet your requirements.

## Business Development Managers



**Selwyn Owen**  
**North & Mid Wales**

Selwyn's interest in the last five years has been in the waste management, renewable energy and biorefinery markets. In his previous role, he assisted companies to identify waste-to-energy and water treatment technologies in the commercialisation stage. His current research interests include strategic partnerships and developing new green business models.

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**Dr Mike Morris**  
**South and Mid Wales**

Mike is a multidisciplinary scientist and expert analytical chemist with supplementary industrial experience ranging from medical sciences, agrochemicals, pharmaceuticals, gas sensor technology, biodiversity, soil science and multivariate modelling to the biorefining of high sugar ryegrasses to fuel ethanol and higher value platform chemicals.

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