Sustainable Packaging & Waste Workshop 13th of March 2019

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BEACON Project

- Partnership between Aberystwyth, Bangor and Swansea Universities funded by ERDF
- Aim to establish a Biorefining Centre of Excellence in Wales
- Enables research and collaboration between academia and industry to create new jobs, products and processes and IP that will support the growth of the bio-economy in Wales
- Provides access to R&D capability, scientific expertise and infrastructure at pilot-scale to develop economically viable industrial applications across a range of industry sectors
- Collaborating with business to use plant derived products and low carbon technologies to help mitigate climate change
What is Biorefining?

“Any system that processes biologically renewable materials or waste streams into economically valuable end products”
From Plants to Multiple Products

BIOMASS
- Ryegrass
- Agricultural and forestry residues
- Process waste streams
- Macroalgae

CONVERSION

PRODUCTS
- Chemicals
- Fuels
- Materials
- Natural Products
- Bio actives
BEACON Facilities

A summary of facilities available through the BEACON project to aid the development of the circular economy...
Pilot Scale Biorefinery

- Pressurised Refining
- Wet Fractionation

Life Cycle Assessment

- CO₂ Extraction & Green Solvents
- Biopolymers & Thermoforming
- Extrusion & Sheet Forming
- Packaging

Biomass Processing

BioComposites Centre
Innovation in biomaterials for industry

Modelling

Natural Product Extraction

Construction

Bioplastics
Thermochemical conversion

FEEDSTOCK DEVELOPMENT

BIOCHAR

DEWATERING

STEAM EXPLOSION

DENSIFICATION

MICROBIAL CONVERSION

CONTINUOUS CENTRIFUGATION

CROSS-FLOW FILTRATION

FLASH & CC CHROMATOGRAPHY

Extraction & Isolation

Pilot Scale Biorefinery

Downstream processing

BIERS

IB Development & scale-up

Biomass Processing

IBERS

100 Years of Plant Breeding

PRIFYSGOL ABERYSTWYTH UNIVERSITY

1872
Institute of Life Sciences Swansea

- Protein Chemistry & Enzymology
- Mass Spectroscopy
- Filamentous Microorganisms
- Molecular Modelling
- Synthetic Biology & Metabolic Engineering
- Novel Microbial Products
- Fermentation
How We Can Help You?

- Analyse waste streams for high value compounds
- Risk free scale-up processing to demonstrate commercial viability
- Access to scientists, equipment and funding
- Life cycle assessment (LCA)
How We Can Help You?

Enterprise Assistance
BEACON support is Free under de-minimise European rules for companies in the convergence area of Wales:

- Support for 2-3 days (analytical work, literature review, tailored advice, workshops)

R&D Collaborations
- Projects – various timescales from a couple of days to significant engagement
- Company in-kind contribution (i.e. material, company time)
- Undertake trials at pilot scale to develop new products and processes
- Grant funding applications – Innovate UK, Welsh Government and Horizon 2020 funding
Life Cycle Assessment & Economic Analysis

- BEACON have specialist life cycle and economic analyst
- A method to calculate the environmental footprint of a product
- Identifies hotspots within the material composition / production chain
- Fundamental to scale up and efficient processing
- Local energy monitoring of equipment
- Market-leading LCA analysis software
Convergence Area of Wales

15 Local Authorities
- Isle of Anglesey
- Conwy
- Denbighshire
- Gwynedd
- Ceredigion
- Pembrokeshire
- Carmarthenshire
- Swansea
- Neath Port Talbot
- Bridgend
- Rhondda Cynon Taff
- Merthyr Tydfil
- Blaenau Gwent
- Caerphilly
- Torfaen
Distribution of companies interacting with BEACON based on their Standard Industrial Classification SIC codes.

- Biotechnology R&D: 23%
- Food & beverage processing: 13%
- Food & feeds: 10%
- Environmental consulting: 11%
- Agriculture: 6%
- Forestry: 4%
- Pharmaceuticals & chemicals: 6%
- Wood products: 5%
- Food & beverage processing: 13%
- Wholesale products: 5%
- Waste management: 5%
- Scientific consulting: 3%
- Knowledge transfer: 3%
- Warehousing & storage: 1%
# Value from Waste

## Problem

- Waste biomass accumulates as a result of many different types of manufacturing activity; agriculture, food and beverage, chemical and pharmaceutical process streams.
- Waste biomass is a problem with a cost but also a potential value.

## Drivers

- Increasing business awareness of responsibility for the waste they generate to consumers of their products.
- Increasing environmental legislation regarding the pollution of our planet is leading to ever increasing landfill disposal costs.
- As fuel costs rise, the economics of transporting waste long distances will become more prohibitive.
## Value from Waste

### Solution

- A sustainable outcome is required for the waste we generate.
- Management, recovery, re-use or recycle waste has always been considered a more costly and complex solution.
- However, significant reductions in the cost and complexity of technologies to extract valuable resources from waste are developing.
Examples of Waste Valorisation
Bread Waste

Objectives

• To obtain new biodegradable packaging for bakery and pastry products using alternative Polylactic acid (PLA)
• To demonstrate the technical viability at pilot plant scale

Conclusions

• By existing fermentation technology, bread waste was transformed into lactic acid pure enough for further polymerisation into PLA
• Oxygen and water vapour barrier properties compare well to commercially available PLA such as polypropylene (PP) packaging
Beer Waste

- Brewer’s spent grains for use as cattle feed, lipids/phenolics extraction
- Include human and animal nutrition, usage in high fibre bakery products, building materials, paper manufacturer, energy production, substrate for cultivation of mushrooms (ex. Oyster/Shiitake)
- Xylitol – a natural sugar substitute and important sweetener
- Spent yeasts for yeasts extracts, salt replacement in foods. Varieties of yeast and micro-organisms for flavours
Waste from Cider and Spirits

Cider
• Pomace, fruit skins, pulp and seeds for waxes, pigments, personal care products, fibre and phenolics and for pectin a gelling agent in the food industry

Spirits
• Bioethanol – biofuel for transport and solvent
• Biobutanol (next generation biofuel and superior transport fuel)
• Bioacetone is a very widely used chemical, both as a chemical feedstock and also as a solvent
Coffee Waste

- Coffee logs are high-performance, sustainable briquettes made from recycled coffee grounds for use in woodburners and stoves.
- Biomass coffee pellets are carbon neutral biomass pellets used for heating buildings, a sustainable alternative to imported woody biomass and alternative to conventional fossil fuels.
- As a substrate for cultivating mushrooms.
- Cosmetics, ex. body soap scrubs.
Apple Pomace By-Product
into ‘Fat-mimicking’ Functional Fibres

Pomace by-product from cider production
BEACON Case Studies
BOSS Brewery

- BOSS Brewing was established in 2014 in Swansea Enterprise Park
- BEACON scientists provided the company with expertise on growing, storing and analysing yeast fermentations. Know-how was then transferred to the BOSS brewing process.
- This has allowed BOSS brewing to undertake better monitoring of quality control factors such as dissolved oxygen, PH and bitterness.
Pennotec iCRAB Project

- Pennotec – Industrial Biotechnologists, Pwllheli
- Collaboration with IBERS, Aberystwyth University to investigate alternative techniques for the fermentation of crab shell waste into new marketable resources
- Biorefinery Approach: Integrated Chitin Ryegrass Acid Biorefinery (i-CRAB)
- Successful 9 month technical feasibility study using grass fermentation to aid crab shell decalcification £126,000 from (Innovate UK)
- New technology for extracting ‘chitin’ from crab shell waste for various industrial applications such as waste water treatment
Potato Processing for Protein and Iminosugars

350,000 tonnes/year
10% rejection

Potato protein

• Nutritionally comparable to whole egg
• High potential for food applications (vegan)
• Current process: starch by-product, recovery by heat coagulation (reduces solubility)
• Economic method to recover soluble potato protein would increase food uses & add to commercial value

Calystigines

• Antimicrobial
• Glycosidase inhibitor
• Potential for shelf life extension

Good source of iminosugars (calystigines)
Potato Processing for Protein and Iminosugars

1. Juicing using 10” screw press
2. Membrane separation
3. Centrifuge solids
4. Centrifugation
Quorn

- High levels of salt consumption amongst UK consumers
- Quorn manufacturing process generates a water based effluent (Centrate) containing compounds Nucleotides & Glutamates (NAGs)
- 1-1.5% nutrient rich dissolved solids in “waste” representing significant loss of value
- Potential for new product development as a salt replacer and natural flavouring enhancer
- Concentrate the effluent and using enzymes to maximise the NAGs to deliver a highly potent flavouring system. Is it economically viable?
Quorn Waste Stream Filtration

Daisy-Chained Filtration Rigs: MF to RO

This work has lead to a 2 year Innovate UK project: Value £265,639 (Quorn Nucleotides & Glutamates (NAGs))

The NAGs can then be used as part of a flavouring system or to reduce added salt in a number of foods.
Summary

• BEACON capability and expertise can assist you from initial analysis to scale-up and demonstrate commercial and economic viability

• Opportunity to exploit the potential value of waste streams into new by-products and new income streams

• Circular economy – opportunity for smaller producers to partner and form collaborative ventures to create value

• **Explore the potential in your waste streams!**
BEACON has helped forge collaborative links with a range of companies and research institutes including the following......
Diolch am Wrando
Thankyou for Listening