Biomass Biorefinery Network

4th BBNet Conference

The future prospects for biorefining:
Feedstocks, technologies and products

15-17 October 2025

Mercure Sheffield St Paul's Hotel & Spa
Sheffield

Biotechnology and Biological Sciences Research Council

Engineering and Physical Sciences Research Council

University of York

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Welcome

Welcome to the 4th, and final, BBNet conference, "The future prospects for biorefining: Feedstocks, technologies and products". This event aims to highlight cutting-edge research and practical applications in biorefining and explore opportunities for the future. We are delighted to bring together leading experts from industry, academia, and the policy sector to share insights, foster collaboration, and celebrate the significant impact the Biomass Biorefinery Network has had. We hope this abstract booklet provides a valuable overview of the innovative work being presented and helps you navigate the exciting programme ahead.

BBNet Team

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Feedstocks, technologies and products

15-17 October 2025

Programme

Day 1: Wednesday 15th October

Time	Event	Abstract
11:00	**Registration and refreshments** (Hotel Foyer)	
From 11:45	*Lunch* (Yard Restaurant)	
12:15	**Exhibition opens** (City Suite Foyer & City Suite A)	
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Speaker abstracts

01 Keynote: The future of biorefining

Lee Lynd, Terragia Biofuel Inc.; Thayer School of Engineering, Dartmouth; University of Campinas, Brazil; Center for Bioenergy Innovation, Oak Ridge National Lab

The emergence of biorefineries producing multiple products from renewable biomass feedstocks has long been anticipated as a key component of a sustainable, circular economy. However, with perhaps a few exceptions, such biorefineries have been slow to emerge as indicated by both the deployment of cellulosic biofuels and the stock values of industrial biotechnology companies falling short of expectations. The speaker will offer perspectives on understanding this slow emergence and reasons to persist in biorefinery development and deployment. Dimensions considered will include feedstock availability and choice, conversion technology, product demand and choice, and climate stabilization. Consolidated bioprocessing of cellulosic biomass and Terragia, a biofuel startup, will be offered as examples of promising initiatives.

Lee Lynd is Co-founder and Chief Technology Officer of Terragia; Paul and Joan Queneau Distinguished Professor of Engineering and Adjunct Professor of Biology at Dartmouth College; Sao Paulo Excellence Chair and Director of the Advanced Second Generation Biofuel Laboratory at the University of Campinas (Brazil); and Research Council member at the US Department of Energy Bioenergy Science Center. Past leadership positions include Executive Committee Chairman of the Global Sustainable Bioenergy Initiative, Co-Leader of the Role of Biomass in America's Energy Future Project, Co-Founder and Director of Mascoma and Enchi Corporations, and Biofuel Industry Representative on the Advisory Committee to the Executive Office of President Clinton on Reducing Greenhouse Emissions from Personal Vehicles. His work in the biofuels field includes over 300 papers cited over 44,000 times as well as 23 granted patents.

02 Feeding the bioeconomy – UK biomass availability

Adrian Higson, Alder BioInsights

All elements of the bioeconomy rely on an effective supply of biomass feedstock. At Alder BioInsights, our work focuses on unlocking the potential of sustainable biomass feedstocks to drive the transition toward a low-carbon, circular bioeconomy. Our projects span a broad range of applications, including benchmarking agricultural waste streams for advanced biofuel production, to performing feedstock availability assessments for regional supply chains. These efforts have informed both industry and policy stakeholders, accelerating the deployment of biomass-based solutions across energy, materials, and chemical markets.

Understanding feedstock availability and accessibility form a critical aspect of business development. From investor due diligence through to the development of national policy and strategies understanding feedstock arisings, elasticity, sustainability and dynamics underpins good decision making.

UK biomass feedstock is manifold, ranging from agricultural and forestry products through many industrial by-products to municipal wastes and water treatment residues.

At Alder we maintain a view of key biomass feedstock through a set of feedstock platforms derived from published information and which underpin subsequent analysis to provide estimates of actual accessibility.

This presentation will describe the UK's biomass feedstock landscape, feedstock types and availability and discuss the factors which influence accessibility and future availability. We will also consider how reframing policy from maximising energy output to maximising carbon savings influences feedstock demand.

Project case studies will be used to demonstrate how estimates of feedstock volumes are influenced by projections of market, policy and societal activities.

03 Improving biomass feedstocks for biorefineries

Leonardo Gomez, University of York

Biomass holds great potential in the transition from traditional oil based processes to a low carbon economy. However, the efficient use of biomass is dependent on breakthroughs in our understanding of the bottlenecks preventing the conversion of plant biomass into crude sugars. Knowing these barriers will allow the development of new strategies for breeding added-value plants with modified cell wall properties which are easier to deconstruct for biorefining. Conversion of the biomass polysaccharides to sugars provides cheap and abundant raw materials for industrial biotechnology. The use of plant biomass in this way is hampered by the high cost of saccharification due to the recalcitrance of cell walls to enzymatic hydrolysis. The polysaccharides that make the plant lignocellulosic biomass can be broken down to produce a range of sugars that can, subsequently, be used for establishing a biorefinery based on biomass. The recalcitrance to deconstruction observed in lignocellulosic materials is produced by several intrinsic properties of plant cell walls. Crystalline cellulose is embedded in matrix polysaccharides such as xylans and arabinoxylans, and the whole structure is encased by the phenolic polymer lignin. The lignin fraction has emerged as one of the main bottlenecks for the saccharification of cell walls. The selection of the best genotypes for processing into biofuels requires the screening of populations to evaluate the variability in saccharification. Our aim over the last decade has been to map genes that alter the digestibility of energy crops lignocellulose in order to provide genetic markers for selection of the best genotypes for industrial applications.

04 From waste to wealth - Lixea's waste biorefinery scale-up journey

Krisztina Kovacs-Schreiner, Lixea

Lixea's novel, environmentally friendly waste biomass refinery technology has the potential to save billions of tons of woody (soft and hard wood) and agricultural materials (wheat and rice straw, sugarcane bagasse) as well as contaminated wood waste that would otherwise be landfilled or burnt globally.

The powerful, ionic liquid-based fractionation process produces high-quality renewable input materials, such as cellulose, lignin and organic molecules for a broad range of application areas, including packaging, textile (dissolving fibre), absorbents, adhesives, glues, battery anode, asphalt, bioplastics and biofuels – these are all multibillion-dollar industries with significant drive to replace currently oil-based building blocks or virgin wood fibre ingredients.

The technology was invented in the UK, piloted in Sweden and now scaled in Central Europe with support from the EU's Innovation Fund. After the building of the 25,000 tonne per year demonstration plant, the technology will be licensed in Europe and beyond in South & North America and Asia with the main focus on India in the coming years.

Lixea's journey started 15 years ago - reflections and lessons learnt will be shared during the talk.

05 Enzyme discovery for lignocellulose biorefining

Mario Murakami, Brazilian Biorenewables National Laboratory (LNBR), Brazilian Center for Research in Energy and Materials (CNPEM)

Cellulose degradation is one of the most fundamental reactions in nature and a cornerstone for transforming plant biomass into fuels and chemicals. However, the microfibrillar organization of cellulose and its tight association with other plant cell wall components hinder efficient enzymatic breakdown. By mining the metagenomic "dark matter" from a lignocellulose-specialized microbial community, we uncovered an unprecedented copper enzyme that performs oxidative cleavage of cellulose. This enzyme exhibits an exo action mode with strict C1-regioselectivity, producing exclusively cellobionic acid. Crystallographic analyses reveal a jelly-roll fold harboring a catalytic copper site and a flat cellulose-binding surface. The enzyme functions as a homodimer, where one subunit generates hydrogen peroxide *in situ* while the partner interacts with cellulose to catalyze the reaction. When heterologously expressed in *Trichoderma reesei*, the secretome containing this enzyme boosted glucose release from pretreated biomass under industrially relevant conditions. Beyond expanding the paradigm of bacterial redox enzymatic systems to tackle plant biomass recalcitrance, this discovery provides new avenues to convert agro-industrial residues into high-value bioproducts, reinforcing the potential of biotechnology for a sustainable bioeconomy.

06 From cane to molecule: Raizen's cellulosic ethanol program and integrated ethanol, sugar and bioenergy production model

Marisa Coral, Raizen, Brazil

Raizen is a Brazilian company, joint venture between Shell and Cosan, worldwide leader in sugar and ethanol production from sugarcane. Our integrated production model guarantees the best sustainability practices from the sugarcane plantation fields to the final customers to support the energetic transition, positioning Brazil strategically, by delivering sugar, 1G ethanol, 2G ethanol, biogas and bioelectricity. Raizen's E2G advanced and proprietary technology is proved on a commercial scale after 15 years of development and industrial process optimizations. Currently, Raizen is the only player with continuous operation in the world, with 3 plants in operation (Biopark Bonfim, Barra and Univalem) and two new plants in construction to be commissioned in 2027 and 2028. Raizen's pretreatment process guarantees an efficient conversion of cellulose and hemicellulose in fermentable sugars to produce ethanol and other chemicals, and the residual lignin is used as fuel to produce steam and power. The vinasse is used as substrate to produce biomethane and bioelectricity, and the digestate rich in salts is applied in the sugarcane plantation fields as fertiliser to replace chemicals. 1G and 2G ethanol are potential feedstock to SAF, hydrogen, bioplastics production and other chemicals, reducing about 50% the carbon footprint compared to fossil fuels. E2G increases in about 50% ethanol production with the same planted area, and 30% lower footprint compared to 1G ethanol.

07 From second generation to second chance

Jeremy Jentys, BioConsulting GmbH

Decades of research and billions of dollars have gone into second generation (2G) ethanol. While some manufacturers remain (e.g. Raizen, Brazil) two of the technology's flagship facilities (POET-DSM, USA & Clariant, Romania) have closed.

However, closure does not necessarily mean all is lost. 2G ethanol plants are uniquely positioned to be reconfigured as multi-product facilities, with bulk commodities supporting the production of lower volume, higher margin specialty ingredients. This talk will describe efforts to reboot activity at the shuttered 2G ethanol site in Romania.

08 Bug-busting spandex

Helen Hailes, University College London

The enzymatic molecular recycling of plastics is of increasing importance, where polymers are converted into monomers for reuse or upcycled into value added chemicals. Polyurethanes are a key class of synthetic hydrolysable polymers found in a wide range of products including textiles as an elastane component, also known as spandex and lycra. Most post-consumer polyurethane waste is currently disposed of in landfill.

In our recent work we have been developing enzyme strategies for the breakdown of PET, PLA, and PBAT as well as polyurethanes. In this presentation the identification of three active novel urethane hydrolytic enzymes from a drain metagenome, able to break down methylenedianiline-based elastane model substrates, will be described. In addition, a new colorimetric assay using tyrosinases will be presented, suitable for high throughput urethanase detection. For the enzymes identified, the reaction conditions and substrate scope were established and use of the urethanases and assay with commercial fabrics will be detailed demonstrating breakdown of the polymer.

09 Microbial upcycling of non-conventional polyester feedstocks

Joanna Sadler, University of Edinburgh

End-of-life polymers are emerging as a novel feedstock for sustainable chemical manufacture, particularly via engineered microbial metabolism. Whilst much work to date has focused on standardised 'ideal' polymer feedstocks, this is rarely representative of real-world waste streams. This work seeks to address this through developing chemo-biological upcycling technologies of 'non-conventional' feedstocks, including end-of-life textiles, composite materials and authentic industrial waste streams. In particular, we demonstrate upcycling of fibreglass and sail cloth into protocatechuate and vanillin, and demonstrate next-generation hydrolysable plastics as a novel feedstock for the bioeconomy.

10 Fueling a greener future with waste: Hydrogen from plastics

Jack Guo, Protonera

Plastic waste is piling up worldwide, while the demand for cheap, clean hydrogen grows stronger. Protonera's chemoenzymatic reforming process addresses these challenges, utilising discarded plastics as a feedstock to produce pure hydrogen and valuable chemicals.

By combining enzymatic treatment with a catalyst-driven reforming step, our technology works under mild conditions, avoiding the harsh heat and chemicals. The result is a scalable, energy-efficient process that tolerates dirty feedstocks and creates multiple revenue streams. This talk will show how we envision the process we developed at the University of Cambridge to transform a material often perceived as an environmental burden into a clean energy resource that fuels a greener future.

11 Polymer recycling technology for the textiles industry

Chenyu Du, University of Huddersfield

The textile industry produces 8-10% of global CO_2 emissions, 20% of industrial water pollution and 92 million tonnes of waste per year. At the University of Huddersfield, a new approach to the valorisation of textile waste was developed. In this method, cellulase was used to partially degrade cellulose to separate cotton fibres from union fabrics containing synthetic fibres. Then the separated cotton fibre and polyester components were recycled into recycled PET and recycled cellulose fibre respectively. Pretreatment of textiles with NaOH/urea enhances cellulase penetration resulting in cotton yarns losing 95% of their tensile strength within 2-hour. It was found that 2-4 hours of enzymatic hydrolysis is sufficient to separate cotton fibres from the PET fibres for the subsequent recycling. The textile to recycled fibre yield reached 78.9% using the exemplar polycotton fabric.

12 Defossilisation of the chemistry industry – The scale of the challenge

Al Sanderson, Alastair Sanderson Consulting Limited

Using fossil fuels has increased CO_2 levels in the atmosphere by 50% compared to pre industrial revolution levels. Without intervention, these levels will continue to increase, triggering changes in our climate and affecting the way we live and interact with the world around us.

Reducing emissions from energy is well understood and the conversion is underway, with the introduction of renewable energy, bio-fuels, e-fuels and application of carbon capture and storage for hard to abate industries.

What about the chemical industry? Fossil fuels play two roles; the first is the source energy and the second is the source of the carbon that is contained within the chemicals – providing their skeleton. Carbon within chemicals is released at their end of life, contributing c.70% of their lifetime emissions. Unless this hidden carbon footprint of chemicals is addressed, the use of chemicals will never get close to net zero.

We can not replace carbon in chemicals with another element and we can not live well without chemicals. To reach net zero, the chemical industry must be both decarbonised and defossilised. There are only three sources of carbon that can replace virgin fossil carbon as the feedstock for chemicals: biomass, CO_2 and carbon in materials that do not readily biodegrade. All will be needed.

This presentation will explore the scale of this challenge and propose routes to achieve it.

13 Microbial conversion of lignin to monomers for bioplastic production: A case study

Victoria Sodré, University of Warwick

Lignin is a largely untapped source of renewable aromatic compounds, offering significant potential for sustainable chemical production if efficient depolymerisation strategies are developed. In this talk, we present case studies on the microbial production of pyridine dicarboxylic acids (PDCAs) from lignin and lignocellulosic biomass using the lignin-degrading bacterium *Rhodococcus jostii*.

By expressing heterologous extradiol dioxygenases *LigAB* and *PraA* in *R. jostii*, we successfully redirected the native ortho-cleavage pathway of protocatechuic acid toward meta-cleavage, resulting in the formation of the ring-fission intermediates CHMS and 5-CHMS. These intermediates spontaneously

cyclise in the presence of ammonium chloride to yield 2,4- and 2,5-pyridinedicarboxylic acids - structural analogues of terephthalic acid with potential application in bioplastic synthesis.

Over the past decade, iterative engineering efforts have enhanced this biotransformation by stabilising gene expression, removing competing pathways, and increasing lignin degradation capacities, leading to a maximal PDCA yield of 510 mg/L.

We also highlight current challenges and opportunities in scaling this process, with a focus on downstream product recovery and fermentation optimisation. Finally, we explore broader applications of PDCAs, including their potential as versatile building blocks for the synthesis of other commercially valuable pyridine derivatives.

14 Accelerating the commercial path of industrial biotechnology

Charles Dimmler, Holiferm

Successfully commercializing industrial biotechnology requires more than superior science—it demands strategic navigation of psychological and economic barriers that impede market adoption. Drawing from real-world commercialization experience, this presentation explores the dual pillars essential for breakthrough success: compelling emotional storytelling that inspires change, paired with clear economic opportunity that returns shareholder value. Traditional approaches often fail by relying on fear- or guilt-based motivation that reinforces status quo thinking. This requires demonstrating not just environmental benefits, but tangible performance improvements and cost advantages. The presentation examines critical scaling milestones—from pilot production through commercial manufacturing—using Holiferm's sophorolipid biosurfactants as a case study. Key learnings include achieving performance parity or superiority across diverse applications (agriculture, personal care, home cleaning solutions), while delivering measurable sustainability benefits like 1.5 tonnes CO_2 savings per tonne versus petrochemical alternatives. Commercial success hinges on three interconnected elements: developing performance products that outcompete incumbents, achieving scale at competitive costs, and inspiring further market innovations. The path forward for industrial biotechnology requires accepting that technical excellence alone is insufficient—market transformation demands addressing both emotional and economic drivers that influence adoption decisions across the entire value chain.

15 Organic waste as a feedstock for bio industries

Mark Richmond, WRM

Mark will provide an overview of the sources of organic wastes that are currently used and have potential as feedstock for bio-industries, with segmentation of priority waste streams. He will examine current market volumes and will address growth and reduction potential in response to waste management policy drivers. His presentation shall conclude by addressing the policy and conceptual drivers that look to valorise organic waste from their legacy treatment routes.

16 Feeding people first: Why edible surplus belongs on plates

Vic Harper, The Bread and Butter Thing

Anaerobic digestion (AD) has become the default option for surplus food because it is easy and can generate a revenue stream. For producers and retailers, sending food to digesters offers a simple waste management solution with minimal reputational or operational risk. By contrast, redistribution requires surpluses to remain food safe. It can look hard in comparison.

But convenience is not the same as best practice. The food waste hierarchy is clear: edible food should feed people first, then animals, before being diverted into energy recovery. Yet in practice, those priorities are often ignored. Subsidies and commercial incentives make it more attractive and convenient to send food to AD than to support redistribution. The result is that good food, fit for human consumption, is routinely wasted under the banner of sustainability.

At The Bread and Butter Thing (TBBT), we see every day how redistribution can work at scale. We supply affordable food to more than 100,000 families across England, improving diets and reducing stress, while tackling waste at its source. We know redistribution is harder to manage than AD - but harder does not mean less valuable. Arguably, the social and environmental return is greater.

Our proposition is simple: align policy and incentives with the waste hierarchy. Feeding people first is not just a moral imperative, it is an environmental one. Academics and policymakers alike have the evidence and influence to shift this balance - and build a food system that values people and planet in equal measure.

17 Barriers and enablers for further segregation at source

Paul Buxton, Samworth Brothers

At Samworth Brothers our purpose is 'we do good things with great food.' Therefore, we are committed to reducing food waste within our operations and the wider supply chain. However, food waste is generated, and we must manage this waste out of our facilities in the most sustainable way possible.

The segregation of this food waste is complicated by the variability in waste volumes and composition-ranging from protein to vegetable matter and carbohydrate-based waste such as bread. This complexity demands tailored handling and disposal processes, which can strain existing infrastructure and capabilities.

Segregation processes must not compromise food safety, hygiene standards or introduce cross-contamination risks, particularly in high-care environments. Additionally, the lack of consistent waste streams and the dynamic nature of production schedules further complicate standardisation efforts.

However, several enablers support progress. These include increased regulatory and stakeholder pressure for sustainable practices, technological advancements in waste tracking and processing, and growing internal awareness of environmental impact. Investment in staff training, waste reduction projects and collaboration with waste management partners can unlock efficiencies and improve compliance. Digital tools and data analytics also offer potential to monitor waste generation patterns and optimise segregation strategies.

Success will depend on cross-functional alignment, agile process design, and a commitment to continuous improvement in sustainability performance.

18 Influence of bioeconomy policies in valorisation of beet and cane bagasse

Maureen Okibe, University of Surrey

Sugar crops (sugarcane and sugar beet) are renewable, carbon-depleting plants. Cane and beet are predominantly cultivated in over 100 countries from parts of Europe, Russia, Africa, Central and South America, USA, Caribbean, Asia, and Australia. Sugar mills around the globe are struggling financially following fluctuating sugar prices leading to significant decline in profitability margins. Bioeconomy initiatives create opportunities for revenue diversification, reusing byproducts from sugar processing mills, i.e., sugarcane bagasse (SCB) and sugar beet bagasse (SBB) for fuels, platform chemicals and power. SCB/SBB residues are fibrous, agro-industrial lignocellulosic biomass derived during sugar/ethanol production. SCB/SBB are generally burnt inefficiently in traditional boilers for cogeneration of heat and power. In some cases, these bagasse byproducts are dumped on landfill sites and arable farming lands without reaping the benefits of lignocellulosic biomass reuse. The aim of this work is to investigate the influence of bioeconomy policies on improved valorisation of SBB and SCB. This study surveys literature on SCB/SBB, classifying outcomes, researching national and regional bioeconomy policies of bagasse producing nations and evaluating the impact of policy interventions on lignocellulose reuse. In regions where bioeconomy policies are robust, i.e., Europe and EU innovative uses of bagasse byproducts are dense. In parts of Sub-Saharan Africa, i.e., West Africa and South Asia, i.e., Pakistan, where bioeconomic policies are deficient, optimal valorisation of these residues are minimal. Future work may identify macro-economic and environmental factors driving poor SCB reuse.

19 Engineering division of labour in *Yarrowia lipolytica* for polysaccharide degradation

Eliza Atkinson, Imperial College London

Agricultural and food wastes are a promising renewable, low-cost feedstock for bioproduction of value-added compounds. Creating a consolidated bioprocess using these complex substrates in a single microorganism is limited by metabolic burden; the overexpression of heterologous genes redirects endogenous resources from essential processes, thus reducing the growth and productivity of the cell.

Microbial consortia, employing division of labour (DOL) between cells, can mitigate this burden and achieve waste utilisation beyond that attainable in monocultures. In this project we investigate the use of DOL in consortia for the degradation of plant-derived polysaccharides by *Yarrowia lipolytica*, a promising host for a range of biotechnological applications.

20 Biomanufacturing chemicals using maritime waste feedstocks: Assessing the carbon footprint of pilot scale processes

Joe Penhaul Smith, Sustainable Extricko

In the maritime industry, synthetic textiles such as Dacron and composites such as glass reinforced polymers, have replaced the use of cotton, wood or steel across a range of vessel sizes since the 1960s. However, reliance upon these synthetic polymer textiles and composites has a range of challenges, in particular: waste. Waste during the manufacturing process and at the end of the product's life currently has limited, if any, solution at end of life apart from landfill or incineration. The breakdown of these wastes has been linked to the production of microplastics, microfibres and leaching of heavy metals into the surrounding environment (Lekshmi et al. 2023; Hopkinson et al. 2021; Ciocan et al. 2024; Geraghty et al. 2025). As a result, recycling solutions which can reduce the flow of these textiles and composites to landfill are critical.

Current recycling solutions such as mechanical, chemical or pyrolytic are limited in their application, as these textiles and composites are chemically complex and often coated with additional products to render them more resistant to UV or salt damage. As a result, Sustainable Extricko and the Sadler lab in the University of Edinburgh have combined a novel recycling solution for these textiles and composites (pressolysis), with a metabolic upcycling solution, to valorise the recovered chemical monomers. To understand the potential of such solutions to address this waste stream, the carbon footprint of this process was quantified and contextualised to address this kiloton waste stream in the UK.

21 Chitin-degrading enzymes: Potential tools for wide biotechnological applications

Mohammad Dadashipo, Teesside University

Chitin, a linear polymer of β-1,4-linked N-acetylglucosamine (GlcNAc) residues, is the second most abundant polysaccharide in nature following cellulose. This biopolymer is a fundamental structural component in diverse organisms, including the exoskeletons of insects and crustaceans, the cell walls of fungi, and certain internal structures of invertebrates. Unlike petrochemical-based polymers (e.g., PET), natural carbohydrate polymers, e.g., cellulose and chitin, have been efficiently degraded in nature, which is in line with the lack of any report on a major accumulation of them on the planet. Enzymes capable of breaking down chitin are gaining increasing recognition for their diverse applications across various industrial and scientific fields, such as biotechnology, agriculture, medicine, and environmental management. The abundance and inherent resilience of chitin underscore the importance of chitin-degrading enzymes for natural nutrient recycling and industrial processes aiming to valorise chitinous waste streams. The escalating interest in these enzymes reflects a growing awareness of their potential to address significant global challenges in areas such as sustainable agriculture, effective waste management, and advancements in human health.

This short presentation comprises an introduction on chitin-degrading enzymes, including chitinases, their existing and potential applications and hurdles in their wide usage, along with some screening results from terrestrial and seawater sources in northern England.

22 Characterisation of novel biocatalysts with unique properties towards sustainable biocatalysis

Henry Madubuike, University of Salford

The sustainable valorisation of biomass into fuels and high-value chemicals requires the action of specialised enzymes with unique properties. Accessory enzymes such as arabinofuranosidases relax the intricate polymer structure of lignocellulosic biomass, thereby improving the efficiency of backbone-acting enzymes, and the release of substrates for the synthesis of platform chemicals. In this study, we report the characterisation of a novel arabinofuranosidase (*KcArf*) mined from the gut microbiota of the common black slug. The DNA sequence of *KcArf* was cloned in *pET(21)b+*, and expressed recombinantly in *Escherichia coli BL21* (DE3). The query sequence showed 100% sequence identity to an uncharacterized protein described as family 43 glyco-sylhydrolase from *Kluyvera cryocrescens* hence

the protein is designated *KcArf*. Homology mod-elling and multiple sequence alignment showed the presence of catalytic residues reported in the activity of arabinofuranosidase family. *KcArf* was active on 4-nitrophenyl-α-L-arabinofuranoside (specific activity- 0.185 U/mg) and showed optimal temperature of 30°C, optimal pH of 7, and Km value of 0.84 µmol. *KcArf* showed measurable activity when tested on xylosidase and rhamno-sidase substrates suggesting multifunctionality. *KcArf* was active on linear 1,5 α-L-arabinan, and debranched arabinan but no activity was detected when tested on arabinoxylan confirming *KcArf* as an exo-1,5-α-L-arabinofuranosidase. The characterization of *KcArf* presents interesting prop-erties suitable for developing a sustainable route to biomass valorisation which supports the prospect of producing molecules with reduced environmental and energy impact.

23 Developing frameworks that deliver whole-system sustainability benefits for the bioeconomy

Daniel Taylor, Aston University

The development of net zero has focused minds on carbon balances, and the potential for biomass use to generate negative emissions, but optimising systems to maximise carbon removals risks unsustainable biomass use. In contrast, developing a sustainable bioeconomy that delivers benefits across the value-chain will present challenges and trade-offs to policy practitioners who are seeking to achieve a singular net zero target. Sustainability assessment tools, such as the Supergen Bioeconomy Sustainability Indicator Model (BSIM), demonstrate and quantify the opportunities and risks associated with biomass use to support decision-making.

But going beyond sustainability assessment, this research seeks to understand what the enabling environment for policy needs to deliver whole system sustainability that goes further than a singular goal. It will also address how the interfaces between individual indicators of bioeconomy sustainability determine the overall system sustainability. The aim is to support policy design and decision making in navigating the complex and tricky trade-offs associated with biomass use, which links our environment, economy, and society.

This presentation will briefly contextualise interdisciplinary work on the bioeconomy, sustainability, net zero and policy completed to date, as well as outlining our plans to develop new frameworks that support the delivery of sustainability benefits across the whole bioeconomy system.

24 Developing a biological route towards the green solvent anisole using *Pseudomonas putida*

Micaela Chacon, University of Manchester

Anisole is a biodegradable, non-toxic solvent with wide industrial utility across electronics, coatings, and fine chemicals. Its low flammability, phase-separation properties, and favourable sustainability score on solvent selection guides make it a strong candidate to replace more hazardous solvents like chlorobenzene. Despite its potential, anisole is currently derived solely from petrochemical feedstocks, and no biological production route has previously been demonstrated.

Here we developed the first microbial platform for anisole production by engineering *Pseudomonas putida* with a modular biosynthetic pathway capable of converting lignocellulose-derived sugars and aromatics into anisole. Strain development focused on enabling mixed-substrate metabolism and redirecting carbon flux toward aromatic precursor formation via the shikimate pathway. Small-scale fermentations confirmed pathway functionality and identified feedstock compositions – closely resembling real lignocellulose hydrolysates – that support improved titres and process relevance.

This project demonstrates the feasibility of bio-based anisole production and lays the groundwork for further optimisation, scale-up, and integrated sustainability assessment.

25 Synthetic organelles to convert lignocellulosic biomass into chemical wealth

Mauro Rinaldi, University of Hull

Our society urgently needs to transition away from petrochemicals in the manufacture of high-value chemicals to meet sustainability and carbon goals. These everyday chemicals include medicines, agrichemicals, and flavours and fragrances. Because the manufacture of carbon-based chemicals cannot itself be decarbonised, biomass is the only abundant alternative—yet bio-based conversion is challenging and yields are often low.

We addressed this by partnering with Lixea, who specialise in purifying cellulose from forestry residues. Using Lixea's cellulose as feedstock, we established saccharification and fermentation conditions that supported robust microbial growth and chemical production comparable to conventional sugar feedstocks at lab scale and in 1-L bioreactors.

To overcome product toxicity and improve titres, we evaluated engineering biology strategies that create subcellular compartments ("synthetic organelles") to sequester hydrophobic products. As a result, we obtained higher titres for some high-value chemicals.

These bio-produced chemicals will supply a large chemical manufacturer like Croda with renewable carbon—sustainable chemicals that can be incorporated into their processes and products to meet the demand from a more responsible consumer culture. We will thus build a whole supply chain and give industrial partners competitive advantages. In collaboration with chemical engineers, we have begun preliminary techno-economic and life-cycle assessments to guide future development.

Overall, our results demonstrate the feasibility of converting purified lignocellulosic biomass into high-value chemicals via microbial fermentation and show a clear path to integrating renewable carbon into real-world products.

26 Novel valorisation routes of red seaweeds

Federico Sabbadin, University of York

This project focused on unlocking the potential of UK-cultivated red seaweeds (*Palmaria* and *Porphyra*) as sustainable sources of valuable bioactive compounds and protein, in collaboration with The Cornish Seaweed Company and The UK Agri-Tech Centre.

Detailed chemical analysis of the seaweed biomass provided critical insights into their composition, informing further processing and product development strategies. Using advanced microwave-assisted extraction combined with enzymatic treatments, we developed scalable methods to efficiently extract functional oligosaccharides. These molecules were shown to support the growth of beneficial gut bacteria, highlighting their potential as prebiotics for improving human and animal health. In addition to these nutraceutical applications, we explored the use of red seaweed as a sustainable feed for black soldier fly larvae, an emerging eco-friendly protein source for poultry, fish farming, and pet food. The larvae fed on seaweed performed comparably to those given conventional, more expensive feeds, suggesting a promising route to valorise seaweed biomass within circular bioeconomy models.

Overall, the project has paved the way for new sustainable bioproducts from UK seaweeds, contributing to the development of greener food systems, novel health ingredients, and alternative protein sources.

27 De-centralised flower waste biorefinery: Towards continuous supply of feedstock for the fine chemical industry

Parimala Shivaprasad, University of Nottingham

The transition to a circular bioeconomy requires scalable technologies that valorise non-food biomass into high-value chemicals. Floral waste, which is generated globally in large volumes, is rich in terpene-based compounds that can serve as precursors for fragrance and bioactive ingredients in the home and personal care sector. This talk will present a circular biorefinery approach that integrates enzymatic catalysis, microbial fermentation and intensified reactor design to convert crude flower oils and spent biomass into functional ingredients. The outcomes from reaction optimisation, biocatalyst performance in multi-substrate systems and the techno-economic feasibility of deploying decentralised, point-of-source biorefinery systems will be presented in the talk.

28 Pulcherrimin: A bio-derived mineral catalyst for 5-HMF oxidation

Jonathan Wagner, Loughborough University

As we seek to reduce our dependence on fossil fuels and move towards a more circular process, interest in bio-based feedstocks is continuously increasing. However, current approaches continue to employ conventional noble or transition metal catalysts, developed for fossil-based chemistry, which may be less effective for the transformation of oxygen-rich bio-derived compounds.

Here, we explore the use of the bio-derived iron chelate pulcherrimin as a novel, recyclable catalyst for the base-free oxidation of 5-hydroxymethylfurfural (5-HMF) into 2,4-furandicarboxylic acid (FDCA).

We demonstrate pulcherrimin's catalytic performance, stability over multiple cycles, and its techno-economic viability compared to conventional Pt/C systems. Despite lower surface area and pore volume, pulcherrimin achieves competitive FDCA yields without requiring alkaline conditions. A detailed cost and energy analysis reveals significant advantages in catalyst production and regeneration, with an E-factor highlighting its low environmental impact. This work positions pulcherrimin as a promising candidate for scalable, green FDCA synthesis from biomass-derived feedstocks.

29 Anaerobic fermentation working group

Yue Zhang, University of Southampton

Mixed-culture anaerobic fermentation (AF) is an enabling bioprocess with significant potential to valorise a wide range of unavoidable, heterogeneous organic wastes and residues. Its strength lies in the metabolic versatility of the microbial community, which can convert diverse substrates into a single major product group: volatile fatty acids which represent an underexplored yet promising platform for biorefinery development. In parallel, essential plant nutrients locked within the biomass are released into the fermentation broth, offering opportunities for nutrient recovery and the creation of an additional value stream.

This approach can therefore be regarded as a "dirty" biorefinery, where mixed organic waste streams can be processed without the need for pre-sterilisation, due to the robustness and resilience of the microbial consortia. This operational flexibility, however, introduces complexity in process control and optimisation. The performance of AF is very dependent on microbial ecology, the dynamic interactions between the microbiome and its engineered environment, substrate characteristics, and the integration of production with downstream extraction processes. These factors collectively influence process efficiency and whole-system optimisation.

It is our collective aim to accelerate the implementation of AF-based systems for value recovery from diverse putrescible waste streams, including agro-industrial residues, food waste, wastewater biosolids, and residuals from existing biorefineries. This presentation will provide an overview of the working group's recent activities and outline areas for future focus.

30 Integrating thermal and bio-conversion and the future of the EBNet biochar working group

Meredith Barr, London South Bank University

The integration of thermal, thermochemical, and biological conversion technologies is emerging as a critical opportunity to enhance the environmental and economic performance of waste and biomass valorisation. In February 2025, the EBNet Biochars for Pollution Prevention Working Group hosted a two-day workshop, co-funded with BBNet, to scope this field and identify research, enterprise, and regulatory priorities. Experts from academia, industry, and policy contributed through research presentations, consensus-building activities, and an industry panel discussion. Priority pathways highlighted included valorisation of anaerobic digestion residues through hydrothermal carbonisation and pyrolysis, the use of biochar in soil and wastewater microbiome engineering, and the application of hydrothermal pretreatments to bioconversion feedstocks. These were perceived to offer high potential in terms of ecological benefits, market disruption, and waste valorisation. Panel discussions underscored both the opportunities for circularity, multi-output value chains, and decentralised integration, and the challenges posed by regulatory misalignment, knowledge gaps, and the complexity of scaling integrated systems.

As EBNet approaches its conclusion in January 2026, the Biochar Working Group will continue as a community of practice, maintaining its mailing list to foster communication and knowledge exchange. We are also exploring avenues for future collaboration and funding to sustain momentum and support the growing community engaged in advancing integrated biochar and bioconversion technologies.

31 The Continuous Bioflow Network

Sebastian Cosgrove, Keele University

The Continuous BioFlow Network was established in January 2025 thanks to funding from BBNet and the RSC. The network is focussed on promoting the use of flow biocatalysis and biomanufacturing, bringing like minded individuals together from across UK academia and industry, with the kick off meeting attracting over 80 attendees. This talk will discuss the founding of this network and the future aims, and how BBNet enabled this.

32 Mission Innovation: Integrated biorefineries mission for fuels and chemicals

Kees Kwant, Rijksdienst voor Ondernemend Nederland (Netherlands Enterprise Agency)

The Integrated Biorefineries Mission offers the opportunity to support the development of bio-based Sustainable Fuels and Chemicals. It is part of Part of Mission Innovation, an international initiative to support innovation to a net-zero economy.

Participants in this mission are Brazil, Canada, India, European Commission, the Netherlands, the UK and Switzerland, but the mission is open to new members. The co-leads of this mission are India and the Netherlands.

Mission Innovation is a governmental collaboration, but acts in close collaboration with industry, research institutes and other international bodies. This collaboration has led to the formulation of a roadmap and organizing national consultations and webinars. There is ongoing collaboration on innovation in Sustainable Aviation Fuels, Biopolymers, Financing opportunities, Standards, Sustainability and improved Market conditions.

In 2024 a start was made with matchmaking researchers and industries from the participating countries through the digital tool B2Match. International collaboration around research, development, and demonstration (RD&D) for fuels and chemicals will help to accelerate their production at commercial scale. This will be expanded in 2025.

You can follow this mission on Linked In: Integrated Biorefineries Mission | LinkedIn

More info: Mission Innovation (mission-innovation.net)

33 Biorefining landscape report - A review of biorefining in the UK

Adrian Higson, Director, Alder BioInsights

This study, commissioned by BBNet, will provide a comprehensive landscape and opportunity analysis of the UK biorefining sector from 2014 to 2024. The research assesses the progress, challenges, and future priorities of the industry since the inception of the BBSRC Networks in Industrial Biotechnology and Bioenergy (NIBBs) and will map the evolution of the UK's biorefining ecosystem, highlighting key investments, policy developments, and regulatory changes in a global context.

The report will share insights on technical barriers, commercialisation achievements, and challenges related to process scale-up, and will assess trends in revenue, employment, and private investment.

Due to be launched in December, the report will offer a set of strategic recommendations for industry, research funders, and government policymakers, with the objective of informing future actions that will drive technological innovation and commercial exploitation, ultimately enhancing the UK's position as a global leader in the sustainable bioeconomy. This presentation will share the preliminary findings which aim to provide a critical evidence base for shaping the future direction of the biorefining sector in the UK.

34 The UK bio-based sector - where are we, and where are we headed?

Jen Vanderhoven, BBIA

This session will examine how UK policy and regulation are shaping the growth of the bio-based sector. It will explore the current landscape, and highlight the opportunities created by supportive frameworks and the challenges posed by regulatory gaps or uncertainty.

35 BBSRC Forward Look and funding opportunities

Stephen Webb, BBSRC

BBSRC recently published its revised Forward Look, which I will present in the context of industrial biotechnology. I will also review key drivers and constraints for BBSRC spending plans and current funding opportunities from across UKRI.

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Poster abstracts

P01 Mapping food waste disposal: Identifying gaps and strategies for sustainable management in North East England

Louise Amor-Seabrooke, Sharon Velasquez Orta

In the UK, approximately one third of household and agricultural food waste is sent to landfills, where it decomposes to release methane, a greenhouse gas significantly more potent than carbon dioxide. This research investigates the gaps in food waste collection and reporting by local authorities in North East England, as currently none track or report their food waste volumes to the Department of Environmental, Food and Rural Affairs (DEFRA). The study aims to analyse existing data to identify authorities lacking effective food waste disposal strategies and assess the overall volume of food waste being sent to landfill. By mapping these deficiencies, the research highlights the importance of improved data collection for developing sustainable waste management solutions and achieving the UK government's goal to halve food waste to landfill by 2030. This work aims to provide a clearer understanding of food waste disposal across North East England, facilitating the development of strategies for recycling and recovery, and ultimately supporting the potential production of bioethanol from food waste.

P02 Engineering division of labour in *Yarrowia lipolytica* for polysaccharide degradation

Eliza Atkinson, Guy-Bart Stan, Rodrigo Ledesma-Amaro

Agricultural and food wastes are a promising renewable, low-cost feedstock for bioproduction of value-added compounds. Creating a consolidated bioprocess using these complex substrates in a single microorganism is limited by metabolic burden; the overexpression of heterologous genes redirects endogenous resources from essential processes, thus reducing the growth and productivity of the cell. Microbial consortia, employing division of labour (DOL) between cells, can mitigate this burden and achieve waste utilisation beyond that attainable in monocultures. In this project we investigate the use of DOL in consortia for the degradation of plant-derived polysaccharides by *Yarrowia lipolytica*, a promising host for a range of biotechnological applications.

P03 Partnership on valorisation of crop wastes to address climate challenges in agriculture

Eleanor Binner, Erkan Senses, Yujie Mao, Paul Berlu

We would like to share details of our British Council International Science Partnerships Fund (ISPF) Grant for International Research Empowerment entitled "Partnership on Valorisation of Crop Wastes to Address Climate Challenges in Agriculture". The project focuses on strengthening knowledge and research capabilities between the University of Nottingham and Koç University (Türkiye) to address environmental and agricultural challenges driven by climate-change. The collaboration aims to improve the valorisation of agricultural waste, particularly residues like corn and sunflower stalks with high lignocellulosic content, by developing high-value materials and provide a showcase for their applications in agriculture.

The project is structured around three key objectives: use of microwave technology and environmentally friendly deep eutectic solvents to extract cellulose from agricultural waste; creation of high-value nanocellulose-based hydrogels, which can act as soil conditioners to retain water and fertilisers, especially important for regions facing water scarcity, and application of hydrogels into soil in real and simulated drought settings.

P04 Complex waste stream valorisation through combined enzymatic hydrolysis and catabolic assimilation by *Pseudomonas putida*

Micaela Chacon, Guadalupe Alvarez Gonzalez, Piya Gosalvitr, Adokiye Berepiki, Karl Fisher, Rosa Cuéllar-Franca, Neil Dixon

Biogenic waste-derived feedstocks for production of fuels, chemicals, and materials offer great potential supporting the transition to net-zero and greater circularity. However, such feedstocks are heterogeneous and subject to geographical and seasonal variability. Here, we show that, through careful strain selection and metabolic engineering, *Pseudomonas putida* can be employed to permit efficient co-utilisation of highly heterogeneous substrate compositions derived from hydrolysed mixed municipal-like waste fractions (food, plastic, organic, paper, cardboard, and textiles) for growth and synthesis of exemplar bioproducts (a biopolymer and a human therapeutic protein). Design of experiments was employed to explore the combinatorial space of nine waste-derived monomers, with *P. putida* displaying robust catabolic efficiency regardless of substrate composition. Prospective Life-Cycle Assessment (LCA) and Life-Cycle Costing (LCC) illustrated the climate change (CC) and economic advantages of biomanufacturing compared with conventional waste treatment options, demonstrating a 41–62% potential reduction in CC impact. This work demonstrates the potential for expanding treatment strategies for mixed waste to include engineered microbes.

P05 Analytical tools for supporting biorefining: Assessing the degradability of Polysaccharide-based polymers

Prabodhi Preethika, Russell Davenport, Kathleen Mcdonough, Jennifer Menzies

Polysaccharide-based polymers are increasingly recognised as promising renewable feedstocks for biorefining, due to their biodegradability and bio-based origins. However, their high molecular weight and structural complexity present challenges for standardised biodegradation tests, which are typically optimised for low molecular weight compounds. Addressing these limitations is essential for assessing environmental fate and guiding the design of next-generation sustainable materials.

This project focuses on developing analytical workflows to evaluate the degradability of water-soluble polysaccharides, including both unmodified and chemically modified variants. Unmodified pullulan and dextran were selected as initial polymers. A tiered analytical approach was implemented, starting with rapid enzymatic degradation assays followed by screening techniques such as thin-layer chromatography and 96-well plate-based colorimetric detection to monitor the release of mono/oligosaccharides. To improve analytical resolution, Ultra-High Performance Liquid Chromatography with Charged Aerosol Detection was employed, achieving a limit of detection of 15 µg/mL and a limit of quantification of 20 µg/mL for selected saccharides. Additional techniques, including derivatisation-based UHPLC-DAD and LC-MS, are being optimised for compatibility with more complex degradation matrices.

The developed methods provide scalable tools for characterising biodegradable polymer feedstocks, supporting sustainable material design and circular bio-economy goals. Future work will apply these workflows to additional modified polysaccharides (including carboxymethyl cellulose and cationic pullulan) to explore the impact of chemical structure on degradability.

P06 Digitalisation of the bioenergy sector: Insights from industrial surveys and workshops

Benaissa Dekhici, Michael Short

The global transition to sustainable energy systems hinges on advancing bioenergy through digitalisation. This study explores the challenges and opportunities of integrating digital technologies, such as Artificial Intelligence (AI) and digital twins, into bioenergy processes, using a mixed-method approach combining insights from an academic/industrial workshop (80+ participants) and a targeted industrial survey (22 industry stakeholders), where the authors asked for participants to identify challenges and opportunities. Findings reveal significant and diverse barriers, including fragmented data infrastructure, skills gaps in using digital tools, and institutional resistance, alongside opportunities for AI-driven process optimisation, real-time monitoring and control, and supply chain transparency via digital passports. The study highlights the need for interdisciplinary collaboration, open data frameworks, policy incentives, and new tools needed to bridge lab-scale innovation and industrial

implementation. By addressing these challenges, the bioenergy sector can leverage digitalisation to enhance efficiency, scalability, and sustainability, aligning with the UK's mission to reach its net-zero target.

P07 Turning floral waste into profit: A techno-economic assessment of rose oil-derived fragrance ingredients

Vipada Sansen, Ioanna Dimitriou

Terpenes are one of the most important and versatile compounds for the flavour and fragrance industries and are currently produced commercially using petrochemical-based starting materials and chemical catalysis routes. Flowers are an abundant source of terpenes, which can be tailored to a range of starting materials and are easy to process due to low lignin content. The UK generates 2.5 million tonnes of flower waste annually, much of which is discarded, despite its high potential as a renewable feedstock. This study presents a techno-economic analysis for producing terpene esters — specifically citronellyl acetate and geranyl acetate — via the transesterification of rose oil. The process was modelled using a process simulation software (Aspen Plus) to generate mass and energy balances, which were used as inputs for a costing model to assess the economic feasibility of the process. Our results show that the rose oil refinery achieves a positive net present value (NPV) by the end of the first year of operation. This early profitability is attributed to the high market prices of citronellyl acetate and mixed terpenes, resulting in revenues exceeding expenditures within the first year. The calculated minimum selling price to break even is £13.89/kg for citronellyl acetate and £6.94/kg for mixed terpenes. These are approximately 70% lower than their current market selling prices, indicating the significant economic potential of fragrance ingredients produced in flower waste biorefineries.

P08 Design of experiment driven optimisation of microbial conversion of agri-processing waste to fatty acids

Nichakorn Fungprasertkul, James Winterburn, Peter Martin

Unsaturated fatty acids are suggested as a primary source of fat consumption for humans by WHO as they can decrease the risk of heart diseases. The most significant by-product of rapeseed oil production is rapeseed meal (RSM), with approximately 39 million metric tons per annum produced. *Metchnikowia pulcherrima* is an under-explored oleaginous yeast with potential as a lipid producer by utilising biomass as a feedstock. The key factors for maximizing the lipid production by M. pulcherrima were identified and optimized by using Plackett-Burman design with multiple linear regression model and Box-Behnken design with quadratic model subsequently. Aspergillus oryzae was used for RSM hydrolysis (i.e., converting RSM to assimilable molecules for *M. pulcherrima*) in solid-state fermentation (SSF). SSF conditions were optimized by using five-factors Doehlert design with quadratic model. Carbon and nitrogen sources were identified as important factors for lipid production by *M. pulcherrima*. The optimal C:N ratio was at 28.58 (g carbon/g nitrogen). SSF time was identified as the important factor, and the optimal SSF time was at 3 days. *M. pulcherrima* utilised the hydrolysate and produced unsaturated fatty acids in 500 ml bioreactor which are 60% Oleic acid (C18:1) and 21% Linoleic acid (C18:2) of total fatty acids.

P09 Food waste valorisation: Guidance for decision-making in the selection of food waste management

Rendra Hakim Hafyan, Jhuma Sadhukhan, Siddharth Gadkari

A substantial volume of food waste (FW) poses serious challenges, including threats to biodiversity, economic loss, and environmental harm. Current FW management aims to reduce waste across the food supply chain. FW also offers potential for conversion into valuable products, presenting economic opportunities and reducing environmental burdens—key to a circular bioeconomy. Effective FW management requires structured assessment to limit impacts, boost economic returns, and ensure social acceptance. This is especially difficult in developing countries, where waste systems are underdeveloped, resources are limited, and public support is low. Decision-making in such settings is complex due to competing criteria, highlighting the need for advanced tools. Integrating sustainability evaluation with decision-making frameworks enables selection of optimal solutions.

This work explores value-added products from FW and FW biorefineries, focusing on economic and environmental aspects. It also examines integrated biorefinery strategies to improve sustainability. Finally, it emphasizes the need for decision-making approaches that balance economic, environmental, and social considerations for effective FW management.

P10 Assessing stakeholder perception and socio-economic readiness for rice straw valorisation in the Philippines: A gamified approach

Thea Mae Q. Baltazar, Czaneil C. Gomez, Mirjam Röder (presented by Catriona Heaton and Rebecca Fothergill)

Rice straw, often managed through environmentally damaging open burning, holds potential as a feedstock for bioenergy and bioproducts. While technology on biomass conversion has advanced, its deployment depends heavily on stakeholders' willingness, capacity, and perceived benefit of adopting such innovations.

The study delves into the socio-economic readiness of farmers, local policy actors, and service providers in four major rice-producing regions of the Philippines to engage with rice straw valorisation. A gamified participatory approach was developed to simulate decision-making in the value chain. The board game guided participants through structured discussions on the current practices, future innovations, and the associated resources, challenges and opportunities in the value chain. After which, participants ranked these identified resources, challenges and opportunities, and allocated tokens and bank notes to simulate which areas to prioritise and where they would invest limited capital.

The findings highlighted a nuanced landscape of cautious optimism, where participants showed openness to innovation, primarily when linked to income diversification and local benefit. However, challenges, such as climate change, limited access to financial capital, and irrigation water problems, were consistently identified as the most pressing constraints in rice farming. Major roadblocks to adoption include perceived cost and complexity, technical capacity, and uncertainties around technology performance. Should there be adequate support mechanisms in place, strong interest emerged in decentralised biogas systems and community-based models.

P11 Cultivation of chemoautotrophs on electricity and air

Robin Hoeven, James Winterburn

This is a proof of concept study that looks at ways to grow chemoautotrophic bacteria on electricity, either with a mediator molecule or via direct electron uptake from an electrode. We solely conduct experiments under aerobic conditions, as the main aim is to use CO_2 from air as the carbon source.

The current approach is doing an enrichment experiment of medium with the inoculum coming from environmental samples that are rich in chemoautotrophs (hot spring in Iceland). We run long (multiple weeks) chronoamperometry experiments either with or without aeration and we look for a downward trend in the current (consumption). Biomass that accumulates is sent for DNA analysis to investigate which species can grow electrotrophically. We aim to obtain a single species that we can continue to perform laboratory evolution on to improve growth rate and eventually genetically modify to produce a product.

Any help or suggestions are greatly appreciated, particularly with regard to the electrochemistry.

P12 Development of a lactic acid production platform from municipal solid waste derived carbohydrates

Alun Thomas Hughes, Dhivya Puri, David Bryant, Ana Winters, Joe Gallagher

Municipal solid waste (MSW) usually destined for landfill can often contain a wide variety of recyclable materials, such as metals, glass and plastics. Fiberight Ltd have developed the Hydracycle process to maximise recovery of these items and minimise landfill waste. During this process, a high cellulose fibre pulp is generated which can then be converted to fermentable sugars via a novel enzymatic hydrolysis strategy. In conjunction with Fiberight, the Biomass Conversion and Biorefining team

at Aberystwyth University have developed a highly productive, high yielding lactate fermentation strategy to produce high optical purity *L*(+) Lactic acid from the MSW derived sugar stream. Further to this downstream processing approaches including membrane separation, ion exchange and chromatographic separation technologies have been applied to the fermentation broth to increase product purity prior to further processing into a final product.

This technology has been operated at laboratory scale in 100mL to 10L scale in controlled Bioreactor systems within Aberystwyth University and recently at demonstration scale in 1000L reactors at the Centre For Process Innovation (CPI) as part of the Value Added Materials from Organic Waste Sugars (VAMOS) Bio-Based Industries Joint Undertaking project funded under the Horizon 2020 research and innovation programme.

P13 A comparative study of effects of microwave-assisted polyol and acid based deep eutectic solvents pretreatment on delignification and enzymatic digestibility of rice straw

Longinus Ifeanyi Igbojionu, Yujie Mao, Eleanor Binner, Alfred Fernandez-Castane

Lignocellulosic biomass (LCB), such as agricultural residue rich in cellulose and hemicellulose, can serve as a feedstock for bioethanol production due to its environmental benefits. Deep eutectic solvents (DES) are low-cost and greener solvents for LCB pretreatment. The present study investigated the efficiency of two DES types for rice straw pretreatment under microwave conditions: choline chloride:glycerol (ChCl:Gly) and choline chloride:formic acid (ChCl:FA). DES pretreatment was performed under microwave conditions (100-140°C and 5-15 min) at 10% solids loading and constant power 200W. After pretreatment, the samples were characterized, and enzymatic digestibility was investigated at 50°C for 72 h using enzyme loading of 6 filter paper unit (FPU) g-1 cellulose and 10% solids loading. Untreated rice straw consists of cellulose (41.8%), hemicellulose (24.9%), lignin (17.0%) and ash (15.0%). The cellulose content increased to 59.8% and 59.2% after ChCl:Gly and ChCl:FA pretreatment, respectively, while hemicellulose decreased to 15.6% and 10.1% after ChCl:Gly and ChCl:FA pretreatment, respectively. Lignin content decreased to 8.2% after ChCl:Gly pretreatment compared to 9.6% after ChCl:FA pretreatment. Ash content (20.4%) obtained after ChCl:FA pretreatment was higher than 20.4% obtained after ChCl:Gly pretreatment. The cellulosic and hemicellulose fractions from ChCl:Gly pretreatment were effectively hydrolyzed with glucose and xylose yield of 86.0% and 68.4%, respectively, compared to glucose and xylose yield of 58.2% and 62.8%, after ChCl:FA pretreatment. ChCl:Gly pretreatment enriched cellulosic content and preserved hemicellulose fraction, achieving a higher yield of fermentable sugars than ChCl:FA pretreatment; hence, it can potentially support a biorefinery.

P14 Feasibility study of domestic-scale anaerobic digestion: Enhancing biogas production through experimental and modelling approaches

Gina Javanbakht, John M Allport, Constanza Sadino, Andrés Donoso Bravo

Food waste is a major contributor to organic solid waste and a key environmental concern due to its disposal via landfill and incineration. Anaerobic digestion (AD) presents a promising method for converting this waste into renewable energy in the form of biogas. This study explores the feasibility of using domestic-scale AD systems to process household food waste for sustainable energy production and resource recovery. Conducted in partnership with modelling company Modela under the BBNet BIV scheme, this project combines experimental validation with advanced process modelling. The aim is to improve the efficiency and predictability of biogas production under typical household conditions, where feedstocks are mixed and variable. The University of Huddersfield leads the experimental work using the AD unit, supported by real-time measurements of biogas yield and digestate quality. By adapting and calibrating an ADM1-based model with experimental and historical data, this research addresses key challenges in scaling and optimizing AD systems for household and small-business use. The integrated model functions as a “virtual co-pilot,” helping to reduce reliance on frequent sampling and enabling more efficient feedstock selection and system control. Ultimately, this work contributes to sustainable waste management and energy generation, offering insights into the practical, financial, and environmental viability of small-scale AD technology.

P15 Co-cultivation of yeast and algae for enhanced lipid and metabolite production in an algal biorefinery framework

Ushna Khalid, Jon Pittman, Constantinos Theodoropoulos

The yeast and microalgae co-cultivation systems are gaining attention as advanced and promising sources of biofuel and metabolite production. This study is focused on a novel co-cultivation process which involves oleaginous yeast *Yarrowia lipolytica* with either *Chlorella vulgaris* or *Chlorella sorokiniana* to increase lipid and other high value metabolites productions. This research is built on some of our successful previous studies. The integration of both yeast and algae takes advantage of each other's complementary pathways, with yeast providing organic carbon and other growth increasing factors, while algae facilitate with oxygen and some essential metabolites through photosynthesis.

Multiple parameters optimisation was carried out, including different concentrations of carbon source, inoculum ratios and cultivation modes. The mixotrophic mode proved to be most effective, providing significantly higher yields of biomass and lipids with improved fatty acids composition in comparison to other modes. Individual fermentation of *Y. lipolytica* exhibited 5.5 g/L of biomass, while *C. vulgaris* and *C. sorokiniana* yielded biomass concentration of 4.87 g/L and 4.1 g/L respectively. However, co-cultivation has provided marked synergistic effects, with maximum DCW of 9.5 g/L and 8.8 g/L for Y. lipolytica + *C. vulgaris* and *Y. lipolytica* + *C. sorokiniana*. This increment in DCW highlights the benefits of co-cultivation over individual growth.

Other than lipids, the co-cultivation system also provided valuable co-products such as carotenoids, proteins, erythritol and chlorophyll. The system's versatility can be explained by its potential to be integrated into an algal biorefinery, enabling the biofuel production with valorisation of high value chemicals.

P16 Enzymatic degradation of man-made plastics

Zhaoyue Li

This project investigates the enzymatic degradation of man-made plastic. *Sphingobacterium sp.* T2 *MnSOD1* is a manganese superoxide dismutase, showing novel reactivity for lignin oxidation, that generates hydroxyl radical to attack lignin, and lignin model compounds. (Rashid et al., 2015; Rashid et al., 2018). Preliminary work (2020-2021) indicated that these enzymes show activity for breakdown of man-made plastics, such as polystyrene (PS), polyethylene terephthalate (PET), and thermoset plastics.

In 3-day incubations, increasing *MnSOD1* concentrations correlated with greater weight loss in thermoset plastics, consistent with enzyme-catalysed breakdown. Colorimetric assays (DNP/FCA) detected the release of aldehyde/ketone or phenolic products, further supporting the plastic degradation. Additionally, an aryl sulfotransferase (*AST*) enzyme was tested on thermoset plastic, showing a time- and enzyme concentration-dependent increase in DNP and FCA signals while the amount of *SOD1* fixed.

A set of isolated strains were also able to depolymerize size-fractionated high and low molecular weight Kraft lignin breakdown (Taylor et al., 2012). A 7-day co-culture experiment was conducted to explore the synergistic potential of *Sphingobacterium* with the other strains, including *Rhodococcus jostii* and *Agrobacterium*. For thermoset plastic, the combined cultures produced a higher FCA signal compared to the strains alone, suggesting enhanced depolymerization activity through microbial synergy. Other methods, such as FTIR, HPLC, GPC, and LC-MS, will further characterize the degradation products.

P17 Biochemical and functional characterisation of a novel arabinofuranosidase for sustainable biocatalysis

Henry Madubuike, Chinalurum Ichu, Lateefah Busari, Stephen Austin, Natalie Ferry

The sustainable valorisation of biomass into fuels and high-value chemicals requires the action of specialised enzymes. The activity of accessory enzymes such as arabinofuranosidase relaxes the intricate polymer structure of lignocellulosic biomass thereby improving the efficiency of back-bone-acting enzymes. In this study, we report the characterisation of a novel arabinofuranosidase (*KcArf*) mined from the gut microbiota of the common black slug. The homology model of *KcArf* developed *in-silico* was used for molecular dynamics simulation (MDS). The DNA sequence of *KcArf* was cloned in pET(21)b+, and expressed recombinantly in *Escherichia coli BL21* (DE3). The query sequence showed 100% sequence identity to an uncharacterized protein described as family 43 glycosylhydrolase from *Kluyvera cryocrescens* hence the protein is designated *KcArf*. Homology modelling showed the presence of catalytic residues reported in the activity of arab-inofuraniosidase family. *KcArf* showed activity in an assay with 4-nitrophenyl-α-L-arabinofuranosidase as substrate (specific activity- 0.185 U/mg). Biochemical characterization of *KcArf* showed optimal temperature of 30°C, optimal pH of 7, and Km value of 0.84 µmol. *KcArf* showed measurable activity when tested on xylosidase and rhamnosidase substrates suggesting multifunctionality. *KcArf* presents interesting characteristics suitable for developing a sustainable bioconversion route to biomass valorisation, and supports the prospect of producing molecules at high efficiency with reduced environmental and energy impact.

P18 Utilising BSFL as a chemical feedstock

Swathi Mukundan, Eleanor O'Doherty, James McGregor

The use of black soldier fly larvae (BSFL) in waste remediation and their application as a protein source, particularly in agriculture, is increasingly well established. BSFL however, also provides a unique opportunity as a sustainable chemical feedstock for the production of fuels and value-added chemicals such as surfactants. Fats derived from BSFL exhibit a composition similar to vegetable oils such as palm kernel, coconut or corn oils. 30-40% of the BSFL biomass can comprise these valuable lipids, while their ability to be reared on waste or low-value organic feedstocks sites this process firmly within the frameworks of a circular economy.

This work demonstrates the successful synthesis of a number of products from BSFL. Our work calculates that the energy yield per unit area of biofuel derived from BSFL-lipids can be up to 55.8 MJ m-2, over twice that of miscanthus, often described as the most efficient energy crop. Furthermore, we have demonstrated through laboratory studies the successful conversion of BSFL-derived FAMEs to a wide range of anionic, cationic and non-ionic surfactants with current and wide-ranging applications in the consumer goods sector.

In addition to the conversion of BSFL-derived lipids we have also demonstrated applications of another major component of BSFL: chitin. Chitosan produced from chitin has successfully been shown to act as an adsorbent, catalyst and as an additive in soil strengthening for infrastructure applications.

The application of BSFL as a chemical feedstock has the potential to improve the economics of waste remediation and protein production processes, while providing a more sustainable and highly scalable approach to the production of fuels and chemicals with-out reliance on fossil sources or vegetable oils.

P19 A diverse *[FeFe]-hydrogenase* repertoire supports H_2 metabolism during dark fermentation

Abdulrahman Alogaidi, Sabrina Dezzani, Anca Pordea, John Heap, Simone Morra

Hydrogen metabolism plays a crucial role for a variety of anaerobic microorganisms, some of which are capable of coupling H_2 production to effective degradation of various types of biomass (so-called fermentative bio-hydrogen). In addition to H_2, dark fermentation also leads to several by-products that are valuable in a biorefinery context.

H_2 metabolism is enabled by specialised enzymes named *[FeFe]-hydrogenases*, *[NiFe]-hydrogenases*, and *[Fe]-hydrogenases* alongside, in some organisms, nitrogenases. Most species possess multiple genes (between 2-10) that contribute to H_2 production or its uptake, in a complex redox balance that

interplays with overall energy metabolism. The exact role of each enzyme is not fully understood.

This poster will present current efforts at characterising the diversity of *[FeFe]-hydrogenases* in model species from the genus *Clostridium*, including their functional regulation during fermentation. *C. acetobutylicum* and *C. beijerinckii* are well-known for solvent production (acetone, butanol, ethanol - ABE) and they are also good H_2 producers, being frequently found in mixed consortia established in pilot-scale bio-hydrogen reactors.

We provide the full biochemical investigation of 8 different *[FeFe]-hydrogenases* from these two model organisms. We also provide the first comprehensive investigation of the functional regulation of all 4 enzymes responsible for H_2 metabolism in *C. acetobutylicum*, *[FeFe]-hydrogenases CaHydA1*, *CaHydA2*, *[NiFe]-hydrogenase MBH*, and nitrogenase. A deeper understanding of the specific function of each hydrogenase will expand our understanding of H_2 metabolism, leading to better strategies for engineering H_2 biology and future applications.

P20 The forgotten half of the harvest

Alexander Nicholls, Tom Simmons

Despite the abundance of sugar-free drinks, the food industry still cannot economically produce sugar-free foods like cookies and cakes. Artificial sweeteners can provide intense sweetness, but not texture, mouthfeel or colour. Food ingredients have one thing in common: they derive from just one part of the crop. Sugar cane, one of the worst offenders, only uses about 22% of the material harvested. The remaining biomass is mostly wasted. Biomass is largely made of fiber which is a core macronutrient we don't get enough of. At the Supplant Company, we make use of Enzymatic Biotechnology to process the biomass side-streams into fibre rich ingredients for the food industry such as sugars and flour. We use engineering biotechnology to transform under-utilised plant matter into value-add food, addressing poor nutrition, environmental impact and food insecurity in our food system.

P21 Influence of bioeconomy policies on biorefining bagasse byproducts

Maureen Chiebonam Okibe, Michael Short, Franjo Cecelja, Madeleine Bussemaker

Sugar crops (sugarcane and sugar beet) are renewable, carbon-depleting plants. Cane and beet are predominantly cultivated in over 100 countries from parts of Europe, Russia, Africa, Central and South America, USA, Caribbean, Asia, and Australia. Sugar mills around the globe are struggling financially following fluctuating sugar prices leading to significant decline in profitability margins. Bioeconomy initiatives create opportunities for revenue diversification, reusing byproducts from sugar processing mills, i.e., sugarcane bagasse (SCB) and sugar beet bagasse (SBB) valorisation for fuels, platform chemicals and power. SCB/SBB residues are fibrous, agro-industrial lignocellulosic biomass derived during sugar/ethanol production. They are burned in traditional boilers for cogeneration of heat and power. In some cases, these bagasse byproducts are dumped on landfill sites and arable farming lands without reaping the benefits of lignocellulosic biomass reuse. These non-edible residues have gained traction in biorefining domains for numerous green applications in chemical, pharmaceutical and energy industries. The reuse of these bagasse byproducts supports modern bioeconomy focusing on delivering economic and environmental benefits by minimizing wastes and replacing fossil-based materials with sustainable alternatives. This study surveys scholarly literature on SCB/SBB, researching national and regional bioeconomy policies of bagasse producing nations, evaluating the impact of policy intervention on lignocellulose reuse.

P22 Yeast-based biosurfactant production: A sustainable approach for future biorefineries

Walid Omara

With increasing global concern over environmental contamination from oil spills and industrial pollutants, biosurfactants have emerged as eco-friendly alternatives to synthetic surfactants. This study explores the biosynthesis of biosurfactants using non-pathogenic yeasts, particularly Saccharomyces cerevisiae, as a viable and scalable strategy for bioremediation and biorefinery applications. Unlike traditional petroleum-based surfactants, yeast-derived biosurfactants—primarily

glycolipids and glycoproteins—exhibit high emulsification activity and surface tension reduction, making them suitable for use in oil spill cleanup and heavy metal remediation.

Biosurfactants were produced using hydrophilic (e.g., glucose) and hydrophobic (e.g., hydrocarbons) substrates, linking glycolytic, lipogenic, and TCA pathways in metabolite synthesis. Preliminary biochemical analyses revealed promising surface-active properties, comparable to commercial standards like Triton X-100. In addition to phenotypic evaluation, genetic expression studies using RT-qPCR highlighted pathway activity associated with biosurfactant production, laying a foundation for targeted metabolic engineering.

This research supports the integration of yeast-based biosurfactant production into future biorefinery models, utilising low-cost and renewable feedstocks. By optimising production conditions and uncovering key genetic pathways, we contribute to the advancement of sustainable bioprocesses in line with circular economy principles and the growing demand for green technologies.

P23 Biomass valorisation and high-purity cellulose production using a cost-effective protic ionic liquid

Cariny Polesca, Suhaib Nisar, Antonio Ovejero-Pérez, Jason P. Hallett

Lignocellulosic biomass is a renewable resource for bio-based materials. Among its components, cellulose is especially valuable, but its recovery requires the development of efficient strategies to replace toxic solvents while valorising all compounds. Protic Ionic liquids (PILs) offer a promising alternative for lignin and hemicellulose dissolution while leaving a cellulose-rich pulp as solid residue. Nevertheless, recent findings from our group have highlighted the importance of developing pulp washing protocols to reduce residual lignin content and minimise water requirements. In this study, we used a low-cost PIL, N,N,N-dimethylbutylammonium hydrogen sulphate ([DMBA][HSO4], 80 wt% in water), in a two-step process. After biomass pretreatment, a second washing step using the same IL was optimised to improve pulp purity. A statistical design of experiments was applied, evaluating the IL concentration, pulp: IL ratio, and temperature. The composition of the obtained pulps was evaluated through compositional analysis, Kappa number, and near-infrared (NIR) spectroscopy. Under optimal conditions, a high-purity cellulose pulp containing ~2% residual lignin was obtained. This approach demonstrates how a single, cost-effective protic IL can be efficiently used for both biomass fractionation and pulp purification, providing a more sustainable pathway for lignocellulosic biomass valorisation in the biorefinery process. Additionally, the purified cellulose pulp is being explored for the development of advanced materials, expanding its potential applications in sustainable materials science.

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P24 Biovalorisation of municipal wastewater via microalgae cultivation into sustainable biofertiliser

Nayab Raza, Jon Pittmann, Giles Johnson, Constantinos Theodoropoulos

This study has explored the integration of microalgal nutrient-rich biomass as biofertiliser after cultivating native microalgae species into municipal wastewater. Utilising microalgae in municipal wastewater treatment is seen as a sustainable approach towards the green circular economy, aiding in the removal of pollutant load from water bodies. In this study, *Chlorella vulgaris* CCAP 211/11B, and *Chlorella sorokiniana* CCAP 211/8 K, with two different optical densities, such as 0.05 (lowest) and 0.10 (highest), to assessed for growth in synthetic municipal wastewater as compared to bold basal medium (BBM) as a control. The selection of mostly green microalgae was photosynthetic freshwater microalgae, especially Chlorella species, because they can fix and convert nitrogen from the atmosphere, which can be further used by plants. All experiments were statistically performed using GraphPad Prism, and differences were considered statistically significant using two-way ANOVA, $p < 0.05$, followed by Tukey's test with replicates (n=3). The Growth of both species was monitored using the Optical density (OD), dry cell weight (DCW), and growth rate calculation. In addition, chlorophyll content was also measured to assess microalgae's health and overall growth. In addition, metabolites such as protein, lipids and chemical composition such as total organic carbon (TOC), inorganic carbon (IC), total nitrogen (TN), total carbon (TC), and dissolved organic carbon (DOC) using a Shimadzu TOC-V CPN and heavy metals removal using ICP-OES, were also monitored in the

synthetic municipal wastewater and BBM as control. Resultantly, along with wastewater treatment, biomass was extracted as biofertiliser, and a nutrient-rich material was produced to be further utilised for plant experiments.

P25 The fastest growth bacterium *vibrio natriegens* a novel strain for bioplastic (PHB) production for the next generation of industrial biotechnology

Roger Romero, James Winterburn

Polyhydroxybutyrate (PHB) is a promising biodegradable polymer that can be synthesized through microbial fermentation. However, large-scale PHB production is hindered by several challenges, including the inefficient utilisation of organic waste due to inhibitory compounds, slow microbial growth rates, and the high energy demand for feedstock sterilisation.

In this study, we explore *Vibrio natriegens*, the fastest-growing known bacterium, renowned for its exceptional tolerance to salt and toxic compounds, as a potential candidate for enhancing PHB production. Despite its advantageous traits, limited information is available on PHB production in *Vibrio natriegens*. Therefore, this research aims to deepen our understanding of its fermentation process and PHB synthesis using the wild-type strain.

P26 Resilient succinic acid production using biofilm-based fermentation

Ruveyda Sadauki, Benjamin Moore, Yongqiang Liu

Valorising lignocellulosic biomass hydrolysate for bioproduction is a promising route toward sustainable chemical manufacturing in the circular economy. However, the hydrolysate often contains toxic compounds such as furfural, formate, and syringaldehyde, which inhibit microbial growth and reduce fermentation efficiency. Detoxication is generally needed before microbial fermentation, which increases the process complexity and cost.

This study explores the potential of *Actinobacillus succinogenes* to produce succinic acid (SA) from waste-derived hydrolysates using a biofilm-based fermentation approach. Biofilms, consisting of microbial cells embedded in a protective extracellular matrix, offer improved resistance to environmental stresses. Biofilms of *A. succinogenes* were cultivated on K1 micro carriers and evaluated for SA production in serum bottles and 2 L bioreactors under various stress conditions. $MgCO_3$ concentration significantly affected pH stability and SA yield, while K1 packing density had minimal impact. Repeated batch fermentations demonstrated the robustness of biofilm cultures, maintaining SA production after multiple media exchanges. Inhibition assays using common hydrolysate-derived toxins showed that biofilm cultures experienced reduced inhibitory effects compared to free cells. Moreover, bioreactor experiments with continuous feeding revealed minimal impact of furfural on SA production in biofilm systems.

These preliminary findings suggest that biofilm-based fermentation has great potential to enhance microbial tolerance to hydrolysate inhibitors and support more stable bioconversion of waste to value-added chemicals. This approach offers a promising strategy for overcoming key bottlenecks in the bioprocessing of lignocellulosic substrates.

P27 Perennial lignocellulosic biomass (using miscanthus): How much carbon is stored below-ground?

Anita Shepherd, Antonio Castellano Albors, Jon McCalmont, Astley Hastings, Chris Ashman, Jonathon Dearlove, Will Macalpine, Ian Shield, Caio Fernandes Zani, Kelly Mason, Jeanette Whittaker, Judith Thornton

Biomass crops have the potential to capture carbon from the atmosphere and store it in vegetation and soil, but how much biomass is in the soil?

Carbon accounting does not include the rhizomes, stools and roots belowground, but this is becoming a perennial feature of the landscape if a percentage of land is consistently cropped with perennial biomass crops, so should we take the belowground capture of carbon into account?

Here we develop a belowground module of biomass into an aboveground growth model based on previous crop trials and literature, we are currently testing this against measurements from our biomass crop site of the new-to-market seed-established variety of *Miscanthus sacchariflorus x sinensis*, known as Aphrodite.

Our results show the UK capacity for production of miscanthus, and also how much biomass carbon is belowground using an industry standard of miscanthus replacing 10% grassland and arable. This is based on an assumption that these fields are under-productive for other crops, whereas miscanthus has been shown to grow on many types of under-productive lands (Shepherd *et al*, 2023, https://doi.org/10.1111/gcbb.13029).

P28 Spatial assessment of feedstock availability for future biorefining: Integrating distribution, transport, and competitive uses

Yuzhou Tang, Tim Cockerill

Ensuring a sustainable and reliable feedstock supply is fundamental to the future development of biorefining technologies. This study presents a spatially explicit assessment of feedstock availability in Great Britain, focusing on agricultural residues such as straw, manure, food waste, and maize silage. Using detailed feedstock distribution data combined with national road network information, we developed an optimisation model to define feasible supply areas based on realistic transport conditions. Scenario analysis was conducted to reflect variations in feedstock availability under current practices, policy-driven improvements, and theoretical maximum utilisation. Our results highlight significant regional disparities: biomass resources are unevenly distributed, and local competing demands (e.g., soil improvement, livestock bedding) further constrain practical availability. Some regions exhibit surplus potential, while others face restricted accessibility due to high local use priorities or transport limitations. This work demonstrates that feedstock availability assessments must move beyond simple resource quantification to integrate spatial distribution, transport access, and competing uses, offering more realistic insights for planning sustainable biorefining deployment strategies.

P29 Distributing the benefits of biomass – The polycrisis, the public, and the political bioeconomy

Daniel Taylor, Mirjam Röder

Beyond the technical challenges associated with utilising biomass to create bioenergy and bioproducts, non-technical challenges exist within our political and economic institutions, which present tricky trade-offs for policymakers aiming to use biomass to achieve a variety of political agendas. Policymakers who are currently faced with a 'polycrisis' of complex and wicked problems to solve, in the climate, ecological, and energy emergencies. It is therefore important to understand the politics and economics of biomass, sometimes termed the "political bioeconomy", which shape biomass decision making. It is the political bioeconomy that governs the interactions between social, environmental, and economic systems linked to biomass extraction and will determine where wealth and inequality are generated within biomass supply-chains, where value is applied to or extracted from the biomass, and who benefits.

To interrogate the non-technical forces at play, impacting the design of policy relevant to bioenergy deployment in the UK, this qualitative study draws on insights gathered during semi-structured interviews with experts from across the UK bioenergy sector covering industry, policy, and non-governmental organisations. A thematic analysis was conducted on participant responses, highlighting the dominant themes in UK biomass policy discourse, exposing the underlying drivers for policy development, and revealing the current and future beneficiaries of biomass use. This poster presentation will showcase a policy framework for an alternative political bioeconomy, which has the potential to support policymakers in the design of a more sustainable UK biomass policy that achieves net zero by putting people and planet first.

P30 Biohydrogen production of agricultural waste: Novel strain and feedstock characterisation

Ariadna Vidal, Leonardo Rios-Solis, Sharon Velasquez-Orta, Jose Muñoz-Muñoz, Thomas Howard

Biohydrogen is a promising alternative to fossil fuels and can be produced via dark fermentation of biomass. This project explores feedstocks, microbial strains and metabolic engineering strategies for optimising biohydrogen production from lignocellulosic agricultural waste. Feedstocks such as willow, hay, wheat, and barley—rich in carbon—were pretreated by hydrolysis and characterised to assess their suitability for microbial fermentation.

Shewanella oneidensis MR-1, *Cellvibrio japonicus* Ueda107, and *Sorangium cellulosum* So ce26 were tested for H_2 and volatile fatty acids (VFA) production. This is the first report of these strains being used for biohydrogen generation from lignocellulosic substrates. Maximum H_2 concentrations were obtained with *S. oneidensis* (70.9 ± 6.2 ppm at 12 h) and *C. japonicus* (76.6 ± 1.9 ppm at 36 h). Hydrogen yields exceeded literature values by up to sevenfold. *S. oneidensis* primarily produced acetic acid (6.48 mmol/L in willow medium) demonstrating that the strain follows acetic fermentation, which holds the theoretical maximum for hydrogen production at 4 mol H_2/mol glucose.

S. oneidensis has been genetically engineered to enhance hydrogenase expression, guided by metabolic modelling. This work highlights how synthetic biology and metabolic engineering can improve microbial hydrogen production.

P31 A process intensified flower waste oil valorisation: Continuous-flow biphasic transesterification of rose oil in a coiled flow inverter (CFI) microreactor

Alisa Wikaputri, Shyam Rana, Derek Irvine, Robert Stockman, Volker Hessel, Parimala Shivaprasad

Flower waste valorisation presents a promising avenue for sustainable flavour and fragrance production. This study pioneers the conversion of high-value compounds, i.e. terpene esters such as citronellol and geraniol, from flower waste oils. The challenge lies in scaling up the reaction to significantly enhance productivity while maintaining operational efficiency and sustainability. We introduce a novel process intensification approach, utilising a Coiled Flow Inverter (CFI) microreactor for the enzyme-assisted transesterification of rose oil. To optimise the system, we transition to a biphasic configuration, where the enzyme remains in the aqueous phase, separated from the organic phase. This biphasic system offers critical advantages: improved enzyme recyclability, enhanced mass transfer (addressing limitations inherent in batch systems), and the ability to operate at elevated temperatures, increasing yields without compromising enzyme stability. The system consists of an organic phase (acyl donor and rose oil) and an aqueous phase (enzyme in phosphate buffer), continuously fed into the CFI. A 2-level full factorial Design of Experiment (DoE) optimised process parameters, identifying key variables and refining them to maximise productivity. Preliminary results demonstrated a 1000% increase in productivity, with yield rising from 22% over 5 hours in batch mode to 38% in just 30 minutes in continuous flow. The productivity reached as high as 28 kg/L.day. DoE analysis revealed that temperature and phase flow ratio are the most influential parameters for optimisation. These findings may provide a robust pathway for scalable production, transforming floral waste into high-value compounds, and advancing sustainable practices in fragrance manufacturing.

Delegate List

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Asma Ahmed	University of Nottingham
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Mohammad Alyassin	University of Huddersfield
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