Bioresource Processing Alliance

- A six year, MBIE funded research and development program
- Main aim is to help industry create economic value for NZ
  - Exports increased by $100 M by 2020
  - Displacement of imports, reduction of environmental impact
- Achieve by processing of low value by-product and waste streams derived from the processing of primary products
Why the BPA was established

Secondary products from biological industries worth $2.4 billion per year, but...

- 50-55% of fish harvest converted to fish meal
- ¼ to ½ of mussel harvest goes to waste
- 15% of wood harvest is left in the forest
- 45% of kiwifruit harvest unsuitable for export
BPA Approach

• ‘Best team’ and ‘best equipment’ approach
• BPA also draws on expertise from universities, private industry and other R&D organisations
  • Massey University & Waikato Innovation
• Connect people with related interests
BPA Objective: value creation from co-products & waste streams

- To achieve its objective the BPA would like to connect with companies that:
  - generate volumes of low value streams from primary production and processing;
  - are interested in new technologies that could make better use of these low value streams (covers both equipment suppliers and specialist processing companies); and/or
  - are interested to take low value streams and add value to them (e.g. biopolymer manufacturer)
Four key areas of focus for the BPA

- **Extraction** – direct recovery of high value, low volume constituents
  - *e.g.* bioactive peptides, lipids or antioxidants for functional foods, nutraceuticals
- **High Value Processing** – to transform functionality
  - *e.g.* to produce food products, animal feeds
- **Deconstruction** – pulling things apart
  - *e.g.* convert bulk residual materials to recover simple chemicals (*e.g.* acetate), nutrients (*e.g.* for fertilizers) and energy
- **Reconstruction** – putting things together
  - *e.g.* combining functionalised bulk materials to produce biopolymers or novel biocomposites
- **Tech transfer** – economic evaluation, pilot plant, scale-up
Partner sector and expertise

- **AgResearch**: Agricultural sector
  - Agricultural, dairy, meat, wool, animal feeds
- **Callaghan Innovation**: Industrial/Manufacturing Sector
  - Processing, pilot plant (tech transfer), extraction, fermentation, automation
- **SCION**: Forestry and forest products
  - Wood processing, pulp & paper, biopolymers, biofuels, modelling
- **Plant & Food Research**: Horticultural, Seafood and Food Sectors
  - Marine, horticultural, food, bioactives, nutrition
- **Universities and other R&D providers** provide additional expertise
Sectors and by-product/waste streams

• Horticulture (Fruit, Vegetable, Plant)
  – *Seconds, harvesting waste, processing plant waste*

• Agriculture (Meat, Dairy, Wool, Skins)
  – *Farm waste, processing plant, waste water, rendering*

• Marine (Fish, Aquaculture, Seaweed)
  – *Processing plant, by-catch, nuisance species*

• Forestry
  – *Bark, slash, sawdust, pulp & paper, treated timber waste*

• Microbiological
  – *Brewing waste, waste treatment*
• Depends on where in value chain you sit
• Providing raw material or developing exclusive technology

Image:

- Raw material provider
- Processor of raw material
- Seller of products or ingredients
- Channel to market
Types of projects

• BPA-led infrastructure projects
  – Virtual pilot plant
  – Decision making framework
• Industry led new product/process projects
  – Feedstock provider
  – Product manufacturer
  – Technology supplier
• University led underpinning science projects
  – MSc and PhD projects
  – Additional expertise
Infrastructure: Virtual Pilot Plant Network

- **44** Pilot plants identified & described
- **22** Of which held within BPA
- **8** University or NZFIN hosted
- **14** Private sector

- Additional **7** significant expansions or new facilities are planned
- Other privately held plants identified
- Keen to understand what industry suppliers of equipment and expertise can offer
Virtual Pilot Plant Network

https://vppn.bioresourceprocessing.co.nz
Virtual Pilot Plant Network
BPA partner and capability case studies

- AgResearch: processing of yeast fermentation broths
- Plant & Food Research: extracting bioactives from horticulture streams
- SCION: processing of organic waste to produce biopolymers
- Callaghan Innovation: Avocado pomace waste to high value powder
• Post-farm gate:
  – Knowledge of meat, wool and dairy processing technologies and their influence on bioresource properties.
  – Protein/lipid science – characterisation, modification, bioactive efficacy, etc.
  – Pilot plants and chemical/process engineering.

• On-farm:
  – Animal feeds – ruminant nutrition.
  – Fertiliser/nutrient losses.
AgResearch Example

- Waste/co-product stream: Applicable to many; current focus is yeast-rich brewing waste (‘trub’).
- Problems to solve:
  - High BOD/COD wastes; cost of disposal
  - Some existing uses, often low value
- Approach: Extraction/deconstruction, generating two streams: DNA and high-quality protein.
  - DNA – bio-based industrial chemical
  - Protein – nutrition, food ingredient
- Status: Proof-of-concept
BPA – SCION Capability

- Forest industry
  - Wood, fibre processing
  - Fuels and chemicals

- Biopolymers and composites

- Waste conversion

- Fermentation technology

- Techno-economic modelling
Scion example: Organic waste to biopolymers

Progress – Business case development for Pilot scale production
BPA: Plant & Food Research Capability

- Nutrient analysis and bioactivity testing (*in vitro*, animal and human)
- Human sensory perceptions and consumer purchasing decisions
- Extraction and characterisation of bioactive compounds from plant and seafood raw materials, e.g.
  - Proteins, peptides and lipids from seafood harvesting and processing discards
  - Polyphenol extracts and compounds from fruit and vegetable side streams
- Process scale-up and transfer to commercial partners
- Development and market testing of prototype ingredients for food and nutraceutical products
Example: Extracting value from marine resources

PFR, AUT, Callaghan Innovation

- Co-product/waste stream:
  *Undaria pinnatifida – an introduced seaweed growing in NZ waters, and found as a pest on Greenshell™ mussel lines*

- Opportunities:
  food (wakame); food ingredient; dietary supplement; animal feed

- BPA work to date:
  - Document growing patterns and seasonality
  - Develop analytical methods to characterise raw materials and extracts
  - Evaluate commercial options for harvesting, transport and storage
  - Determine what affects yield and quality

- Progress: Feasibility study by industry partner
Example: Extracting value from horticultural side streams: PFR, Massey University

- Co-product/waste stream: onion skins
- Opportunities: food ingredient; dietary supplement ingredient
- BPA work to date:
  - Explore commercial potential
  - Analyse raw material streams and characterise valuable components
  - Develop industry-ready extraction processes
  - Demonstrate bioactivity and value
- Progress: Project development by researchers and industry partner
BPA – Callaghan Innovation Capability

• **Product and Process Development**
  – Nutraceuticals, functional foods
  – Extraction and purification technologies (esp. supercritical)
  – Bioprocessing: Fermentation & enzyme pre-and post processing
  – General chemical engineering (freezing, drying, grinding etc)
  – Specialist chemical and biochemical analysis

• **Scale up and tech transfer**
  – Pilot to pre-commercial scale including the FoodBowl
  – Secondments and industry placements

• **Automation**
  – Specialist equipment design
  – Sensing and control
Example: Further processing of horticultural streams

- Waste streams – avocado pomace
- Opportunity – dry powder for foods & cosmetics
- BPA & partner work:
  - Control sterility, degradation
  - Optimise drying technology
  - Develop new opportunities for products from skins and stones
- Progress – powder product undergoing commercialisation, first sales already made!
Frequently asked questions

• Is the BPA a funding organisation for private companies?
  – No, funding goes to the BPA Partners and their research Partners for their part in the R&D work

• How much funding do I need to put in?
  – Depends on the stage of the project

• Who owns the IP?
  – Depends on the industry partner interests, proprietary knowledge, co-investment in a project, and who is best placed to manage the IP to create value for NZ Inc
Workshop Follow Up - Contact Details

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Catherine Andrews, Senior Business Development Manager
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Thank you!
Virtual Pilot Plant Network

Industry
- Food & beverage
- Textile (i.e. wool)
- Natural products
- Horticulture (i.e. crops)
- Pharmaceutical
- Biochemicals (i.e. biofuels)
- Energy (i.e. solid energy)
- Timber
- Waste products (i.e. sludge)

Water removal
- Freeze drying
- Spray drying
- Tray drying
- Dehumidifying
- Evaporation
- Fluid bed drying

Biotechnology
- Fermentation
- Chemical processing
- Enzymatic
- Pharmaceutical

Separation
- Liquid ext.
- Supercritical ext.
- Centrifugation
- Membrane filtration
- Chromatography

Sterilization
- High pressure proc.
- Pasteurisation
- Autoclave
- Pulse electric field

Thermal proc.
- Cooking
- Freezing
- Hydrothermal
- Combustion/pyrolysis/gasification
- Environmental chamber
- Over/furnace/kiln
- Heat exchange

Auxiliary proc.
- Pelletizing
- Packaging
- Granulation
- Milling/grinding
- Blending/mixing/homogenising
- Extrusion
- Coating
- Pressing
- Dyeing
- Briquetting
- Spinning
- Post harvest
- Electrospinning
- Pulping
## Virtual Pilot Plant Network

### Enquiries received (before launch)

<table>
<thead>
<tr>
<th>Enquiry by</th>
<th>Request</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPA member</td>
<td>Small-scale continuous flow centrifuge</td>
<td>Three potential units identified at CI, SCION, P&amp;FR. Contact details provided</td>
</tr>
<tr>
<td>BPA member</td>
<td>Solvent evaporation</td>
<td>Three potentially suitable units identified. Specification and contact details provided</td>
</tr>
<tr>
<td>BPA member</td>
<td>Pasteurisation</td>
<td>Various options identified. Some potential lack of appropriate scale noted</td>
</tr>
<tr>
<td>Database participant</td>
<td>Hammer Mill</td>
<td>One suitable unit identified, contact details provided</td>
</tr>
<tr>
<td>BPA project partner</td>
<td>Mobile pasteurisation unit</td>
<td>Not identified</td>
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<tr>
<td>Survey Respondent</td>
<td>Pulsed electric field</td>
<td>Two potentially suitable units identified. Specification and contact details provided</td>
</tr>
<tr>
<td>BPA member</td>
<td>DAF</td>
<td>Not identified</td>
</tr>
<tr>
<td>BPA member</td>
<td>Cheese Press</td>
<td>One identified, contact details provided</td>
</tr>
<tr>
<td>BPA member</td>
<td>Continuous centrifuge, no scale or specific capability at first requested. Processing cost requested</td>
<td>Various options identified within BPA. More information requested, numerous contacts provided with information on scale and capability where available</td>
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