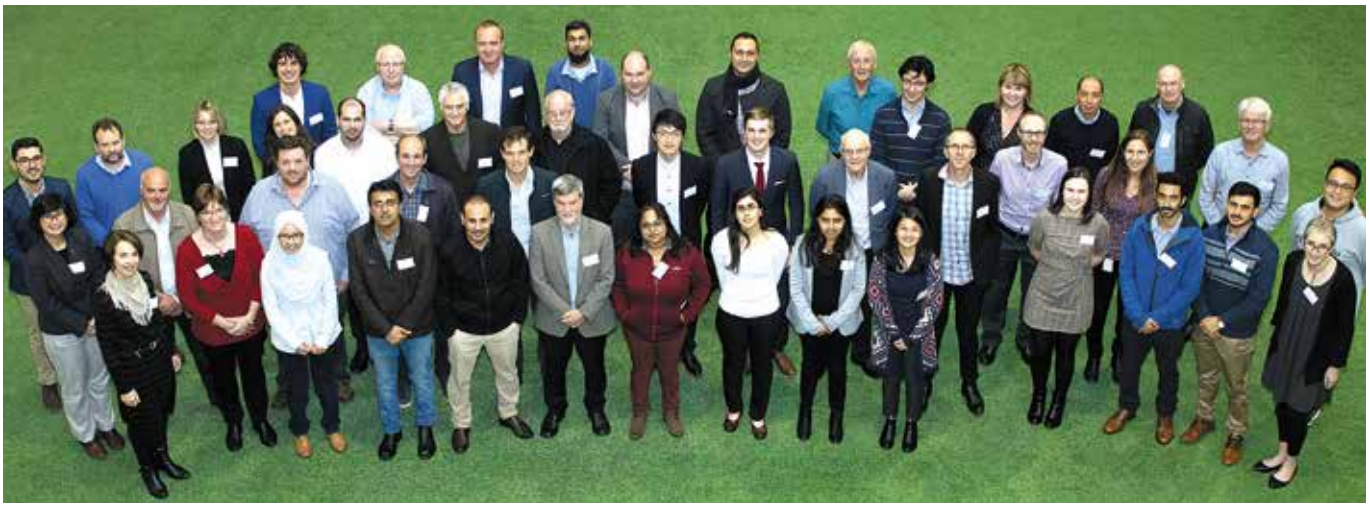

The FIET team at the 2018 FIET Colloquium

FIET projects refreshed, three years into the six year programme

Professor Richard Archer, Massey University

The Food Industry Enabling Technology (FIET) Research Programme is now in the middle of the fourth year of its six-year funding cycle. A major mid-term review was held about this time last year. As a result four projects were stopped, six continued and three new ones started. Right now there are nine projects live with one of those due to complete within six months.

FIET Structure

FIET has six partners: Massey University as host, the Universities of Auckland and of Otago, Plant and Food Research, AgResearch and the Riddet Institute. The partners devolve governance to an independent Board chaired by Dr Kevin Marshall. Board members are Prof Pare Keiha, Dr David Tanner, Dr Peter Fennessy and Katy Bluett of Callaghan Innovation. Dr Ross Holland is FIET Programme Director, handling most of the communication and operational duties and Prof Richard Archer is Chief Technologist. Management of the FIET work programme and monitoring of science quality is the role of the Science Management Team (SMT) with one member drawn from each partner and chaired by the Chief Technologist. FIET also has two advisory groups, the Industry Advisory Group (IAG) and Te Roopu Maori (TRM). The IAG has been refreshed and members are now drawn from the lead companies assisting each of the projects and likely to be lead users of, or agents for, the technologies under development.

FIET holds an annual colloquium in June for all participating researchers, governance group members, advisors and companies supporting FIET projects.

Process Unit Operations

FIET is focused on process unit operations (PUOs) for food processing. A PUO is a Chemical/Food Engineering definition used to describe a single step in the transformation of raw food into processed products. Examples of PUOs are roasting, which is driven by heat, crystallisation – driven by increasing solute concentration and filtration which is driven by an imposed pressure gradient across a membrane. Entire processes contain many PUOs. In FIET, specific PUOs, or combinations thereof, that offer advantages not possible with conventional processing have been selected. Some of the PUOs are long-standing ones which still have a major impact on New Zealand industry and need an update to be suitable for the coming decades. Others are new, or new to New Zealand.

Richard Archer, FIET Chief Technologist

FIET Programme Director, Ross Holland

The Matrix of FIET Projects

Within the suite, projects have various short- to long-term realisation horizons. Short-term projects have PUOs with mature technology and expected rapid uptake, and immediate co–funders. Long-term projects have new or greatly modified PUOs that require science or technical feasibility hurdles to be met, and thus have a greater risk element, with supporters becoming co-funders after progress is demonstrated. Some of these need to develop new equipment from scratch. Some intermediate-term projects develop systems of PUOs to enable a new class of processing involving enzymatic and physical treatments. Some use existing equipment but must define new processing regimes for New Zealand use. One project is focused on rapid validation techniques

The prototype phase-change material ice-bank (the square tank) vat on the Waikato farm of Stuart Husband who says, "The milk quality results improved from B to A+ when the ice storage system was installed and this is because the milk is chilled down quickly so no time for the bacteria growth, which is great for us." Inset, Stuart Husband

for gaining regulatory acceptance. All three new projects are nearer-term with clear and present industry need. At least one project contains a mix of near and long-term objectives with the same PUOs.

Projects

There are now 14 projects in the FIET portfolio, nine live, four either finished or finishing and one which will not start.

1. Milk chilling and farm vat

This project develops a better ice-bank for snap chilling and a new vat for holding snap-chilled milk on dairy farms. It targets milk quality, energy efficiency, tanker utilisation and on-farm safety and has three parts. Subproject 1 successfully prototyped an ice-bank using phase-change materials. Better performing and less expensive than any current model, it is now proven at full-scale on a Waikato farm, see photograh and caption above. Subproject 2 is designing the best practice future vat – a stainless-plastic hybrid, to hold snap-chilled milk. Safer to maintain and cheaper to build, it will have low-shear agitation and pump-less emptying. Subproject 3 is stretchy: low-cost, 3D-printing tank insulation with in-built strong zones to support a light stainless liner. Project 1 is currently winding down.

2. Rapid milk freezer

This project seeks to freeze sheep or goat milk on-farm fast enough to keep it intact for months in storage. Current freezing in bags or pails kills the milk within weeks and safe thawing is challenging. The new PUO is a simple, affordable, robust, low-maintenance, on-farm rapid milk freezer that preserves the sheep milk without loss of functional value. It should also suit colostrum, plasma, blood, and other milks. The frozen form is easy to store, handle, transport, measure and thaw. This project will complete by mid-2019.

3. Meat tenderisation

This project continues until mid-2021 and develops a system of PUOs that together increase the tenderness of low-value meat cuts. It uses several alternative techniques, such as enzymes or PEF in combination with sous vide, to achieve rapid tenderization, yet a meat that is stable on subsequent storage.

4. Smoke generator

This project advances the PUO for smoke generation, to provide precision controlled culinary smokes from New Zealand woods like manuka. It has wide cross-sector applications, wherever smoking adds value. This continues to mid-2021.

5. Meat liquefaction

This project develops a system of PUOs that together produce highly enriched cooked meat flavours from low-value meat streams. The target application is plant-protein based meat alternatives. It did not pass the formal review due to narrow industry support and ceased at 1 January 2018.

6. Pomace fracturing

This project develops a system of PUOs to manufacture a creamy-textured, fibre-rich ingredient with high water-holding properties from fruit pomaces, at high yield. The project is very successful and is nearly complete. It was not offered for the mid-term review but applications aspects are being merged into Project 7. Commercial production of full-scale, skid-mounted plants is being discussed with an engineering company and a juice maker.

7. Drying sticky products

This project focuses on the suite of PUOs broadly classified as thermal drying. It develops fundamental prediction methods to enable drying of sticky foods with no, or very little, drying aid. Also, it investigates spraying of fibre-containing liquids. The applications are wide, across all sectors wanting to produce dehydrated powders. Project 7 investigates one use of the product from project 6. It will run until mid-2021.

8. Atmospheric freeze drying

This project develops a new PUO to bridge the cost gap between conventional air- and freeze-drying. It has wide cross-sector application and can dry products from frozen at lower temperatures

than experienced during normal vacuum freeze drying. Good for large scale continuous operation, it suits delicate low-sugar materials such as flowers, leaves, roots, glands, shell fish and some fruits and vegetables. A pilot unit at 10 kg/day water removal, and smaller batch units, are available for trialling products.

9. Pulsed electric field (PEF) and high pressure processing (HPP)

This project introduces two newly mature PUOs to New Zealand where there has been low uptake. Application is wide, across many sectors. The project passed the mid-term review but has been refocused on PEF only, and on potatoes as the lead product, with wine as a possible second. The project continues for years 4-6.

10. Pasteurisation and sterilisation technologies

This project develops new technologies of paired PUOs (e.g., thermal + HPP) that together achieve pasteurisation and sterilisation at lower thermal stress for heat sensitive foods. The project has been successful technically but was stopped at the mid-term review since the regulatory hurdles would delay commercial application more than suited FIET objectives. It ceased at 1 January, 2018.

11. Robotic valve plate

This project, planned to start in Year 4, was to redesign the PUO of milk distribution at dairy factories in order to minimise shear stress on milkfat globules, one of the determinants of dairy product quality. The project was not put forward for the mid-term review and never started.

12. MAP-enable (Microwave assisted thermal processing)

This new project brings to New Zealand the emerging PUO of microwave-heated pasteurisation and pressure sterilisation of packaged food or RTE meals. It will use the Meyer Burger pilot industrial CiMPAS unit being installed at Massey University Palmerston North. The FIET project is to develop rapid validation techniques for regulatory approval to permit fast commercialisation of new products and newly tuned heating profiles. MPI is a key stakeholder. The capability is also being used to support several companies developing shelf-stable, heat-sensitive packaged foods, or could be applied to any application of microwave-assisted processing.

13. UV technologies for fresh export

This new project targets "fresh" exports, which are growing in volume and value. Microbial contamination can put shelf-life and food safety of fresh fruit at risk. The PUO of UV light irradiation can help but the challenge is to illuminate all the surface, under industrial conditions, gently, reliably and affordably. This project will prototype a device to expose rolling blueberries uniformly to UV light. It will optimise fruit motion to maximise disinfection and minimise handling damage. The technology should suit other fragile, round products.

14. Spectral separations

This new project will apply modern hyperspectral image capture and analysis to two New Zealand applications with current needs. Under Subproject 1, a hyperspectral video camera will inspect potatoes rolling on a grading line and determine if individual tubers have too much potato-psyllid damage (through Liberibacter infection) for processing. Ultimately a robotic arm will pick out failing potatoes. Under Subproject 2, the hyperspectral camera will inspect frames of honey within the extraction plant, and predict the "Manukaness" of each individual cell. The line operator can set threshold values for extraction as Manuka or as another class of honey, and frames get separated into one pile or the other for extraction.

Personnel and support

Most projects have two or more FIET partners and well-formed end-user relationships. Each project employs a mix of post-graduates, post-doctoral fellows and named key researchers.

Most importantly, each project has the support of more than one end user company. Some partner companies are food manufacturers, some equipment manufacturers, who may take the technology to market in New Zealand and abroad. A few are ingredient suppliers. Most projects have room for another partner. Most need more direct involvement of Māori enterprise but are struggling a little to make rich contacts in this vibrant, fluid sector. At least one project was stopped because its support shrank to just one company. Several FIET projects are lasting three to six years and are finding that their erstwhile industry partners suffer changes of personnel and priority within that timeframe.

Each project has milestones to meet, some technical and some concerning the level of industry support it attracts. Even some projects planned to run until 2021 could get suspended if they fall short or their industrial purpose fades.

Future of FIET

FIET is looking to be very successful. It has built several productive collaborations and is developing technologies which offer great value to the New Zealand food processing industry. But the challenges faced in marrying relatively painstaking high quality research to relatively mercurial industry are never easy and require more fleet-footedness than is easy in a large, closely-contracted research programme. Despite the challenges, we are succeeding and those at MBIE who conceived this as an area of endeavour have reason to be pleased.

FIET
Food Industry Enabling Technologies

Food Industry Enabling Technologies (FIET) is funded by the Ministry for Business, Innovation and Employment and its purpose is to support new process developments that have the potential to add significant value to our national economy. The programme has six partners, Massey University (the host), Riddet Institute, University of Auckland, University of Otago, Plant and Food and AgResearch. Funding is $18m over six years (2015-2021) and targets pre-commercialisation activities. If you are interested in more information, then please contact either Dr Ross Holland, Programme Director, (R.Holland1@massey.ac.nz) or Professor Richard Archer, Chief Technologist, (R.H.Archer@massey.ac.nz).