

Branching Out Concept Paper

# Precision Fermentation

THE OPPORTUNITY FOR TARANAKI, NEW ZEALAND



**venture**  
TARANAKI  
Te Puna Umanga

# An opportunity for the future of food and fibre

Branching Out is a project that has been initiated and led by Venture Taranaki. It is underpinned by funding from the Ministry for Primary Industries' Sustainable Food and Fibre Futures fund (SFFF). It is supported by local sponsors as well as the region's three district councils – New Plymouth District Council, South Taranaki District Council and Stratford District Council. The project has identified a number of innovative, commercially viable food and fibre value chain opportunities for Taranaki. This work supports the region's strategy and long-term vision for a resilient, high-value, and low-emissions economy built on inclusivity and sustainability, as articulated by Tapuae Roa and Taranaki 2050 – the guiding strategic documents for the region, co-created with the people of Taranaki.

Branching Out aims to strengthen and diversify the Taranaki economy and has taken input from a wide range of industry participants, from landowners to interested growers, manufacturers to food and fibre entrepreneurs and potential investors. Through a process of investigation, a shortlist of eleven feasible ventures have been selected. Crown Research Institutes and universities, including Massey and Lincoln, were engaged to provide robust research that underpins each venture selection. Work has also been undertaken with commercial partners to support the development of prototypes with significant market potential, and a core focus on sustainability and waste reduction.

The investigations, collaborations, and potential commercial pilot opportunities for the region that have been explored as part of this project are being presented

as Venture Blueprints. These blueprints aim to build investor confidence and serve as an informative and inspirational roadmap to kick-start complementary land-based activities and associated value chain enterprises in Taranaki.

The blueprints focus on traditional methods of assessing value, determined by comparing inputs (land, animals, machinery, time) and outputs (milk, meat, wool, other products). However, consumer expectations and an increased awareness of environmental degradation mean that thought should also be given to how the natural environment can be protected and what value this action can add to a developing sector.

## TE TAIAO

In 2020, the Primary Sector Council released their Food and Fibre Strategy, Fit for a better world. This strategy adopted the Te Taiao framework, acknowledging that Te Taiao is all of the natural world that contains and surrounds us (land, water, air, and biological life). It is a uniquely New Zealand perspective that is underpinned by three guiding principles:

- Our land, water, air, and biological life must be able to thrive without over-use
- Any use is a privilege, not a right
- If something is not healthy or well, we must fix it.

Developing or participating in a new value chain is an opportunity to consider your business's relationship with Te Taiao. It is a chance to farm, produce and engage in a way that safeguards the mana and integrity of the natural world. If the whenua (land), and the entities that are connected to it, are to be nourished and thrive, then it must be cared for and protected. Each blueprint opportunity should be considered with Te Taiao in mind.

## DISCLAIMER

This document, produced by Venture Taranaki, provides an overview of the opportunity for precision fermentation in Taranaki. It does not constitute investment advice and professional advice should be sought if you wish to explore this opportunity further. This concept paper is correct to our knowledge and based on the best information we could access as of August 2022. However, this work is ongoing, and we welcome new or emerging information about this opportunity. For more information or for input, please contact [branchingout@venture.org.nz](mailto:branchingout@venture.org.nz).

**How to reference:** Venture Taranaki – *Branching Out, Precision Fermentation: The opportunity for Taranaki*, August 2022

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# Future food ecosystem

**As the global population continues to grow, increasing pressure is being put on our food production systems.**

By 2050, there will be almost 10 billion people on Earth, and it is estimated that globally we will need to produce approximately 56% more food than we did in 2010<sup>1</sup>. This level of food production will have an impact on efforts to reduce greenhouse gas emissions (GHG), as well as put more stress on already challenged water and land resources. As consumers become more mindful of the environmental impacts of food production and how their individual choices can impact this, it is likely that demand for alternative products will increase and that plant-based diets will become more common. Growth of the flexitarian<sup>2</sup> market, which is already approximately 10% of New Zealanders<sup>3</sup>, is also expected.

One emerging scientific technique that is displaying signs of rapid international growth is Precision Fermentation. Precision fermentation could complement existing food production methods and offer a sustainable long-term solution for many aspects of the food sector, including for milk and value-added dairy products. The existing knowledge and capabilities in the region mean that Taranaki is ideally suited to capitalise on this area of growth and become a hub for precision fermentation in New Zealand.

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<sup>1</sup> Tim Searchinger, Richard Waite, Craig Hanson and Janet Ranganathan, World Resources Institute, [Creating a sustainable food future](#), July 2019.

<sup>2</sup> Consumers that are not strictly vegan but are open to animal-free alternatives.

<sup>3</sup> Amber-Leigh Woolf, Stuff, [The rise of vegetarians: 1 in 10 New Zealanders mostly, or completely, meat-free](#), February 2019.

# Precision fermentation

**Fermentation is the process of a micro-organism breaking down an organic substance, such as sugars or carbohydrates, resulting in the production of one or more new substance(s).**

As the reaction takes place, certain molecules such as proteins, enzymes and fats are produced by the micro-organism, depending on its genetic makeup. Fermentation has been used for thousands of years to make a range of everyday foodstuffs, such as bread, yoghurt, beer, and wine.

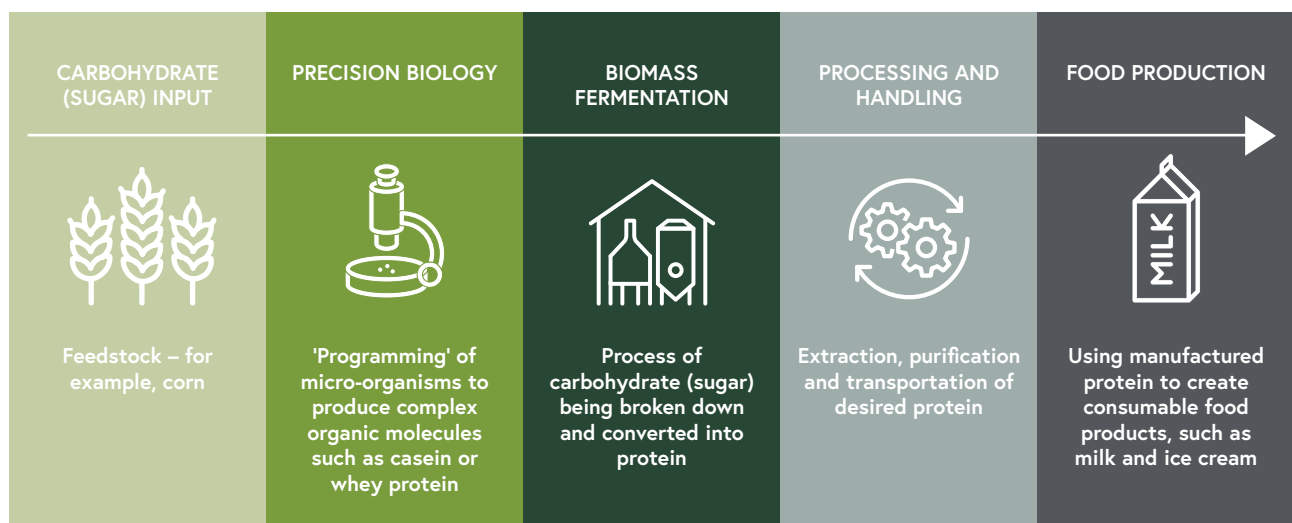
Precision fermentation is the next step in the evolution of this process. It uses precision biology to enable the 'programming' of micro-organisms to produce complex organic molecules. This allows the fermentation process to be adjusted to produce a specific desired organic matter, such as casein or whey proteins, which can then be used to make milk and other value-added products including cheese, yoghurt, and ice-cream.

## HOW HAS IT BEEN USED?

The historically high costs of precision fermentation as an emerging technology have meant that the process has been primarily used in the pharmaceutical industry. In 2000, the cost to produce a single kilogram of one type of specific molecule was USD\$1m, however, further development and technological advancements reduced that cost to approximately USD\$100 in 2020<sup>4</sup>. Forecasts predict that this cost will continue fall to below USD\$10 by 2025, before becoming up to five times cheaper than traditional animal proteins by 2030<sup>5</sup>.

These advancements mean that the process is now relatively common practice in the food industry, particularly in the meat-alternative sector, as well as in the cosmetic and material industries. Precision fermentation is now regularly used to create ingredients that improve the flavour or texture of a product, for example, a fatty protein in a plant-based burger that makes it smell and have a similar texture to traditional meat. Precision fermentation technology is already being used internationally to create a range of dairy products.

## PRECISION FERMENTATION PROCESS



<sup>4</sup> Flora Southey, *Disrupting dairy with precision fermentation: 'By 2035, industrial cattle farming will be obsolete'*, February 2020.

<sup>5</sup> Catherine Tubb and Tony Seba, *RethinkX: Disruption, Implications and Choices*, *Rethinking Food and Agriculture 2020-2030*.



## INTEGRATION INTO THE EXISTING DAIRY ECOSYSTEM

While precision fermentation could be seen as a threat to the existing dairy industry, a likely outcome is that fermented dairy products will complement cow-derived dairy products and be an 'AND' opportunity, rather than an 'OR'. There is room for both products to exist alongside each other.

As Dr Nikki Freed of Daisy Lab, a New Zealand-based biotechnology research company who is exploring precision fermentation for dairy protein production, explains,

*"I think we will end up seeing a hybrid approach where we do have farms producing animal proteins, with alternative protein through fermentation as complementary to standard dairy. I don't think it is going to take over."*

When referring to the wider food sector, Emerging Proteins NZ<sup>6</sup> support this idea stating,

*"Developing emerging proteins is about portfolio diversification, not replacing all traditional agricultural systems and products... There is an opportunity for New Zealand to have a more diverse food production system that produces both sustainable high-quality animal and emerging protein products<sup>7</sup>."*

There may also be an increased appetite for blended or hybrid products, something which is now common practice in the meat sector and enables a reduction of conventional consumption without a significant shift in consumer behaviour<sup>8</sup>.

<sup>6</sup> Emerging Proteins NZ is a virtual network, established by FoodHQ, with the primary focus to accelerate the development of a New Zealand emerging proteins sector through the sharing of knowledge and establishment of connections.

<sup>7</sup> Emerging Proteins NZ, [Emerging Proteins in Aotearoa New Zealand: What will it take for the sector to thrive?](#) (Page 18), April 2021.

<sup>8</sup> Lawrence S, King T, Fish L, Baird Walsh J, Byrd, [Meat Re-Imagined: The global emergence of alternative proteins - What does it mean for Australia?](#), 2019.

# Current landscape

**Internationally, there are already a number of companies researching and developing fermented dairy products, including Change Foods, Formo, Remilk, and All G Foods, all of which have recently completed funding investment rounds to continue this work.**

One example of a company that is further advanced is Perfect Day, a United States based company founded in 2014. They have progressed beyond the R&D phase and now sell animal-free milk protein to companies that use it to make a wide range of value-added products, including ice-cream, protein powder, chocolate, cream cheese, gelato and protein bars.

In New Zealand there are already several organisations investigating the fermented dairy opportunity, such as Daisy Lab, who recently received start-up funding from Stephen Tindall's K1W1 and Icehouse Ventures<sup>9</sup>. However, in a recent address at the 2022 NZIFST conference, Alex Worker, Chair of Future Foods Aotearoa (FFA) and Country Manager for Impossible Foods, stated that to make the most of this opportunity, further growth is needed in the domestic market. He posited that there should already be ten more companies in New Zealand working in this space and that the sector needs to be built and fostered over the next three years, a process which should be industry-led with government support.



*Products made using animal-free milk produced by Perfect Day.*

<sup>9</sup> Stephen Smith, Stuff, [The secret to the perfect dairy free cheese could lie in lab grown milk protein](#), January 2022.

# Changes in consumer preferences

## The key driver for the growth of the precision fermentation sector is consumer preference.

From a consumer's point of view, there are a range of perceived benefits for the production and consumption of fermented milk products, including:

### ENVIRONMENTAL SUSTAINABILITY

It is considered that precision fermentation is more efficient and environmentally sustainable than traditional farming. Predictions indicate that precision fermentation could be up to 100 times more land efficient, 10 – 25 times more feedstock efficient, and 10 times more water efficient than traditional livestock farming<sup>10</sup>.

In 2021, Perfect Day<sup>11</sup> published a report comparing the life-cycle greenhouse gas emissions (GHG) of their products to traditional bovine dairy protein. They found that their products had 91% - 97% lower GHG emissions, 29% - 60% lower energy demand, and 96% - 99% lower water consumption<sup>12</sup>.

A University of Otago study released in January 2020 compared the environmental impact of a vegan diet against one based on consumption of animal products. Analysis revealed that emissions savings equivalent to a 59% reduction in New Zealand's annual light passenger vehicle emissions could be achieved if New Zealand adults consumed exclusively plant-based diets<sup>13</sup>. While this research is not directly related to precision fermentation, and there are numerous other complexities that these, and other similar studies, could also consider in the totality of their analysis, it does highlight the environmental impact that could be realised if there was a reduction in the production and consumption of animal-based food products.

### LOCALISED PRODUCTION

The current food system in New Zealand is very centralised, with relatively few production and supply chain facilities servicing a large area, for example there are only four Countdown Distribution Centres in the whole of

New Zealand. However, Catherine Tubb, co-author of the RethinkX report, suggests that '*anywhere you can brew beer, you can make food*'. As precision fermentation is not reliant on environmental conditions, such as suitable climate and soils, production facilities are able to be constructed in any community.

Having food production facilities close to the markets they will serve, reduces significant transport costs and related heavy freight emissions. It can also provide more resilience to the system by reducing the possible risk of disruption caused by significant events, such as pandemics or natural disasters. A reduction in the length and complexity of the supply chain allows ongoing localised food production and distribution to occur.

### COST

As the inputs and processing costs for various food ingredients and items reduce, so too theoretically do the prices for the consumer purchasing the product. One prediction expects that some lab-grown foods will eventually be priced at least 50%, and as much as 80%, lower than equivalent animal products<sup>14</sup>. While price is not the sole driver for consumer behaviour, it will be an influential factor for many as the cost of living continues to increase.

### MARKET REACH

Dairy products created using precision fermentation are suitable for a wider range of consumers, including vegans and people with intolerances. Precision fermented products are produced without input from animals, alleviating concerns about animal welfare. They are also lactose and cholesterol free, meeting the needs of an ever-growing portion of society, and unlocking an opportunity for further consumption in markets such as Asia that have high prevalence of lactose malabsorption. Given fermentation's positive perception as a health product, consumer adoption may be easier than even for nut mylks which are highly processed, at great distances from where consumed.

<sup>10</sup> Catherine Tubb and Tony Seba, RethinkX: Disruption, Implications and Choices, [Rethinking Food and Agriculture 2020-2030](#).

<sup>11</sup> Perfect Day is an American-based alternative protein company.

<sup>12</sup> Perfect Day, [Life Cycle Assessment of Perfect Day Protein](#), April 2021.

<sup>13</sup> Dr Alex Macmillan, University of Otago, <https://www.otago.ac.nz/news/news/otago731501.html>.

<sup>14</sup> Catherine Tubb and Tony Seba, RethinkX: Disruption, Implications and Choices, [Rethinking Food and Agriculture 2020-2030](#).



# The opportunity for Taranaki

Farming has been at the core of the Taranaki economy since the late 1800's and remains a key aspect of the regional economy, sustaining nearly 6,000 jobs and adding \$1b to the regional economy each year<sup>15</sup>.

Taranaki has built a reputation for being a region that produces a range of high-quality food products, such as milk and cheese. There is a range of knowledge, capabilities, and potential developments in Taranaki that could mean it is well suited to extending into adjacent specialisms, becoming a national hub for a sector that complements that existing cow-derived dairy offering. However, for the potential of the precision fermentation sector to be realised in Taranaki, it is critical that farmers, growers, and producers explore the possibilities together.<sup>16</sup>

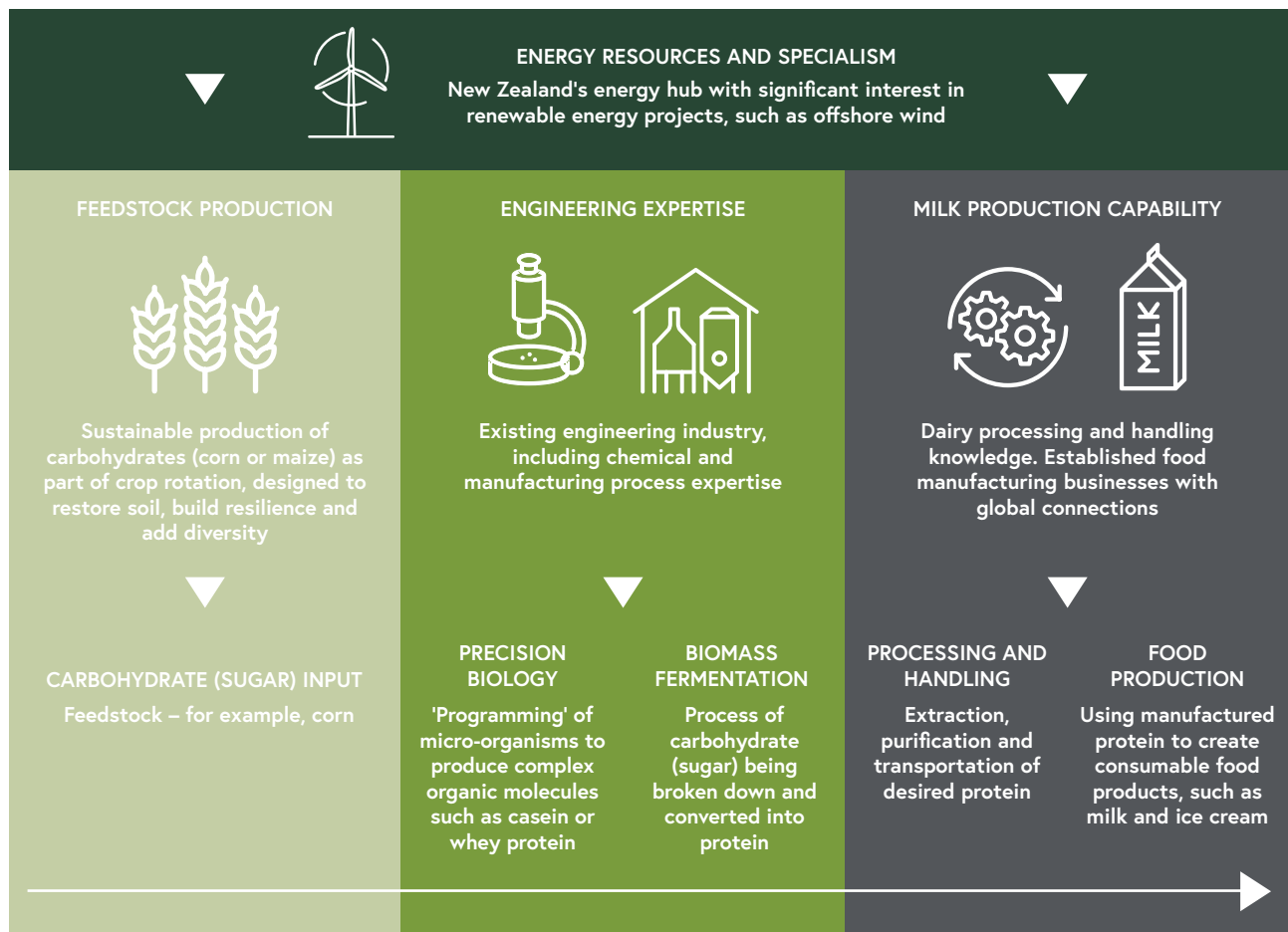
## REGIONAL EXPERTISE

### Milk production capability (Fonterra presence)

Taranaki is one of the hubs for milk production by Fonterra, with multiple processing facilities in region. Proximity to Fonterra would be beneficial for the development of precision fermentation processes for a number of reasons.

Not only is the knowledge and capability of appropriate handling and processing of milk products, including proteins in place; but according to a recent report by Infometrics on *Identifying Niche Industries for the Future: A Data Driven Approach*, Taranaki is currently a producer and exporter of animal-derived casein and casein derivatives, whey and products consisting of natural milk derivatives, and is internationally competitive in their

## TARANAKI CAPABILITY, EXPERTISE AND RESOURCES RELATED TO PRECISION FERMENTATION



<sup>15</sup> Infometrics Industry profile data, Taranaki 2021.

<sup>16</sup> Emerging Proteins NZ, *Emerging Proteins in Aotearoa New Zealand: What will it take for the sector to thrive?*, April 2021.

exports of this product. Taranaki businesses already have established trade links with the rest of the world which means that the region is already well positioned to grow their exports. The export markets for these products could be relatively easily enhanced.

Furthermore, as stated in the *Emerging Proteins Report*, 'Start-ups and SME food businesses have been very successful in sparking increasing consumer interest in emerging proteins with the development of new products either based on what is available overseas or in some cases on novel intellectual property. Small food businesses can innovate fast, develop deep understanding of their niche consumers, and engender trust through clear communication of and commitment to their values<sup>17</sup>. It is possible that some of these businesses will be able to successfully scale and become large players in the local and export markets.

However, international experience has been that most brands with large market share have grown via start-ups or SMEs who have then partnered with, or been acquired by, large companies. These big food companies can unlock the efficiencies of scale to enable rapid and cost-effective expansion that can make the products more widely available and accessible. It seems likely that a successful New Zealand emerging proteins industry will require a combination of innovation and responsiveness from small companies with the resources and involvement of large existing businesses.'

## ENGINEERING EXPERTISE

The engineering sector in Taranaki is large and varied, with extensive global connections, supporting approximately 3,000 jobs throughout the region. The sector grew over time to support oil and gas operations but has shown a willingness to adapt and consider new opportunities. With the development of a precision fermentation sector, the need for related infrastructure and aligned capability will be significant – something which can be potentially serviced by existing local firms. An opportunity also exists for the region's chemical and specialist engineers to apply their skills to advancing precision fermentation technology, improving processes to help increase commercial viability.

One example of Taranaki engineering firms adapting to meet new market demands is Rivet Engineering, a local sheet metal fabricator. They partnered with BeGin Distilling to create their copper still, used for production of gin. This was the first still they produced, however, Rivet have recently completed their sixth installation. Still production is now a growing area of their business.



## ENERGY RESOURCES AND SPECIALISM

The energy costs of maintaining a controlled environment (consistent temperature within a vat) are considerable, as are the energy costs associated with physical production of large vats for fermentation. Taranaki is New Zealand's energy hub and there is significant interest in renewable energy projects around the region. The region is already home to the country's largest solar farm (Kapuni), and the Waipipi wind farm, south of Pātea, that can produce enough energy to power 65,000 homes. The offshore wind resource off the coast of South Taranaki is also great, with the potential to deliver almost 15-Gigawatt worth of renewable energy - double New Zealand's current electricity supply<sup>18</sup>. Several developers are already completing further due diligence with the intention to realise this opportunity within the next decade. The region is therefore not only home to extensive energy resources but energy specialism necessary to underpin precision fermentation.



17 *Emerging Proteins NZ, Emerging Proteins in Aotearoa New Zealand: What will it take for the sector to thrive?*, April 2021.

18 *Venture Taranaki, Power to X: Transforming renewable electricity into green products and services*, December 2021.

## RELATED BRANCHING OUT OPPORTUNITIES

The other key input in the fermentation process is carbohydrates (or sugars), a component added to activate the micro-organisms. As outlined in the *Grains, Legumes and Vegetables Branching Out blueprint*<sup>19</sup>, there is a significant opportunity to 'integrate rotations of grains, legumes, vegetables or bioenergy crops into the existing farming system to restore soil, build resilience and sustainability and add value and diversity to farming incomes'. This includes variations of corn, both of which can be used as the sugar in the fermentation process. As identified in the Emerging Proteins Report, although these products are traditionally used for animal feed, they have the potential to earn a premium price when being used to create food products for humans. However, to ensure this success, it will be important to ensure supply and demand for this product is aligned.

# Next steps

**Precision fermentation as an input into the food ecosystem is a technology that is generating plenty of interest internationally. It has the potential to complement the existing dairy sector, build on our strengths, foster access to new markets and create additional food and fibre opportunities.**

If this opportunity interests you and you wish to further understand the potential for domestic development, please get in touch with the team at Venture Taranaki.

**Get in touch, email [branchingout@venture.org.nz](mailto:branchingout@venture.org.nz)**

## ABOUT VENTURE TARANAKI

Venture Taranaki is the regional development agency for Taranaki. The organisation is responsible for regional development strategy, enterprise and sector development, investment and people attraction, and major project initiatives which contribute to the inclusive and sustainable growth of the region. Venture Taranaki is a registered charitable trust and a New Plymouth District Council Controlled Organisation, supported by the three District Councils of the Taranaki region.



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