

OUR FUTURE ON A PLATE



FOOD FOR THOUGHT: A BITE-SIZED LOOK AT FUTURE FOOD



MENU

Aperitif

**Dystopian or utopian food
future: Food in 2050**

Entrée

**Back to reality: Food in 2024 and
the need to innovate**

Main Course

**A deep dive into alternative
proteins and food waste**

Desert

**How "WE" grow the food system
we want**

A Dystopian
Dinner: Food in
2050 (The
Gloomy Version)





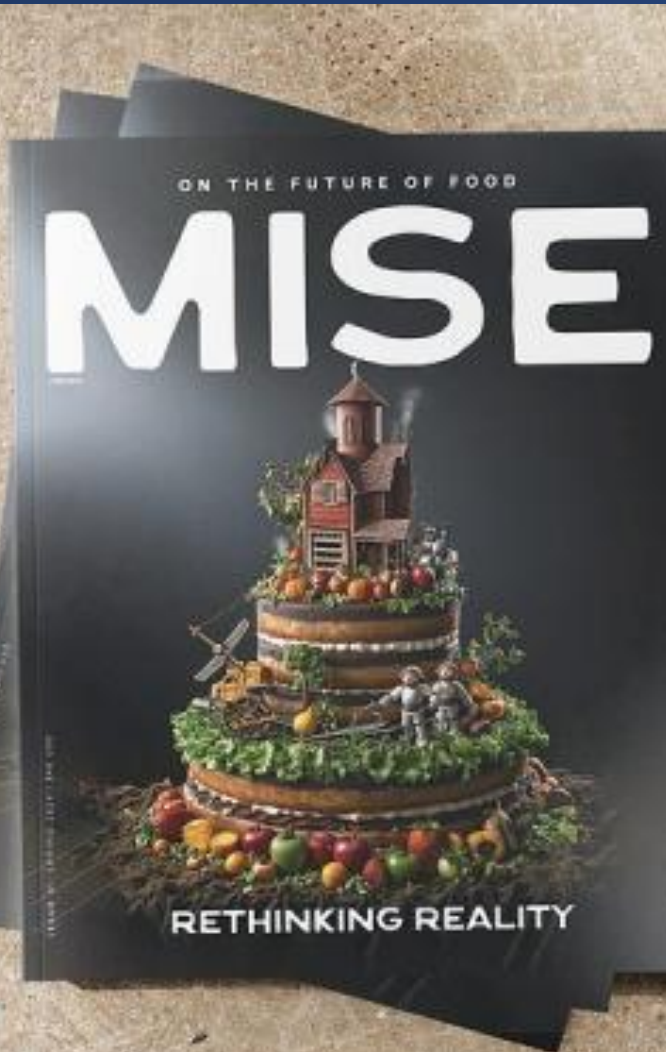
The future of food ISN'T predetermined

By learning from these potential pitfalls, we can work towards a brighter future...

A Utopian
Dinner: Food in
2050 (The
Bright Version)



There ARE food futurists who can help with things like scenario planning



Enhancing Action With Foresight

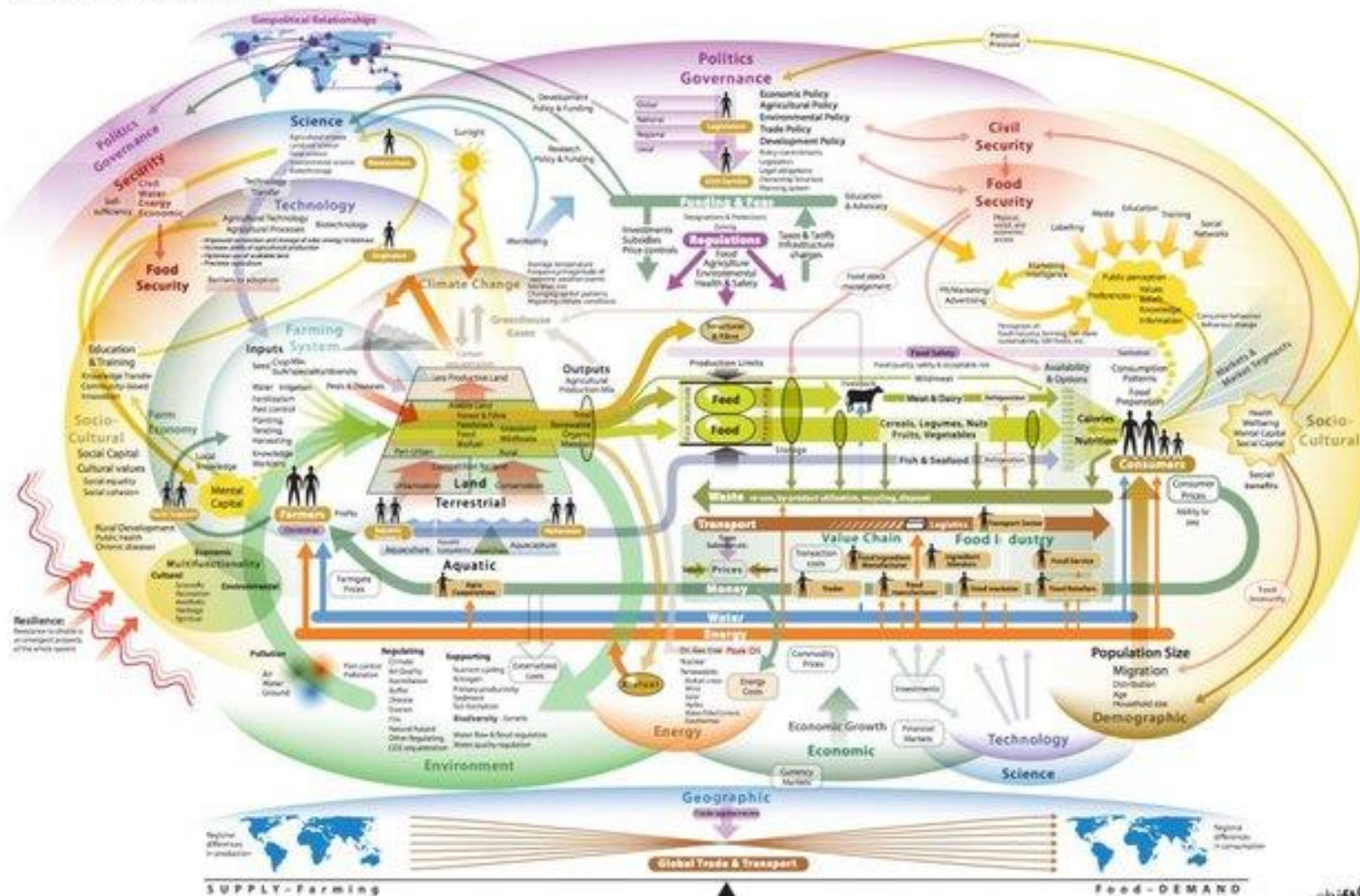
Envisioning future food system scenarios helps us understand the long-term impact of today's choices and guides actions for a better future.



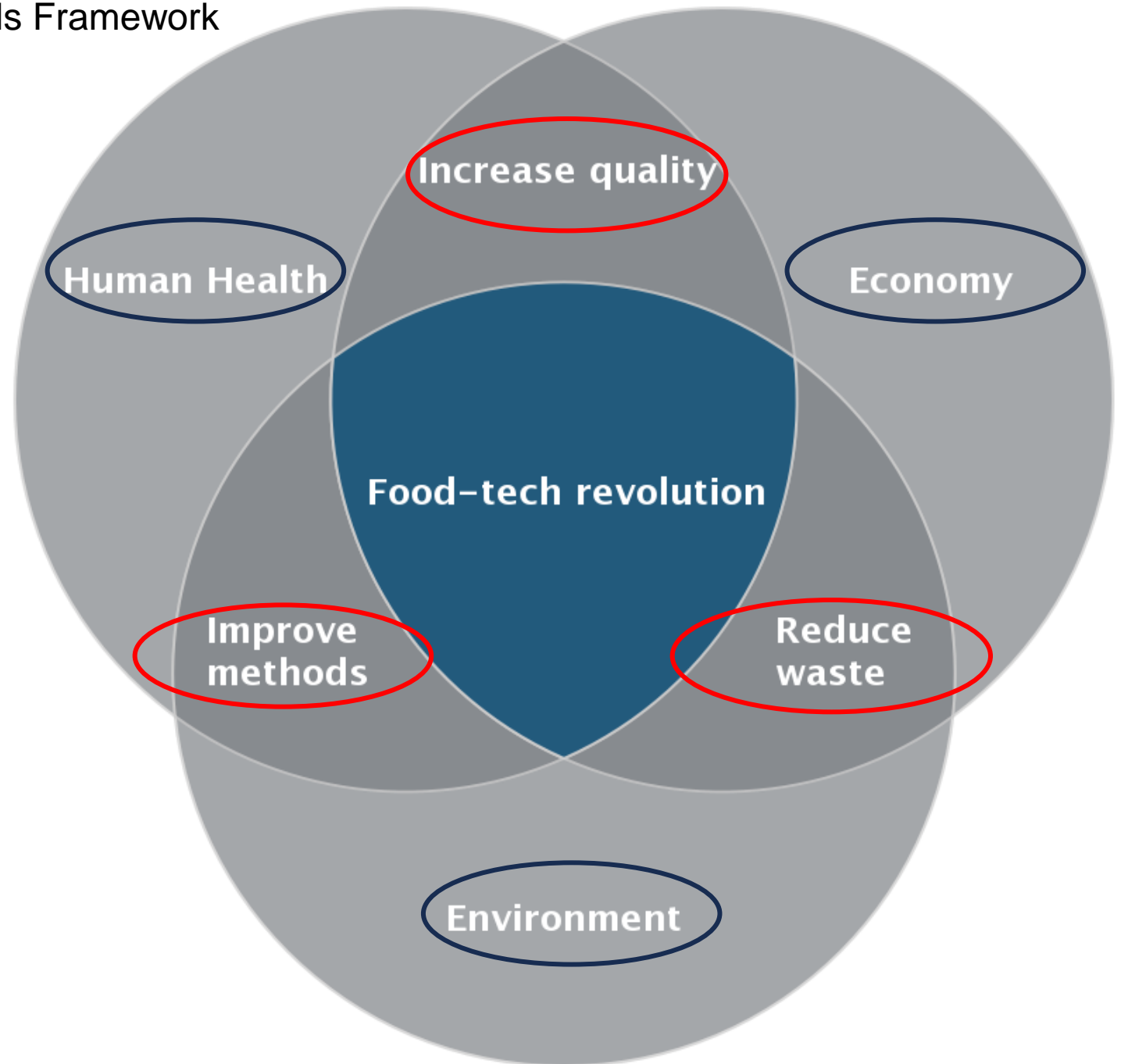
FOUR
VISIONS
OF THE
FUTURE

Back to reality: 2024 Our global food system is hugely impressive...

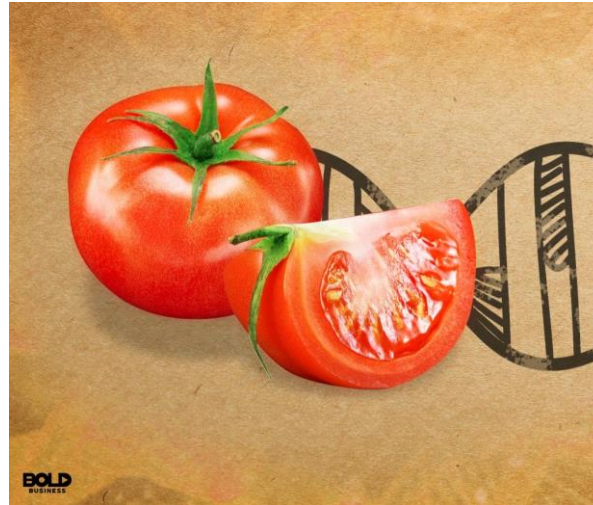
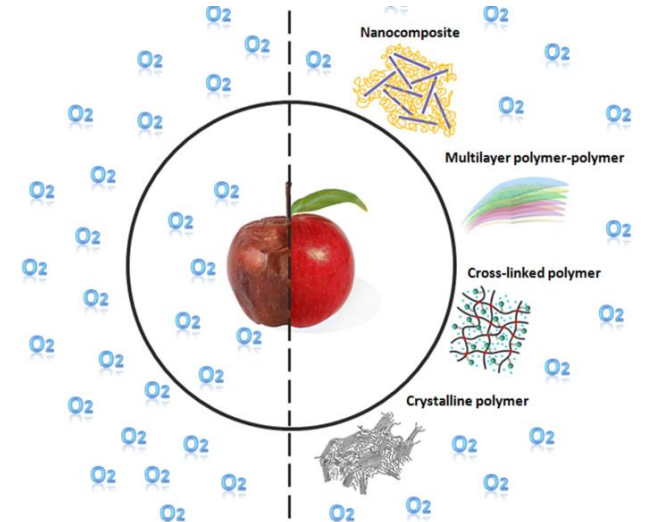
Global Food System Map



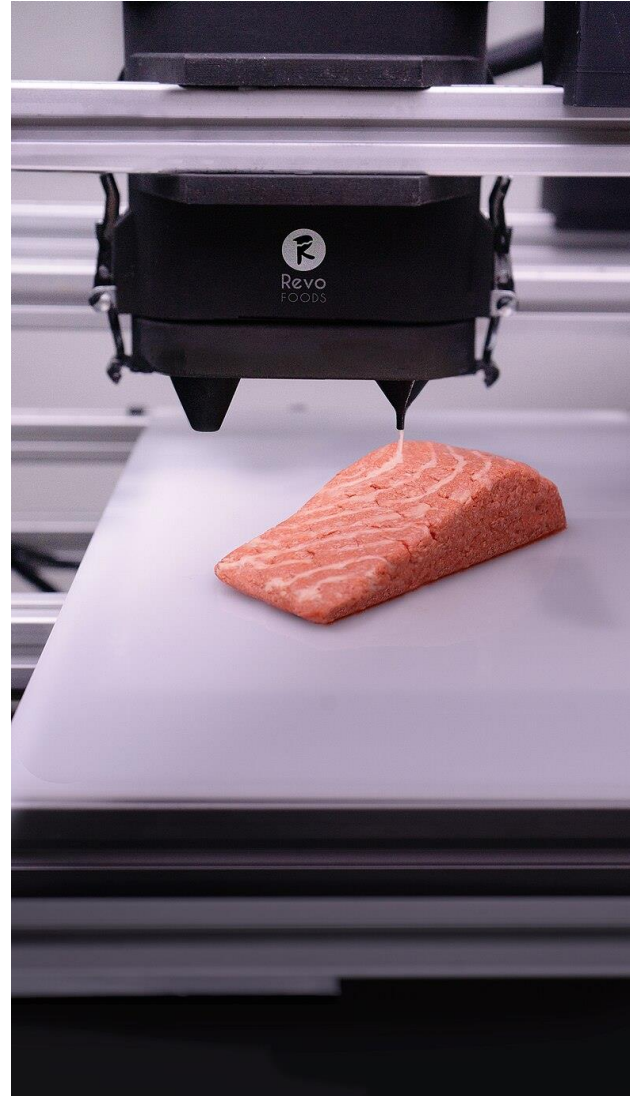
Innovation is
an Effective
Route to
Change



Digital and biological cross-cutting technologies



Digital and biological cross-cutting technologies



A range of innovations hold potential to revolutionise our system

A. Increase quality

B. Improve methods

C. Reduce waste

Precision

New Foods

Supply Chain

- Robotics and automation
- Farm-management software and sensing

- Plant-based food alternatives
- Cultured and lab-grown food

- Food sensing and processing
- Food preservation and smart packaging
- Renewable cold-storage

Protection

New Farms

Marketplaces / mobile services

- Gene editing
- Microbiome technologies for crops and soil
- Biological-based crop protection

- Controlled environment agriculture and vertical farms

- Digital marketplaces

Although this list is not exhaustive, it aims to illustrate the transformative potential of innovations in food and agriculture across the supply chain.

No one technology presents a single perfect solution!
 The task is determining how to make the most suitable technologies work to achieve the greatest impact while minimising risks.



Building the best possible future food system is likely to require embracing some, if not all, of these innovations

What are the key strengths of the innovation area?

What are the current limitations?

What opportunities could be created if this technology was scaled up? What opportunities are there to advance this area of innovation further and how could this have a greater impact?

What are the possible negative implications of scaling the technology up further? What are the trade-offs?



A “DEEP DIVE” INTO TWO INNOVATION CATEGORIES:

- new foods (alternative proteins)
- food waste

INNOVATION CATEGORY: NEW FOODS (ALTERNATIVE PROTEINS)



What are Alternative Proteins?

Precision fermentation



Fermented Protein

Precision fermentation uses fermentation and yeasts to replicate dairy foods. Fermentation is not used to produce meat alternatives.

Whey and rennet derived from precision fermentation are already in commercial production, and casein and milk fats can also be produced.

Fermented proteins have long historical origins, and have been made from nuts, seeds, tubers, and coconuts. There are traditional fermentation methods in te ao Māori.



Plant-Based Protein

Plant-based meat and milk alternatives are made of protein extracted from plants, legumes or grains.

This type of protein includes traditional foods such as tofu, and new technology that mimics meat by modifying protein, perhaps adding soy leghemoglobin to offer a 'bloody flavour'.

<https://ourlandandwater.shorthandstories.com/beyond-meat-and-milk/index.html>

Cellular method



Cell-Cultured Protein

Cell-cultured (or lab-grown) protein is created by extracting cells and replicating them in a laboratory environment. The end product is identical to the original product, having been made from the same genetic material.

This method enables the production of real meat from any species. It is not considered genetic modification.

Cell-cultured foods still await regulatory approval. Just one product is for sale in Singapore.

Beyond meat and milk

Three scenarios show us how the rise of new proteins could radically change the future of farming in Aotearoa



“Countries that are dependent on importing food from countries such as Aotearoa, like China and the UK, will increasingly be able to produce more of their own alternatives to animal protein as technology advances”

(Research lead Jon Manhire, director of The AgriBusiness Group)

Results from Protein Future Scenerios research, a collaborative project from the AgriBusiness Group, Lincoln University, University of Canterbury, University of Otago and Ruralis (Norway)





Perfect Day fermented milk

Scenario Two

Precision fermentation takes off and demand for plant-based milks increases (+22%), impacting traditional dairy products.

Demand for plant proteins continues (+10%) but technical issues stall the development of cellular products.

Sustainability is one factor driving consumer acceptance, in addition to improved taste and texture, and price parity.



Future Meat plant-based meatballs

Scenario Three

Plant-based products take off, while some of the barriers facing precision fermentation and cellular products are removed.

There is increasing demand for plant protein (+22%), precision-fermented dairy (+10%), and cell-cultured protein (+10%).

Sustainability is a key factor driving consumer acceptance.



Wildtype cultivated salmon

Scenario Four

All alternative proteins take off. There is a significant increase in demand for plant protein (+22%), precision-fermented dairy (+22%), and cell-cultured protein (+22%).

All current barriers to the success of alternative proteins have been removed or are in the process of being overcome. Scale of production increases, and price parity is achieved. Taste and texture improve.

Sustainability is a significant factor. Alternative proteins are viewed as solving several global concerns.

These scenarios were used to inform the below proposed land use changes displayed.

Proposed Land Use Changes

Scenario

1

- Base Case – Business as usual

Scenario

2

- 35% reduction in the dairy area
- Arable area increases 50% in Canterbury, Southland, Wairarapa and Horizons

e.g. Precision fermentation takes off

Scenario

3

- 15% reduction in the dairy area
- Arable area doubles across all flat land (25% from dairy, 75% from sheep and beef) - mainly south island
- 15% reduction in sheep and beef sector goes to forestry

e.g. Plant based takes off

Scenario

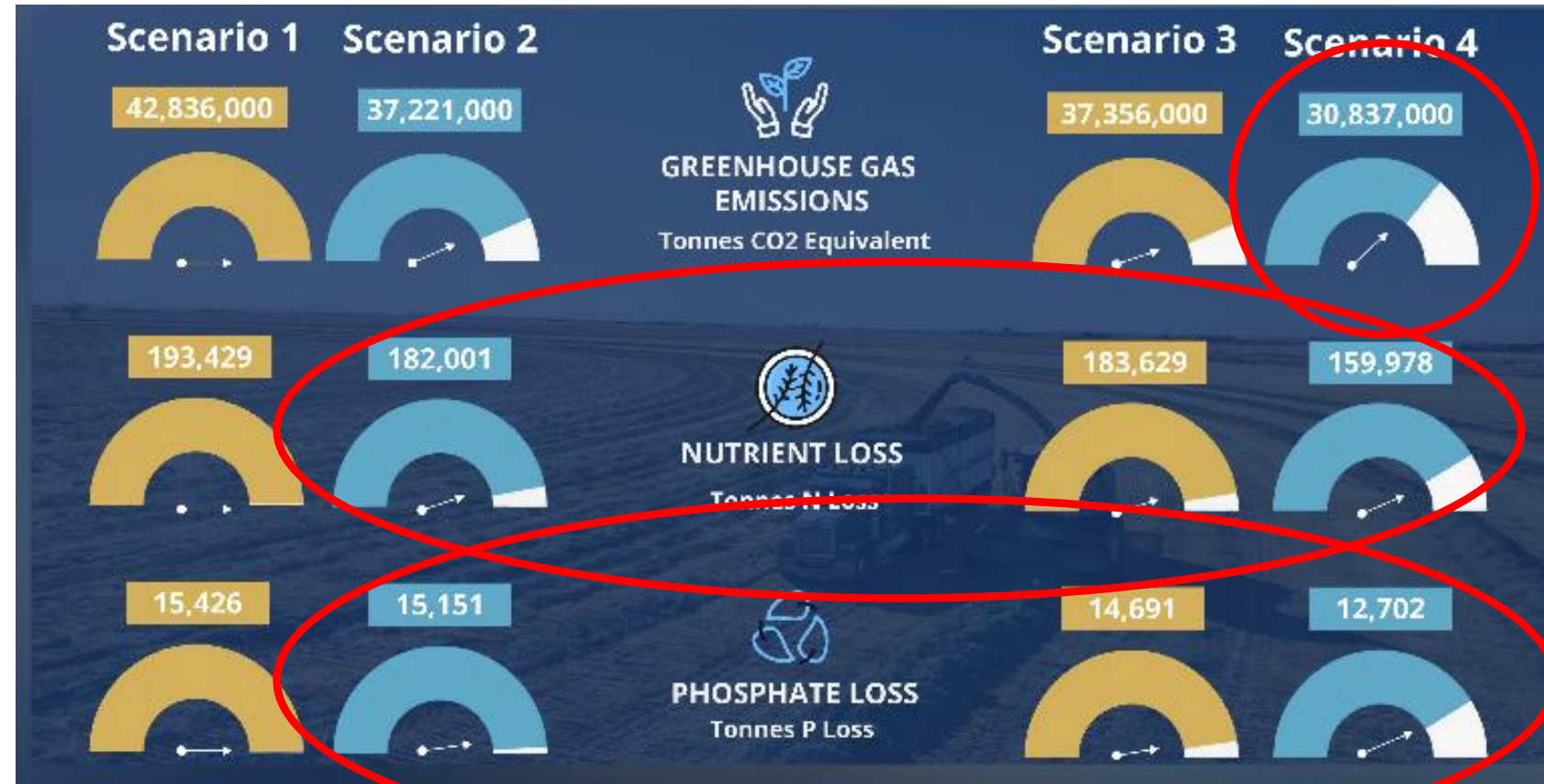
4

- 35% reduction in the dairy area
- Arable area doubles across all flat land (25% from dairy, 75% from sheep and beef) - mainly south island
- 25% reduction in sheep and beef sector goes to forestry

e.g. All APs take off

Environmental Impact

Greater global demand for alternative proteins will have environmental benefits for New Zealand



Economic Impact

Greater global demand for plant protein will also have economic benefits for New Zealand, but these will be unevenly distributed



Regional Analysis

These include impacts over time on employment, land use, and environment, to inform long-term planning and regional development





'Natural' is a Core Strength

The New Zealand pastoral sectors' points of difference may increasingly be as an exporter of high-quality 'natural' meat and milk products, which will appeal to a different market than their highly processed alternatives.



We Must Reduce Agricultural GHGs

The negative impacts of increasing global demand for new proteins on New Zealand's meat and milk industry will be significantly higher if we don't mitigate our agricultural greenhouse gas emissions.

This is because a desire to live more sustainably drives some people to want to eat alternative proteins, which can be marketed as having a lower greenhouse gas footprint.



New Industries Will Emerge

New Zealand has the opportunity to become a major producer of alternative proteins. Significant quantities of renewable energy are needed, and New Zealand's supply of hydro and increasingly wind power put us in a good position.

Māori knowledge of traditional fermentation practices is currently untapped.

Producing large quantities of protein through precision fermentation and cell-culture processes will require a massive supply of inputs such as serum and yeasts, and this emerging 'feed industry' could also provide opportunities for Aotearoa.



Prepare for Market Shifts

New Zealand needs to prepare for significant changes to our key food export markets.

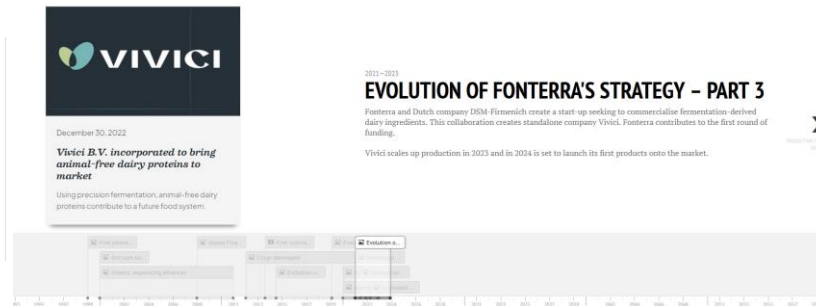
Countries previously dependent on importing food from Aotearoa, including China and the UK, will be able to produce more of their own proteins as technology for producing alternatives to animal protein is adopted.

The dairy sector in New Zealand is more threatened by the development of new proteins than our meat producers. Fonterra's response of engaging with the sector is sensible.

Policy Issues

Timeline

Click the arrow on the right to navigate the timeline



INNOVATION CATEGORY: REDUCE WASTE



Food Waste Innovation Auahatanga Parakai

Research sub-themes:



Metrics and Management



Technical Innovations



Social Innovations



UPCYCLED
FOOD LAB



UPCYCLED
FOOD LAB



Upcycled ginger beer soda recipe



food waste innovation
Food Waste Technical & Social Innovations Research Group



Homebrewers' guide to upcycling bread into beer

GIVE SPENT GRAIN NEW LIFE

In the US 27 billion kilograms of spent grain is generated every year! Spent grain is the leftovers from brewing. There are ample opportunities to upcycle this valuable 'waste' stream. A number of entrepreneurs have built their business on the growing interest of spent grain, for example Regained *(4) take spent grain and upcycle it into flour and Rutherford and Meyer, The Upcycled Grain



Find the recipe on our website
<https://foodwaste-otago.org/news/the-star-cake-and-beer-together-at-last>



food waste innovation
UPCYCLED FOOD LAB

"29 MILLION LOAVES OF BREAD ARE WASTED ANNUALLY IN NEW ZEALAND"

'Upcycling' some of the 29 million loaves of bread wasted annually in New Zealand *(1) into beer, is a fun concept that can help to raise awareness of food waste and divert unused bread away from landfills. Working with Citizen Collective*(2) Food Scientists at the University of Otago set out to explore the maximum amount of bread that could be substituted into a good tasting beer by developing a unique mashing regime. Based on a series of product development trials, a winning recipe which substitutes 50% of the malt with bread has been developed. By optimising the mash regime, we increased the amount of bread in upcycled beer from 25% to 75% of the carbohydrates required. Using this recipe, 4.75 slices of bread are used per 500ml of beer. The team are delighted to share this with you now, all in the name of waste reduction and good beer brewing! This infographic provides step-by-step instructions on how you can become a food waste conscious brewer. From a simple 'how-to-guide' through to a section on 'Extra for Experts', this resource guide contains everything you need to know about brewing beer from bread. So, we challenge you now to attempt brewing your own beer using any leftover bread you can find and in doing so join the movement in reducing the number of loaves going to waste whilst contributing to the overall global food waste problem! We are confident this winnable solution will lead to nothing but happiness!



Happy brewing!

The Upcycled Food Lab *(3),
University of Otago



WHAT YOU'LL NEED:

- | FOR THE MASH | FOR THE BOIL | TO FERMENT |
|--------------------------------|-------------------------------------|----------------------|
| • 1900g unwanted bread | • 20g Rakau hops (9.5% alpha acids) | • 1L water |
| • 1300g NZ pilsner malt | • 16g Riwaka hops (4% alpha acids) | • 14g 34/74 |
| • 9.1L water + 2L sparge water | • 1.2L water | • Safale Lager yeast |
| | | • 60g sugar |

BEER STYLE: KIWI PILSNER | ORIGINAL GRAVITY: 1.053 | YIELD: 10L

1. PREPARE THE BREAD

- Using a food processor grind the bread into a consistent, small crumb (this can be done in small batches with a regular kitchen processor).
- In the same manner, mill the malt in the food processor to achieve a crushed grain ensuring the kernels break apart.

SEE EXTRA FOR EXPERTS: TIP 1

2. STEP MASH

- Add the bread and malt to a 20L plastic bucket. Mix well and place the bucket in a large container of water at 45°C (a chilly bin is good as it holds heat well).
- Mash in by adding to the bucket containing the bread and malt 9.1L strike water (~55°C) to hit a mash temp of 45°C and hold for an hour. Monitor the temp and add more hot water to the water bath (chilly bin) if needed.
- Add boiling water to the water in your water bath to raise the mash temp to 60°C. Hold at 60°C for 20 minutes. Monitor the temp and add more hot water if needed.
- Increase the mash temp to 65°C. Hold for 30 minutes, monitor and adjust the temp as required.
- Finally, increase the mash temp to 70°C. Hold for hold for an hour, monitor and adjust the temp as required.

SEE EXTRA FOR EXPERTS: TIP 2

"The bread used for this recipe was Nature's Fresh white sandwich bread, to ensure experimental consistency, which contained 2.71% salt per loaf. Higher percentages of bread substituted for malt can lead to salty beer, which can be desirable if you wish to make a salty beer, e.g. an oyster stout. Try to use low salt bread if possible, to avoid saltiness"

"The goal of the typical mashing process is for enzymes in the malt to break down the starch in the grain and the bread to fermentable sugars. This creates the sweet fermentable liquid called sweet wort"

food waste innovation
UPCYCLED FOOD LAB

3. SPARGE AND FILTER

- Filter the contents of the mash to obtain the sweet wort. It will be best to put it through progressively finer sieves and finally several layers of muslin cloth. You should retain ~7L.
- Sparge the mash with 2L of hot water (~80°C).
- Four the remaining grain through a sieve using a spoon to move the grain around to squeeze out the liquid.
- Discard the leftovers and repeat until all the grain has been drained.
- Transfer the extracted wort into a large pot for boiling.

SEE EXTRA FOR EXPERTS: TIP 3

4. BOIL AND ADD HOPS

- Add 1.2L boiling water to the boiling pot to allow for water loss during the boil.
- Add the Rakau hops, then boil the wort for 30 minutes (a rice rolling boil).
- After boiling for 30 minutes, add the Riwaka hops, turn off heat, put on the lid on the and let sit for 10 minutes.

5. COLD BREAK

- Prepare sterile vessels for the cold break using Star San or a similar product.
- Add 1L of boiling water to the bitter wort.
- Transfer the bitter wort into the vessels.
- Place in the fridge overnight to let the clear wort separate or until the solids and liquid have visibility separated.

6. FERMENT

- Sterilise the fermentation vessel using Star San or a similar product.
- Carefully pour the clear wort from the fridge to the fermenting vessel, leaving behind the solid material (trub). Alternatively, you can siphon out the clear wort.
- Pitch 14g of yeast 10L of wort.
- Leave to ferment at 15°C for 5 days.
- Monitor the specific gravity and end of ferment.
- Carefully pour/rhish the beer into sterile bottles.
- Add 4g of sugar per litre of beer and seal the bottles.
- Leave in a cool, dark place for two

EXTRA FOR EXPERTS:

This next section is for those that are seeking a little deeper understanding into the bread-beer brewing process. Understanding the process in a more precise way will help you to brew better more consistent beer. In relation to brewing beer with bread, the four key areas of expertise are the ratio of bread to malt, the unique mashing regime, the lautering and filtration process without a grain bed and the secondary fermentation. Read on to learn more and expand your knowledge to become a bread-beer brewing expert.

TIP 1

The recipe provided works with a 50:50 malt to bread. If you would like to experiment with different ratios use the conversion factor provided to calculate the mass of malt to substitute with bread.

Conversion Factor: 1.46
To calculate bread required in recipe:
Total Malt in original recipe (g) x Fraction to replace (i.e. 0.5 for 50%)
Mass of Bread (g) =
Mass of Malt to substitute (g) x 1.46
Example for 40% substitution:
Mass of Malt to substitute = 2600g Malt x 0.4 = 1040g
Mass of Bread = 1040 x 1.46 = 1518g Bread for a 40% substitution

TIP 3

In traditional brewing a lautering step is used

TIP 2

In step mashing, the mash temperature increases through a series of rests (time at a particular temperature). 45°C is termed the enzyme rest. At this temperature, the enzyme phytase breaks down a molecule called phytin and releases phytin acid which lowers the mash pH. 60°C is termed the protein rest. Here, two enzymes (protease and peptidase) break down long chained proteins, into medium and short chains and break them down to their component forms. 70°C is termed the saccharification rest. This rest is required in all mash programs. Here, two enzymes (alpha-amylase and beta-amylase) convert starch to fermentable sugars.

TIP 4

Secondary fermentation is carried out in the

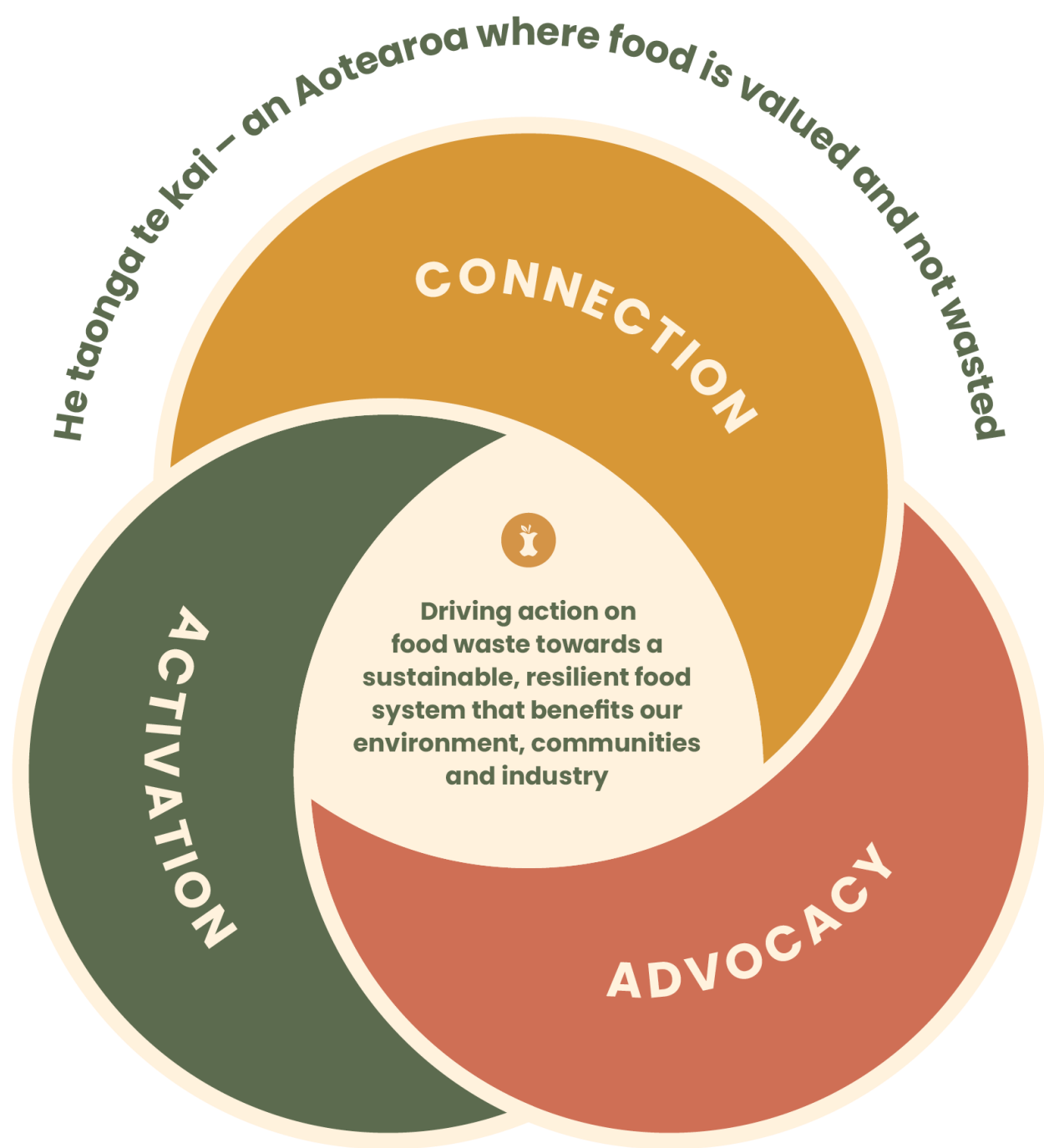
"Due to the bread's composition, small particles end up in the wort. Removing the wort in a muslin cloth retains most of those small particles, retaining a clearer wort"

"Hops are the flowers or cones of a plant called Humulus Lupulus. The hops are a key component of the beer's aroma, flavour and bitterness. Hops are divided into two very general varieties: bittering and aroma. Bittering hops will have higher alpha acids, whereas hops will tend to have more essential oils."

"Chilling the wort quickly will help the protein in the wort clump together and fall out of solution. Brewers call this the 'cold break'. Removing protein at this step helps to achieve a clearer, better looking beer"

"The yeast strain used is originally the most important contributor to beer flavour. Brewers must consider 5 factors when selecting yeast strains: attenuation, flocculation, alcohol tolerance, temperature range and sensory profile."

New Zealand Food Waste Champions 12.3



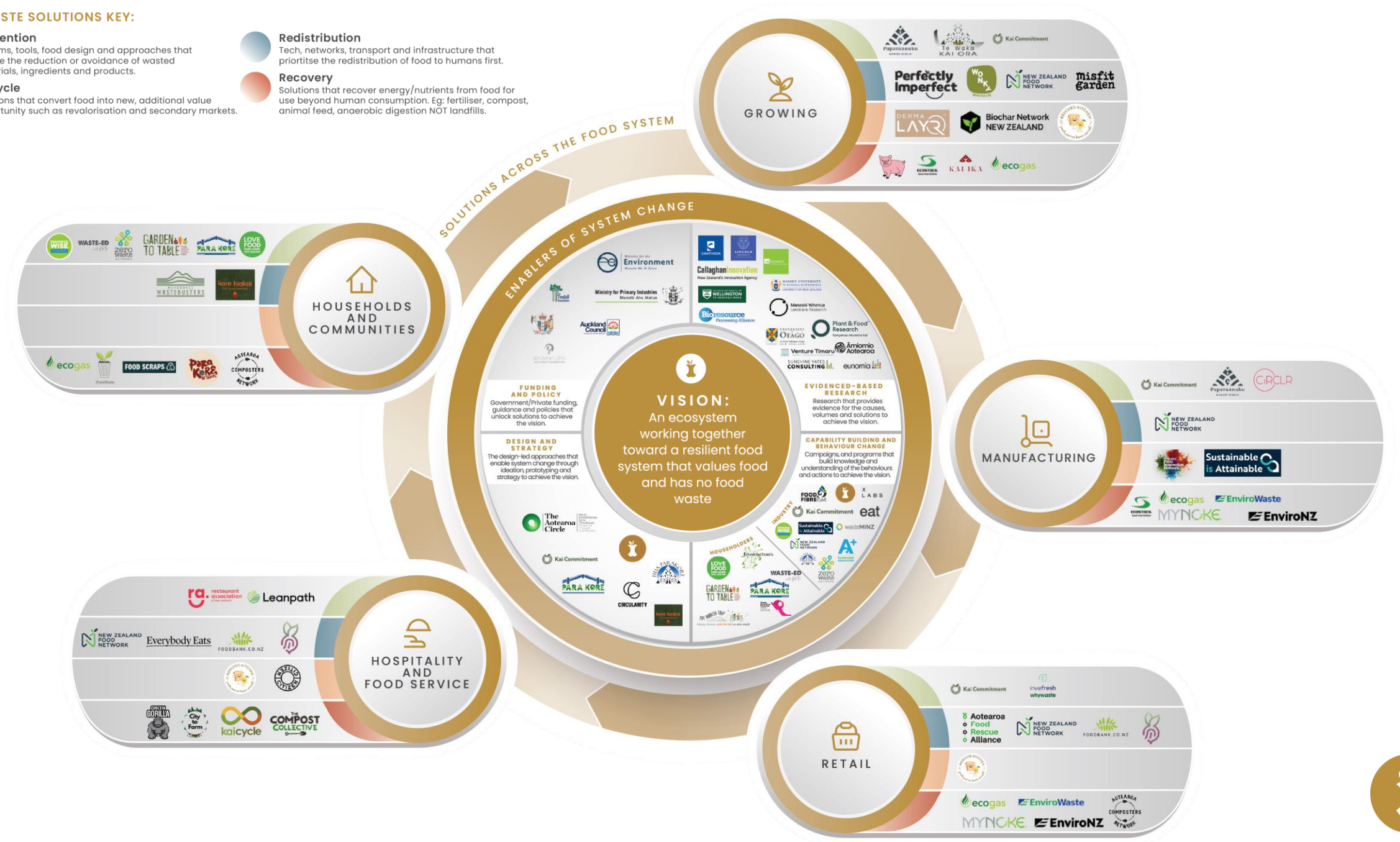
Kai Commitment



FOOD WASTE SOLUTIONS KEY:

- Prevention**
Systems, tools, food design and approaches that enable the reduction or avoidance of wasted materials, ingredients and products.
- Upcycle**
Solutions that convert food into new, additional value opportunity such as revalorisation and secondary markets.

- Redistribution**
Tech, networks, transport and infrastructure that prioritise the redistribution of food to humans first.
- Recovery**
Solutions that recover energy/nutrients from food for use beyond human consumption. Eg: fertiliser, compost, animal feed, anaerobic digestion NOT landfills.



A top-down view of a person's hands, wearing a grey knit sweater, carefully planting rows of young lettuce seedlings in a garden bed. The soil is dark and rich. The seedlings are arranged in neat, parallel rows, with some showing a reddish-purple hue and others a bright green. The person's hands are positioned to gently press the seedlings into the soil. The overall scene is peaceful and focused on the act of gardening.

Seeding a Brighter Future

Shifting Mindsets and Skillsets:

The crucial role Agribusiness teachers play in this transformation!



Cultivating Future-Ready Skills



Encouraging Collaboration and Entrepreneurship



Fostering a Sustainable Mindset



Building a Global Perspective



Inspiring a Passion for Food





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0:01 / 1:00

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HD



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Don't just take our word for it...





Questions?

otago.ac.nz/apply/fosc

otago.ac.nz/apply/agri

