

FINDING THE WAY

*Emerging and future platforms in
New Zealand's bioeconomy*

FINAL REPORT
June 2023; v1.01

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GENERAL

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If at any point you are unclear where a number came from or how a conclusion was derived, please contact the authors directly. We are always happy to discuss our work with interested parties.

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FINDING THE WAY

Emerging and future platforms in New Zealand's bioeconomy

FINAL REPORT

JUNE 2023

v1.01

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EXECUTIVE SUMMARY

The New Zealand bioeconomy needs to drive change.

WHAT IS THE SITUATION?

The world primarily wants biomaterials from New Zealand and as a result, the bioeconomy is critical to the total economy.

The world has a growing population with growing incomes, or in other words, a growing number of consumers. Eight billion people are alive today on Earth. Forty percent (or 3.2 billion people) live in subsistence agriculture where they operate a family-scale bioeconomy for their own consumption with little surplus for trade or sale. However, sixty percent (or 4.8 billion people) now participate in the modern economy as consumers and this group continues to grow. This large and growing group of global consumers are seeking to increase their consumption of biomaterials, particularly food & beverages.

New Zealand has a successful bioeconomy built on producing a wide range of biomaterials, much of which is exported to these same consumers.

WHAT IS A BIOECONOMY?

At the simplest level, the bioeconomy produces and processes biomass (“bio”) for sale in markets (“economy”) to consumers (or other suppliers to them). In New Zealand, these stages of the bioeconomy are given a wide range of names, but the core functions remain constant. This core bioeconomy is supported by a huge range of suppliers, service providers, rule makers and wider stakeholders.

WHY DO WE CARE ABOUT THE NEW ZEALAND BIOECONOMY?

The bioeconomy is very important to New Zealand in terms of land use, jobs and trade. The wider bioeconomy accounts for at least a quarter of employment in New Zealand, depending on how you think about tertiary sectors and service providers. At the same time, the bioeconomy accounts for 60% of New Zealand land use.

The products of the bioeconomy account for at least two thirds of New Zealand total exports of goods and services. Right now, the bioeconomy is basically the only major sector of the economy holding up New Zealand’s global trade position. The bioeconomy achieves a large trade surplus, while most other sectors are underperforming or in deficit. In addition, parts of the bioeconomy are growing exports strongly, where most other sectors are underperforming or going backwards.

SOUNDS GREAT. WHAT’S THE COMPLICATION?

The wider bioeconomy is New Zealand’s largest single contributor to climate change.

Greenhouse gas emissions from human activity including agriculture are driving climate change. Human activity is leading to increased greenhouse gas emissions. A significant part of these global greenhouse gas emissions are caused by agriculture, both directly and indirectly. These greenhouse gas emissions are leading to increasing average temperatures (climate change).

New Zealand is part of the problem. New Zealand has high per capita greenhouse gas emissions that are not coming down.

The country produces a disproportionate share of global emissions and these emissions are not declining. Relative to a peer group, New Zealand has high emissions per capita, but low emissions per square kilometre.

Almost two thirds of New Zealand’s greenhouse gas emissions come from the wider bioeconomy. The wider New Zealand bioeconomy currently accounts for at least ~57% of New Zealand’s total greenhouse gas emissions. At the same time, New Zealand has a deficiency in both ‘fresh’ and ‘fossil’ biomass causing it to import massive amounts of biomass from elsewhere.

WHAT NEEDS TO HAPPEN? WHAT IS A POTENTIAL RESOLUTION?

The New Zealand bioeconomy can shift from being ‘part of the problem’ to being ‘part of the solution’.

A lot of pressure is being put on the New Zealand bioeconomy.

Government – ultimately society – is asking a lot of the New Zealand bioeconomy and multiple, somewhat conflicting, objectives need to be delivered. In essence, society is asking our foresters, farmers, fishermen and factories to create more wealth, with less resources and higher costs, while at the same time dramatically shrinking emissions and waste and becoming ultimately more circular. This is ultimately the problem we are trying to solve with this project. How can the New Zealand bioeconomy ‘square the circle’ and deliver on these conflicting objectives? Can we do this? Is this even possible or does something ‘have to give’ in the part of the economy that pays most of the bills?

EXECUTIVE SUMMARY

Six high level strategic themes emerged from our research to guide New Zealand towards delivering on this 'big ask' for our bioeconomy of the future and assist the sector in being 'part of the solution':

(1) INCREASING BIOMASS

New Zealand currently uses something like at least 15 million tonnes of fossil biomass in various forms. This implies that our proposed future circular bioeconomy will need something like at least 30 million tonnes of fresh biomass (assuming a minimum of just 50% fresh loss) to replace fossil fuels. To put this number in perspective, this is 15 times more volume than our milk powder exports. High yielding crops are needed or as they say in private equity, the country is going to 'need to sweat the assets harder.' However, in reality a significant of the energy used in the future will be renewable or electricity.

(2) INCREASING VALUE ADDED

Independent of (1), there will likely be less of key traditional biomass we transform and sell to global consumers to pay for our imports. This means New Zealand needs to convince global consumers to pay more for less. In other words, New Zealand needs to export finished, consumer ready goods rather than raw material ingredients/inputs.

(3) BUILDING RESILIENCE

Regions beyond Auckland and Wellington rely on the bioeconomy. At the same time, numerous recent events have demonstrated the importance of stable supplies of key inputs. Therefore New Zealand needs to grow not shrink the regional bioeconomy and, at the same time, ensure

alternative supplies of key inputs are produced in New Zealand (where it makes sense), particularly by proactively adapting to the changing climate.

(4) REDUCING AGRICULTURAL GHG EMISSIONS

Cows and sheep account for the largest share of New Zealand's current emissions, while other bioeconomy sectors are also major emitters. There is an urgent need to reduce cow and sheep emissions.

There is also a need for continuous improvement across a large number of areas of the bioeconomy.

(5) REPLACING FOSSIL FUELS

The modern economy currently runs on 300-360m year old biomass (aka. fossil fuels). Fossil fuels are ubiquitous and 'in everything'. There is a need to identify, develop and implement biomass-based processes and systems that replace fossil fuels. Ideally, these need to work with not against market forces.

(6) RETHINKING WASTE

New Zealand is sending growing amounts of biomass to landfills. Unfortunately, New Zealand often lacks the scale needed for international solutions. There is a need to develop new pathways for existing large waste (aka. 'biomass without a home') and to link problems with solutions (e.g. byproducts into animal feed).

WHAT WERE YOU ASKED TO DO?

MBIE commissioned this research to identify commercial

opportunities and platforms that are emerging now, and potential opportunities that might be viable in the future.

To do this, the widest possible pool of opportunities was fed through a multi-stage screening process to deliver a short list of high potential bioeconomy platforms with the needed desirable characteristics to deliver on some part of the 'big ask'. From this process, the research identifies high potential platforms that both (1) have a clear business opportunity and (2) that support the bioeconomy of the future.

HOW DID THE SCREENING PROCESS WORK?

The project sought to identify all biomass production and processing systems being pursued by "someone, somewhere" in New Zealand, but to control scope, ignored hypothetical or theoretical products without local champion(s).

As discussed above, the New Zealand bioeconomy is comprised of (1) biomass production systems (e.g. farming) and (2) biomass processing systems (e.g. milling). During our initial analysis, it was realised that these two types of systems had very different characteristics and thus needed evaluating separately. In particular, biomass production systems (forestry, farming, fishing) were more binary (yes/no) in terms of global competitiveness than processing systems. In other words, you can either produce, for example, soybeans at the world price or you can't.

SCREEN 0

The need for Stage 0/Screen 0 was realised part way into the process to thin down the list for analysis in Stage 1 to a manageable amount (i.e. 100) or, in consulting-speak, to avoid "boiling the ocean."

EXECUTIVE SUMMARY

Numerous sources were analysed to identify over 240 crops and animals production systems that were being successfully produced in New Zealand. The initial SCREEN 0 asked nine specific questions for biomass production systems to reduce 240+ to 52 for STAGE I.

For biomass processing systems, ANZSIC classifications were used, amended with North American (NAICS) and European (NACE) definitions as needed. Similar to above, the initial SCREEN 0 asked ten specific questions for biomass processing systems to reduce ~100 to 48 for STAGE I.

In total, from this process one hundred biomass production (52) and processing (48) systems emerged into STAGE I for evaluation.

STAGE I - BUILDING A WIDE POOL OF OPPORTUNITIES

STAGE I then profiled these products and looked at fit with New Zealand as well as ranked it against the six "strategic themes of the bioeconomy" (discussed above) as a scorecard to give a final score. These profiles are presented in the second half of this document.

As part of this process, all one hundred platforms were scored for being both (A) attractive growth opportunities and (B) moving the New Zealand bioeconomy forward to deliver thirty high scoring systems into STAGE II.

A wide range of interesting platforms "just missed the cut" in this process and all present solid additional opportunities.

STAGE II – HIGH POTENTIAL PLATFORMS

High scoring systems were triaged based on whether they

were a high potential new and emerging platform (or a feedstock to those). There was no perfect platform; different identified platforms addressed different requirements of the bioeconomy of the future.

The 31 platforms that emerged from STAGE I into STAGE II are spread across a wide range of systems, products, processes and categories.

BIOMASS PRODUCTION SYSTEMS (8)

1. Native botanicals
2. Medicinal mushrooms
3. Seaweed
4. Microalgae
5. Pine Nuts
6. Industrial Hemp
7. Bananas
8. Pineapples

BIOMASS PROCESSING SYSTEMS (22+1)

9. Feed Milling
10. Nutraceuticals
11. Biogas
12. Cosmetics, Toiletries
13. Soil Amendments
14. Essential Oils
15. Cleaning, Soap
16. Sports Nutrition

17. Marine Bioactives
18. Meat Bioactives
19. Wood Pellets
20. Vegetable Oils
21. Alternative Dairy
22. Bioplastics
23. Reconstituted Wood Products
24. Natural Insulation
25. Wine Grapes/Wineries
26. Bioethanol/Biodiesel
27. Infant Nutrition/similar
28. Alcoholic Spirits
29. Veneer/Plywood
30. Alternative Meat
31. Forestry-based Biochemicals (added by client)

These thirty STAGE II platforms are all developed in more detail in a separate document. Each STAGE II platform is developed individually from a whole of value-chain perspective by answering a set of common questions.

STAGE III – INVESTMENT READY FOCUS AREAS

Following extensive feedback and discussion with our client, three platforms were highlighted for further development in STAGE III: bio-based cosmetics, sports nutrition and marine bioactives. All three are developed in detail in separate documents.

This project works to a clear client brief

CLIENT BRIEF: SELECT KEY CONCEPTS

“Currently New Zealand’s economic activity exceeds environmental limits on several measures, of which high emissions (in absolute terms and per capita) is one. As a signatory to the Paris Agreement, New Zealand’s Nationally Determined Contributions (NDC) target is to reduce New Zealand’s net emissions by 50 per cent below gross 2005 levels by 2030. This equates to a 41 per cent reduction on 2005 levels using what is known as an ‘emissions budget’ approach.”

CHALLENGE

“The purpose of this bioeconomy research is to establish an evidence base to enable New Zealand’s bioeconomy to further develop. To support investment, innovation and the further development of New Zealand’s bioeconomy, business decision makers and policy makers need high quality information on emerging and future bioeconomy platforms as well as up to date intelligence on technological developments, market opportunities and trends, both local and global.”

PURPOSE OF RESEARCH

“This research identifies commercial opportunities that are emerging now, and potential opportunities that might be viable in the future. The research will focus on identifying platforms as distinct from individual products. As an illustration, examples of emerging and future bioeconomy platforms could include nutraceuticals and foods for health, biotechnology (as an enabler), alternative proteins, biomaterials, essential oils, botanical waste streams (transforming the waste streams from existing plant-based food systems into health products), health focused Alt/Dairy (leveraging existing arable crop and dairy capabilities into innovative, health focused milks).

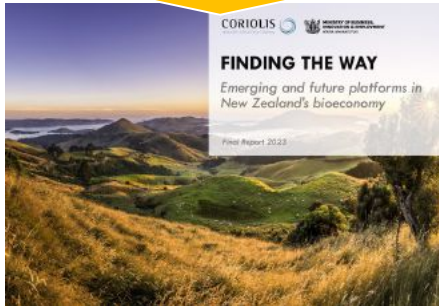
We are seeking a report that provides this comprehensive set of information. The report will provide businesses (particularly start-ups and small and medium enterprises), investors, Māori enterprises, research organisations and policy makers access to a baseline of market information and analysis and a common framework of facts, figures, and analysis. This information is currently either missing, fragmented or too costly to obtain for all but the largest businesses.

The report must be in a format that is familiar and useful to business. It must include data, analysis and commentary on trends and opportunities in a form that will materially assist with business strategy and government policy.”

REQUIREMENTS

This report is part of a wider suite of related and associated analysis

THIS REPORT



STAGE I – FINDING THE WAY

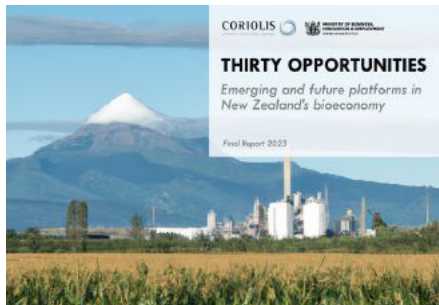
Finding and screening all emerging and future platforms in the New Zealand bioeconomy



SPORTS NUTRITION & WEIGHT MANAGEMENT



BIOCOSMETICS



STAGE II – 30 OPPORTUNITIES

Developing thirty emerging and future platforms in the New Zealand bioeconomy



MARINE BIOACTIVES

STAGE III – THREE HIGH POTENTIAL PLATFORMS

Detailed analysis to make the high level case for investment in three high potential platforms in the New Zealand bioeconomy



SITUATION & CAPABILITIES

Providing a granular assessment of New Zealand's available biological resources

SITUATION COMPLICATION RESOLUTION

01

- + Why are we here?
- + Situation
- + Complication
- + Resolution
- + Six strategic themes

The New Zealand bioeconomy needs to drive change

SITUATION

The world primarily wants biomaterials from New Zealand and, as a result, the bioeconomy is critical to the total economy

COMPLICATION

The wider bioeconomy is New Zealand's largest single contributor to climate change

RESOLUTION

The New Zealand bioeconomy can shift from being 'part of the problem' to being 'part of the solution'

SITUATION: The world primarily wants biomaterials from New Zealand and as a result, the bioeconomy is critical to the total economy

The world has a growing base of consumers that want biomaterials

- The world has a growing population with growing incomes, or in other words, a growing number of consumers
- The growing number of global consumers are seeking to increase their consumption of biomaterials (or substitutes), particularly food & beverages

New Zealand has a successful bioeconomy that produces a wide range of biomaterials

- At the simplest level, the bioeconomy produces and processes biomass (“bio”) for sale in markets (“economy”) to consumers (or other suppliers to them)
- In New Zealand, these stages of the bioeconomy are given a wide range of names, but the core functions remain constant
- This core bioeconomy is supported by a huge range of suppliers, service providers, rule makers and wider stakeholders

The bioeconomy is very important to New Zealand in terms of land use, jobs and trade

- The wider bioeconomy accounts for at least a quarter of employment in NZ, depending on how you think about tertiary sectors and service providers
- The bioeconomy accounts for 60% of New Zealand land use
- The products of the bioeconomy account for at least two thirds of New Zealand total exports of goods and services

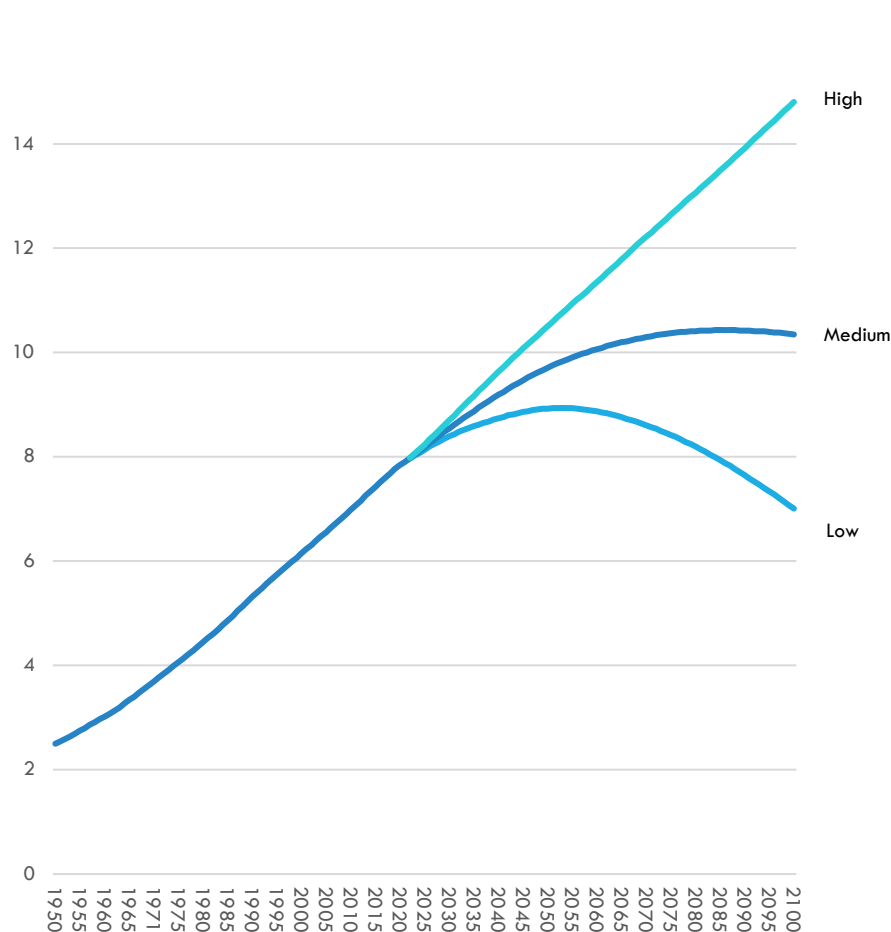
The bioeconomy is basically the only major sector of the economy holding up New Zealand's global trade position

- The bioeconomy achieves a large trade surplus, while most other sectors are underperforming or in deficit
- Parts of the bioeconomy are growing exports strongly, where most other sectors are underperforming or going backwards

The world has a growing population with growing incomes, or in other words, a growing number of consumers

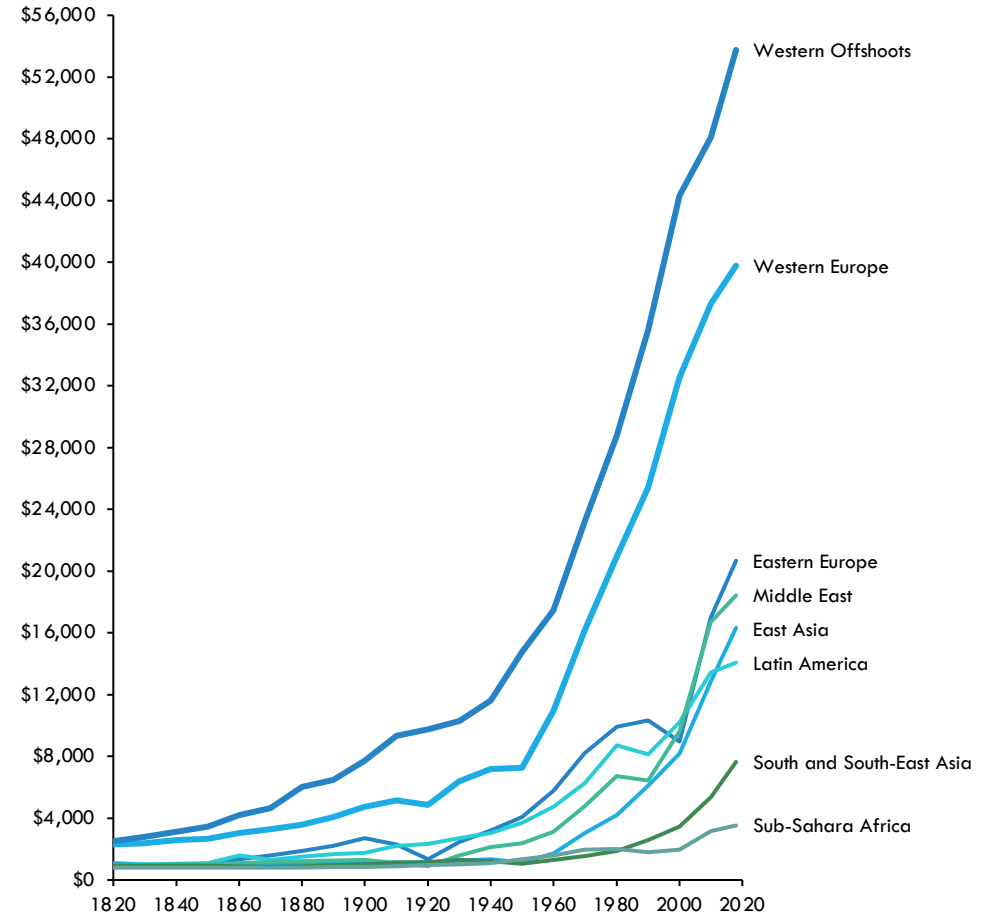
WORLD POPULATION

People; b; 1950-2100f



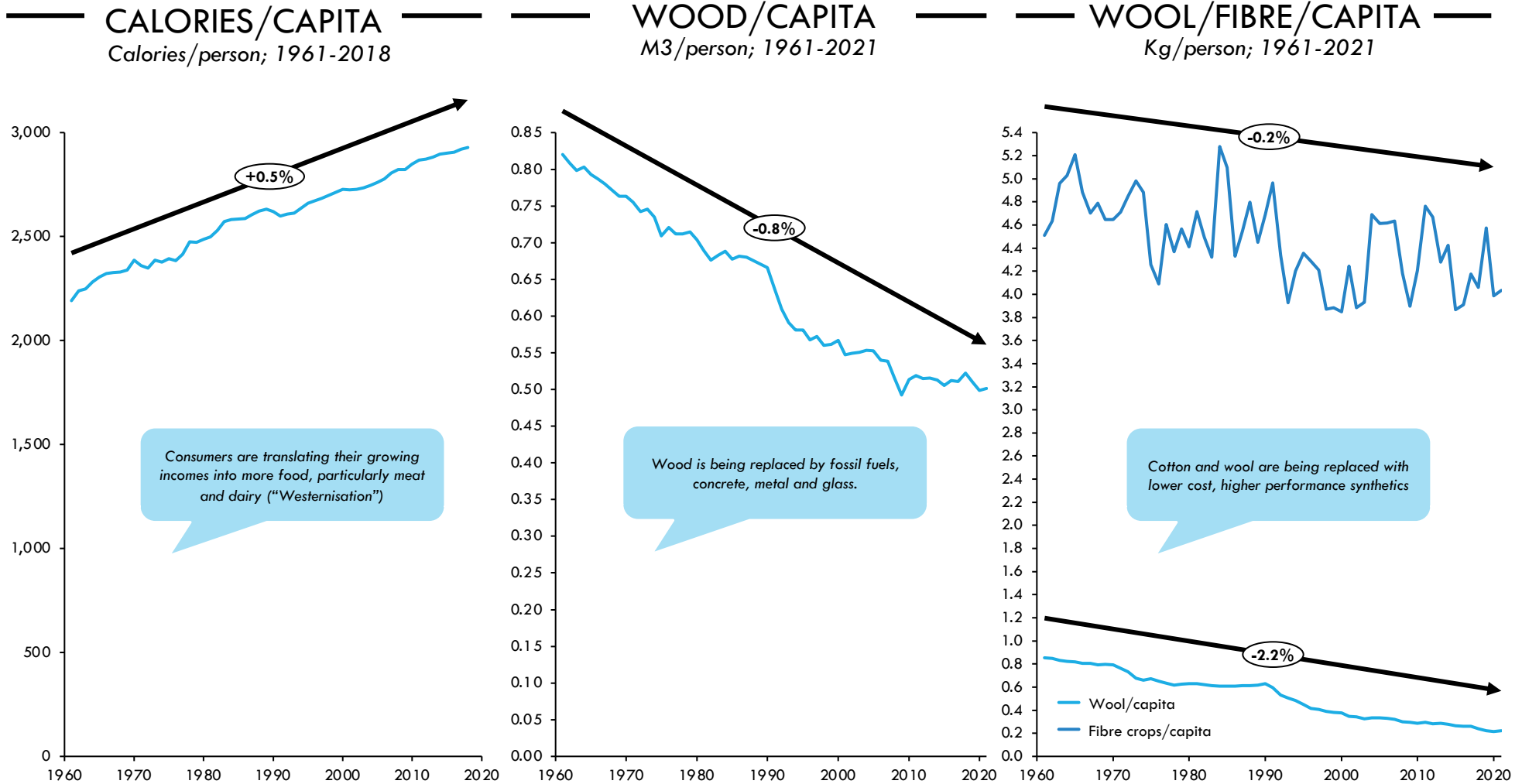
GDP/CAPITA BY REGION

US\$; inf. adj. 2011 prices; 1820-2018



Source: UN World Population Prospects (2022); Maddison Project Database 2020 (Bolt and van Zanden, 2020); Coriolis analysis

The growing number of global consumers are seeking to increase their consumption of biomaterials (or substitutes), particularly food & beverages



Source: UN World Population Prospects (2022); UN FAOStat; Coriolis analysis

At the simplest level, the bioeconomy produces and processes biomass (“bio”) for sale in markets (“economy”) to consumers (or other suppliers to them)

SIMPLIFIED MODEL OF THE CORE BIOECONOMY



“For the purposes of the research, “bioeconomy” is defined as “the sustainable production and conversion of biomass, for a range of food, health, fibre and industrial products and energy, where renewable biomass encompasses any biological material to be used as raw material.”

Albrecht; D. Carrez; P. Cunningham; L.Daroda; R. Mancina; L. Máthé; A. Raschka; M. Carus; S.Piotrowski (2010). “The Knowledge Based Bio-Economy (KBBE) in Europe: Achievements and Challenges”; MBIE RFQ p7

In New Zealand, these stages of the bioeconomy are given a wide range of names, but the core functions remain constant

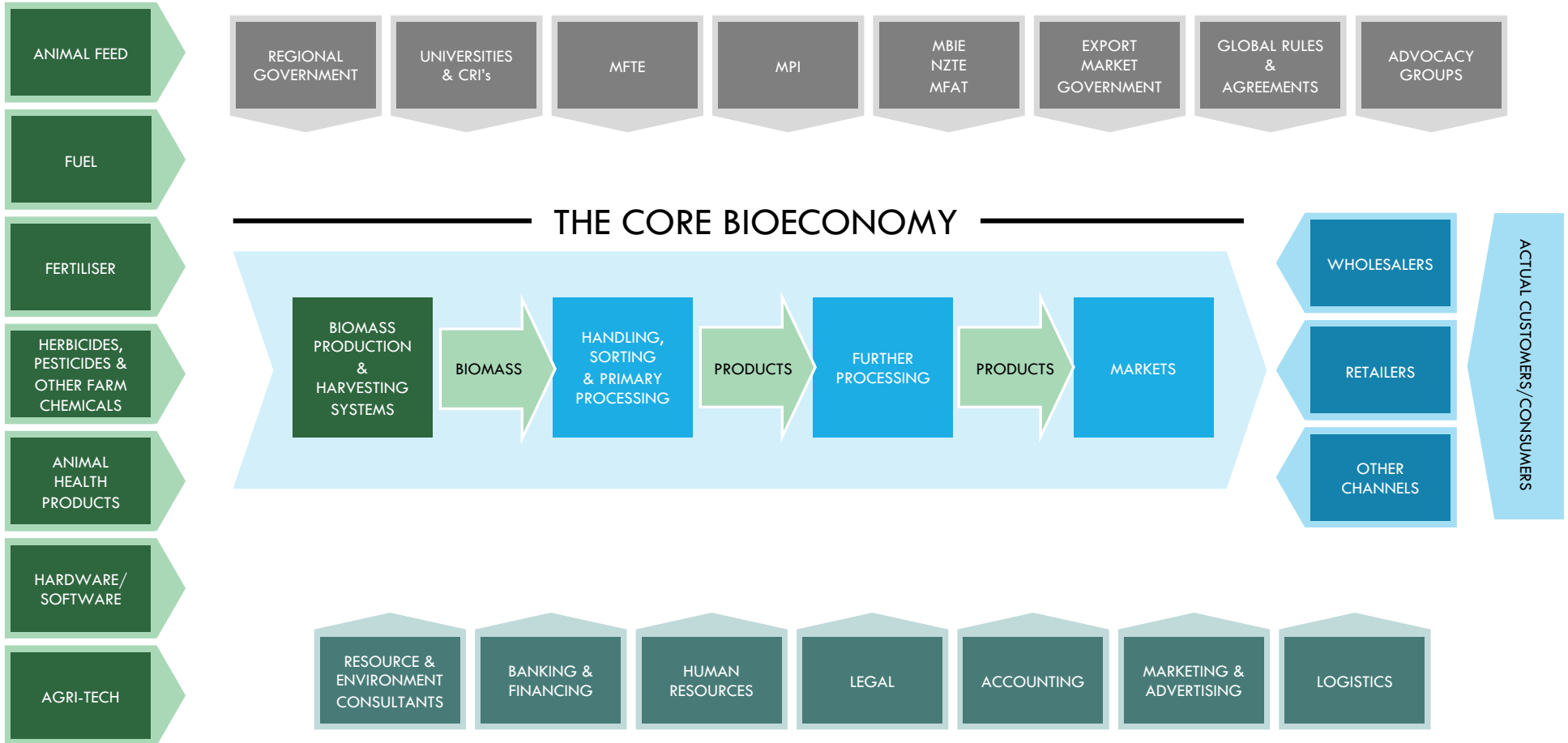
SIMPLIFIED MODEL OF THE CORE BIOECONOMY



* Non-recreational hunting and fishing only

This core bioeconomy is supported by a range of suppliers, service providers, rule makers and wider stakeholders

THE WIDER BIOECONOMY ECOSYSTEM

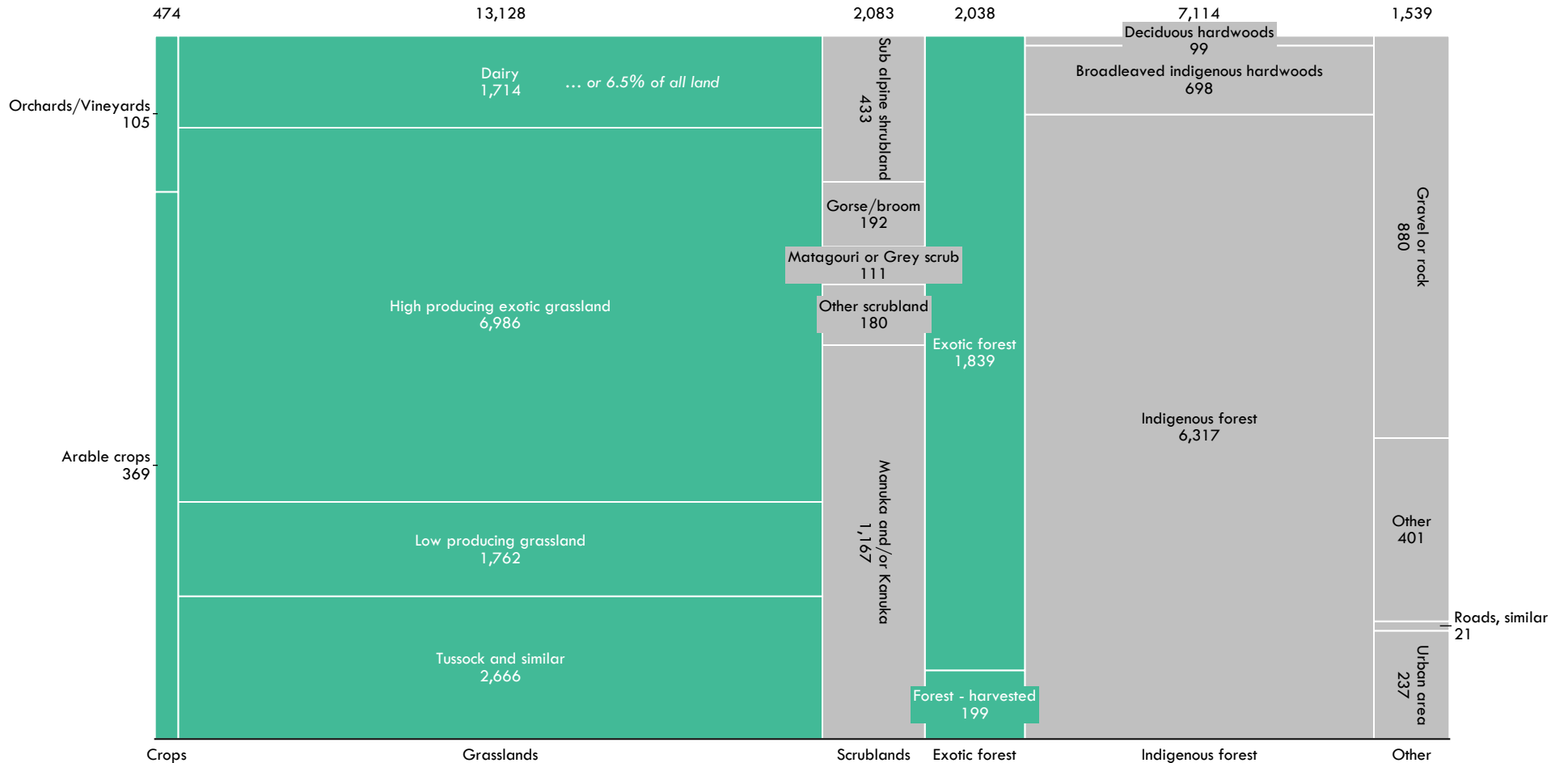


CRI's = Crown Research Institutes; MFTE = Ministry for the Environment; MPI = Ministry for Primary Industries; MBIE = Ministry Business, Innovation & Employment; NZTE = New Zealand Trade & Enterprise; MFAT = Ministry of Foreign Affairs and Trade;

The bioeconomy accounts for 60% of New Zealand land use

NEW ZEALAND LAND AREA BY TYPE
(Ha; 000; 2018 or as available)

TOTAL = 26,376 (000) hectares

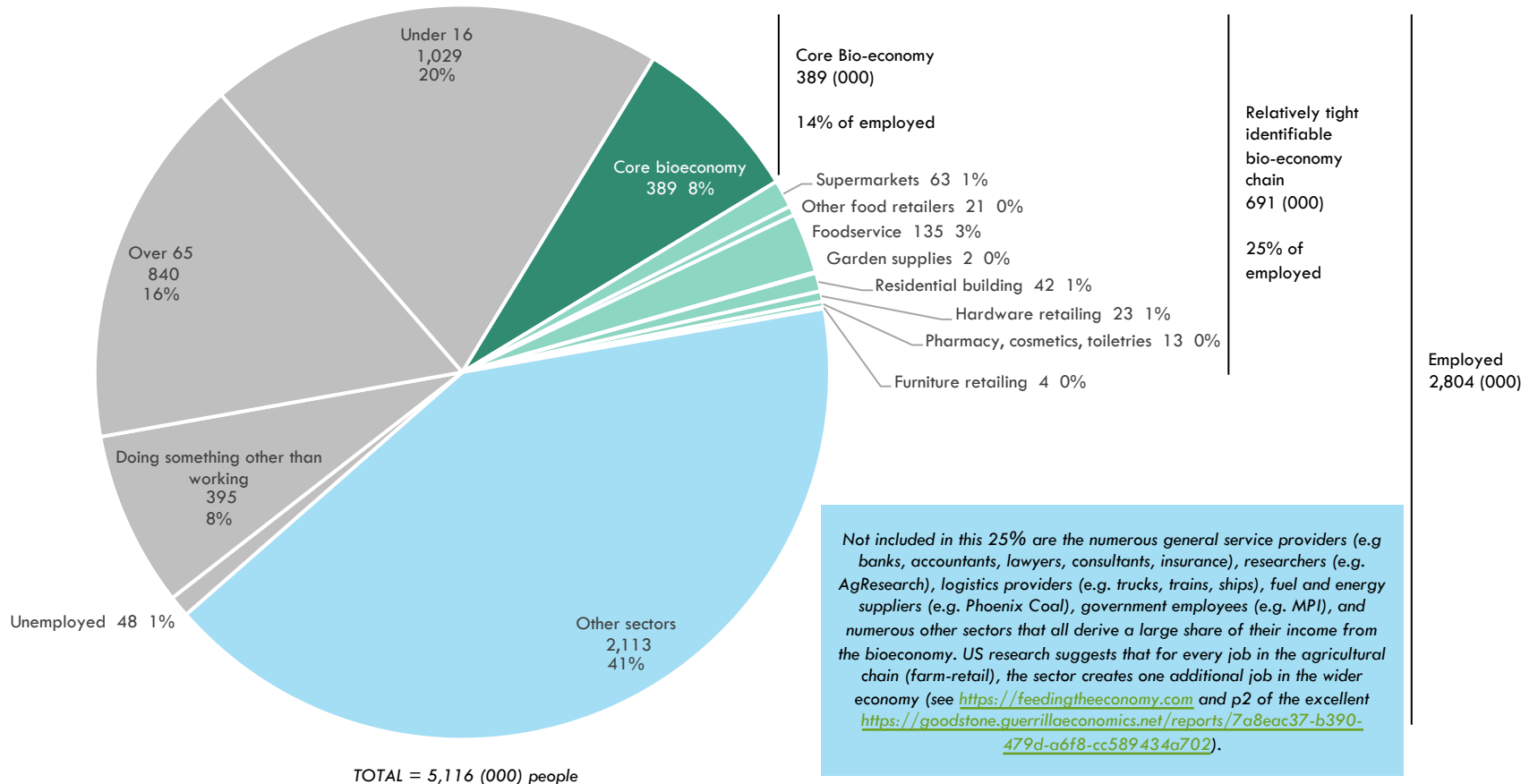


Source: MfE/StatsNZ New Zealand Land Cover Data Base (LCDB5); DairyNZ ("Effective hectares in dairy"); Coriolis analysis

The wider bioeconomy accounts for at least a quarter of employment in NZ, depending on how you think about tertiary sectors and service providers

NEW ZEALAND EMPLOYMENT BY SECTOR

People; 000; March 2022

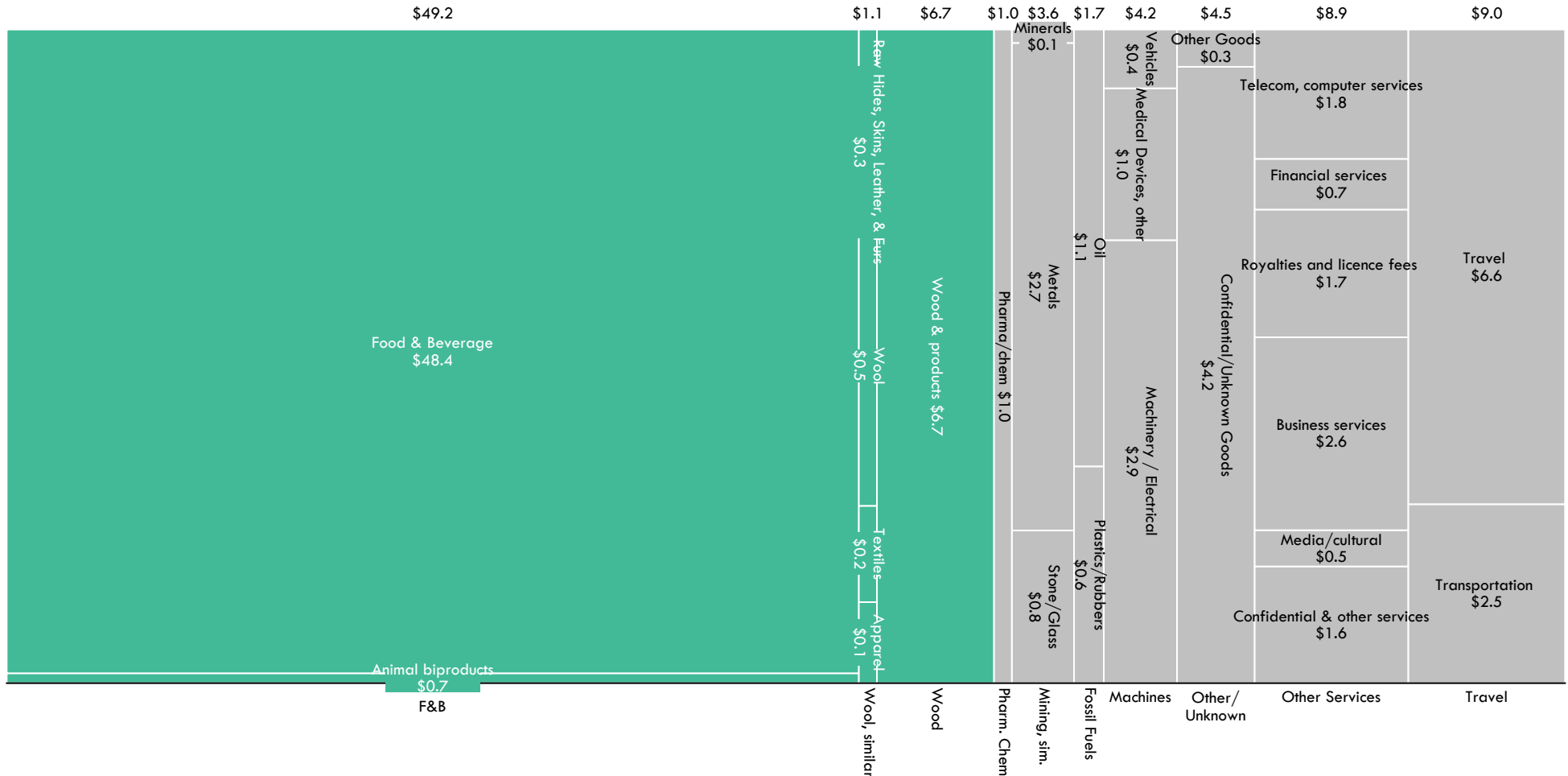


Note: This chart pulls together a range of sources; due to data limitations around self-employment and employers, it assumes every farm and food company has an owner-operator (a "shareholder /director"); this will over estimate some and underestimate others (e.g. husband/wife); it also assumes all people over 65 are retired and not working (again due to lack of data); "residential building" is only direct builders (formerly known as "carpenters"), does not include other building trades (e.g. plumbers); treat as directional; please call with questions; Source: SNZ (Household labour force survey estimated working-age population: March 2022 quarter; Business Demographics (NZ.Stat); Population projections by age); Coriolis analysis

The products of the bioeconomy account for at least* two thirds of New Zealand total exports of goods and services

TOTAL NEW ZEALAND GOODS & SERVICES EXPORTS

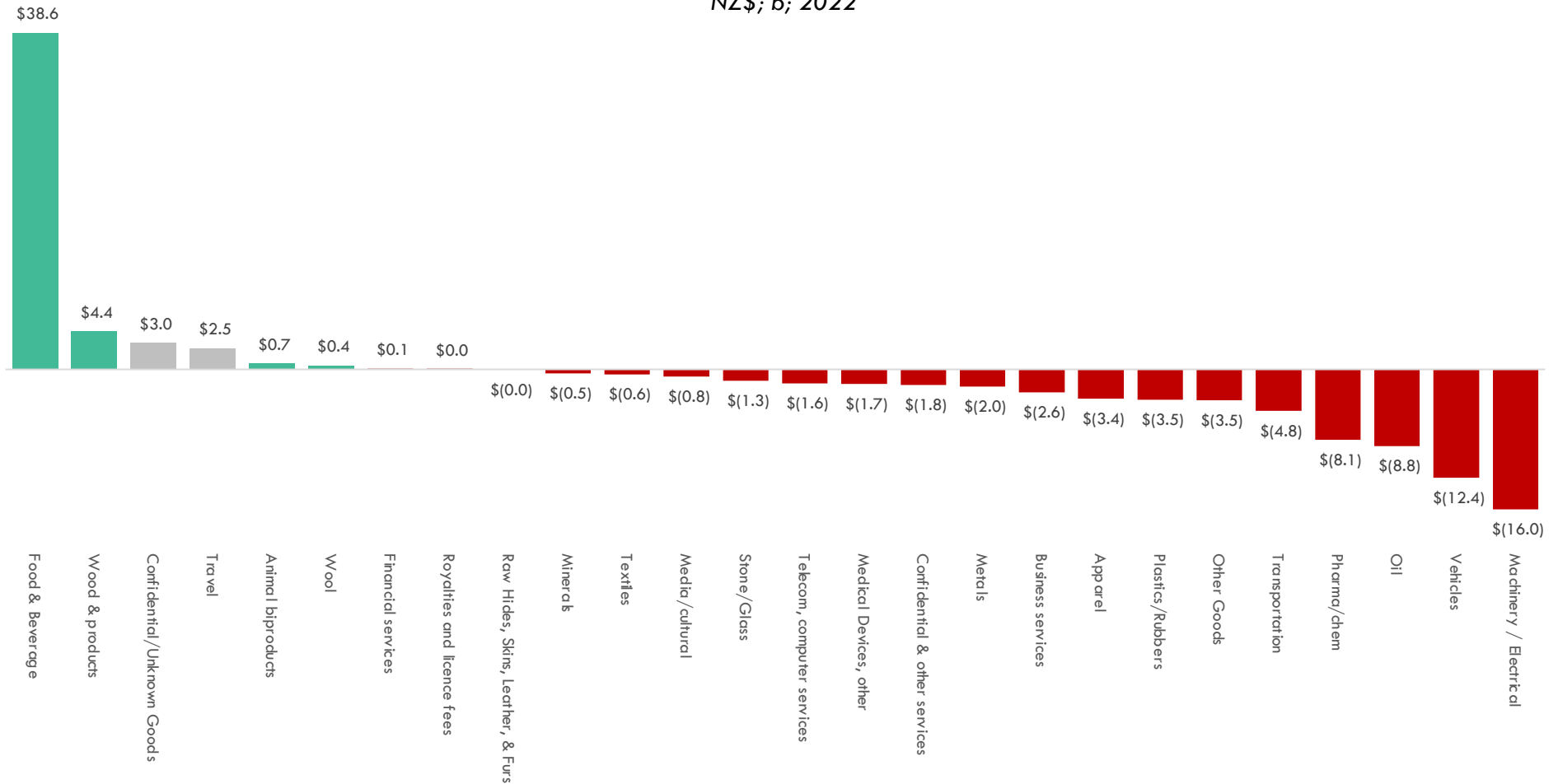
NZ\$, b; 2022



* We say "at least" as we believe large parts of "confidential" goods are F&B (and coal); Source: StatisticsNZ (Infoshare); Coriolis classification and analysis

The bioeconomy achieves a large trade surplus, while most other sectors are underperforming or in deficit

NET TRADE POSITION IN TOTAL NEW ZEALAND TRADE (EXPORTS-IMPORTS)
NZ\$; b; 2022

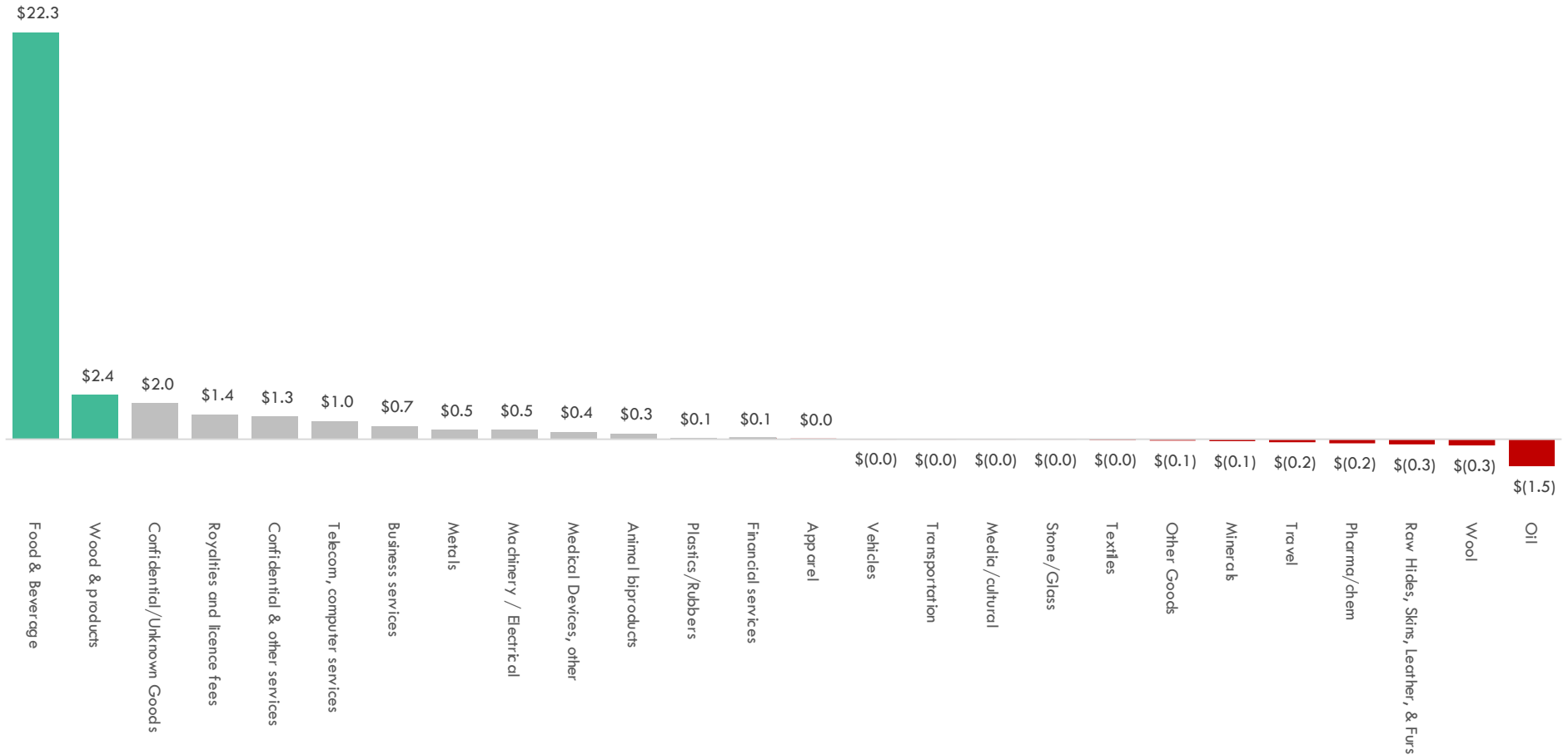


Note: We believe large parts of "confidential" are F&B (and coal); Source: StatisticsNZ (Infoshare); Coriolis classification and analysis

Parts of the bioeconomy are growing exports strongly, where most other sectors are underperforming or going backwards

10 YEAR NET CHANGE IN TOTAL NEW ZEALAND EXPORTS

NZ\$; b; 2012 vs.2022



COMPLICATION: *The wider bioeconomy is New Zealand's largest single contributor to climate change*

Greenhouse gas emissions from human activity including agriculture are driving climate change

- Human activity is leading to increased greenhouse gas emissions
- A significant part of global greenhouse gas emissions are caused by agriculture, both directly and indirectly
- These greenhouse gas emissions are leading to increasing average temperatures (climate change)

New Zealand has high per capita greenhouse gas emissions that are not coming down

- New Zealand is part of the problem; the country produces a disproportionate share of global emissions
- New Zealand's emissions are not declining
- Relative to a peer group, New Zealand has high emissions per capita but low emissions per square kilometre

Almost two thirds of New Zealand's greenhouse gas emissions come from the wider bioeconomy

- The wider New Zealand bioeconomy currently accounts for at least ~57% of New Zealand's total greenhouse gas emissions

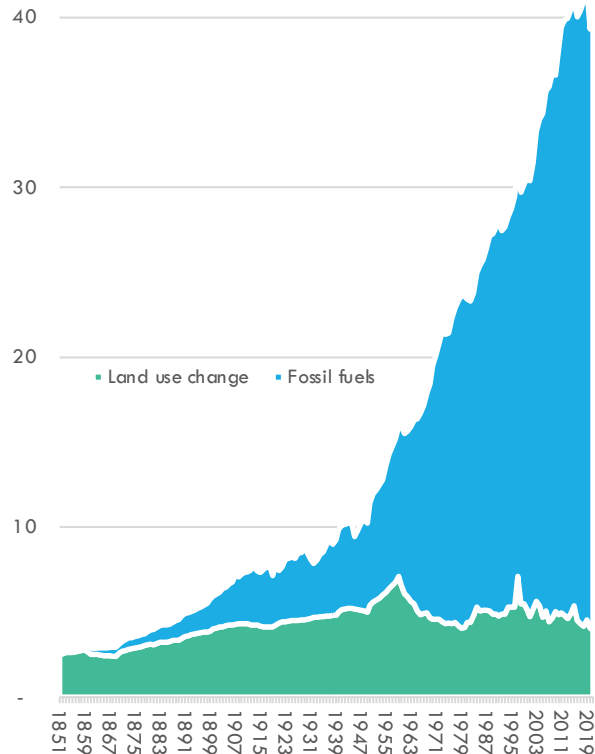
At the same time, New Zealand has a deficiency in both 'fresh' and 'fossil' biomass causing it to import massive amounts of biomass from elsewhere

Human activity is leading to increased greenhouse gas emissions

ANNUAL GLOBAL GREENHOUSE GAS EMISSIONS

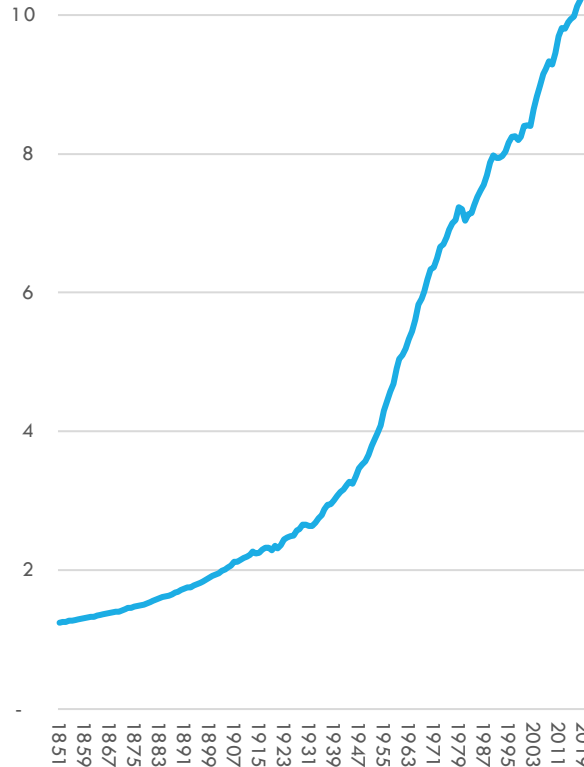
CARBON DIOXIDE

Tonnes; b; 1851-2021



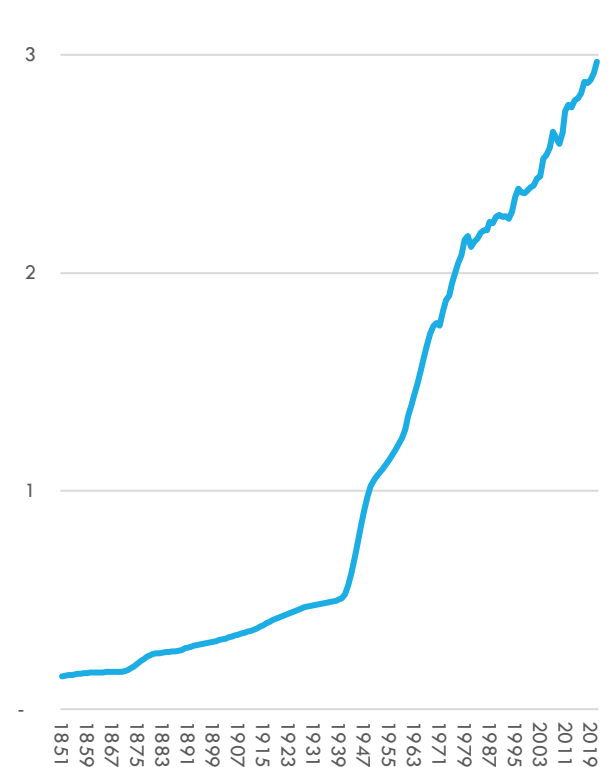
METHANE

Tonnes (CO₂e); b; 1851-2021



NITROUS OXIDE

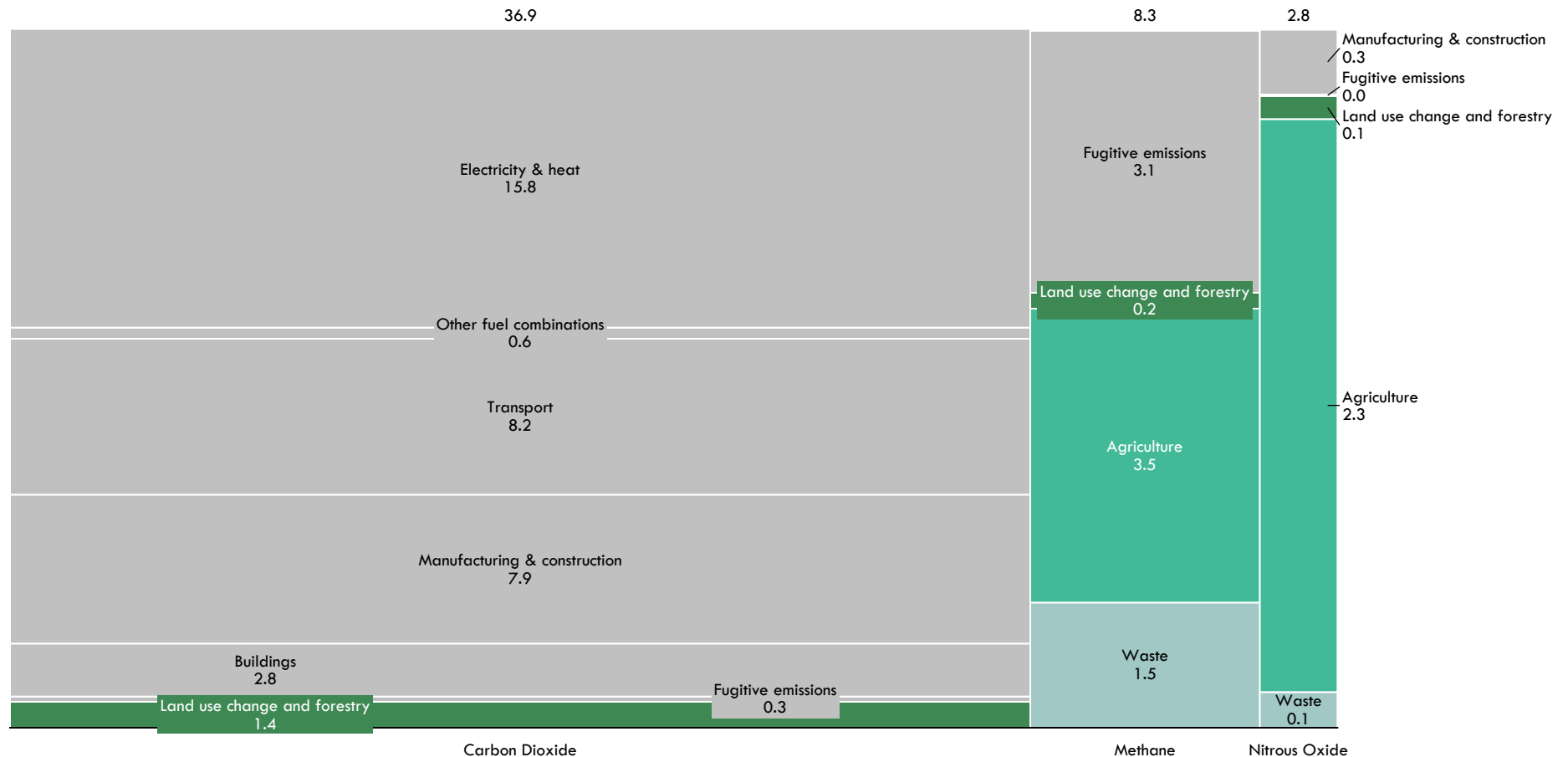
Tonnes (CO₂e); b; 1851-2021



A significant part of global greenhouse gas emissions are caused by agriculture, both directly and indirectly

GLOBAL GREENHOUSE GAS EMISSIONS BY SECTOR

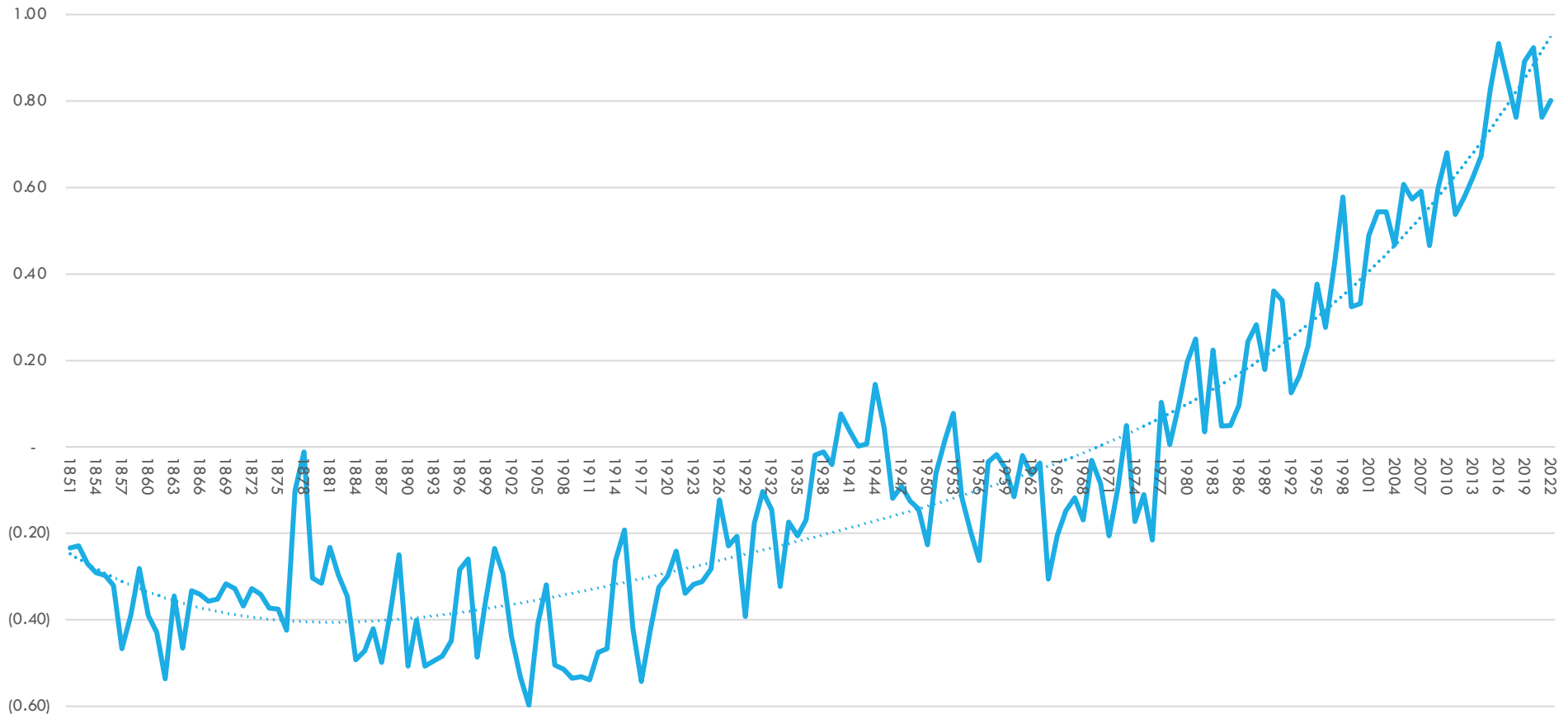
Tonnes (CO₂e); b; 2019



These greenhouse gas emissions are leading to increasing average temperatures (climate change)

GLOBAL AVERAGE LAND-SEA TEMPERATURE ANOMALY

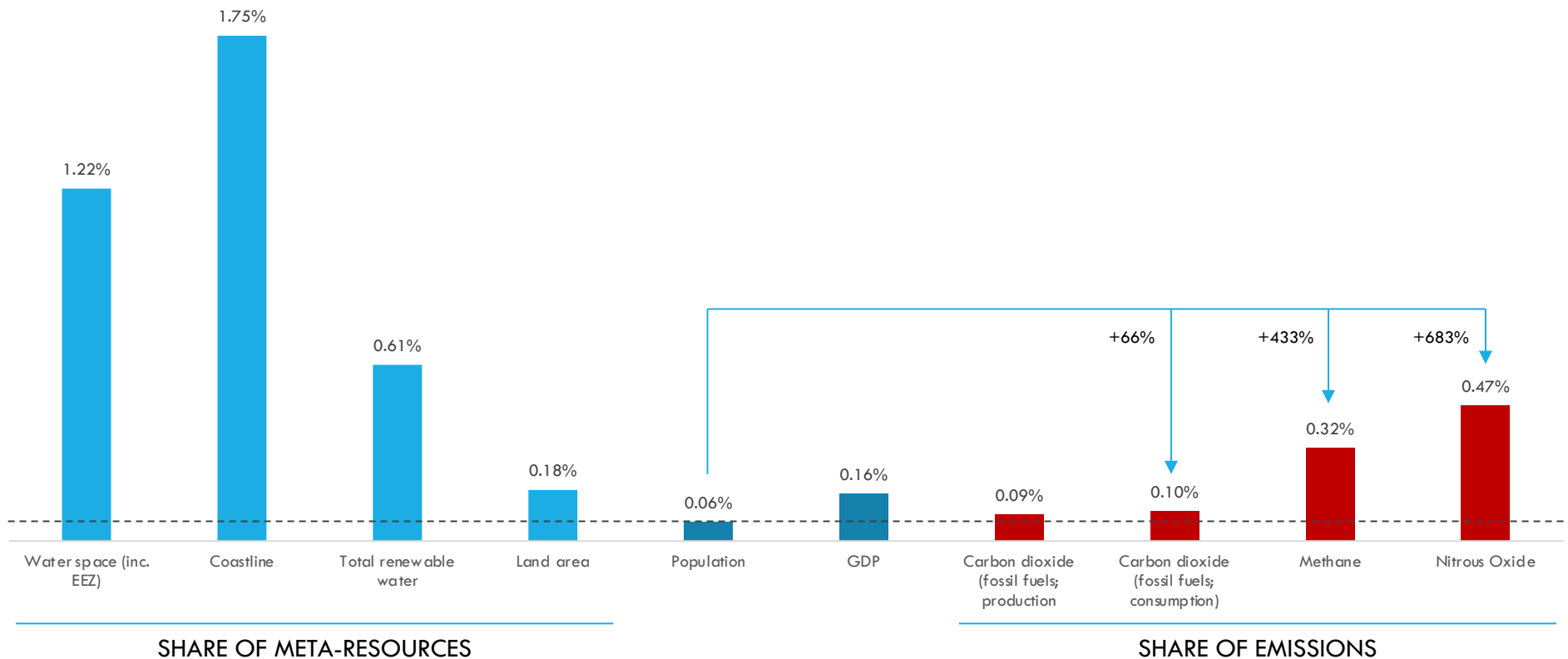
Average temperature between 1961-1990 = 0; 1850-2022



New Zealand is part of the problem; the country produces a disproportionate share of global emissions

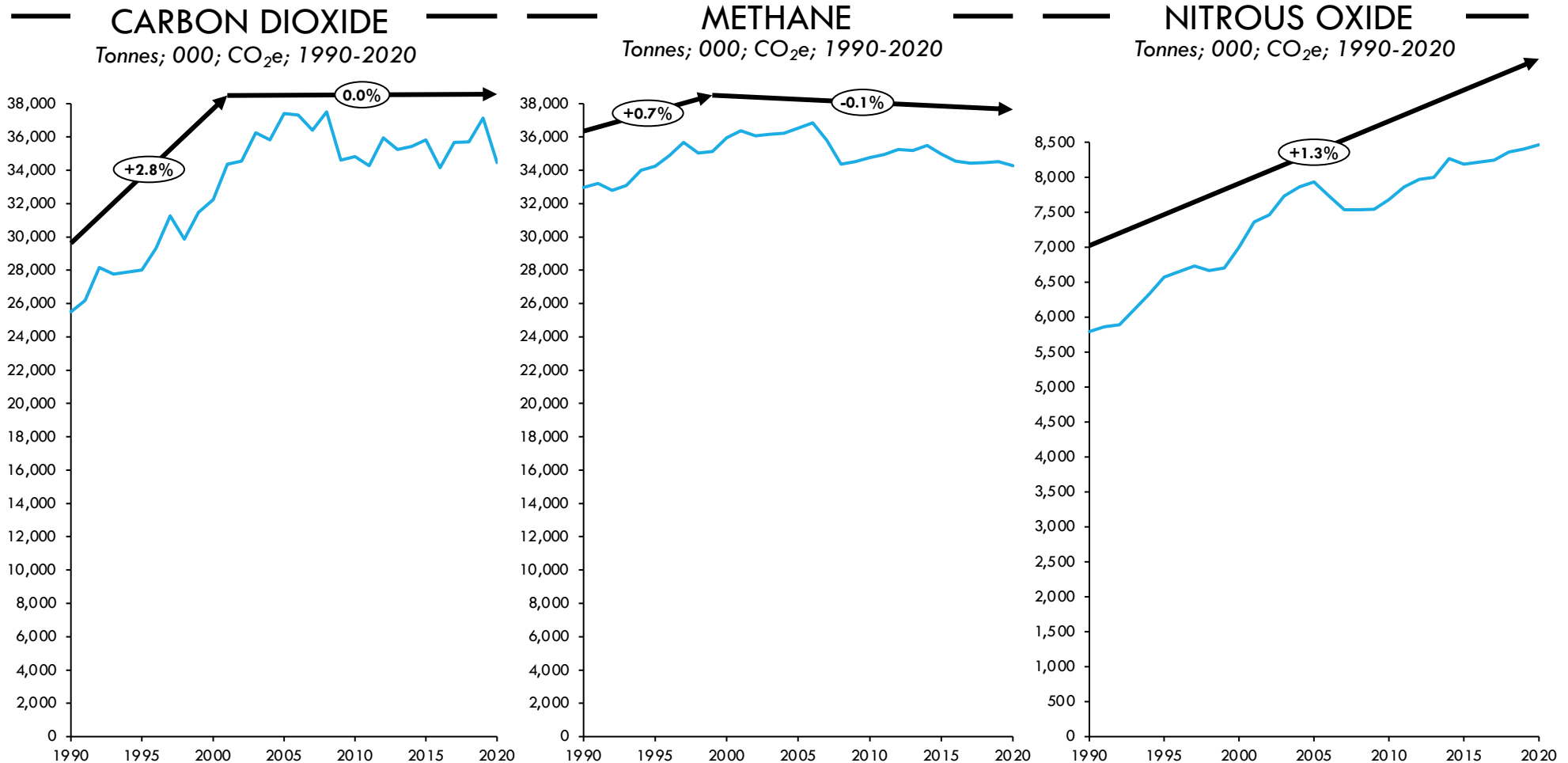
NEW ZEALAND SHARE OF VARIOUS GLOBAL MEASURES

NZ % of global total; 2022 or as available



New Zealand's emissions are not declining

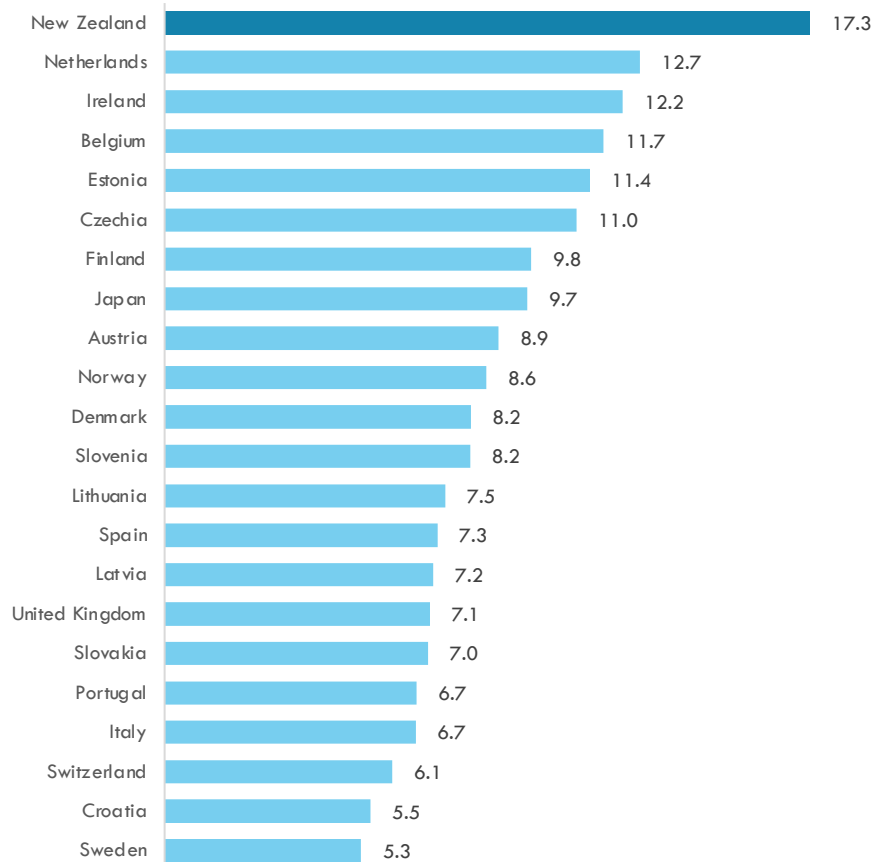
NEW ZEALAND GROSS EMISSIONS OF KEY GASSES (EX. LAND USE CHANGE)



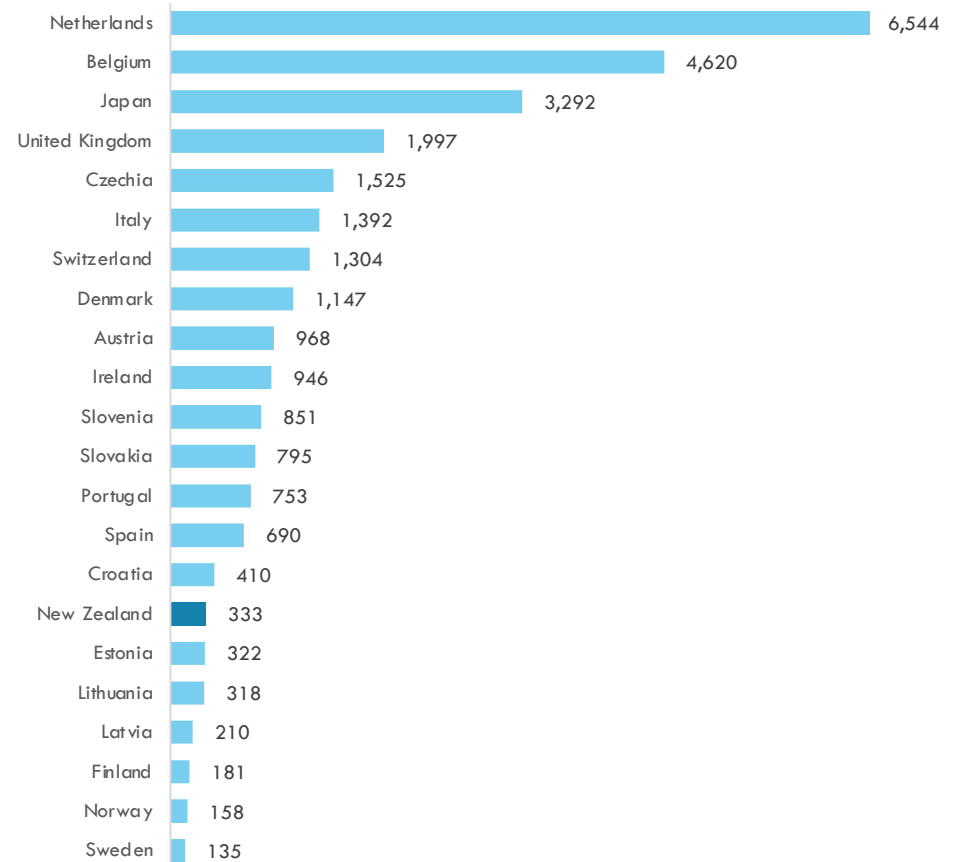
Source: MfE (<https://environment.govt.nz/publications/new-zealands-greenhouse-gas-inventory-1990-2020/>); Coriolis analysis

Relative to a peer group, New Zealand has high emissions per capita but low emissions per square kilometre

GHG EMISSIONS/CAPITA
Tonnes/person; CO₂e; 2019



GHG EMISSIONS/SQ KM
Tonnes/km²; CO₂e; 2019

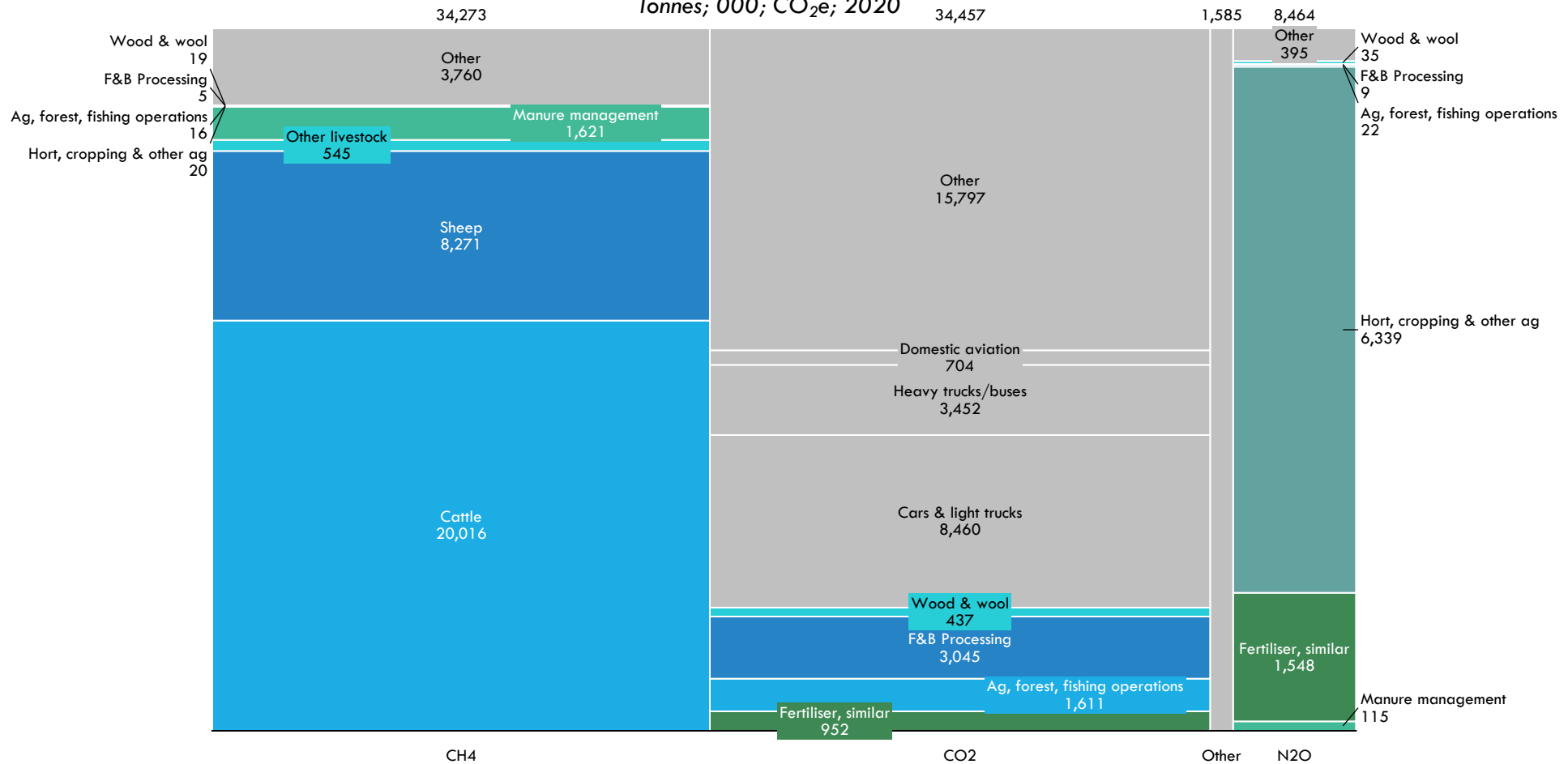


NOTE: According to NZTE we feed an additional 40 million beyond the 5 million people in New Zealand. Source: OurWorldInData (<https://ourworldindata.org/co2-and-greenhouse-gas-emissions>)
CC BY; Coriolis research and analysis

The wider New Zealand bioeconomy currently accounts for at least ~57% of New Zealand's total greenhouse gas emissions

GHG EMISSIONS BY SECTOR

Tonnes; 000; CO₂e; 2020



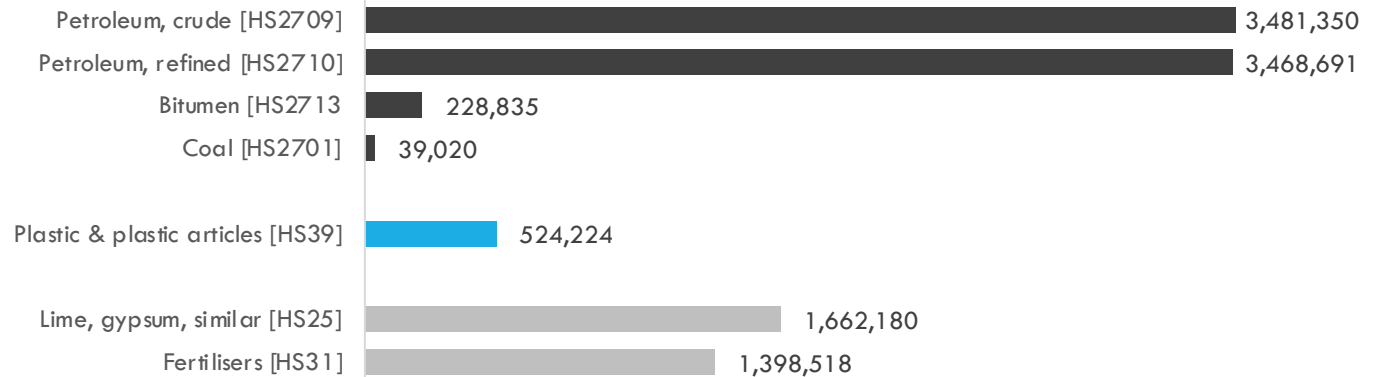
At the same time, New Zealand has a deficiency in both 'fresh' and 'fossil' biomass causing it to import massive amounts of biomass from elsewhere

NEW ZEALAND IMPORT VOLUME OF SELECT PRODUCTS

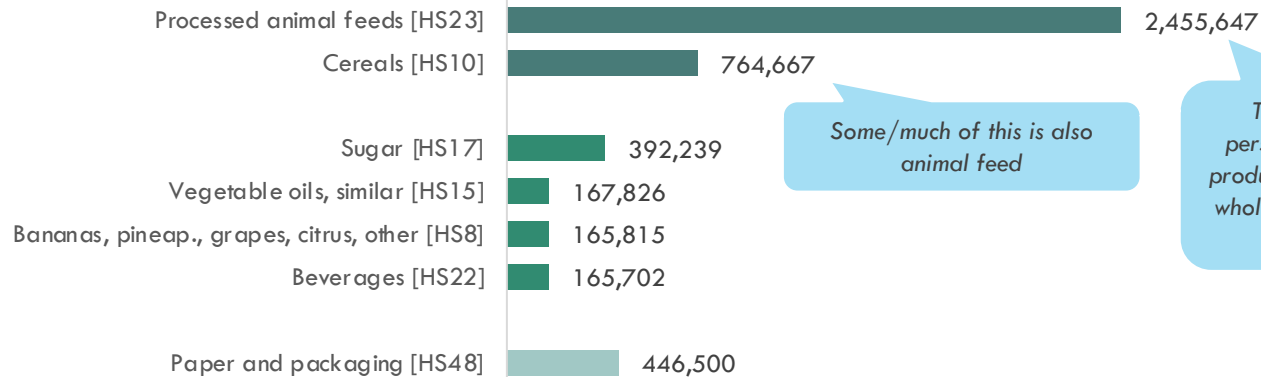
Tonnes*; 2022 (provisional)

These products are both major imports and major contributors to New Zealand's emissions and waste

Reducing emissions, reducing waste and moving toward a circular economy will require a substitute biomass



These products are the largest types of biomass imported into New Zealand



Some/much of this is also animal feed

To put this number in perspective, New Zealand produced just 1,919,000t of whole and skim milk powder in 2020

* or litres where relevant; Source: Statistics New Zealand (<https://www.stats.govt.nz/large-datasets/csv-files-for-download/overseas-merchandise-trade-datasets#yearly-datasets-of>)

RESOLUTION: The New Zealand bioeconomy can shift from being ‘part of the problem’ to being ‘part of the solution’

A lot of pressure is being put on the New Zealand bioeconomy

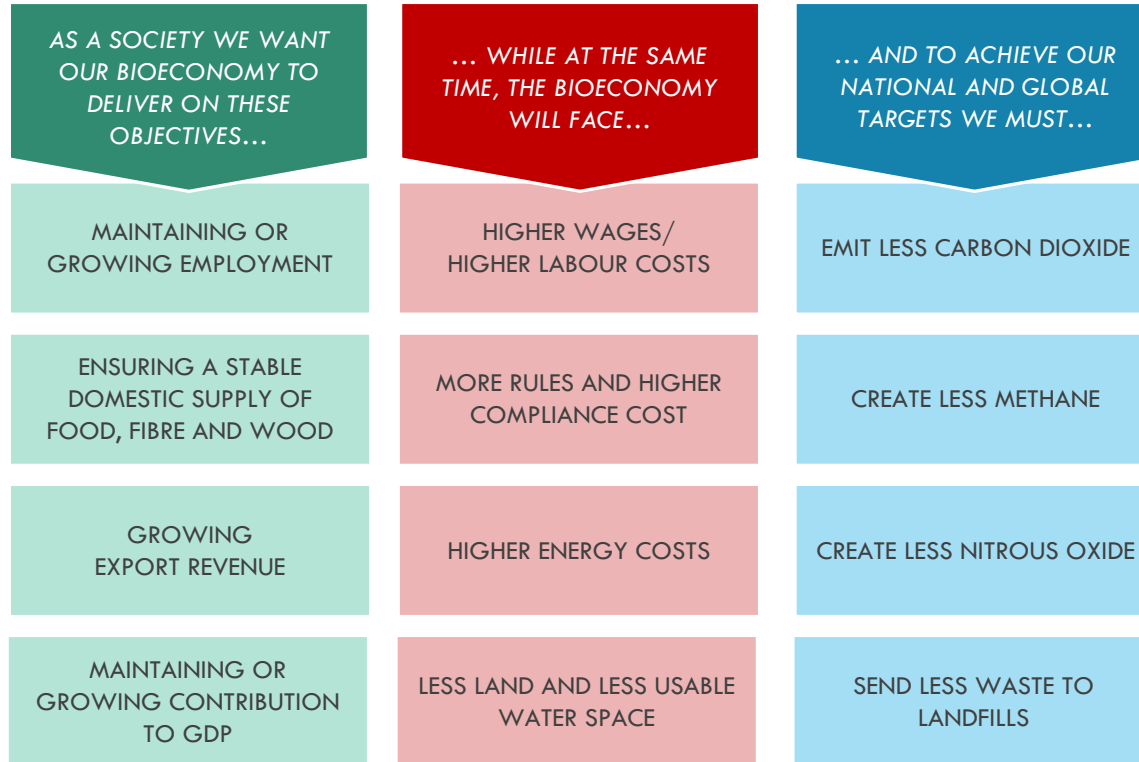
- Government – ultimately society – is asking a lot of the New Zealand bioeconomy; multiple somewhat conflicting objectives need to be delivered

Six high level strategic themes emerged to guide New Zealand towards the bioeconomy of the future and being ‘part of the solution’

1. Increasing biomass
2. Increasing value added
3. Building resilience
4. Reducing agricultural GHG emissions
5. Replacing fossil fuels
6. Rethinking waste

Government – ultimately society – is asking a lot of the New Zealand bioeconomy; multiple somewhat conflicting objectives need to be delivered

IN A NUTSHELL, WHAT PROBLEM ARE WE TRYING TO SOLVE?



This is ultimately the problem we are trying to solve with this project. How can the New Zealand bioeconomy 'square the circle' and deliver on these conflicting objectives? Can we do this? Is this even possible or does something 'have to give' in the part of the economy that pays most of the bills?

Six high level strategic themes emerged to guide New Zealand towards the bioeconomy of the future

WHAT IS THE SOLUTION? HOW WILL WE ACHIEVE IT?

WHAT PROBLEM ARE WE TRYING TO SOLVE?

AS A SOCIETY WE WANT OUR BIOECONOMY TO DELIVER ON THESE OBJECTIVES...

MAINTAINING OR GROWING EMPLOYMENT

ENSURING A STABLE DOMESTIC SUPPLY OF FOOD, FIBRE AND WOOD

GROWING EXPORT REVENUE

MAINTAINING OR GROWING CONTRIBUTION TO GDP

... WHILE AT THE SAME TIME, THE BIOECONOMY WILL FACE...

HIGHER WAGES/
HIGHER LABOUR COSTS

MORE RULES AND HIGHER COMPLIANCE COST

HIGHER ENERGY COSTS

LESS LAND AND LESS USABLE WATER SPACE

... AND TO ACHIEVE OUR NATIONAL AND GLOBAL TARGETS WE MUST...

EMIT LESS CARBON DIOXIDE

CREATE LESS METHANE

CREATE LESS NITROUS OXIDE

SEND LESS WASTE TO LANDFILLS

HOW WILL WE ACHIEVE IT?

1 INCREASE BIOMASS

2 INCREASE VALUE ADD

3 BUILD RESILIENCE

4 REDUCE AGRICULTURAL GHG EMISSIONS

5 REPLACE FOSSIL FUELS

6 RETHINK WASTE

Each theme stands alone, with its own measure of success; at the same time, together they form an interlinked strategy

WHAT ARE THE SIX STRATEGIC THEMES FOR THE FUTURE NZ BIOECONOMY?

STRATEGIC THEME	WHAT IS THE SITUATION?	WHAT NEED DOES THIS CREATE?	HOW TO MEASURE ?
1 INCREASE BIOMASS	<ul style="list-style-type: none"> - Most area produces very little output - Total land available to agriculture and forestry in NZ is constantly decreasing - Available ocean water space is increasingly constrained; most deep and hard to farm 	<ul style="list-style-type: none"> - Need to 'sweat the assets harder' - Need to get more output from less land just to remain level, let alone grow - Needs significantly more fresh biomass to support the shift from fossil biomass (5) 	Tonnes per hectare
2 INCREASE VALUE ADD	<ul style="list-style-type: none"> - Independent of (1), there will likely be less of key traditional biomass we transform and sell to global consumers to pay for our imports 	<ul style="list-style-type: none"> - Need to convince global consumers to pay more for less - Need to export finished, consumer ready goods rather than raw material ingredients/inputs 	Revenue per tonne
3 BUILD RESILIENCE	<ul style="list-style-type: none"> - Regions beyond Auckland and Wellington rely on the bioeconomy - Recent events have demonstrated the importance of stable supplies of key inputs 	<ul style="list-style-type: none"> - Need to grow not shrink the regional bioeconomy - Need to ensure alternative supplies of key inputs are produced in NZ where it makes sense - Need to proactively adapt to the changing climate 	Tonnes of biomass imported
4 REDUCE AGRICULTURAL GHG EMISSIONS	<ul style="list-style-type: none"> - Cows and sheep account for the largest share of New Zealand's current emissions - Other bioeconomy sectors also major emitters 	<ul style="list-style-type: none"> - Urgent need to reduce cow and sheep emissions - Need for continuous improvement across a large number of areas of the bioeconomy 	Emissions per hectare Emissions per kg
5 REPLACE FOSSIL FUELS	<ul style="list-style-type: none"> - The modern economy currently runs on 300-360m year old biomass (aka. fossil fuels) - Fossil fuels are ubiquitous and 'in everything' 	<ul style="list-style-type: none"> - Need to identify, develop and implement biomass-based processes and systems that replace fossil fuels - Ideally need to work with not against market forces 	Tonnes of domestically produced and imported fossil biomass used
6 RETHINK WASTE	<ul style="list-style-type: none"> - NZ is sending growing amounts of biomass to landfills - NZ often lacks the scale needed for solutions 	<ul style="list-style-type: none"> - Need to develop new pathways for existing large waste (aka. 'biomass without a home') - Need to link problems with solutions (e.g. animal feed) 	Biomass to landfill

THE SCREENING PROCESS

02

+ Sources

+ Stage I

+ Stage II

+ Stage III

The widest possible pool of opportunities was fed through a screening process to deliver a short list of high potential platforms

This research identifies high potential platforms that both (1) have a clear business opportunity and (2) support the bioeconomy of the future. To achieve this, the project used a multi-stage screening process to identify bioeconomy platforms with the needed characteristics.

STAGE 0 & I – BUILDING A WIDE POOL OF OPPORTUNITIES

To control scope, the project sought to identify all biomass production and processing systems being pursued by “someone, somewhere” in New Zealand, but ignored hypothetical or theoretical products without local champion(s).

(1) Biomass production systems (e.g. farming) and (2) biomass processing systems (e.g. milling) needed to be addressed separately.

1. Biomass Production Systems (e.g. farming, forestry fishing)

- Numerous sources were analysed to identify over 240 crops and animals production systems that were being successfully produced in New Zealand.
- The initial SCREEN 0 asked nine specific questions for biomass production systems to reduce 240+ to 52 for STAGE I.
- STAGE I for biomass production systems looked at supply and demand side factors and ranked against a bioeconomy scorecard to give a final score.

2. Biomass Processing Systems (e.g. winery, sawmill)

- For biomass processing systems, ANZSIC classifications were used, amended with North American (NAICS) and European (NACE) definitions as needed.
- The initial SCREEN 0 asked ten specific questions for biomass

processing systems to reduce ~100 to 48 for STAGE I

- STAGE I for biomass processing systems looked at fit with New Zealand and ranked against a bioeconomy scorecard to give a final score.
- In total, one hundred biomass production (52) and processing (48) systems emerged into STAGE I for evaluation.

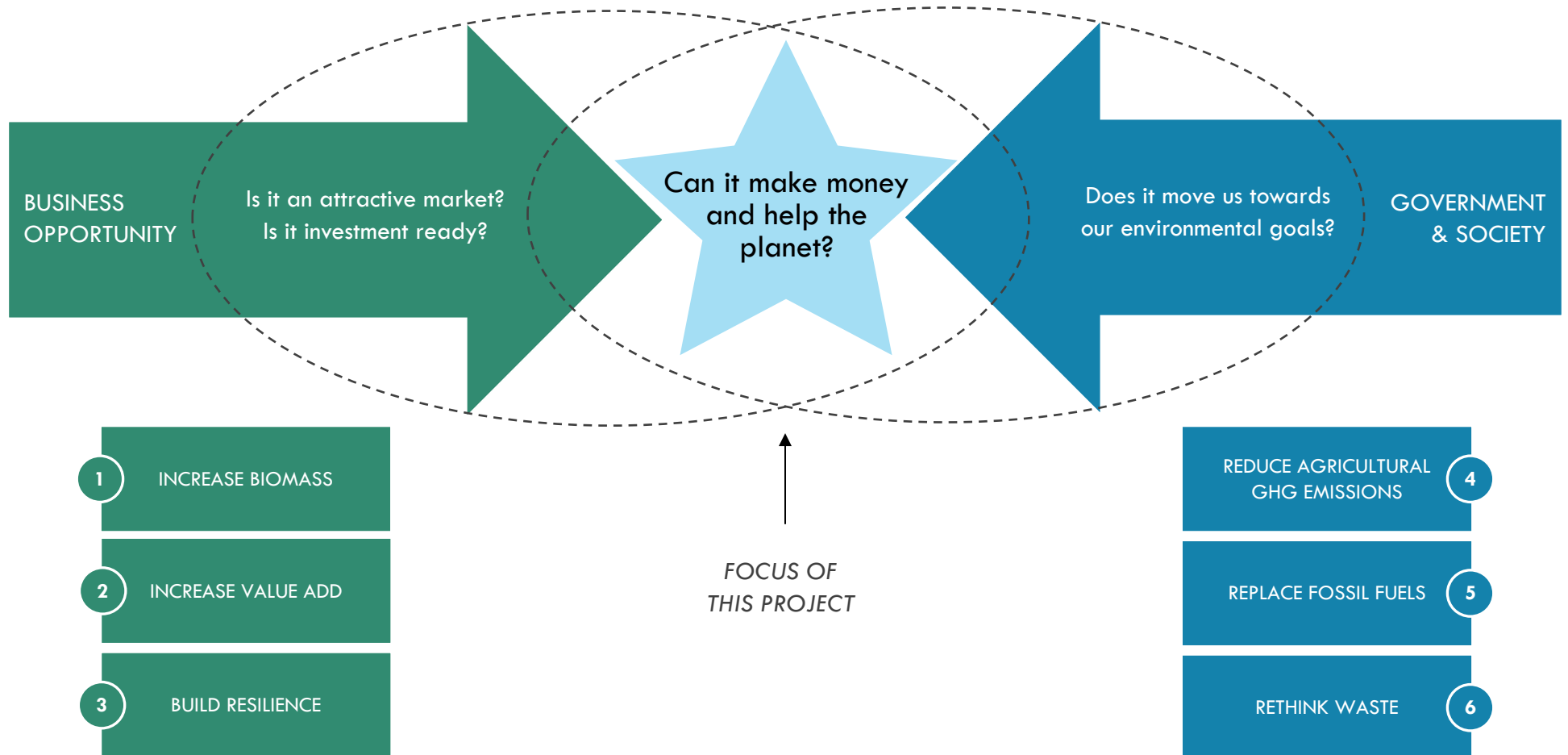
STAGE II – HIGH POTENTIAL PLATFORMS

- Platforms were scored for being both (A) attractive growth opportunities and (B) moving the New Zealand bioeconomy forward.
- A wide range of interesting platforms “just missed the cut” and all present solid opportunities.
- High scoring systems were triaged based on whether they were a high potential new and emerging platform (or a feedstock to those). There was no perfect platform; different identified platforms addressed different requirements of the bioeconomy of the future.
- The thirty platforms that emerged from STAGE I into STAGE II are spread across a wide range of systems, products, processes and categories. These thirty platforms went into STAGE II for development in more detail (see separate document).
- Stage II develops each platform individually from a whole of value-chain perspective by answering a set of common questions.

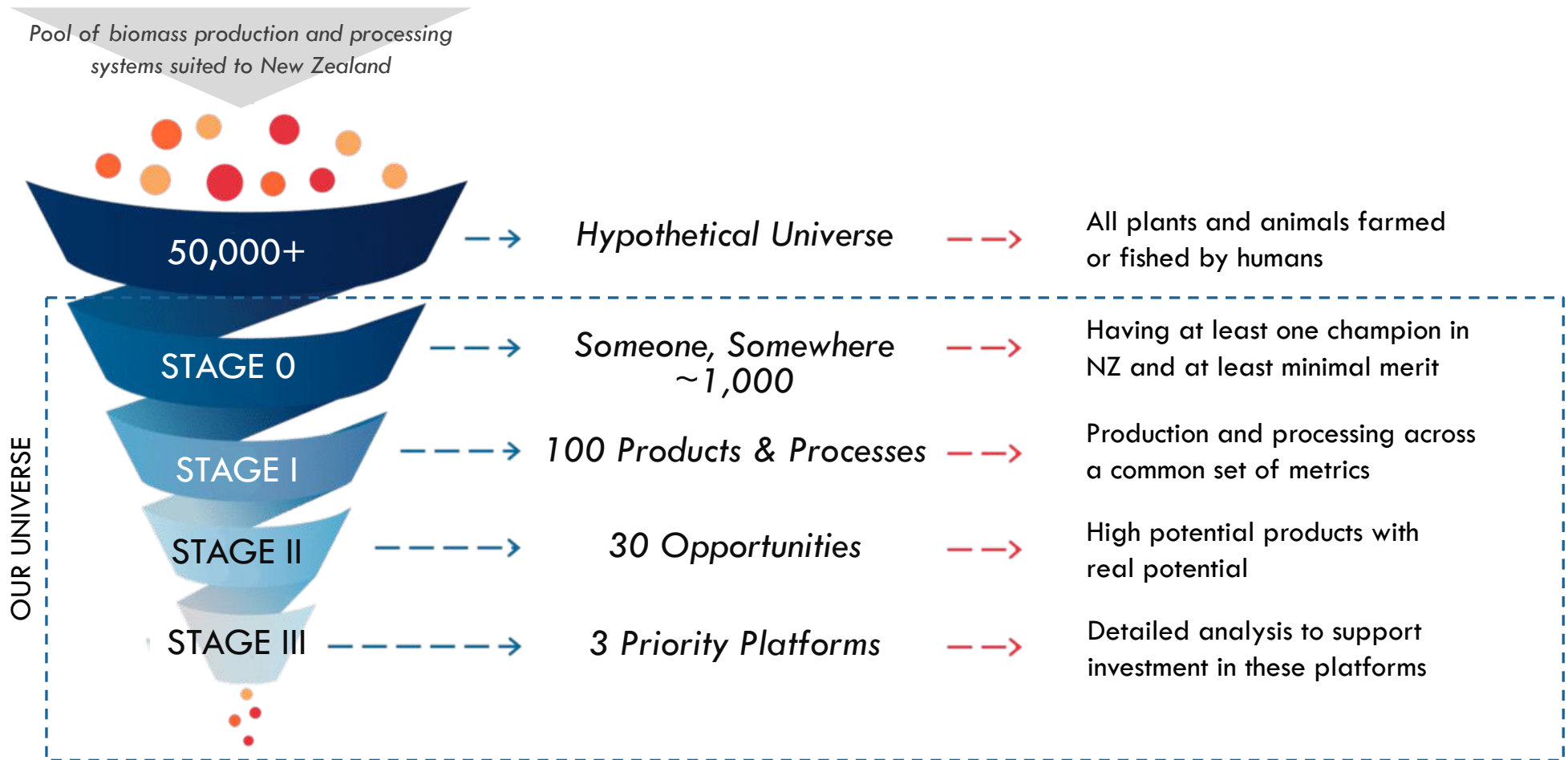
STAGE III – INVESTMENT READY FOCUS AREAS

- Three platforms were highlighted for further development as separate document in STAGE III

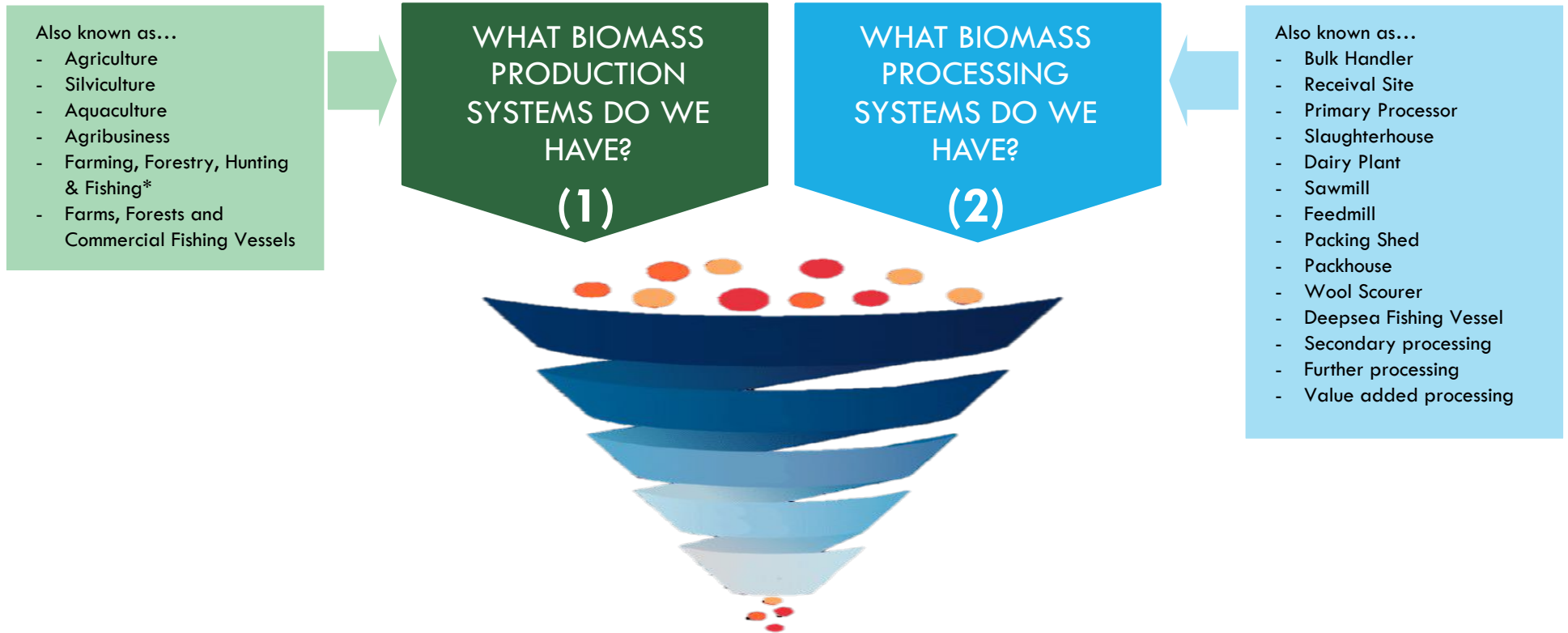
This research identifies high potential platforms that both (1) have a clear business opportunity and (2) support the bioeconomy of the future



The project uses a multi-stage screening process to identify bioeconomy platforms with the needed desirable characteristics



Biomass production systems (1) (e.g. farming) and Biomass processing systems (2) (e.g. milling) were addressed separately

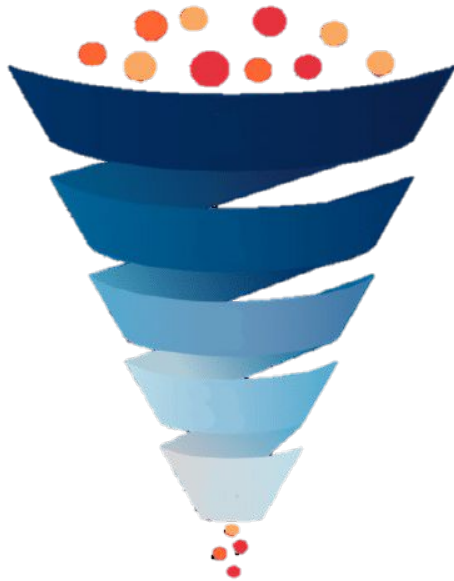


During our initial analysis, it was realised that these two types of systems had very different characteristics and thus needed evaluating separately. In particular, biomass production systems (forestry, farming, fishing) were more binary (yes/no) in terms of global competitiveness than processing systems.

* Non-recreational hunting and fishing only

Numerous sources were analysed to identify over 240 crops and animals production systems that were being successfully produced in New Zealand

WHAT BIOMASS PRODUCTION SYSTEMS DO WE HAVE? (1)



<ul style="list-style-type: none"> - Mānuka - M. pine (radiata) - Eucalypts - Cyprus (Macroc.) - Douglas fir - Numerous nursery - Black beech (NZ) - Kahikatea (NZ) - Red beech (NZ) - Rimu (NZ) - Silver beech (NZ) - Tawa (NZ) - Totara (NZ) - Acacia - Alder - Ash - Birch - Blackwood - Coast redwood - European larch - Giant sequoia - Grand fir - Himalayan cedar - Japanese cedar - Japanese larch - Kawa poplar - Moutere willow - Narfalk Isl. pine - Oak - Spruce - Tangoio willow - Veronese poplar - Bamboo 	<ul style="list-style-type: none"> - Maize - Barley - Oats - Wheat - Sunflower - Field peas - Soybeans - Canola/Rapeseed - Rice - Sugarcane/beet - Hemp - Com. flax/Linseed - Hay - Peanuts - Sorghum - Buckwheat - Cannabis (THC) - Chickpeas - Faba beans - Poppy - Quinoa - Safflower - Amaranth - Farro (Em./Spelt) - Kidney beans - Lentils - Millet - Triticale - Miscanthus - Switchgrass - Agave - Mustard - Rye 	<ul style="list-style-type: none"> - Turf/lawn grass - Harakeke (flax) - Sweetcorn - Tobacco - Wharariki (flax) - Saffron - Dill - Medicinal mushrooms - Potatoes - Sweet potato - Onions - Capsicum - Hay - Beans - Specialty mushrooms - Cucumber - Wombok/Napa - Taro - Spring onions - Snap/Snow Peas - Leafy salad - Leafy Asian gr. - Head lettuce - Eggplant - Chillies - Carrots - Broccoli - Beetroot - White/Brown mushrooms - Nursery production - Spin./Silver./Kale - Rutab./Swedes 	<ul style="list-style-type: none"> - Parsley/oth. herbs - Garlic - Cabbage - Zucchini/courgette - Watermelons - Rockmelons - Pumpkin/Squash - Oca/Yam - Cauliflower - Water chestnut - Turnips - Truffles (all var.) - Ginger - Leek - Kohlrabi - Daikon - Chives - Celery - Asparagus - Lemongrass - Thyme - Radish - Pūhā (sow thistle) - Pikopiko (fern sh.) - Parsnip - Parsnip - Okra - Lavender - Kōwhitiwhiti (wat.) - Mint - Jerusalem artich. - Horsera./Wasabi - Globe artichoke 	<ul style="list-style-type: none"> - Brussels sprouts - Horn mel./Kiwano - Ginseng - Floriculture - Wine grapes - Avocado - Citrus - Cherries - Blueberries - Walnuts - Almonds - Pineapples - Bananas - Table grapes - Coffee - Hops - Native botanicals - Tea - Pine nuts - Pecans - Olives - Hazelnuts - Pomegranate - Cranberries - Strawberries - Raspberries - Persimmons - Peaches - Pistachios - Chestnuts - Nectarines 	<ul style="list-style-type: none"> - Mangos - Lemons - Kiwiberries - Finger limes - Boysenberries - Blackcurrants - Apricots - Pears - Papaya/Pawpaw - Nashi - Figs - Plums - Passionfruit - Grapefruit - Feijoa - Cherimoya - Juniper berries - Tamarillo - Sapote/Casimiroa - Pitaya (dragonfr) - Guava - Loquat - Elderberries - Caramb/Star Fruit - Chicken - Cranberries - Pigs - Honeybee - Sheep - Goat - Turkey - Insects - Water buffalo 	<ul style="list-style-type: none"> - Possum - Duck - Quail - Deer - Pheasant - Muttonbird - Horse - Guinea Fowl - Geese - Wallaby - Rabbit - Pigeons/Squab - Partridge - Ostrich - Llama - Himalayan tahr - Emu - Elk - Alpaca - Bison - Ferret - Gr. mussels - Seaweeds (aqua.) - Microalgae - Rainbow trout - Brown trout - Atlantic salmon - Kingfish - King salmon - Blue mussels - P. oysters - Abalone/Pāua - NZ Scallop 	<ul style="list-style-type: none"> - NZ rock oyster - Fr. prawns - Carp - Bluff Oyster - Blue grenadier/Hoki - Wellington flying/arrow squid - Jack and horse mackerels nei - Snoek/"Barracouta" - Rink cusk-eel/Ling - Southern blue whiting - Oreo dories - "Bycatch" collectively - Rock lobster "crayfish" - Another ~290+ marine fish species - Another ~27 mollusc species) - Another ~17 crustacean species - All seaweeds - 10+ sea urchins and other misc. aquatic species - 10+ aquatic mammals primarily bycatch (e.g. fur seal, sea lions)
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The initial SCREEN 0 asked nine specific questions for biomass production systems to reduce 240+ to 52 for STAGE I

WHAT 'SCREEN 0' QUESTIONS WERE USED FOR BIOMASS PRODUCTION SYSTEMS?

240+ BIOMASS PRODUCTION SYSTEMS INTO SCREEN 0

SCREEN 0	
WHAT?	WHY?
Is there currently large biomass harvested	<ul style="list-style-type: none"> - Is there a lot of it currently? - This works in conjunction with others to identify large waste sources
Are there huge waste streams and clear, material co/by-product opps.?	<ul style="list-style-type: none"> - Reducing and/or creating value from waste a project priority - Scale is the key issue in many cases
Are there clear global consumer demand macro-drivers?	<ul style="list-style-type: none"> - Is it a long term play that has 'legs'? - Will there be demand 20 years from now? - It is difficult for new entrants without growing demand
Are there proven, scalable farming systems in developed countries?	<ul style="list-style-type: none"> - High income, developed countries cannot compete in high labour goods without the assistance of scale and mechanisation - Ideally someone would have already figured out how to produce it
Is there material production growth happening in NZ peer group countries	<ul style="list-style-type: none"> - Is it working at any scale in a country like ours (e.g. Ireland)? - Does it work in a similar climate? Can we get competitive yields? - Let's not reinvent the wheel. Lets adopt and adapt?
Is material growth happening in NZ (in a relative sense)?	<ul style="list-style-type: none"> - Is local production achieving any growth? - There is no point wasting time on stable, tertiary products (e.g. rhubarb)
Is significant volume imported directly (or clear substitutes) into NZ?	<ul style="list-style-type: none"> - There is already a market in New Zealand - Obviously the challenge for local production is to get to world price
Does it have clear social licence to operate from NZ public?	<ul style="list-style-type: none"> - Government can't be seen to be advocating for certain things - No point wasting time on products that attract protesters
Are there traditional/ Māori/Pacific socio-cultural connections?	<ul style="list-style-type: none"> - Often useful in creating and defining a clear point-of-difference - A project and client priority

52 BIOMASS PRODUCTION SYSTEMS INTO STAGE I

The need for Stage 0/Screen 0 was realised part way into the process. The purpose of these questions isn't to give the final answer, just to thin down the list for analysis in Stage I to a manageable amount (i.e. 100). Or in consulting-speak, to avoid "boiling the ocean."

STAGE I for biomass production systems looked at supply and demand side factors and ranked against a bioeconomy scorecard to give a final score

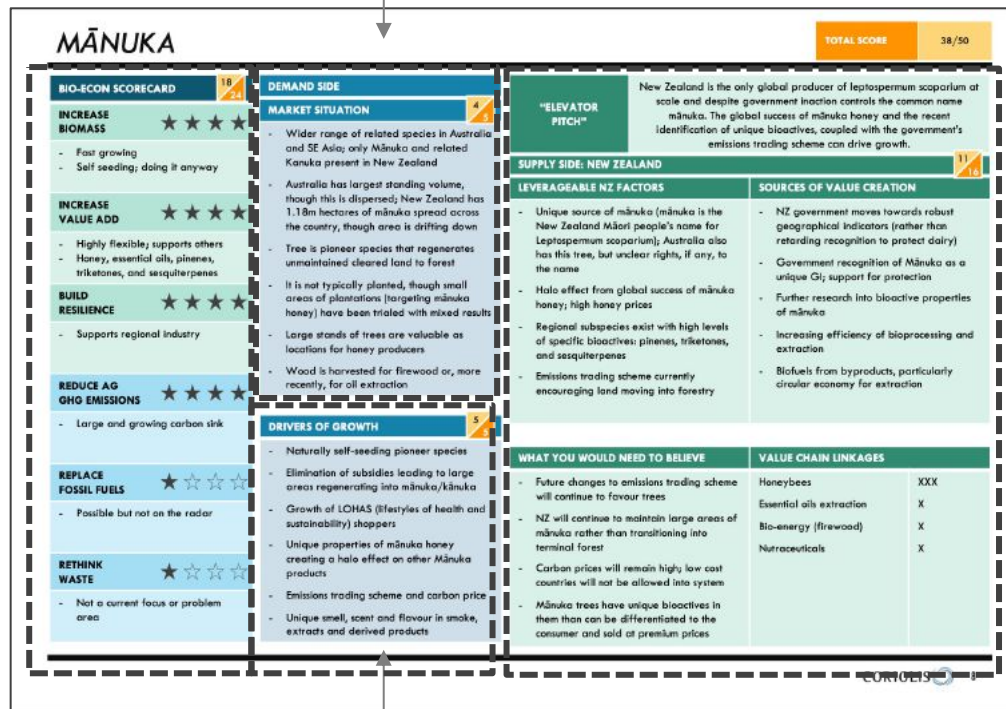
DEMAND SIDE

Market demand based on market insights
0-to-5 points possible

FIT WITH BIO-ECONOMY SCORECARD

How does this biomass production system fit with the six high level strategic themes that emerged to guide New Zealand towards the bioeconomy of the future

0-to-4 stars or points
24 points total possible



SUPPLY SIDE

Can New Zealand compete and win?

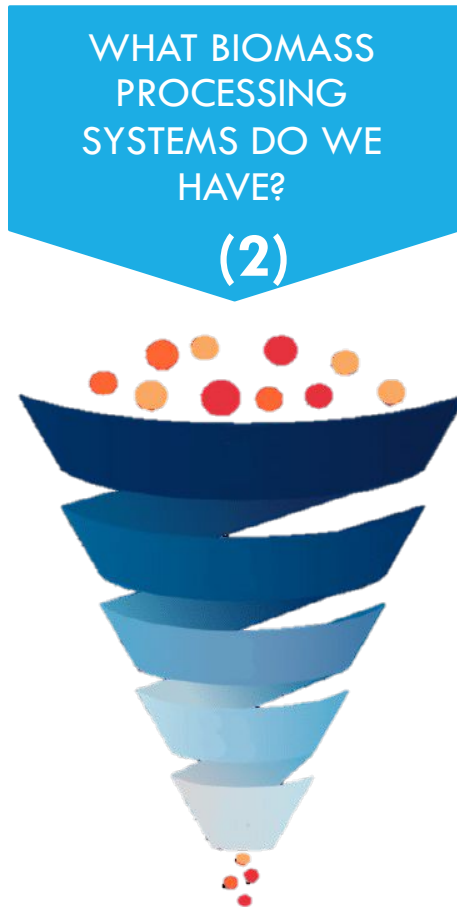
- Leverageable NZ factors
- Sources of value creation
- What you would need to believe
- Value chain linkages

0-to-16 points possible





DRIVERS OF GROWTH

Long term consumer demand based on market insights
0-to-5 points possible

For biomass processing systems, ANZSIC classifications were used, amended with North American (NAICS) and European (NACE) definitions as needed



WHAT WAS USED FOR DEFINITIONS?

 Australian and New Zealand Standard Industrial Classification (ANZSIC) 2006 (Revision 2.0) 2013 1292.0	 NACE Rev. 2 Statistical classification of economic activities in the European Community 	 NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM United States, 2022 EXECUTIVE OFFICE OF THE PRESIDENT OFFICE OF MANAGEMENT AND BUDGET
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WHY?

- Clear, detailed, well developed definitions that prevent debates or disputes
- Can be measures across multiple metrics (e.g. employee growth, firm growth)

The initial SCREEN 0 asked ten specific questions for biomass processing systems to reduce ~100 to 48 for STAGE I

WHAT 'SCREEN 0' QUESTIONS WERE USED FOR BIOMASS PROCESSING SYSTEMS?

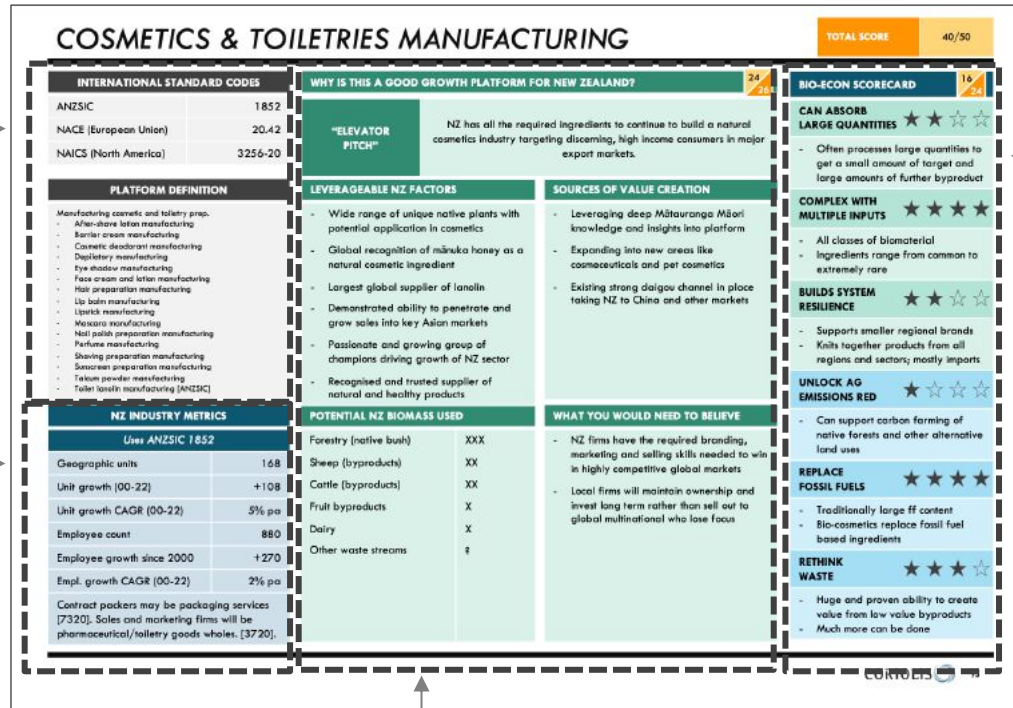
~100 BIOMASS
PROCESSING
SYSTEMS INTO
SCREEN 0

SCREEN 0	
WHAT?	WHY?
Is there a growing number of firms in NZ?	- A simple, clear sign of growing comparative advantage - All other things being equal, it will continue to grow
Is there growing employment in NZ?	- A simple, clear sign of growing comparative advantage - All other things being equal, it will continue to grow
Is the sector a large employer in NZ?	- A simple, clear sign of scale and activity today - Not starting 'from scratch' or 'from zero'
Does NZ produce the ingredients or precursors?	- It is difficult to be competitive with imported biomass as feedstock - Need some reason to do it in New Zealand
Do global leaders achieve large gross margins? Is there money in it?	- Trying to avoid replacing one raw material commodity with another - Can't support the social system of Sweden on the economy of Kenya
Is it defensible with barriers to entry?	- Supports higher prices and locating in New Zealand - Need to be careful not to confuse biosecurity with defensibility
Is it a clear growth platform in peer group countries?	- Other similar economic and climatic countries succeeding is a strongly positive sign that de-risks investment
Is there a significant volume imported into NZ? (or of a clear substitute)	- There is already a market in New Zealand - Obviously the challenge is to get NZ production to the world price
Does it have a complex value chain drawing in numerous diverse inputs?	- Products vary by complexity; more complex is generally better - Complexity, defensibility and profitability are a related set
Are high levels of ongoing innovation occurring in it?	- Rapid ongoing innovation supports new entrants - High levels of innovation reduce price pressure (all other things...)

48 BIOMASS
PROCESSING
SYSTEMS INTO
STAGE I

The need for Stage 0/Screen 0 was realised part way into the process. The purpose of these questions isn't to give the final answer, just to thin down the list for analysis in Stage I to a manageable amount (i.e. 100). Or in consulting-speak, to avoid "boiling the ocean."

STAGE I for biomass processing systems looked at fit with New Zealand and ranked against a bioeconomy scorecard to give a final score



HOW IS IT DEFINED?

What is a clear definition of the sector or industry?

WHAT IS THE NZ SITUATION?

How big is it? Is it growing?

FIT WITH BIO-ECONOMY SCORECARD

How does this biomass processing system fit with the six high level strategic themes that emerged to guide New Zealand towards the bioeconomy of the future

0-to-4 stars or points
24 points total possible

WHY IS THIS A GOOD GROWTH PLATFORM FOR NZ?

What is the opportunity? Is it attractive? Can we win?

- Leverageable NZ factors
- Sources of value creation
- Potential NZ biomass used
- What you would need to believe

0-to-26 points possible

One hundred biomass production (52) and processing (48) systems emerged into Stage I for evaluation

WHAT EMERGED INTO STAGE I?

BIOMASS PRODUCTION SYSTEMS (52)			
FORESTRY (3)	ARABLE (14)	NON-TREE HORT (4)	TREE/BUSH/VINE (20)
<ul style="list-style-type: none"> - Mānuka - M. pine (radiata) - Eucalyptus 	<ul style="list-style-type: none"> - Grass - Maize - Barley - Oats - Wheat - Sunflower - Field peas - Soybeans - Canola/Rape - Rice - Sugarcrops - Hemp - Opium poppies - Cannabis (THC) 	<ul style="list-style-type: none"> - Medicinal mushrooms - Potatoes - Sweet potato - Onions 	<ul style="list-style-type: none"> - Wine grapes - Kiwifruit - Avocado - Apples - Citrus - Cherries - Blueberries - Walnuts - Almonds - Pineapples - Bananas - Table grapes - Coffee - Hops - Native botanicals - Tea - Pine nuts - Olives - Hazelnuts - Pitaya (Dragon fr.)
LAND ANIMALS (7)	AQUACULTURE (3)	WILD CAPTURE (1)	
<ul style="list-style-type: none"> - Chicken - Cattle - Pigs - Honeybee - Sheep - Goat - Insects 	<ul style="list-style-type: none"> - Greenshell mussels - Seaweed (aqua.) - Microalgae 	<ul style="list-style-type: none"> - Bycatch 	

BIOMASS PROCESSING SYSTEMS (48)			
WOOD PROCESSING (4)	FIBRE PROCESSING (2)	NON-FOOD CPG/FMCG (4)	BEVERAGES (5)
<ul style="list-style-type: none"> - Forestry-based biochemicals - Paperboard/packaging Mnfg. - Veneer/plywood - Reconstituted wood product Mnfg. 	<ul style="list-style-type: none"> - Natural Home Insulation Mnfg. - Wool Fractionates 	<ul style="list-style-type: none"> - Nutraceuticals - Cosmetics & Toiletries Mnfg - Soap, similar - Essential Oils Extraction 	<ul style="list-style-type: none"> - Alcoholic Spirits Manufacturing - Wineries - Soft drink Manufacturing - Beer Breweries - Bottled Water Manufacturing
FOOD PROCESSING (26)			FARM INPUTS (3)
<ul style="list-style-type: none"> - Infant Nutrition/ Specialty Dairy - Sports Nutrition / Weight Control - Biscuits, Cookie, Cracker, Muesli Bar Mnfg. - Pet (Dog and Cat) Food Mnfg. - Dairy Substitutes - Ice Cream and Frozen Dessert Manufacturing - Chocolate Confectionery - Snack Food Manufacturing - Coffee & Tea Manufacturing 	<ul style="list-style-type: none"> - Meat Substitutes / Meat Analogues Manufacturing - Marine Byproduct - Meat Byproduct Processing - Baby Food (non-IF) - Frozen Specialty Food Mnfg. - Dough, Flour/ Baking Mixes and Ing. Mnfg. - Animal (x Poultry) Slaughtering & Processing - Breakfast Cereal Manufacturing - Mayonnaise, Dressing, and Other Prepared Sauce Mnfg. 	<ul style="list-style-type: none"> - Fluid Milk & Chilled Dairy Manufacturing - Cheese & Whey Manufacturing - Pastry/Cakes, Frozen Cakes, Pies, and Other Pastries Manufacturing - Non-chocolate Confectionery - Fats and Oils Refining and Blending - Dry, Condensed, and Evaporated Dairy Prod. Mnfg - Cultivated Meat - Precision Fermentation 	<ul style="list-style-type: none"> - Farm Animal Feed - Fertiliser - Pesticides /Herbicides
			FOSSIL FUEL REPLACEMENT (4)
			<ul style="list-style-type: none"> - Wood Pellets/similar - Petrol/Diesel - Biogas - Bioplastic

A wide range of interesting platforms “just missed the cut” and all present solid additional opportunities

INTERESTING PLATFORMS THAT “JUST MISSED THE CUT”

SPECULATIVE ECONOMICS SCIENCE NEEDS MORE WORK	EXISTING & EMERGING HIGH YIELD BIOMASS	EARLY STAGE HIGH VALUE SPECIALTY CROPS	EXISTING PLATFORMS WITH FURTHER UPSIDE	MATURE SECTORS THAT NEED TO PIVOT
<p>SOLUTIONS CHASING PROBLEMS</p> <p>Forestry-based Biochemistry[^] Wool Fractionates Insects Biopesticides/bioherbicides</p> <p>FEAR DRIVEN IN NZ</p> <p>Precision Fermentation</p>	<p>EXISTING</p> <p>Grass & Similar Oats Field Peas Potatoes</p> <p>EMERGING</p> <p>Soybeans Sugarcane/beet</p>	<p>Opium Poppies Cannabis (THC) Hazelnuts Walnuts Almonds Dragon Fruit Coffee Tea Table Grapes</p>	<p>Kiwifruit Chicken Apples Avocados Cherries Greenshell Mussels Beer/Breweries NARTD* Beverages Ice Cream/Frozen Desserts Breakfast Cereal Baby Food (non infant formula) Olives Paperboard/Packaging</p>	<p>Milk Powder Cheese & Whey Fluid Milk Meat Processing Bycatch</p>

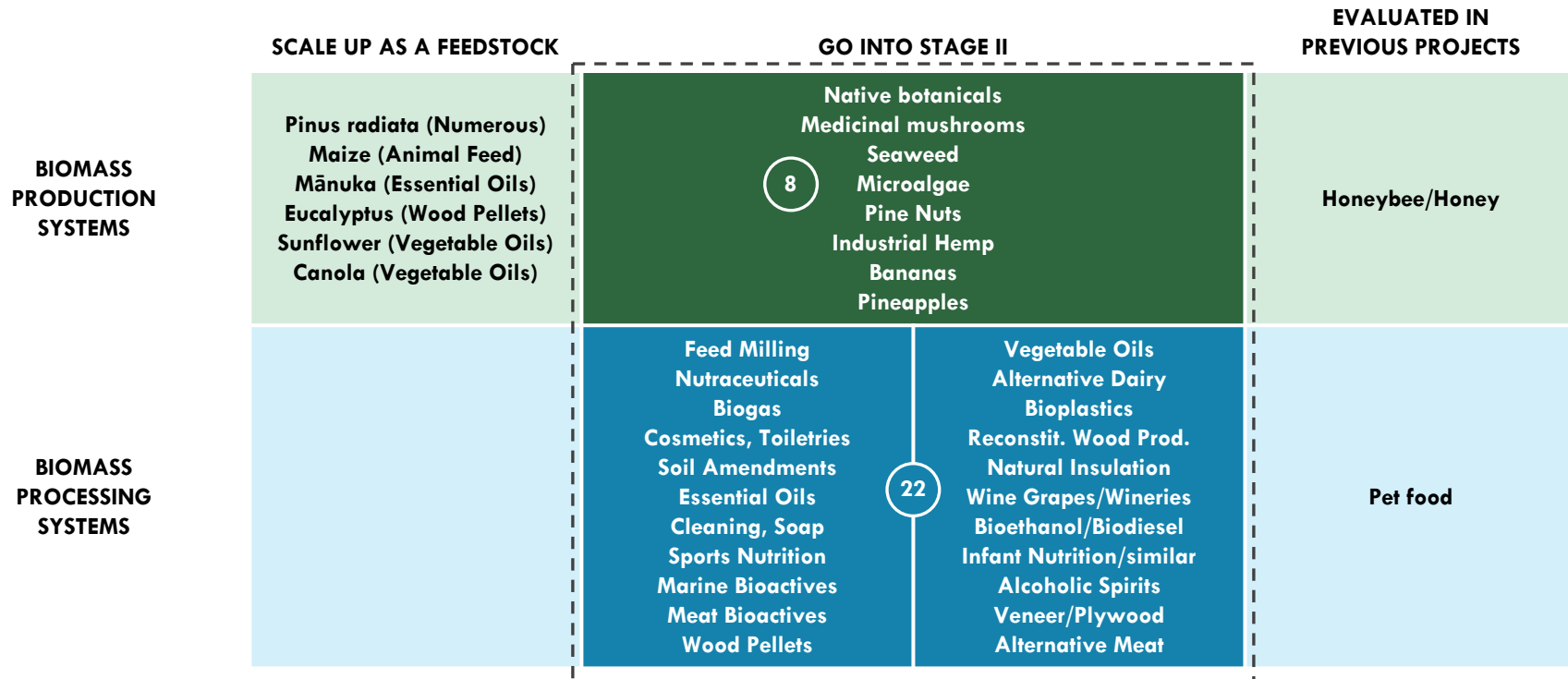
CAN YOU MAKE MONEY IN NZ AGAINST EXISTING SOLUTIONS?	WHY AREN'T MARKET FORCES SENDING PRICE SIGNALS?	CAN YOU REMOVE THE ROADBLOCKS?	WHAT NEEDS TO HAPPEN TO GROW BY 5X?	WHEN ARE YOU GOING TO GET AHEAD OF THE PROBLEM?
<ul style="list-style-type: none"> - Forestry based biochemistry is attempting to create value from slash and other forestry waste - Wool fractionates is attempting to be a solution to low wool prices - Insects are attempting to solve waste challenges - Precision fermentation threatens NZ dairy fractionates and has regulatory considerations 	<ul style="list-style-type: none"> - All existing can produce more biomass given the right market signals - Emerging face a fundamental challenge of penetrating a mature commodity industry without protection from world prices 	<ul style="list-style-type: none"> - Good platforms that work elsewhere in the world - All need specific roadblocks removed to release growth 	<ul style="list-style-type: none"> - All platforms that have achieved growth in the past - Challenges have emerged than need to be addresses to grow further - Opportunity to rethink 'waste' 	<ul style="list-style-type: none"> - Need to become fully part of the solution - Need to support a drive to the bioeconomy of the future

[^]Added by client later in process; *NARTD = Non-Alcoholic Ready-to-Drink

High scoring platforms were triaged based on whether they were a high potential new and emerging platform (or a feedstock provider to those)

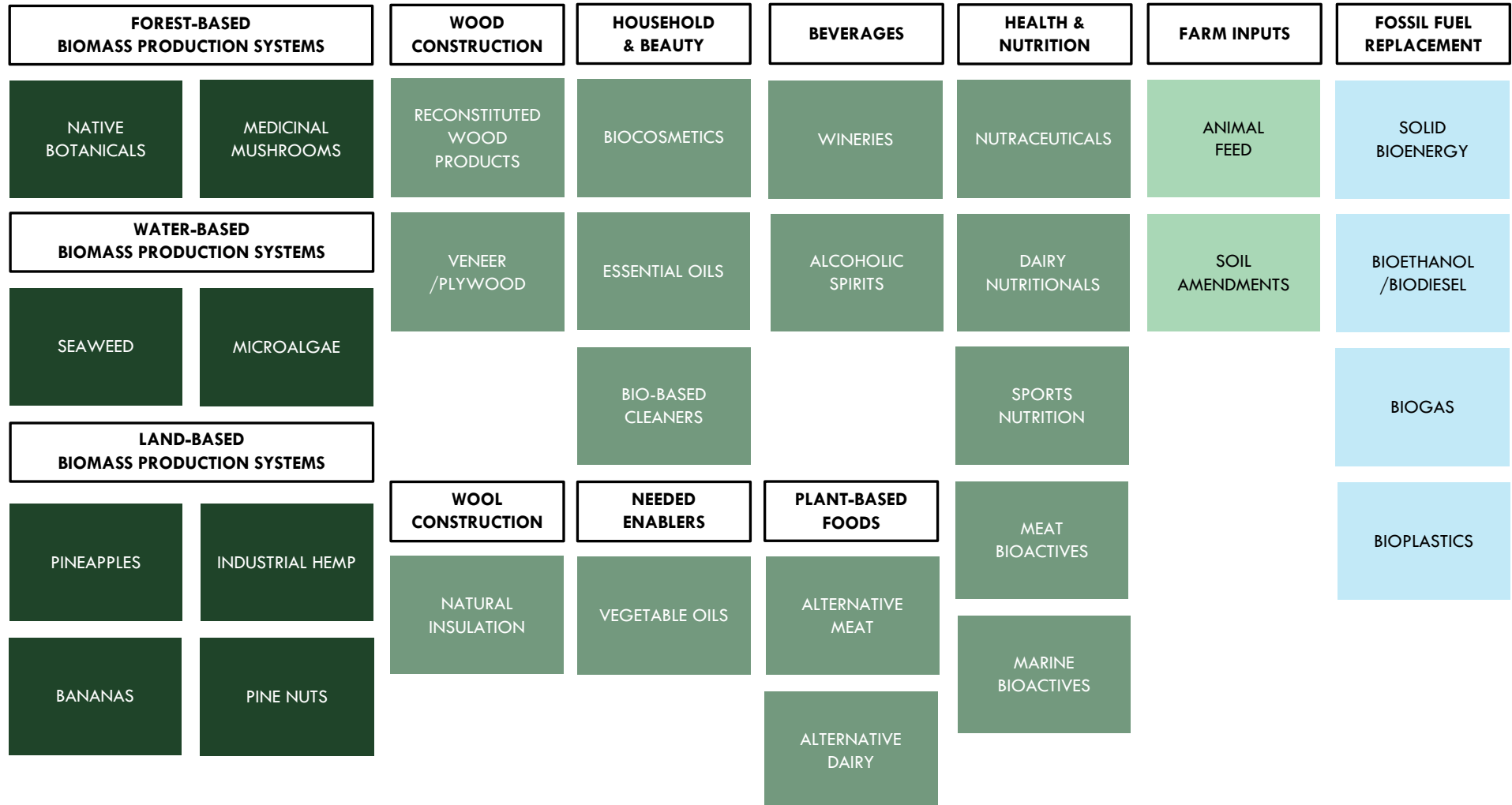
WHAT IS ITS ROLE IN THE BIOECONOMY?

IDENTIFIED HIGH POTENTIAL NEW & EMERGING PLATFORMS



^ Forestry-based Biochemistry added to Stage II by client later in process

The thirty platforms that emerged from STAGE I into STAGE II are spread across a wide range of systems, products, processes and categories



There was no perfect platform; different identified platforms addressed different requirements of the bioeconomy of the future

“IS IT MOVING NEW ZEALAND TOWARDS THE BIOECONOMY OF THE FUTURE?*

8 BIOMASS PRODUCTION SYSTEMS							
	TOTAL	INCREASE BIOMASS	INCREASE VALUE ADD	BUILD RESILIENCE	REDUCE AG GHG EMISSION	REPLACE FOSSIL FUELS	RETHINK WASTE
Native Botanicals	17	4	4	3	3	1	2
Pine Nuts	14	3	2	3	3	2	1
Medi. Mushrooms	15	2	4	2	3	0	4
Bananas	16	4	1	4	2	2	3
Pineapples	14	4	1	3	2	2	2
Hemp	9	3	3	1	0	2	1
Seaweed	15	4	3	2	4	1	1
Microalgae	14	4	3	2	3	1	1

22 BIOMASS PROCESSING SYSTEMS							
	TOTAL	ABSORB LARGE QUANTITIES	COMPLEX W/ MULTI INPUTS	BUILD SYSTEM RESILIENCE	UNLOCK AG EMISSIONS RED	REPLACE FOSSIL FUELS	RETHINK WASTE
Recon. wood prod.	16	3	2	1	2	4	4
Eng./veneer/ply.	15	3	1	1	2	4	4
Alternative dairy	16	2	4	3	4	1	2
Natural insulation	14	4	0	1	1	4	4

BIOMASS PROCESSING SYSTEMS							
	TOTAL	ABSORB LARGE QUANTITIES	COMPLEX W/ MULTI INPUT	BUILD SYSTEM RESILIENCE	UNLOCK AG EMISSIONS RED	REPLACE FOSSIL FUELS	RETHINK WASTE
Nutraceuticals	17	3	4	3	1	2	4
Biocosmetics	16	2	4	2	1	4	3
Essential oils	19	4	4	4	3	2	4
Bio-based cleaners	19	4	4	3	0	4	4
Wineries	12	3	0	3	1	0	4
Alcoholic spirits	15	3	2	2	1	3	4
Sports nutrition	15	4	4	2	1	0	4
Vegetable oils	18	3	2	4	1	4	4
Meat bioactives	16	4	3	1	1	3	4
Marine bioactives	15	4	4	2	1	0	4
Dairy nutritionals	13	4	4	2	1	1	1
Alternative meat	16	2	4	3	4	1	2
Animal feed	21	4	3	4	4	2	4
Soil amendments	20	4	2	2	4	4	4
Solid bioenergy	20	4	1	3	4	4	4
Bioethanol/diesel	19	3	1	4	3	4	4
Biogas	20	4	2	2	4	4	4
Bioplastics	18	4	1	4	2	4	3

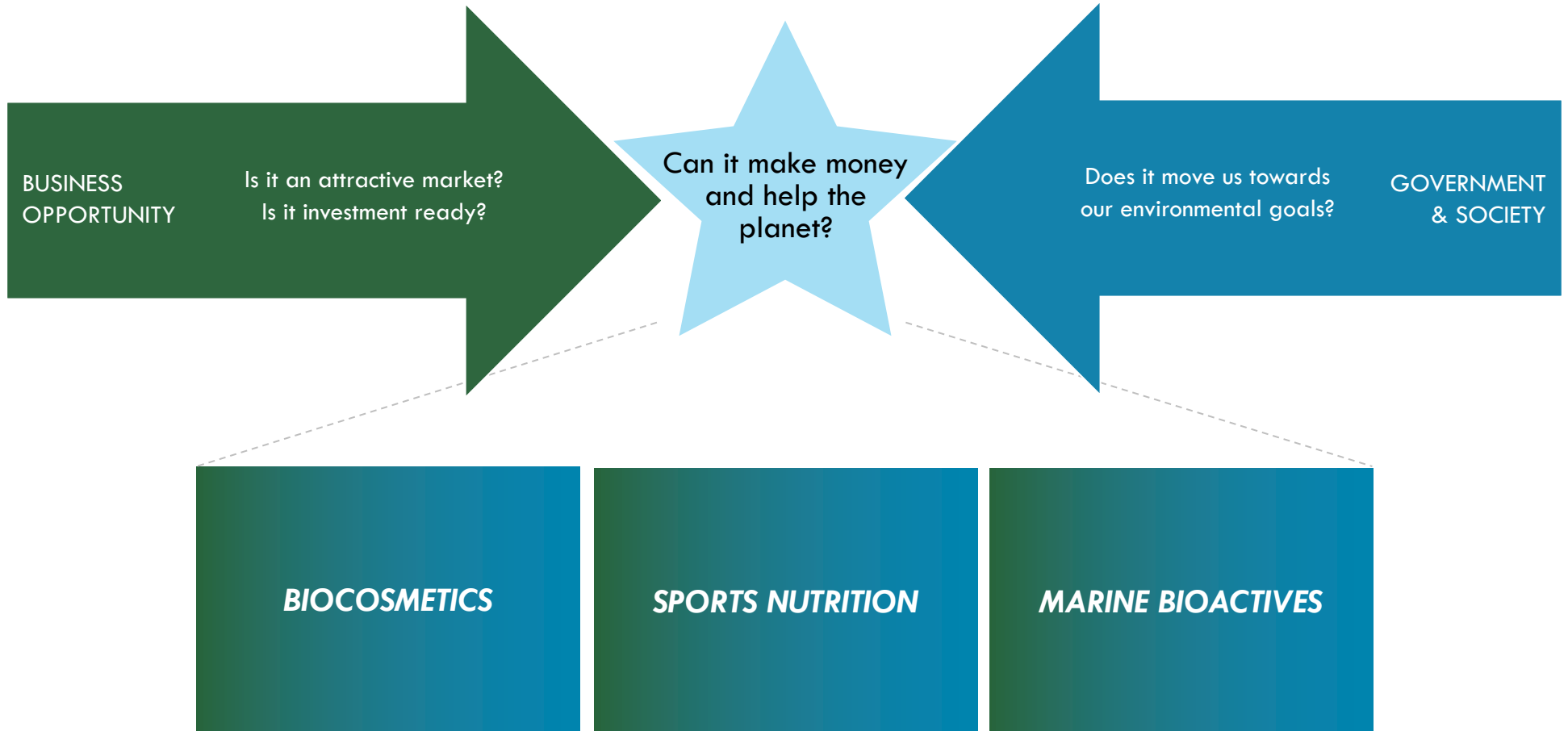
* In other words, ignoring any measure of “is it an attractive growth opportunity”

Stage II develops each platform individually from a whole of value-chain perspective by answering a set of common questions

The following table summarizes the central questions and key points from the 15 slides:

Slide Title	Central Question	Key Points
Why do we care?	WHY DO WE CARE?	Platform scales up production of native botanicals for use in a wide range of biomass processing systems.
What is the concept?	WHAT IS THE CONCEPT?	Conceptually, this opportunity uses native mushrooms to produce medicinal mushroom extracts.
What are the current and potential linkages?	WHAT ARE THE CURRENT AND POTENTIAL LINKAGES?	Native botanicals are a small, but critical ingredient in product differentiation for a huge range of New Zealand products in the market.
What can you do with it?	WHAT CAN YOU DO WITH IT?	Medical mushrooms are the key ingredient in a range of products including beverages, snacks, and cosmetics.
How does this platform support a better future?	HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?	Medical mushrooms are in line with the desired direction for the bioeconomy.
What are the opportunities to build a more circular economy?	WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?	Medical mushroom production can be part of a wider circular system.
Where is the industry located?	WHERE IS THE INDUSTRY LOCATED?	Mushrooms grow across New Zealand.
Who are some of the other stakeholders?	WHO ARE SOME OF THE OTHER STAKEHOLDERS?	There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform.
Why this platform?	WHY THIS PLATFORM?	There are strong economic arguments for this platform being a growth opportunity going forward.
Is the platform growth ready?	IS THE PLATFORM GROWTH READY?	Improvements are required to get the platform growth ready.
What questions would an independent investor ask?	WHAT QUESTIONS WOULD AN INDEPENDENT INVESTOR ASK?	An independent investor might ask four broad questions.
What is a Māori perspective?	WHAT IS A MĀORI PERSPECTIVE?	Medical Mushrooms.
Where is investment required?	WHERE IS INVESTMENT REQUIRED?	Three broad categories of investment are highlighted: Farming Systems, Research, and Management.

Three platforms were highlighted for further development as separate document in STAGE III



THE HUNDRED: PRODUCTS & PROCESSING

03

+ Production systems

+ Screen 0: All identified
products

+ Stage I: Enough details to
evaluate

+ Screen I

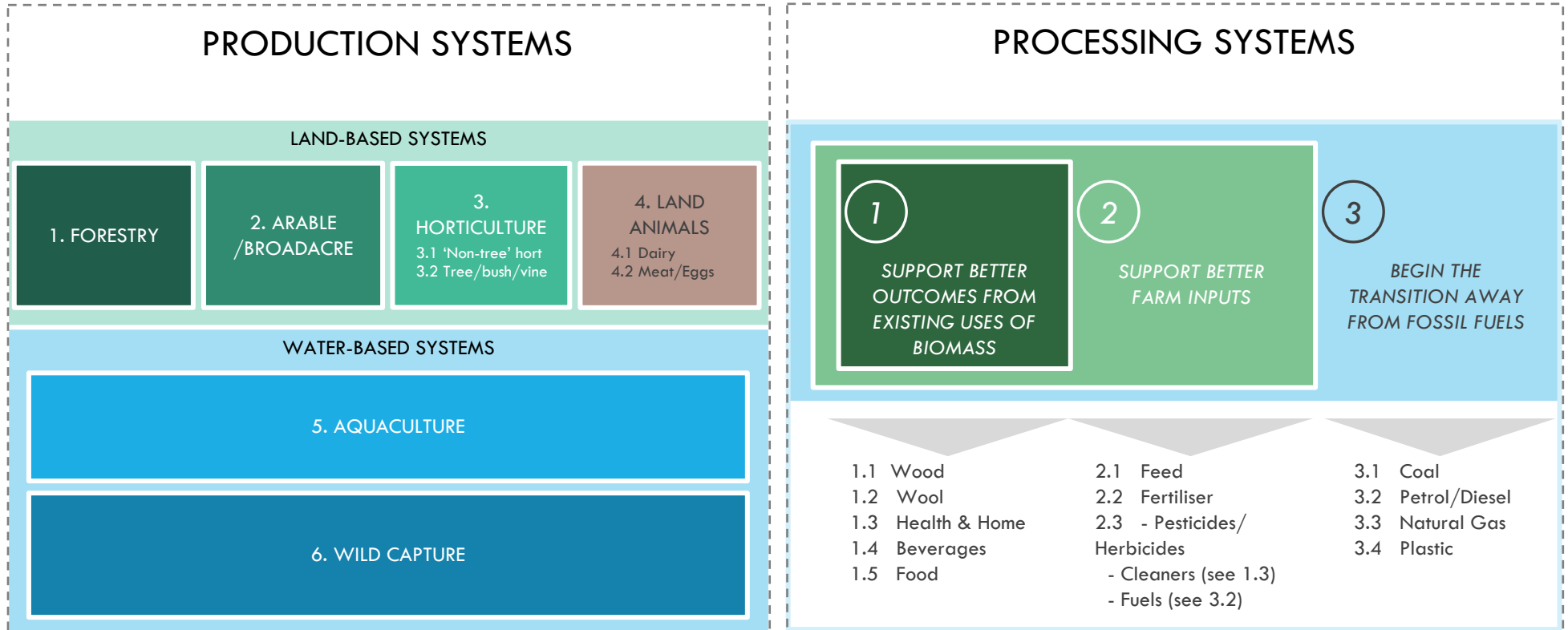
+ Processing systems

+ Screen 0: All identified
products

+ Stage I: Enough details to
evaluate

+ Screen I

THE ONE HUNDRED: PRODUCTION AND PROCESSING SYSTEMS



DEFINED HIGH LEVEL BIOMASS PRODUCTION SYSTEMS

LAND-BASED SYSTEMS

1. FORESTRY

2. ARABLE
/BROADACRE

3. HORTICULTURE

- 3.1 'Non-tree' hort
- 3.2 Tree/bush/vine hort.

4. LAND ANIMALS

- 4.1 Dairy
- 4.2 Meat/Egg

WATER-BASED SYSTEMS

5. AQUACULTURE

6. WILD CAPTURE

II.1. FORESTRY

LAND-BASED SYSTEMS

1. FORESTRY

New Zealand forestry is dominated by Monterey pine/radiata

PRELIMINARY IDENTIFICATION OF BIOMASS PRODUCTION SYSTEMS: FORESTRY

Global silvicultural industry with no farming activity identified in New Zealand	Hobby/Micro currently in New Zealand	Emerging/Tertiary Agricultural Industry	Secondary Agricultural Industry	Major Agricultural Industry
Pine (various sp.) Cedar (various sp.) Eucalyptus (various sp.) Aspen (various sp.) Cypress (various sp.) Sandalwood Numerous other	Bamboo Spruce Birch Alder Ash Oak Acacia Numerous nursery/ornamental	Introduced species Blackwood (<i>Acacia melanoxylon</i>) Himalayan cedar (<i>C. deodara</i>) Japanese cedar (<i>C. japonica</i>) Giant sequoia (<i>S. giganteum</i>) Coast redwood (<i>S. sempervirens</i>) Grand fir (<i>Abies grandis</i>) Japanese larch (<i>L. kaempferi</i>) European larch (<i>Larix decidua</i>) Veronese poplar (<i>P. eurameric.</i>) Kawa poplar (<i>Populus deltoides</i>) Norfolk Island pine (<i>A. heterop.</i>) Tangoio willow (<i>Salix mats. var</i>) Moutere willow (<i>Salix mats. var</i>)	Douglas fir (<i>Pseudotsuga m.</i>) 97,584ha (2021) Cyprus species Macrocarpa (<i>C. macrocarpa</i>) Lusitanica (<i>Cupressus lusitanica</i>) 9,970ha “Other softwoods” 24,027ha (2021) Eucalypts Mountain ash (<i>E. regnans</i>) Blackbutt (<i>Eucalyptus pilularis</i>) 21,950ha (2021) “Other hardwoods” 14,866ha (2021)	Monterey pine (<i>P. radiata</i>) 1,571,574ha (2021) Mānuka/Kānuka (Total area; not just plantation) 1,176,000ha (2012)
Native species present in NZ not farmed or harvested	Native species only selectively harvested in New Zealand	Indigenous species Silver beech (<i>N. menziesii</i>) Red beech (<i>Nothofagus fusca</i>) Rimu (<i>Dacrydium cupressinum</i>) Tawa (<i>Beilschmiedia tawa</i>) Black beech (<i>N. solandri</i>) Kahikatea (<i>D. dacrydioides</i>) Totara (<i>Podocarpus totara</i>)		
Numerous	Rimu and miro Matai Kauri Beech (various) Kahikatea (<i>D. dacrydioides</i>) Hinau Others			

Three forestry systems emerged from “Screen 0”...

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/ Māori/Pacific socio-cultural connections
Mānuka	13	●	●	●	●	○	●	○	●	●
M. pine (radiata)	11	●	●	●	●	○	●	○	●	○
Eucalyptus	10	●	●	●	●	●	○	○	●	○
Cyprus (Macroc.)	9	●	●	●	●	○	○	○	●	○
Douglas fir	8	●	●	●	●	○	○	○	●	○
Numerous nursery	8	●	○	●	●	○	○	○	●	○
Black beech (NZ)	6	○	○	●	●	○	○	○	●	●
Kahikatea (NZ)	6	○	○	●	●	○	○	○	●	●
Red beech (NZ)	6	○	○	●	●	○	○	○	●	●
Rimu (NZ)	6	○	○	●	●	○	○	○	●	●
Silver beech (NZ)	6	○	○	●	●	○	○	○	●	●
Tawa (NZ)	6	○	○	●	●	○	○	○	●	●
Totara (NZ)	6	○	○	●	●	○	○	○	●	●
Acacia	6	○	○	●	●	○	○	○	●	○
Alder	6	○	○	●	●	○	○	○	●	○
Ash	6	○	○	●	●	○	○	○	●	○

... continued

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/ Māori/Pacific socio-cultural connections
Birch	6	○	○	●	●	○	○	○	●	○
Blackwood	6	○	○	●	●	○	○	○	●	○
Coast redwood	6	○	○	●	●	○	○	○	●	○
European larch	6	○	○	●	●	○	○	○	●	○
Giant sequoia	6	○	○	●	●	○	○	○	●	○
Grand fir	6	○	○	●	●	○	○	○	●	○
Himalayan cedar	6	○	○	●	●	○	○	○	●	○
Japanese cedar	6	○	○	●	●	○	○	○	●	○
Japanese larch	6	○	○	●	●	○	○	○	●	○
Kawa poplar	6	○	○	●	●	○	○	○	●	○
Moutere willow	6	○	○	●	●	○	○	○	●	○
Norfolk Isl. pine	6	○	○	●	●	○	○	○	●	○
Oak	6	○	○	●	●	○	○	○	●	○
Spruce	6	○	○	●	●	○	○	○	●	○
Tangoio willow	6	○	○	●	●	○	○	○	●	○
Veronese poplar	6	○	○	●	●	○	○	○	●	○
Bamboo	5	○	○	●	●	○	○	○	◐	○

BIO-ECON SCORECARD 20/24

INCREASE BIOMASS ★★★★★

- Fast growing
- Proven performer; clear economics

INCREASE VALUE ADD ★★★★★

- Fundamental building block for numerous downstream sectors

BUILD RESILIENCE ★★☆☆

- Supports regional industry
- Supports regional employment
- Carbon-only forests drives down

REDUCE AG GHG EMISSIONS ★★★★★

- Large and growing carbon sink

REPLACE FOSSIL FUELS ★★★★★

- Byproducts and waste used extensively in primary processing
- R&D focus area; unclear economics

RETHINK WASTE ★★★★★

- Significant slash issue
- Solutions are unproven

DEMAND SIDE

MARKET SITUATION 4/5

- No reliable source of global forestry data by species
- Forests cover 4b hectares or 31% of land; 93% are natural; 7% farmed (280m ha of farmed forestry globally); 1.15b ha of global forests managed for wood prod.
- New Zealand has 1.7m ha in plantation forestry (0.6% of global); 531m m³ standing volume of which 34.4m m³ harvested in 2020
- 88% of NZ plantation forestry is radiata
- Forestry ownership highly concentrated; 21 organisations appear to own 70% of New Zealand plantation area

DRIVERS OF GROWTH 5/5

- Huge historical government programs that planted most existing NZ forest
- Both income and population growth increasing demand for construction material
- Large scale Chinese infrastructure projects
- Ongoing changes to New Zealand government emissions trading scheme (ETS)
- Growing carbon price
- Attractiveness of sector to certain classes of investors

“ELEVATOR PITCH”

New Zealand has a large supply of pinus radiata being harvested annually on an ongoing basis. As part of this process, significant biomaterials are left in the plantation. At the same time, recent changes to the emissions trading scheme (ETS) could increase the supply of pine biomaterials in the distant future.

SUPPLY SIDE: NEW ZEALAND 12/16

LEVERAGEABLE NZ FACTORS | **SOURCES OF VALUE CREATION**

- | | |
|---|--|
| <ul style="list-style-type: none"> - Climate ideally suited to growing Monterey pine - Fast growing under NZ conditions - Forestry, logging and processing industry focused on Monterey pine - Ongoing changes to NZ government emissions trading scheme (ETS) have increased returns to farm forestry while decreased the attractiveness of other competing land uses - Breeding program driving long-term productivity gains - Growing automation of harvesting | <ul style="list-style-type: none"> - Ongoing productivity increases across all stages of supply chain, from planting through to harvesting - Finding profitable uses for slash/residues - Biofuels from byproducts - Essential oils, nutraceuticals and other extracts and concentrates - Geographic clustering of facilities |
|---|--|

WHAT YOU WOULD NEED TO BELIEVE | **VALUE CHAIN LINKAGES**

<ul style="list-style-type: none"> - Forestry industry can manage negative externalities and regain social licence - Anti-cow/anti-sheep forces stronger than anti-commercial forestry forces - Despite a large number of failed predictions of sector growth, the latest prediction of growth will eventuate - Future changes to the ETS will continue to favour introduced species for harvest (rather than natives for permanent cover) 	<table border="0"> <tr> <td>Sawmilling</td> <td>XXX</td> </tr> <tr> <td>Forestry product mnfg.</td> <td>XXX</td> </tr> <tr> <td>Biofuel</td> <td>XXX</td> </tr> <tr> <td>Nutraceuticals</td> <td>X</td> </tr> <tr> <td>Biochemical extracts</td> <td>?</td> </tr> <tr> <td>Essential oils</td> <td>?</td> </tr> <tr> <td>Soil amendments</td> <td></td> </tr> </table>	Sawmilling	XXX	Forestry product mnfg.	XXX	Biofuel	XXX	Nutraceuticals	X	Biochemical extracts	?	Essential oils	?	Soil amendments	
Sawmilling	XXX														
Forestry product mnfg.	XXX														
Biofuel	XXX														
Nutraceuticals	X														
Biochemical extracts	?														
Essential oils	?														
Soil amendments															

BIO-ECON SCORECARD 18/24

INCREASE BIOMASS ★★★★

- Fast growing
- Self seeding; doing it anyway

INCREASE VALUE ADD ★★★★

- Highly flexible; supports others
- Honey, essential oils, pinenes, triketones, and sesquiterpenes

BUILD RESILIENCE ★★★★

- Supports regional industry

REDUCE AG GHG EMISSIONS ★★★★

- Large and growing carbon sink

REPLACE FOSSIL FUELS ★☆☆☆

- Possible but not on the radar

RETHINK WASTE ★☆☆☆

- Not a current focus or problem area

DEMAND SIDE

MARKET SITUATION 4/5

- Wider range of related species in Australia and SE Asia; only Mānuka and Kānuka present in New Zealand
- Australia has largest standing volume, though this is dispersed; New Zealand has 1.18m hectares of mānuka spread across the country, though area is drifting down
- Tree is pioneer species that regenerates unmaintained cleared land to forest
- It is not typically planted, though small areas of plantations (targeting mānuka honey) have been trialed with mixed results
- Large stands of trees are valuable as locations for honey producers
- Wood is harvested for firewood or, more recently, for oil extraction

DRIVERS OF GROWTH 5/5

- Naturally self-seeding pioneer species
- Elimination of subsidies leading to large areas regenerating into mānuka/kānuka
- Growth of LOHAS (lifestyles of health and sustainability) shoppers
- Unique properties of mānuka honey creating a halo effect on other Mānuka products
- Emissions trading scheme and carbon price
- Unique smell, scent and flavour in smoke, extracts and derived products

"ELEVATOR PITCH"

New Zealand is the only global producer of leptospermum scoparium at scale and despite government inaction controls the common name mānuka. The global success of mānuka honey and the recent identification of unique bioactives, coupled with the government's emissions trading scheme can drive growth.

SUPPLY SIDE: NEW ZEALAND 11/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Unique source of mānuka (mānuka is the New Zealand Māori people's name for Leptospermum scoparium); Australia also has this tree, but unclear rights, if any, to the name - Halo effect from global success of mānuka honey; high honey prices - Regional subspecies exist with high levels of specific bioactives: pinenes, triketones, and sesquiterpenes - Emissions trading scheme currently encouraging land moving into forestry 	<ul style="list-style-type: none"> - NZ government moves towards robust geographical indicators (rather than retarding recognition to protect dairy) - Government recognition of Mānuka as a unique GI; support for protection - Further research into bioactive properties of mānuka - Increasing efficiency of bioprocessing and extraction - Biofuels from byproducts, particularly circular economy for extraction

WHAT YOU WOULD NEED TO BELIEVE

- Future changes to emissions trading scheme will continue to favour trees
- NZ will continue to maintain large areas of mānuka rather than transitioning into terminal forest
- Carbon prices will remain high; low cost countries will not be allowed into system
- Mānuka trees have unique bioactives that can be differentiated to the consumer and sold at premium prices

VALUE CHAIN LINKAGES

Honeybees	XXX
Essential oils extraction	X
Bioenergy (firewood)	X
Nutraceuticals	X

BIO-ECON SCORECARD 17/24

INCREASE BIOMASS ★★★★

- Fast growing
- Potential to create lots of biomass (10-40t ha/yr)

INCREASE VALUE ADD ★★★★☆

- Secondary feedstock currently for NZ; large elsewhere (e.g. Brazil)

BUILD RESILIENCE ★★☆☆

- Supports regional industry

REDUCE AG GHG EMISSIONS ★★★☆☆

- Tree crop

REPLACE FOSSIL FUELS ★★★☆☆

- Conceptually a good feedstock

RETHINK WASTE ★★☆☆

- Slash issue, but small total area
- Solutions are unproven

DEMAND SIDE

MARKET SITUATION 3/5

- Global area in plantations estimated at 21m hectares in 2020 (FAO), up from 19m hectare in 2010
- Numerous species and sub-species exist
- Grows rapidly in hot, dry climates
- Majority of plantations in Brazil, China and India; also South Africa and Australia
- Flat-to-declining production in Australia
- Widely used for pulp and paper, timber and fuelwood
- Secondary timber species in New Zealand at 22,035ha in 2022
- New Zealand eucalyptus area trending down mid/long term (was 33,000ha in 2005)

DRIVERS OF GROWTH 5/5

- Huge plantation area globally; almost an area the size of New Zealand
- Fastest growing tree species for biomass; lots of low cost biomass relatively quickly
- Drought resistant, will grow in poorer soils; invasive in certain environments
- Emissions trading scheme and carbon price
- Strong, iconic smell, scent differentiating extracts and derived products
- Natural cleaning, sanitising and deodorizing properties

“ELEVATOR PITCH”

Eucalyptus is a fast growing species that can produce large amounts of biomass under the right conditions. New Zealand has proven capability to produce eucalyptus and were the right market signals to appear, relatively low and falling area could easily turn around and grow.

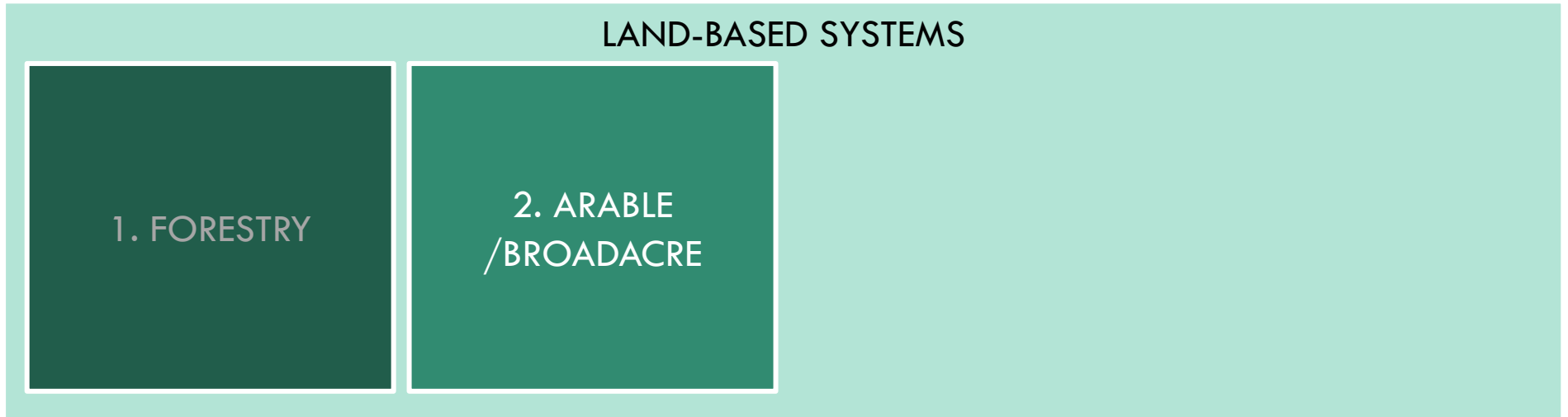
SUPPLY SIDE: NEW ZEALAND 10/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Emissions trading scheme currently encouraging land moving into forestry - Ongoing changes to NZ government emissions trading scheme (ETS) have increased returns to farm forestry while decreased the attractiveness of other competing land uses - Proven ability to grow eucalyptus - Free of many major diseases or pests - Large supply of renewable water on a per capita and per sqkm basis - NZ capabilities in forestry - Strong plant breeding capabilities 	<ul style="list-style-type: none"> - Increasing efficiency of bioprocessing and extraction - Biofuels from byproducts, particularly circular economy for extraction

WHAT YOU WOULD NEED TO BELIEVE

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES										
<ul style="list-style-type: none"> - Future changes to emissions trading scheme will continue to favour trees - Carbon prices will remain high; low cost countries will not be allowed into ETS system - Eucalyptus stacks up economically against other species in New Zealand conditions 	<table border="1"> <tr> <td>Pulp & paper</td> <td>XXX</td> </tr> <tr> <td>Essential oils extraction</td> <td>X</td> </tr> <tr> <td>Bioenergy (firewood)</td> <td>XXX</td> </tr> <tr> <td>Nutraceuticals</td> <td>?</td> </tr> <tr> <td>Bio-cleaners</td> <td>XX</td> </tr> </table>	Pulp & paper	XXX	Essential oils extraction	X	Bioenergy (firewood)	XXX	Nutraceuticals	?	Bio-cleaners	XX
Pulp & paper	XXX										
Essential oils extraction	X										
Bioenergy (firewood)	XXX										
Nutraceuticals	?										
Bio-cleaners	XX										

II.2. ARABLE/BROADACRE CROPS



New Zealand produces a small number of arable crops in large quantities and a large number in small quantities

PRELIMINARY IDENTIFICATION OF BIOMASS PRODUCTION SYSTEMS: ARABLE/BROADACRE CROPS

Global agricultural industry with no farming activity identified in New Zealand	Hobby/Micro currently in New Zealand		Emerging/Tertiary Agricultural Industry	Secondary Agricultural Industry	Major Agricultural Industry
Cotton Bambara beans Sisal & Jute Chicory Kañiwa Kiwicha Kamut/Khorasan wheat Kernza Adzuki beans Sesame Plantago Chia Teff Spelt Lupin Lentils Chickpeas Mung beans Fava/Faba beans Others	Tobacco Soybeans Chickpeas Faba beans Lentils Kidney beans Rye Buckwheat Rice Farro (Einkorn/Emmer/Spelt) Millet	Agave Safflower Sorghum Peanuts Mustard Sugarcane/Sugar beet Saffron Dill Agave Miscanthus Switchgrass	Amaranth Hemp Sweetcorn Sunflower Quinoa Turf/lawn grass	Triticale Field peas Canola/Rapeseed Common flax/Linseed (Linum U.) Poppy	Maize Hay Wheat Barley Oats Cannabis (THC containing)
Non-domesticated wild species present in New Zealand	Native species only wild collected in New Zealand				
-	Harakeke/NZ flax (P. tenax) Wharariki/NZ flax (P. colensoi)				

Fourteen arable crop farming systems emerged from “Screen 0”...

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/ Māori/Pacific socio-cultural connections
Grass	14	●	◐	●	●	●	◐	●	●	○
Maize	14	●	○	●	●	●	●	●	●	○
Barley	13	●	◐	●	●	●	○	●	●	○
Oats	13	●	●	●	●	◐	○	●	●	○
Wheat	13	●	◐	●	●	●	○	●	●	○
Sunflower	12	○	○	●	●	●	●	●	●	○
Field peas	11	◐	◐	●	●	●	○	◐	●	○
Soybeans	11	○	○	●	●	●	◐	●	●	○
Canola/Rapeseed	10	○	○	●	●	●	○	●	●	○
Rice	10	○	○	●	●	●	○	●	●	○
Sugarcane/beet	10	○	●	●	●	◐	○	●	◐	○
Hemp	10	○	◐	●	●	●	◐	○	●	○
Opium poppies	10	○	●	●	●	●	○	●	○	○
Cannabis (THC)	10	◐	●	●	●	●	◐	○	○	○
Com. flax/Linseed	9	◐	○	●	●	◐	○	◐	●	○

... continued...

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/ Māori/Pacific socio-cultural connections
Sorghum	8	○	○	●	●	○	○	●	●	○
Peanuts	8	○	○	●	●	○	○	●	●	○
Buckwheat	7	○	○	●	●	◐	○	○	●	○
Chickpeas	7	○	○	◐	●	◐	○	◐	●	○
Faba beans	7	○	○	●	●	○	○	◐	●	○
Quinoa	7	○	○	●	◐	○	●	○	●	○
Safflower	7	○	○	●	●	◐	○	○ ●	●	○
Amaranth	6	○	○	●	●	○	○	○	●	○
Farro (Em./Spelt)	6	○	○	◐	●	◐	○	○	●	○
Kidney beans	6	○	○	◐	●	○	○	◐	●	○
Lentils	6	○	○	◐	●	◐	○	○	●	○
Millet	6	○	○	◐	●	○	○	◐	●	○
Triticale	6	◐	○	○	●	○	○	◐	●	○
Miscanthus	6	○	○	◐	◐	◐	○	◐	●	○
Switchgrass	5	○	○	◐	◐	◐	○	◐	◐	○

... continued

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/ Māori/Pacific socio-cultural connections
Agave	5	○	○	●	○	○	○	◐	●	○
Mustard	5	○	○	○	●	○	○	◐	●	○
Rye	5	○	○	○	●	○	○	◐	●	○
Turf/lawn grass	5	○	○	○	●	◐	○	○	●	○
Harakeke (flax)	4	○	○	○	○	○	○	○	●	●
Sweetcorn	4	○	○	○	●	○	○	○	●	○
Tobacco	4	○	○	○	●	○	○	●	○	○
Wharariki (flax)	4	○	○	○	○	○	○	○	●	●
Saffron	3	○	○	○	◐	○	○	○	●	○
Dill	2	○	○	○	○	○	○	○	●	○

BIO-ECON SCORECARD 18/24

INCREASE BIOMASS ★★★★★

- Proven producer of biomass at massive scale
- Proven yields in New Zealand

INCREASE VALUE ADD ★★★★★

- Fundamental building block of numerous foods, feeds and fuels

BUILD RESILIENCE ★★★★★

- Local production ensures consistent supply of animal feeds

REDUCE AG GHG EMISSIONS ☆☆☆

- Challenges with fertiliser use

REPLACE FOSSIL FUELS ★★★★★

- Largest global biofuel crop via various US market distortions

RETHINK WASTE ★★☆☆

- Basically all of the plant can be or is used; numerous opportunities to add more value to NZ crop

DEMAND SIDE

MARKET SITUATION 5/5

- Largest harvested biomass after sugarcane
- Global production 1.2b tonnes growing at 1.5%pa from 205m hectares
- China now produces more maize than rice
- Production protected and subsidised in US and elsewhere; use in ethanol and High Fructose Corn Syrup (HFCS)
- High average yields globally (5.9t/ha); produces in wide range of conditions
- Global unprocessed trade 196,075kt growing at 5%pa and worth US\$51b
- Major global source of animal feed
- Average export price US\$0.26/kg
- New Zealand produced 209,281t of maize from 18,358ha at 11.4t/ha

DRIVERS OF GROWTH 5/5

- Very high yielding crop; world's largest grain crop by weight
- Low waste, animals can eat total plant
- Growing global demand for meat and dairy products, particularly in developing markets, driving up prices
- Strong milk and meat prices
- Anti-PKE (Palm Kernel Expeller) sentiments among some consumers
- Increasing grain prices due to drought, wars and increasing consumer demand

“ELEVATOR PITCH”

Maize is on a roll in New Zealand, with growing area and growing production. At the same time, animal feed is the New Zealand bioeconomy’s largest input in aggregate into animal-systems

SUPPLY SIDE: NEW ZEALAND 13/16

LEVERAGEABLE NZ FACTORS

- Large supply of renewable water on a per capita and per sqkm basis
- Temperate climate similar to other major maize producing regions
- Large and growing area of maize
- Ample additional area suited to maize
- Huge unmet domestic demand for animal feed (animal feed is the largest aggregate import by volume)
- Multiple pressures on cattle system all driving toward more supplementary feeding

SOURCES OF VALUE CREATION

- Increasing milk production per cow
- Reducing seasonal surges in meat and dairy production
- Scaling up production of numerous corn byproducts
- Corn-based biofuels
- Targeted animal feed products with specialised properties (e.g. emissions)

WHAT YOU WOULD NEED TO BELIEVE

- Climate change can be managed
- NZ grown maize will continue to be price competitive with imported feeds
- Significant additional land exists that can be brought into maize production
- Ongoing transition to more supplementary feeding will continue
- Rise of maize in New Zealand will continue to “fly under the radar”

VALUE CHAIN LINKAGES

Cattle farmers	XXX
Animal feed mnfr.	XX
Starch mnfr.	X
Sugar processors	?
Biofuel mnfr.	?

BIO-ECON SCORECARD 18/24

INCREASE BIOMASS ★★★★

- High yield oilcrop that produces significant biomass (6-10t/ha/yr)
- NZ clearly able to produce

INCREASE VALUE ADD ★★★★☆

- Vegetable oils
- Animal feeds
- Wide range of other uses

BUILD RESILIENCE ★★★★

- NZ currently almost totally reliant on imported vegetable oils
- Growing demand; erratic supply

REDUCE AG GHG EMISSIONS ★☆☆☆

- Challenges with fertiliser
- Large amounts of animal feed a potential net positive

REPLACE FOSSIL FUELS ★★★★

- Can be used in biofuels; other uses typically higher value
- Hulls can be burnt at processor

RETHINK WASTE ★★☆☆

- Waste oil already used as biofuel

DEMAND SIDE

MARKET SITUATION 4/5

- 40y global production growth CAGR of 6%pa driven by yields and new area
- Growing global trade value driven by higher volumes and higher prices
- Global canola oil production increasing at 6% (40y CAGR) with all major producers growing; strong growth over last decade, particularly in Northern Europe
- Global canola processing is relatively concentrated driven by high capital costs and economies of scale
- Attractive competitive set, including Canada, France, Australia and Netherlands
- Temperate climatic peer Germany achieves a yield of 3.5t/ha
- New Zealand used 1,157ha to produce 2,339t in 2021 at 2.0t/ha

DRIVERS OF GROWTH 4/5

- Canola is predominantly used to make canola oil which has a wide range of uses;
- Canola now accounts for ~8% of global oilseed production volume (#3 after #1 palm and #2 soy)
- Oil production process also generates canola meal which is used as animal feed
- Growing use in biodiesel in Europe (driven by regulations not economics)

“ELEVATOR PITCH”

New Zealand currently consumes more vegetable oil than it produces. At the same time, New Zealand has a proven capability to grow canola. Canola production can be scaled up to supply a greater share of domestic demand.

SUPPLY SIDE: NEW ZEALAND 11/16

LEVERAGEABLE NZ FACTORS

- Climate suitable for canola/rapeseed
- Proven ability to produce high yields at competitive prices
- NZ capabilities in arable crops
- Existing oilseed processing and extraction capabilities
- Significant domestic demand for vegetable oils currently met through imports

SOURCES OF VALUE CREATION

- New cultivars better suited to NZ conditions
- Rotation crop
- Cold pressed, mechanical extraction
- Byproduct from oil production can be used for animal feed

WHAT YOU WOULD NEED TO BELIEVE

- Current production (2,339t) can be scaled up significantly
- Domestic production can compete with the cost of imports
- Canadian/Australian production systems can be adapted to NZ conditions
- Returns from canola farming would be comparable to other land uses

VALUE CHAIN LINKAGES

Oil and fat processing	XXX
Various processed foods	XX
Animal feed mnfg.	XXX
Food ingredients	?

BIO-ECON SCORECARD		16 24
INCREASE BIOMASS	★★★★	
<ul style="list-style-type: none"> - High yield temperate climate oilcrop that produces significant biomass (15-20t/ha/year) 		
INCREASE VALUE ADD	★★★☆☆	
<ul style="list-style-type: none"> - Vegetable oils and snacks 		
BUILD RESILIENCE	★★★★	
<ul style="list-style-type: none"> - NZ currently almost totally reliant on imported vegetable oils - Growing demand; erratic supply 		
REDUCE AG GHG EMISSIONS	★☆☆☆☆	
<ul style="list-style-type: none"> - Challenges with fertiliser - Large amounts of animal feed a potential net positive 		
REPLACE FOSSIL FUELS	★★☆☆☆	
<ul style="list-style-type: none"> - Can be used in biofuels; other uses typically higher value - Hulls can be burnt at processor 		
RETHINK WASTE	★★☆☆☆	
<ul style="list-style-type: none"> - Waste oil already used as biofuel 		

DEMAND SIDE		
MARKET SITUATION		3 5
<ul style="list-style-type: none"> - Global production 50,184kt of seeds, of which 96% processed into 20,612kt of oil - Average global per capita consumption of 1.57kg of sunflower oil - Cross border trade of 12,624t of sunflower oil worth US\$13.2b or US\$1.30/kg - Supply currently under pressure due to Russian invasion of Ukraine - New Zealand produces small amounts of sunflowers, primarily in Canterbury 		

DRIVERS OF GROWTH		4 5
<ul style="list-style-type: none"> - Growing global demand for cooking oils, particularly in developing markets - Multiuse crop delivering oils, flours, animal feed, snacks, etc. - Byproduct from oil extraction can be used for animal feed - Known as a "good oil" 		

"ELEVATOR PITCH"	New Zealand has the skills and capabilities required to scale-up existing sunflower production and supply the domestic market with sunflower oil and other sunflower-based products (e.g. lecithin)
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SUPPLY SIDE: NEW ZEALAND		11 16
LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION	
<ul style="list-style-type: none"> - Politically stable (e.g. versus Ukraine or Russia which are ~60% of global production) - Climate suitable for sunflowers - Proven ability to produce high yields at competitive prices - Existing oilseed processing and extraction capabilities - Significant domestic demand for vegetable oils currently met through imports 	<ul style="list-style-type: none"> - New cultivars better suited to NZ conditions - Rotation crop - Cold pressed, mechanical extraction - Byproduct from oil production can be used for animal feed - Ingredient in numerous growing processed foods (e.g. lecithin in infant formula) - Growing use in plant-based vegan food products - Flavoured snack - Specialty bird seed 	

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES	
<ul style="list-style-type: none"> - Current production can be scaled up significantly - Domestic production can compete with the cost of imports under normal market conditions (post Ukraine war) - US/Australian production systems can be adapted to NZ conditions - Returns from sunflower farming will be comparable to other land uses 	<ul style="list-style-type: none"> Oil and fat processing Various processed foods Animal feed mnfg. Food ingredients 	<ul style="list-style-type: none"> XXX XX XXX ?

BIO-ECON SCORECARD 11/24

INCREASE BIOMASS ★ ★ ★ ☆

- Reasonable yield of biomass per hectare under NZ conditions
- Proven ability to produce

INCREASE VALUE ADD ★ ★ ★ ☆

- Multiuse crop; very high in protein
- Growing use in alt meat/dairy
- Secondary streams to animals

BUILD RESILIENCE ☆ ☆ ☆ ☆

- New Zealand has growing need for plant protein isolate that is currently imported (need factory)

REDUCE AG GHG EMISSIONS ★ ☆ ☆ ☆

- Likely mildly net positive

REPLACE FOSSIL FUELS ★ ★ ★ ☆

- Replaces some fertilisers by fixing atmospheric nitrogen

RETHINK WASTE ★ ☆ ☆ ☆

- Fractionates and isolates plant would unlock more value

DEMAND SIDE

MARKET SITUATION 3/5

- Globally 9,633,972ha produce 32,933,281t of peas; top 5 countries ~80%; China (39%), India (20%), Russia (10%), Canada (7%), France (3%)
- Total global consumption is growing at 2%/pa; growth coming from increased processing targeting protein isolates
- 6,346kt crosses borders (~20%) in an unprocessed form
- New Zealand currently has 10,734ha of peas producing 49,372t of output; dry peas are 65% of area and 50% of volume
- New Zealand is currently the 31st largest producer of dry peas and the 24th largest dry pea exporter on a global basis

DRIVERS OF GROWTH 4/5

- High in protein
- Mild, inoffensive flavour
- Nitrogen fixing legume
- No phytoestrogens (unlike soy)
- Shift by Western consumers away from soy protein in some products
- Growing use in alternative meats, alternative dairy and sports nutrition products

“ELEVATOR PITCH”

New Zealand is a world leader in field pea yields and has significant untapped capacity to produce more. At the same time, global demand for pea protein is growing driven by increased consumer acceptance of plant-based meat and dairy substitutes.

SUPPLY SIDE: NEW ZEALAND 13/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Climate and soils well-suited to peas - Achieves world class dry pea yields relative to other major producers (beat only by Germany and Denmark); in addition, yields are consistently high - Pea area and production stable for the last 10-15 years - Clear, readily available capacity to bring more area into peas as required - Modern industry using latest equipment - Limited presence of major global pea diseases - Access to modern genetics 	<ul style="list-style-type: none"> - Ongoing yield improvements - Pea protein isolate production in New Zealand

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES	
- Demand for pea protein is not a fad	Vegetable processors	XXX
- Demand for plant-based foods is not a fad and will go mainstream (beyond milks)	Sports nutrition	XXX
- Returns from pea farming would be comparable to other land uses	Alternative dairy	XXX
- NZ can compete with large global producers at scale, particularly Canada	Alternative meats	XXX

BIO-ECON SCORECARD 13/24

INCREASE BIOMASS ★ ★ ★ ☆

- Significant potential by-product similar to most arable crops
- Unlikely large in absolute sense

INCREASE VALUE ADD ★ ★ ★ ★

- Major pharmaceutical precursor

BUILD RESILIENCE ★ ★ ★ ★

- Suited to regions of South Island similar to Afghanistan
- NZ uses a lot per capita (imported)

REDUCE AG GHG EMISSIONS ★ ☆ ☆ ☆

- Potential to shift land use away from sheep or cattle

REPLACE FOSSIL FUELS ☆ ☆ ☆ ☆

- No standout exceptional opportunities relative to other arable crops

RETHINK WASTE ★ ☆ ☆ ☆

- Possibility to use waste as energy source in processing

DEMAND SIDE

MARKET SITUATION 3/5

- Illegal and legal production occurs in primarily in unstable Asian (Afghanistan, Myanmar, and Laos) and Latin American regions
- Tasmania's ~450 farmers produce ~12,000-20,000ha of opium poppies annually
- Opium poppy cultivation was legalized in Tasmania, Australia in 1966 and the state produces ~40-80%* of global licit supply
- Significant historical investment by global multinationals in Tasmania (e.g. J&J, Abbott)
- Now licensed in Victoria and Northern Territories

DRIVERS OF GROWTH 4/5

- Millions of people need pain management (e.g. for cancer, a bad car accident)
- ~80% of the global pharmaceutical opioid supply is consumed in the United States where 1/3 of population has chronic pain
- Growing global demand for opiate-based painkillers (e.g. morphine, codeine)
- Growing prescription by doctors of opiate-based painkillers due to their efficacy as a relatively quick and low cost treatment
- Addiction to legal and illegal opiate-based substances

"ELEVATOR PITCH"

If it can stomach the moral ambiguity, New Zealand has the resources, climate and rule of law required to build an opium poppy industry similar to that of Tasmania.

SUPPLY SIDE: NEW ZEALAND 8/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Rule of law, with strong regulatory capabilities and low corruption - Climate in parts of the South Island similar to major opium growing regions (e.g. Central Otago and Afghanistan) - Long history of ornamental and illegal kitchen-scale production - Genetics available in country - Multiple proof-of-concept commercial trials have taken place 	<ul style="list-style-type: none"> - Improved genetics - Value adding in New Zealand

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES				
<ul style="list-style-type: none"> - Politicians could "get their head around this" - Social license issues can be managed - NZ has not "missed the boat" on this opportunity and global demand will continue to grow (rather than decline due to ongoing backlash) - Natural opioids can continue to compete with synthetic products 	<table border="1"> <tr> <td>Soil amendments</td> <td>XX</td> </tr> <tr> <td>Fertilisers</td> <td>XX</td> </tr> </table>	Soil amendments	XX	Fertilisers	XX
Soil amendments	XX				
Fertilisers	XX				

* Estimates vary dramatically

BIO-ECON SCORECARD 13/24

INCREASE BIOMASS ★ ★ ★ ☆

- High biomass yields (10-15t ha/yr)
- Growing production in NZ
- Unclear ability to scale hugely

INCREASE VALUE ADD ★ ★ ★ ☆

- Numerous opportunities exist
- New Zealand production needs to compete with imported processed

BUILD RESILIENCE ★ ★ ★ ☆

- Can potentially grow across much of the country
- Multi-use crop

REDUCE AG GHG EMISSIONS ☆ ☆ ☆ ☆

- Not obviously better than any other arable crop

REPLACE FOSSIL FUELS ★ ★ ☆ ☆

- Not a tier one candidate for biofuels; wastes can be burnt; other uses offer higher value

RETHINK WASTE ★ ★ ☆ ☆

- Multi-use plant

DEMAND SIDE

MARKET SITUATION 3/5

- More than 200,000 hectares grown globally; ~110,000 in China and 82,000 in Canada (conflicting data exists)
- Long history in China with a wide range of uses (food, fibre, seed, textile, construction)
- Growing production in Canada, driven by increased demand from food industry, in particular for hemp seeds
- Canadian industrial hemp industry had a farm gate value of \$100 million in 2020 (or C\$1,220/ha)
- Vocal industry with strong, noisy proponents disproportionate to its actual size
- In 2020, it was reported that there were 29 licensed hemp growers in New Zealand, with a total of approximately 400 hectares of hemp under cultivation (13.8 ha/grower)

DRIVERS OF GROWTH 5/5

- Highly flexible crop with numerous uses (fibre, seed, oil, feed) that can be used by numerous processing chains (e.g. textiles, building material, nutraceuticals, sports nutrition, alternative dairy)
- Vague aura of exotic mystery and excitement to the consumer; added to numerous products to spice them up
- Positioning as a healthy, plant-based ingredient
- Growth of alternative meats and dairy

“ELEVATOR PITCH”

New Zealand can nurture its existing industrial hemp industry through a focus on continuous improvement of all facets of the farming system.

SUPPLY SIDE: NEW ZEALAND 11/16

LEVERAGEABLE NZ FACTORS

- Climate well-suited to hemp cultivation
- Free of many major diseases or pests
- Large supply of renewable water on a per capita and per sqkm basis
- NZ capabilities in arable crops
- Strong plant breeding capabilities

SOURCES OF VALUE CREATION

- Sports nutrition products
- Nutraceuticals; CBD oils
- Flours, meals, protein extracts
- Animal feed from byproducts

WHAT YOU WOULD NEED TO BELIEVE

- NZ can compete with Canada and China once the industry is at any scale
- Current trial and lifestyle-scale production can be scaled-up to commercial quantities
- Canadian or Australian production systems can be adapted to NZ conditions
- NZ can move rapidly down the cost/experience curve and match the quality adjusted world price

VALUE CHAIN LINKAGES

Sports nutrition	XX
Vegetable oil	XX
Animal feed	XX
Other foods	X
Bio-insulation	X
Construction	?
Textiles	?

BIO-ECON SCORECARD 9/24

INCREASE BIOMASS ★ ★ ☆ ☆

- New Zealand already has a large illegal industry; absolute volume not large (e.g. relative to potatoes)

INCREASE VALUE ADD ★ ★ ☆ ☆

- Legalisation reduces premiums (and risk) in the long run
- Margins in processed products

BUILD RESILIENCE ★ ★ ☆ ☆

- Already a major regional crop, particularly in less advantaged regions

REDUCE AG GHG EMISSIONS ☆ ☆ ☆ ☆

- Intensive production uses significant energy and fertiliser (more than industrial)

REPLACE FOSSIL FUELS ★ ☆ ☆ ☆

- More an opportunity for industrial hemp (discussed elsewhere)

RETHINK WASTE ★ ★ ☆ ☆

- Multi-use plant

DEMAND SIDE 4/5

MARKET SITUATION

- Global illicit drug market is estimated at around US \$360-440b annually (UN)
- Global pharmaceutical industry is valued at over US\$1t annually
- Global legal cannabis industry is valued at US\$30-40b (Grand View)
- In 2020, New Zealanders voted on whether to legalise cannabis for recreational use. The 2020 cannabis referendum narrowly failed, with 50.7% against/48.4% for.
- The Medicinal Cannabis Scheme came into effect on 1 April 2020 with the commencement of the Misuse of Drugs (Medicinal Cannabis) Regulations 2019
- Medicinal cannabis is now legal in NZ with a prescription from a doctor

DRIVERS OF GROWTH 3/5

- Most widely used illegal drug in NZ and the fourth-most widely used recreational drug after caffeine, alcohol and tobacco.
- Relaxing public attitudes and opinions about cannabis in Anglo-European countries
- Growing willingness by some government agencies to allow and even fund research into potential health benefits
- Growing anecdotal and scientific evidence for positive outcomes for some patients
- Full or partial legalisation of cannabis in some regions

“ELEVATOR PITCH”

Despite arriving late to the party, New Zealand has the skills required to build a capable medicinal cannabis industry going forward. A referendum to legalise recreational cannabis failed in 2020, but medicinal cannabis was allowed under a government scheme.

SUPPLY SIDE: NEW ZEALAND 9/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Proven capability at cannabis production for over a century - Capabilities at high value horticulture - Available farm supplies - Wide range of genetics available in the country (historically smuggled through biosecurity and under scheme) - Legal framework for medicinal cannabis framework now in place 	<ul style="list-style-type: none"> - Further legalisation similar to the US, Canada and Europe enabling expansion into new market segments - Growing research around wider range of conditions that respond to treatment in some patients

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES	
- New Zealand can compete with larger producers	Fertilisers	XXX
- New Zealand can catch-up to other regions that legalised earlier	Soil amendments	XXX
- A stable regulatory framework will remain in place		

BIO-ECON SCORECARD 6/24

INCREASE BIOMASS ★ ★ ☆ ☆

- Already NZ's largest crop by a long margin
- GM lacks social license

INCREASE VALUE ADD ★ ★ ☆ ☆

- Currently transformed into milk and meat; could fractionate directly and skip animal stage

BUILD RESILIENCE ☆ ☆ ☆ ☆

- Currently deficient in animal feed and a net importer of biomass

REDUCE AG GHG EMISSIONS ☆ ☆ ☆ ☆

- Grass currently a recipient of large amounts of fertiliser

REPLACE FOSSIL FUELS ★ ★ ☆ ☆

- Other crops currently better for biofuels

RETHINK WASTE ☆ ☆ ☆ ☆

- Not currently a problem

DEMAND SIDE

MARKET SITUATION 3/5

- Numerous countries export "hay, lucerne (alfalfa), clover and similar forage products
- Global trade was 11,168kt worth US\$4.2b in 2021 at an average price of \$0.37/kg
- Global trade volume growing at 2.7% (CAGR 2011-2021) while value growing at 4.4%
- New Zealand exported 23kt worth US\$7.9m at US\$0.34/kg
- New Zealand's largest crop
- Mature domestic market for leased land for grazing
- Mature domestic market for hay and other similar

DRIVERS OF GROWTH 4/5

- Growing global demand for animal based protein
- Growing global use of contained production systems
- Low cost feed crop will suited to temperate environments

"ELEVATOR PITCH"

Like most other regions with reliable rainfall and a temperate climate, New Zealand has a significant area in grasslands. These grasslands are the current basis for much of the New Zealand bioeconomy. New uses for grass can be developed.

SUPPLY SIDE: NEW ZEALAND 12/16

LEVERAGEABLE NZ FACTORS

- Large supply of renewable water on a per capita and per sqkm basis
- Temperate climate similar to other major grass producing regions
- Large area of grass
- Huge unmet domestic demand for animal feed (animal feed is the largest aggregate import by volume)
- Multiple pressures on cattle system all driving toward more supplementary feeding
- Access to modern genetics

SOURCES OF VALUE CREATION

- Continued improvement in genetics
- New uses beyond feeding cattle and sheep in situ
- Converting grass into protein (e.g. Leafit)

WHAT YOU WOULD NEED TO BELIEVE

- Growing grass for non-pastoral agricultural uses stacks up relative to other crops (e.g. maize)
- US\$0.34/kg is an attractive price in and of itself
- The tangled knot of dairy returns being "baked into" land prices can be separated

VALUE CHAIN LINKAGES

Cattle	XXX
Sheep	XXX
Goats	X
Deer	X
Alternative Proteins	X

BIO-ECON SCORECARD 12/24

INCREASE BIOMASS ★ ★ ☆ ☆

- High yield oilcrop that produces significant biomass (8-10t/ha/yr)
- Unclear potential to scale

INCREASE VALUE ADD ★ ★ ★ ☆

- Vegetable oils, alt milk/meat
- Animal feeds
- Wide range of other uses

BUILD RESILIENCE ★ ★ ★ ★

- NZ currently almost totally reliant on imported vegetable oils
- Growing demand; erratic supply

REDUCE AG GHG EMISSIONS ★ ☆ ☆ ☆

- Challenges with fertiliser
- Large amounts of animal feed a potential net positive

REPLACE FOSSIL FUELS ★ ☆ ☆ ☆

- Can be used in biodiesel; other uses typically higher value

RETHINK WASTE ★ ☆ ☆ ☆

- All of plant can be used
- Waste oil already used as biofuel

DEMAND SIDE 2/5

MARKET SITUATION

- Global production 352,755kt
- Cross-border trade in soybeans was 161,212kt worth US\$77.7b at an average price of US\$0.48/kg
- Major global use in cooking oil, animal feed, soy-based foods and beverages
- Cross-border trade in soybean oil was 12,707kt worth US\$15.4b or US\$1.22/kg
- Global soybean oil consumption was 3.2kg/capita
- New Zealand tried to develop a soybean industry in the 70-80's and failed; recent attempts to restart production

DRIVERS OF GROWTH 4/5

- Highly flexible crop with numerous uses
- Relatively high in protein
- Growing global demand for meat and milk leading to growing demand for animal feed
- High yield, high productivity crop under the right conditions
- Flexible ingredient extensively used as a food ingredient in a huge range of foods
- Cultural and traditional usage, particularly in Asia

"ELEVATOR PITCH"

New Zealand imports a large and growing amount of soybeans, particularly in animal feed. Attempts to build a soybean industry in the 1970s/80s failed. Recent attempts to restart the industry can succeed if costs can be reduced faster than is normal for a new agricultural crop.

SUPPLY SIDE: NEW ZEALAND 6/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Climate suitable for soybeans - Large supply of renewable water on a per capita and per sqkm basis - Relatively high yields demonstrated - Politically stable - Existing animal feed and oilseed processing capabilities - Significant domestic demand for both animal feeds and vegetable oils currently met through imports - Extensive processed foods industry using a wide range of soy products as inputs 	<ul style="list-style-type: none"> - Wide range of plant-based foods (e.g. tofu, tempeh, natto) - Soy-based alternative milks and other dairy products (e.g. soy ice cream) - Soy-based infant formula

WHAT YOU WOULD NEED TO BELIEVE

- The causes for the failure of soybeans in the 70s/80s will not reoccur
- Current trial scale production can be scaled up to commercial quantities
- US/Australian/Japanese production systems can be adapted to NZ conditions
- NZ can move rapidly down the cost/experience curve and match the quality adjusted world price

VALUE CHAIN LINKAGES

Animal feed milling	XXX
Plant-based dairy	X
Food ingredients	X
Various processed foods	X

SUGAR CROPS (SUGARCANE/SUGAR BEETS)

TOTAL SCORE

24/50

BIO-ECON SCORECARD 9/24

INCREASE BIOMASS ★ ★ ★ ☆

- Very high yields per hectare
- No proven model in NZ

INCREASE VALUE ADD ★ ★ ☆ ☆

- Sweeteners used extensively
- Processor (Chelsea) already in New Zealand with imported ingr.

BUILD RESILIENCE ★ ☆ ☆ ☆

- If we could grow it, it would be in Northland (sugarcane) or elsewhere (sugar beet)

REDUCE AG GHG EMISSIONS ☆ ☆ ☆ ☆

- Not obviously better than any other arable crop
- Uses fertiliser

REPLACE FOSSIL FUELS ★ ★ ☆ ☆

- Currently the only biofuel that stacks up (cf. Brazil) without government

RETHINK WASTE ★ ☆ ☆ ☆

- Bagasse from processing used extensively for bioenergy at processing site

DEMAND SIDE

MARKET SITUATION 2/5

- Largest global non-forestry biomass produced (1,869,022kt of cane and 250,239kt of raw beet) leading to 177,408kt of raw sugar
- 30m ha of area (26m cane; 4m beet); 1.2x as much area as total of all New Zealand
- 92% of field production is water and byproduct (bagasse/pulp); bioenergy from waste used extensively in industry (scale)
- Industry distorted by global protectionism
- New Zealand imports 207,702t of sugar (HS1701) worth US\$113m at US\$0.54/kg
- Sugar beet production is possible across New Zealand; production currently for animal feed targeting dairy; yields very high by global standards

DRIVERS OF GROWTH 4/5

- Attractive taste
- Probably mildly addictive
- Extensive use across most parts of the food and beverage industry
- Growing global per capita consumption
- High yields under the right conditions
- Only biofuel that currently stacks up without subsidies (albeit in Brazil)

"ELEVATOR PITCH"

A wide range of climatic peers (e.g. France, UK) suggest that New Zealand can produce a significant sugar crop which could then be processed in the existing sugar refinery that currently runs on imports.

SUPPLY SIDE: NEW ZEALAND 8/16

LEVERAGEABLE NZ FACTORS

- Large, at scale sugar refinery (Chelsea) already present in New Zealand and importing large amounts of biomaterial
- Large supply of renewable water on a per capita and per sqkm basis
- Rich, well-suited soils in some regions
- Mid/long term climate change
- Ongoing arrival of new immigrants with enthusiasm to try new crops and products "from home"
- Proven NZ capabilities at arable cropping
- Existing research and capabilities around sugars (e.g. lactose, monkfruit)

SOURCES OF VALUE CREATION

- Molasses-based nutraceuticals
- Premium sugar products
- Pharmaceutical sugars
- Sugar-based alcoholic spirits (e.g. rum)
- Animal feed from byproducts
- Biofuels and bioenergy

WHAT YOU WOULD NEED TO BELIEVE

- Current hobby-scale production can be scaled-up to commercial quantities
- Australian (sugarcane) or European (sugar beet) production systems can be adapted to NZ conditions
- NZ can move rapidly down the cost/experience curve and match the quality adjusted world price
- NZ government would fund R&D on sugar

VALUE CHAIN LINKAGES

Sugar refining	XXX
Animal feed	X
Bioenergy	?

BIO-ECON SCORECARD 9/24

INCREASE BIOMASS ★★☆☆

- Solid yields per hectare
- Proven performance in NZ
- No clear market signals to grow

INCREASE VALUE ADD ★★☆☆

- Historically primarily horse feed
- Numerous potential/emerging uses
- Mixed signals on net demand

BUILD RESILIENCE ★★☆☆

- Large imports of grains (for both food and animal feed) and other animal feeds could be replaced

REDUCE AG GHG EMISSIONS ☆☆☆☆

- Challenges with fertiliser use
- Alternative landuse vs. dairy

REPLACE FOSSIL FUELS ☆☆☆☆

- Not a leading biofuel candidate
- Byproduct better used as animal feed (rather than fuel)

RETHINK WASTE ★☆☆☆

- No obvious issues on farm
- Stale products a management issue, primarily retail/consumer

DEMAND SIDE

MARKET SITUATION 3/5

- Global production is 22,571,619t from 9,562,497ha at 2.4t/ha
- Global trade 3,749 kt in grain form and 1,364t in rolled form worth US\$2.1b
- Average export price US\$0.27/kg (grain)
- Global demand is 40-50% animal feed, 40-50% breakfast cereals and snacks and 5-10% ingredients
- Global production flat, trade is growing; falling use in feed shifting to exports
- Solid volume, price and value growth in export markets over the past twenty years
- Attractive competitive set (Canada, Finland, Sweden, UK, Germany, etc.)
- New Zealand currently has 5,683ha producing 24,804t of oats at 4.4t/ha

DRIVERS OF GROWTH 2/5

- High carbohydrate energy source
- Consumer positioning/perception of oats as “the healthy grain”
- Used as animal feed across multiple species
- Widespread use in breakfast foods (oatmeal, muesli, granola and in extruded products) and snacks (biscuits, muesli bars)
- Processed into oat flakes, bran, flour, groats and fibre and used as a food ingredient across a wide range of foods
- Emerging use in alternative dairy

“ELEVATOR PITCH”

New Zealand has a long history of oat production and historically produced significantly more oats than it does today. Changing consumer demand patterns have created new opportunities for oat-based products in categories where New Zealand can win.

SUPPLY SIDE: NEW ZEALAND 10/16

LEVERAGEABLE NZ FACTORS

- Climate well-suited to oats
- Rich soils in many regions
- Long history of oat production
- Relatively high yields
- Efficient farmers using modern equipment
- Large supply of renewable water on a per capita and per sqkm basis
- Proven NZ capabilities in arable crops
- Research capabilities in dairy science, including alternative dairy

SOURCES OF VALUE CREATION

- Use in cosmetics/health & beauty care (HBC)
- Oat bio-extracts for supplements
- Oat-based alternative dairy
- Ingredient in snacking and breakfast cereals

WHAT YOU WOULD NEED TO BELIEVE

- Climate change can be managed
- NZ grown oats will continue to be price competitive with imported products
- Returns from oat farming would be comparable to other land uses
- NZ can compete with large global producers at scale, particularly Australia

VALUE CHAIN LINKAGES

Animal feed mnfg.	XXX
Breakfast cereal mnfg.	XXX
Snack mnfg.	XXX
Cosmetics	?
Nutraceuticals	?

BIO-ECON SCORECARD 7/24

INCREASE BIOMASS ★★☆☆

- Solid yields per hectare
- Proven performance in NZ
- No clear market signals to grow

INCREASE VALUE ADD ★★☆☆

- Beer; range of foods
- Animal feed

BUILD RESILIENCE ★★☆☆

- Large imports of grains (for both food and animal feed) and other animal feeds could be replaced

REDUCE AG GHG EMISSIONS ☆☆☆☆

- Challenges with fertiliser use

REPLACE FOSSIL FUELS ☆☆☆☆

- Not a leading biofuel candidate
- Byproduct better used as animal feed (rather than fuel)

RETHINK WASTE ★☆☆☆

- No obvious issues on farm
- Brewing dregs (see brewing) fed to animals (NZ a net importer)

DEMAND SIDE

MARKET SITUATION 2/5

- Global production 146m t from 49m ha at an average of 3.0t/ha
- Global trade 44,160kt in grain form growing a 5% CAGR and worth US\$10.5b
- Average export price US\$0.24/kg
- ~70% of global barley production goes into animal feed; ~30% into beer & food
- Key Southern Hemisphere competitors are Australia and Argentina
- New Zealand produced 325,057t of barley from 44,200ha at 7.4t/ha

DRIVERS OF GROWTH 3/5

- Flexible, widely used in beer, animal feed soups and other food products
- Large and growing demand for animal feeds, both in NZ and globally
- Strong meat prices; growing global demand for meat, particularly in developing markets
- Explosion of microbreweries globally seeking to tell an ingredient story
- Contains beta-glucans a soluble fibre that can lower blood cholesterol

“ELEVATOR PITCH”

NZ can scale-up barley production for domestic use, particularly in animal feed, thus displacing imports

SUPPLY SIDE: NEW ZEALAND 8/16

LEVERAGEABLE NZ FACTORS

- Temperate climate suitable to key European and North American grains
- Large supply of renewable water on a per capita and per sqkm basis
- Highly fertile soils
- High productivity farmers using modern production systems
- Long history of production for use in brewing and animal feeds

SOURCES OF VALUE CREATION

- Continuous yield improvements
- Barley-based alternative milks
- New varieties with unique characteristics

WHAT YOU WOULD NEED TO BELIEVE

- Returns from barley farming would be comparable to other land uses
- NZ can compete with large global producers at scale, particularly Australia

VALUE CHAIN LINKAGES

Beer manufacturing	XXX
Malt production	XXX
Animal feed mnfg.	XXX
Chicken farming	XXX
Nutraceuticals	X
Hops	X
Alternative dairy	?

BIO-ECON SCORECARD

6/24

INCREASE BIOMASS



- Solid yields per hectare
- Proven performance in NZ
- No clear market signals to grow

INCREASE VALUE ADD



- Huge range of uses in human and animal feed; no clear opportunities to do even more

BUILD RESILIENCE



- Large imports of grains (for both food and animal feed) and other animal feeds could be replaced

REDUCE AG GHG EMISSIONS



- Challenges with fertiliser use

REPLACE FOSSIL FUELS



- Not a leading biofuel candidate
- Byproduct better used as animal feed (rather than fuel)

RETHINK WASTE



- No obvious issues on farm
- Stale bread, etc. a management issue, primarily retail/consumer

DEMAND SIDE

MARKET SITUATION

2/5

- Global consumption 66.7kg/capita of wheat and products (excl. animal feed)
- Global production 771m tonnes from 221m hectares at an average of 3.5t/ha
- Global trade as grain 13,688kt worth US\$5.6b or US\$0.41/kg
- Ongoing drought in some regions and Russian invasion of Ukraine has led to market instability; global trade declining from 15.6m t in 2018 to 13.7m t in 2021
- New Zealand produced 422,831t of wheat from 43,536ha at 9.7t/ha

DRIVERS OF GROWTH

3/5

- Growing global demand for meat leading to growing demand for animal feed
- High yield, high productivity crop under the right conditions
- Flexible ingredient extensively used as a food ingredient in a huge range of foods
- Strong cultural association and usage (e.g. pasta, bread, biscuits)

“ELEVATOR PITCH”

New Zealand currently imports large amounts of wheat for human and animal consumption. At the same time, New Zealand wheat farmers achieve world class yields. Changing world market conditions will enable more domestic production going forward.

SUPPLY SIDE: NEW ZEALAND

8/16

LEVERAGEABLE NZ FACTORS

- Long history of excellent yields (particularly relative to Australia)
- Proven capability to produce commercial quantities of wheat at competitive prices
- Large supply of renewable water on a per capita and per sqkm basis
- Proven capability in arable crops
- Strong plant breeding capabilities
- High yields vs peers and global average

SOURCES OF VALUE CREATION

- New varieties with higher productivity in New Zealand conditions
- New varieties with differentiated characteristics

WHAT YOU WOULD NEED TO BELIEVE

- Returns on wheat farming would be comparable to other land uses
- New Zealand can compete with large global producers at scale, particularly Australia
- Growing anti-cow forces will change relative returns in NZ of dairy versus arable crops
- Wheat area will stop shrinking

VALUE CHAIN LINKAGES

Animal feed mnfg.	XXX
Flour milling	XXX
Grain processing	XXX
Baking ingredients	XX
Biscuit manufacturing	XX
Alcoholic spirits mnfg.	X
Biofuel	?

BIO-ECON SCORECARD

4/24

INCREASE BIOMASS



- Strong biomass production (10-15t ha/year), inc. grain and straw
- Very unclear ability to scale

INCREASE VALUE ADD



- Difficult to compete with processed imports

BUILD RESILIENCE



- Growing rice consumption
- Local production would support resilience; competitiveness unclear

REDUCE AG GHG EMISSIONS



- Fertiliser an issue
- Paddy rice farming causes methane; dryland does not

REPLACE FOSSIL FUELS



- Straw can be burned, but other uses are more valuable
- Local might have smaller footprint

RETHINK WASTE



- Not really an issue other than at the consumer level

DEMAND SIDE

MARKET SITUATION

2/5

- Major source of human nutrition; global consumption of 78.9kg/capita
- Global production 758,173kt; China (28%), India (24%), Bangladesh (7%), Indonesia (7%), Vietnam (6%)
- Global trade as grain 68,502kt (9% crosses borders) at ~US\$0.51/kg grain eq.
- New Zealanders consumed 12.1kg/capita in 2021 (up from 9.4kg/capita in 2010)
- New Zealand imported 61,000t of rice at a rice milled equivalent price of US\$1.09/kg
- New Zealand has demonstrated capability to produce rice and small quantities being produced (primarily by newer immigrants)
- The US, Japan, Italy and Australia show mechanised production is viable

DRIVERS OF GROWTH

4/5

- Extremely high yielding per hectare
- Low cost carbohydrate (90% of dry weight is starch) for many consumers
- Mild, inoffensive flavour
- Fundamental building block of numerous cuisines; provides bulk of meal in many
- Numerous distinct varieties
- Highly tolerant of a wide range of growing conditions; grows "almost anywhere"

"ELEVATOR PITCH"

The experience of climatic peer regions suggests that the failure to grow significant amounts of rice in New Zealand to date is a cultural rather than a technological or economic challenge.

SUPPLY SIDE: NEW ZEALAND

7/16

LEVERAGEABLE NZ FACTORS

- Climate well-suited to rice cultivation
- Free of many major diseases or pests
- Large supply of renewable water on a per capita and per sqkm basis
- Ongoing arrival of new immigrants with enthusiasm to try new crops and products "from home"
- NZ capabilities in arable crops
- Growing demand for rice in NZ; large and growing population from traditional rice growing cultures
- Large and growing number of Asian, Indian and other rice-focused restaurants

SOURCES OF VALUE CREATION

- Differentiated "wild rice" varieties
- Targeting high-end foodservice
- Rice-based alcoholic spirits
- Building a sustainable position as a premium supplier
- Identifying and developing a clear point-of-difference with long-term value to the consumer

WHAT YOU WOULD NEED TO BELIEVE

- Current hobby scale production can be scaled up
- US/Australian/Japanese production systems can be adapted to NZ conditions
- NZ can move rapidly down the cost/experience curve and match the quality adjusted world price

VALUE CHAIN LINKAGES

Rice milling

?

II.3.1 'NON-TREE' HORTICULTURE

LAND-BASED SYSTEMS

1. FORESTRY

2. ARABLE
/BROADACRE

3. HORTICULTURE

3.1 'Non-tree' hort

New Zealand produces most climatically suitable non-tree horticulture at some scale; most are insulated from global competition by some biosecurity

— PRELIMINARY IDENTIFICATION OF BIOMASS PRODUCTION SYSTEMS: VEGETABLES/ROOT CROPS/HERBS —

Global agricultural industry with no farming activity identified in New Zealand	Hobby/Micro currently in New Zealand	Emerging/Tertiary Agricultural Industry	Secondary Agricultural Industry	Major Agricultural Industry
Cassava Bamboo (shoots) Bitter melon Yam (<i>Dioscorea</i> sp.) Capers Pigeon pea Lotus root Nopal Turmeric Yacon Malabar spinach	Leek Okra Globe artichoke Horseradish/Wasabi Kohlrabi Chives Daikon Jerusalem artichoke Water chestnut Lavender Mint Thyme Dill Ginseng Numerous others	Rockmelons Watermelons Eggplant Garlic Brussels sprouts Spinach/Silverb./Kale Chillies Beetroot Parsnip Spring onions Wombok/Napa cabbage Radish Oca/Yam (<i>Oxalis tuberosa</i>) Taro (<i>Colocasia esculenta</i>) Lemongrass Horned melon/Kiwano	Head lettuce Leafy salad Cucumber Broccoli Carrots Capsicum Beans Turnips Rutabaga/Swedes Sweet potato Parsley/other culinary herbs Zucchini Asparagus Pumpkin/Squash Celery Leafy Asian greens Snap/Snow Peas (not field) Cauliflower Cabbage Floriculture (Flowers) Nursery production	Potatoes Onions Tomatoes
Non-domesticated wild species present in New Zealand	Native species only wild collected in New Zealand			
Numerous (e.g.)	Kōwhitiwhiti (watercress) Pikopiko (fern shoots) Pūhā (sow thistle) Other native botanicals			

New Zealand farms a limited range of mushrooms and has a wider range wild collected; biosecurity has prevented new species introduction

PRELIMINARY IDENTIFICATION OF BIOMASS PRODUCTION SYSTEMS: MUSHROOMS

Global agricultural industry with no farming activity identified in New Zealand	Hobby/Micro currently in New Zealand	Emerging/Tertiary Agricultural Industry	Secondary Agricultural Industry	Major Agricultural Industry
<p>Lentinula edodes Auricularia auricula Pleurotus ostreatus F.filimormis (velutipes) A.bisporus Pleurotus eryngii Auricularia polytricha Pholiota nameko Hypsizygos ulnarius Lions Mane (<i>Hericium erinaceus</i>) Numerous others</p>	<p>Medicinal Psychedelic mushrooms (Cultivated illegally in NZ) (various <i>Psilocybin sp.</i>, both native and introduced) Pink Oyster/flamingo mushrooms (<i>Pleurotus Djamor</i>) Phoenix grey oyster (<i>Pleurotus Pulmonarius</i>) Turkey Tail (<i>Trametes Versicolor</i>) Pekepekekiore/NZ Lion's Mane/Coral Tooth (<i>Hericium Novae Zelandiae</i>) Others</p>	<p>Truffles Perigold black truffle (<i>Tuber melanosporum</i>) Bianchetto truffle (<i>Tuber borchii</i>) Burgundy truffle (<i>Tuber aestivum</i>) Winter black tr. (<i>Tuber brumale</i>) White truffle (<i>Tuber magnatum</i>)</p> <p>Specialty Shiitake (<i>Lentinula Edodes</i>) Oyster mushrooms (<i>Pleurotus Parsonsaie</i>) Velvet shank/Enoki (<i>Flammulina Velutipes</i>) NZ Shiitake mushrooms (<i>Lentinula novae-zealandiae</i>) Tawaka (<i>Cyclocybe Parasitica</i>)</p>	<p>White/Brown mushroom (<i>Agaricus bisporus</i>)</p>	-
Uncollected wild species present in New Zealand	Species only wild collected in New Zealand			
Numerous	Numerous			

Four ‘non-tree horticulture’ farming systems emerged from “Screen 0”...

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/ Māori/Pacific socio-cultural connections
Medicinal mushrooms	10	○	○	●	◐	◐	●	○	●	●
Potatoes	10	●	◐	●	●	◐	○	○	●	○
Sweet potato	10	◐	○	◐	●	●	○	○	●	●
Onions	10	●	◐	◐	●	●	○	○	●	○
Capsicum	9	◐	○	●	●	◐	◐	○	●	○
Tomatoes	9	●	◐	◐	●	◐	○	○	●	○
Beans	9	◐	○	●	●	◐	◐	○	●	○
Specialty mushrooms	8	○	○	◐	●	◐	○	○	●	●
Cucumber	8	○	○	●	●	◐	◐	○	●	○
Wombok/Napa	8	○	○	●	●	●	○	○	●	○
Taro	8	○	○	●	●	○	○	○	●	●
Spring onions	8	○	○	●	●	●	○	○	●	○
Snap/Snow Peas	8	○	○	●	●	●	○	○	●	○
Leafy salad	8	○	○	●	●	●	○	○	●	○
Leafy Asian gr.	8	○	○	●	●	●	○	○	●	○

... continued...

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/ Māori/Pacific socio-cultural connections
Head lettuce	8	◐	○	●	●	◐	○	○	●	○
Eggplant	8	○	○	●	●	●	○	○	●	○
Chillies	8	○	○	●	●	●	○	○	●	○
Carrots	8	◐	○	◐	●	◐	◐	○	●	○
Broccoli	8	◐	○	◐	●	◐	◐	○	●	○
Beetroot	8	○	○	●	●	●	○	○	●	○
White/Brown mushrooms	7	◐	◐	◐	●	○	○	○	●	○
Nursery production	7	◐	◐	◐	◐	○	○	○	●	◐
Spin./Silver./Kale	7	○	○	●	●	◐	○	○	●	○
Rutab./Swedes	7	◐	○	○	●	○	●	○	●	○
Parsley/oth. herbs	7	◐	○	●	●	○	○	○	●	○
Garlic	7	○	○	●	●	○	○	◐	●	○
Cabbage	7	◐	○	◐	●	◐	○	○	●	○
Zucchini/courgette	6	◐	○	○	●	◐	○	○	●	○
Watermelons	6	○	○	◐	●	◐	○	○	●	○

... continued...

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/ Māori/Pacific socio-cultural connections
Rockmelon	6	○	○	◐	●	◐	○	○	●	○
Pumpkin/Squash	6	◐	◐	○	●	○	○	○	●	○
Oca/Yam	6	○	○	○	●	○	○	○	●	●
Cauliflower	6	◐	○	◐	●	○	○	○	●	○
Water chestnut	5	○	○	◐	●	○	○	○	●	○
Turnips	5	◐	○	○	●	○	○	○	●	○
Truffles (all var.)	5	○	○	◐	◐	○	◐	○	●	○
Ginger	5	○	○	○	●	○	○	◐	●	○
Leek	5	○	○	◐	●	○	○	○	●	○
Kohlrabi	5	○	○	◐	●	○	○	○	●	○
Daikon	5	○	○	◐	●	○	○	○	●	○
Chives	5	○	○	◐	●	○	○	○	●	○
Celery	5	◐	○	○	●	○	○	○	●	○
Asparagus	5	◐	○	○	●	○	○	○	●	○
Lemongrass	5	○	○	◐	●	○	○	○	●	○
Thyme	4	○	○	○	●	○	○	○	●	○

... continued

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/ Māori/Pacific socio-cultural connections
Radish	4	○	○	○	●	○	○	○	●	○
Pūhā (sow thistle)	4	○	○	○	○	○	○	○	●	●
Pikopiko (fern sh.)	4	○	○	○	○	○	○	○	●	●
Parsnip	4	○	○	○	●	○	○	○	●	○
Parsnip	4	○	○	○	●	○	○	○	●	○
Okra	4	○	○	○	●	○	○	○	●	○
Lavender	4	○	○	○	●	○	○	○	●	○
Kōwhitiwhiti (wat.)	4	○	○	○	○	○	○	○	●	●
Mint	4	○	○	○	●	○	○	○	●	○
Jerusalem artich.	4	○	○	○	●	○	○	○	●	○
Horsera./Wasabi	4	○	○	○	●	○	○	○	●	○
Globe artichoke	4	○	○	○	●	○	○	○	●	○
Brussels sprouts	4	○	○	○	●	○	○	○	●	○
Horn mel./Kiwano	3	○	○	○	◐	○	○	○	●	○
Ginseng	3	○	○	◐	○	○	○	○	●	○
Floriculture	3	○	○	◐	●	○	○	○	○	○

BIO-ECON SCORECARD 15/24

INCREASE BIOMASS ★ ★ ☆ ☆

- Tiny biomass; wild supports healthy soils, trees and wider ecosystem

INCREASE VALUE ADD ★ ★ ★ ★

- Very high value per kg
- Strong health and medicinal properties

BUILD RESILIENCE ★ ★ ☆ ☆

- Supports regional areas with large areas of native forest

REDUCE AG GHG EMISSIONS ★ ★ ★ ☆

- Wild collection supports carbon farming of native forests as secondary product

REPLACE FOSSIL FUELS ☆ ☆ ☆ ☆

-

RETHINK WASTE ★ ★ ★ ★

- Some varieties can grow on byproducts of other sectors

DEMAND SIDE

MARKET SITUATION 4/5

- Global market is US\$3.5b in 2022, forecast to grow at 8-9% CAGR to US\$6.9b by 2030 (excluding psychedelic)
- Early-mid stage market unconsolidated globally, particularly on shelf
- Market can be sub-segmented into psychedelic and non-psychedelic
- Non-psychedelic (e.g. Lion's Mane, Turkey Tail, Red Reishi, Chaga) sold worldwide
- Legalisation of psychedelic emerging rapidly in US, Canada and Europe
- Targets multiple segments of the global US\$1.4t pharmaceutical market
- Massive global use of antidepressants (e.g. ~9% of NZ population on Prozac in 2018)

DRIVERS OF GROWTH 4/5

- Long awareness of medicinal mushrooms in Traditional Chinese Medicine (TCM)
- Aging population seeking to maintain and restore health
- Antioxidant, immune, anti-cancer, skin care and other claimed benefits
- Increasing awareness of mushrooms as a therapeutic tool for a wide range of otherwise intractable medical conditions (e.g. PTSD*, depression, addiction)
- Growing awareness of brain health benefits leading to growing demand

"ELEVATOR PITCH"

NZ can leverage its range of unique species of mushrooms and strong nutraceuticals sector to build a defensible position in medicinal mushrooms targeting consumers in developed markets

SUPPLY SIDE: NEW ZEALAND 12/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Proven capabilities at mushroom farming - Unique species of mushrooms not available elsewhere (e.g. NZ Coral/NZ Lion's Mane) - Strong existing nutraceuticals and vitamins, minerals & supplements (VMS) industry with proven manufacturing capability - Demonstrated ability to penetrate and grow sales into key Asian markets - Strong local scientific capability, particularly in plant biology - Small but passionate group of champions driving growth of NZ sector - Trusted supplier of healthy products 	<ul style="list-style-type: none"> - Leveraging deep Mātauranga Māori knowledge and insights into platform - Development of new production systems driving lower cost and higher yields - Bringing a professional, market-led approach to a sector traditionally tinged with "crazy hippies" - Use as a headline ingredient in brain-health beverages (e.g. Ārepa) or in health-focused dairy products - Potential use in a wide range of functional foods and foods for health

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES								
<ul style="list-style-type: none"> - NZ can nurture and build a clear point of difference against other suppliers - NZ can compete with Japanese, Chinese, other Asian and North American producers - NZ medicinal mushrooms have a real point of difference - (Maybe) NZ will follow a wide range of jurisdictions and legalise psychedelic mushrooms for medical treatment at some point in the foreseeable future 	<table border="1"> <tr> <td>Forestry (commercial pine)</td> <td>XXX</td> </tr> <tr> <td>Forestry (native bush)</td> <td>XXX</td> </tr> <tr> <td>Nutraceuticals</td> <td>XXX</td> </tr> <tr> <td>Soil amendments</td> <td>XX</td> </tr> </table>	Forestry (commercial pine)	XXX	Forestry (native bush)	XXX	Nutraceuticals	XXX	Soil amendments	XX
Forestry (commercial pine)	XXX								
Forestry (native bush)	XXX								
Nutraceuticals	XXX								
Soil amendments	XX								

*PTSD = Post Traumatic Stress Disorder

BIO-ECON SCORECARD 10/24

INCREASE BIOMASS ★★☆☆

- Very high yields per hectare
- New Zealand gets world class yields

INCREASE VALUE ADD ★★☆☆

- Well exploited already

BUILD RESILIENCE ★☆☆☆

- Multiple regions across country
- Not currently growing

REDUCE AG GHG EMISSIONS ☆☆☆☆

- Pressures to reduce fertiliser use

REPLACE FOSSIL FUELS ★☆☆☆

- High energy (starch) crop
- Potential but other uses appear to provide higher returns

RETHINK WASTE ★★☆☆

- Clear opportunities to do more

DEMAND SIDE

MARKET SITUATION 3/5

- Major food sources globally; produced in almost every country
- Global per capita consumption (all forms) relatively flat (33kg/head)
- 376,120kt produced on 18.1m hectares
- Fresh/table production is highly fragmented and relatively local/regional
- Processing is highly consolidated globally into a small number of large firms (e.g. McCain, Lamb Wesson, Simplot)
- New Zealand has 173 growers across 10,417ha producing 533,030t; small # of large growers within this total
- NZ production is ~30% fresh/table and ~70% for processing

DRIVERS OF GROWTH 2/5

- Will grow in a wide range of soils
- Very high yields per hectare
- Suited to mechanised production at scale
- Growth of irrigation in key regions
- Low cost per kilogram relative
- High carbohydrate food that is filling
- Highly flexible crop with a wide range of uses
- Westernisation of global diets
- Growth of fast food restaurants

“ELEVATOR PITCH”

New Zealand achieves world leading potato yields and has attracted global processing leaders. The Westernisation of diets and the growth of fast food chains in developed markets can drive further growth.

SUPPLY SIDE: NEW ZEALAND 11/16

LEVERAGEABLE NZ FACTORS

- Climate and soils well-suited to potatoes
- World leading yields per hectare
- Large supply of renewable water on a per capita and per sqkm basis
- Modern industry using latest equipment
- Presence of leading global potato processors with large plants
- Limited presence of major global potato diseases
- Access to modern genetics from global breeding pool
- Political stability; rule of law

SOURCES OF VALUE CREATION

- Industry consolidation into fewer, larger operations (cf. Washington State)
- Continued productivity gains
- More efficient use of water
- New irrigation schemes
- Attracting new global processors (e.g. Lamb Weston)
- Starch extracted from potato processing

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can maintain world leading yields through continuous improvement
- Diseases can be managed cost effectively
- Water will continue to be available
- Returns from potato farming would be comparable to other land uses

VALUE CHAIN LINKAGES

F&V packhouses	XXX
Potato processors	XXX
Snack manufacturers	XXX
Starch manufacturers	?

BIO-ECON SCORECARD 6/24

INCREASE BIOMASS ★☆☆☆

- Relatively high yields
- Stable crop not showing growth

INCREASE VALUE ADD ★★☆☆

- Most currently exported fresh

BUILD RESILIENCE ★☆☆☆

- Secondary crop in many regions

REDUCE AG GHG EMISSIONS ☆☆☆☆

- Pressures to reduce fertiliser use

REPLACE FOSSIL FUELS ☆☆☆☆

-

RETHINK WASTE ★★☆☆

- Lack of scale is the issue

DEMAND SIDE

MARKET SITUATION 2/5

- Globally 5.8m ha produce 106,592kt of onions; 23% in China
- Global consumption is 13.5kg/capita and total consumption is growing at 3.7%pa
- Significant cross border trade, both in dry and processed forms (e.g. soups)
- Major exporters include India, China, Mexico, Pakistan and Iran
- New Zealand has 85 growers on 5,588ha producing 256,545t of onions; production relatively stable since early 90's; ~80% of crop exported (Europe and Asia)
- NZ has a seasonal window it exploits

DRIVERS OF GROWTH 2/5

- Rich, distinct flavour
- Widespread use across numerous cuisine styles worldwide
- Tolerant of a wide range of climates
- Spread of high yield, disease resistant varieties
- Very popular food source in East Asia (China, Japan and S. Korea 40% of global production)
- High yields/highly mechanised production leading to relatively low cost per kg

"ELEVATOR PITCH"

New Zealand has long had a stable onion industry focused primarily on exports. Building on this strong base, new thinking and new market development can re-enable growth.

SUPPLY SIDE: NEW ZEALAND 10/16

LEVERAGEABLE NZ FACTORS

- Climate and soils well-suited to onions
- High yields per hectare
- Large supply of renewable water on a per capita and per sqkm basis
- Modern industry using latest equipment
- Limited presence of major global onion diseases
- Access to modern genetics from global breeding pool
- Political stability; rule of law
- Reputation for quality and reliability of supply in key export markets

SOURCES OF VALUE CREATION

- Industry consolidation into fewer, larger operations
- Continuous productivity gains
- More efficient use of water
- New irrigation schemes
- Use as an ingredient in numerous processed foods (e.g. ready meals)

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can maintain high yields through continuous improvement
- Diseases can be managed cost effectively
- Water will continue to be available
- Returns from onion farming would be comparable to other land uses

VALUE CHAIN LINKAGES

F&V packhouses	XXX
Vegetable processors	XXX
Various processed foods	X

BIO-ECON SCORECARD 6/24

INCREASE BIOMASS ★☆☆☆

- High yields per hectare
- New Zealand underperforms; inefficient behind biosecurity

INCREASE VALUE ADD ★★☆☆

- Numerous opportunities exist
- Struggling against processed imports

BUILD RESILIENCE ★★☆☆

- Concentrated in Kaipara, where it is important
- Challenges exist

REDUCE AG GHG EMISSIONS ☆☆☆☆

- Pressures to reduce fertiliser use

REPLACE FOSSIL FUELS ☆☆☆☆

- High energy (starch) crop
- Potential but other uses appear to provide higher returns

RETHINK WASTE ★☆☆☆

- Opportunities to do more
- Lack of scale is the issue

DEMAND SIDE

MARKET SITUATION 2/5

- Major root crop, particularly in Africa and China; 7kg/capita globally; flat-to-declining global consumption overall
- Global production 88,868kt on 7.4m ha.
- China is 55% of global production
- Almost exclusively consumed “at home”; less than 1% of production crosses borders
- Limited production or production growth across developed, temperate climate peer group to NZ; US has high yields and growing exports
- New Zealand has 48 growers across 1,600ha producing 24,000t; industry concentrated in Kaipara, Northland
- The NZ domestic market was worth \$35m, with no imports (biosecurity) or exports

DRIVERS OF GROWTH 1/5

- Source of carbohydrates; highly efficient in calories per hectare of farmland
- Rich, distinctive flavour
- Strong cultural associations among some ethnic groups
- Large, but flat overall global production (88.9m mt); China (49m mt) is largest global producer
- US (1.6m mt) achieving growing production and growing exports

“ELEVATOR PITCH”

With high domestic per capita consumption, the New Zealand sweet potato industry has reached the limits of easily available growth. International benchmarking shows significant productivity gains are possible. If these gains can be realised, export markets are available.

SUPPLY SIDE: NEW ZEALAND 6/16

LEVERAGEABLE NZ FACTORS

- Climate in Northern regions well-suited to sweet potato production
- Available land that can be rotated into production
- Traditional varieties (no longer cultivated) were introduced by original Māori settlers
- Capabilities in plant breeding
- Regionally concentrated and relatively coordinated industry; farmer control of most primary packhouse activities

SOURCES OF VALUE CREATION

- Improved yields through better management and new varieties
- Consolidation of production to drive scale
- Larger, more modern production systems
- New regions beyond Kaipara
- Value-added products
- Kumara-based alcoholic spirits

WHAT YOU WOULD NEED TO BELIEVE

- Biosecurity that prevents fresh imports will remain in place
- Inefficient New Zealand growers protected by biosecurity can become globally competitive
- Returns from sweet potato farming would be comparable to other land uses in regions beyond Kaipara

VALUE CHAIN LINKAGES

F&V packhouses	XXX
Vegetable processors	XX
Snack manufacturers	X
Alcoholic spirits mnfr.	?

II.3.3 TREE/BUSH/VINE CROPS

LAND-BASED SYSTEMS

1. FORESTRY

2. ARABLE
/BROADACRE

3. HORTICULTURE

- 3.1 'Non-tree' hort
- 3.2 Tree/bush/vine hort.

While New Zealand produces most major climatically suitable fruit at some scale, it is not currently a major producer of any tree nut or other tree crop

PRELIMINARY IDENTIFICATION OF BIOMASS PRODUCTION SYSTEMS: TREE/BUSH/VINE

Global agricultural industry with no farming activity identified in New Zealand		Hobby/Micro currently in New Zealand		Emerging/Tertiary Agricultural Industry	Secondary Agricultural Industry	Major Agricultural Industry
Durian	Palm nuts	Grapefruit	Loquat	Blackcurrants	Cherries	Wine grapes
Guava	Peppercorns	Table grapes	Cherimoya	Boysenberries	Strawberries	Kiwifruit
Lychee	Cinnamon	Cranberries	Mangos	Raspberries	Mandarins/Tangelos	Apples
Mangosteen	Cloves	Passionfruit	Sapote/Casimiroa	Limes	Oranges	Avocado
Rambutan	Cacao/Cocoa	Finger limes	Almonds	Feijoa	Lemons	Blueberries
Jaboticaba	Nutmeg	Pitaya (dragonfruit)	Pistachios	Kiwiberries	Pears	
Longan	Mace	Guava	Pecans	Nashi	Hops	
Dates	Vanilla	Bananas	Coffee	Plums	Persimmons	
Custard apple	Liquorice	Pineapples	Ginger	Tamarillo	Apricots	
Jackfruit	Cardamoms	Papaya/Pawpaw	Ginseng	Figs	Nectarines	
Lúcuma	Anise/Badian seeds	Pomegranate	Saffron	Hazelnuts	Peaches	
Water apple	Cumin	Elderberries	Juniper berries	Chestnuts	Walnuts	
Uvalha	Caraway	Carambola/Star Fruit		Pine nuts	Olives	
Coconuts	Turmeric			Tea		
Cashews	Bay leaves					
Brazil nuts	Mate					
Gingko nuts	Carob					
Karuka	Hundreds of others					
Kola nut						
Non-domesticated wild species present in New Zealand		Native species only wild collected in New Zealand				
Numerous (e.g. Irish strawberry tree)		Native Botanicals (Kawakawa, Kūmarahou etc.)				

Twenty tree/bush/vine-based farming systems emerged from “Screen 0”...

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/Māori/Pacific socio-cultural connections
Wine grapes	15	●	●	●	●	●	●	◐	●	○
Kiwifruit	14	●	●	●	●	●	●	○	●	○
Avocado	14	●	●	●	●	●	●	○	●	○
Apples	14	●	●	●	●	●	●	○	●	○
Citrus	12	◐	◐	●	●	●	○	●	●	○
Cherries	12	◐	◐	●	●	●	●	○	●	○
Blueberries	11	◐	○	●	●	●	●	○	●	○
Walnuts	11	◐	○	●	●	◐	●	◐	●	○
Almonds	10	○	○	●	●	●	○	●	●	○
Pineapples	10	○	◐	●	●	○	◐	●	●	○
Bananas	10	○	◐	●	●	○	◐	●	●	○
Table grapes	10	○	○	●	●	◐	◐	●	●	○
Coffee	10	○	◐	●	◐	◐	◐	●	●	○
Hops	10	◐	○	●	●	◐	◐	◐	●	○
Native botanicals	10	◐	○	●	○	○	●	◐	●	●
Tea	10	○	○	●	◐	○	◐	●	●	●

... continued...

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/ Māori/Pacific socio-cultural connections
Pine nuts	10	○	◐	●	●	○	●	◐	●	○
Olives	10	◐	◐	●	●	◐	○	◐	●	○
Hazelnuts	10	○	◐	●	●	●	○	◐	●	○
Pitaya (dragonfr)	10	○	◐	●	○	●	●	◐	●	○
Pecans	9	○	◐	●	●	◐	○	◐	●	○
Pomegranate	8	○	○	●	●	◐	○	◐	●	○
Cranberries	8	○	○	●	●	○	○	●	●	○
Strawberries	7	◐	○	◐	●	◐	○	○	●	○
Raspberries	7	○	○	●	●	◐	○	○	●	○
Persimmons	7	◐	○	●	●	○	○	○	●	○
Peaches	7	◐	○	●	●	○	○	○	●	○
Pistachios	7	○	○	●	●	○	○	◐	●	○
Chestnuts	7	○	○	●	●	○	○	◐	●	○
Nectarines	7	◐	○	●	●	○	○	○	●	○
Mangos	7	○	○	●	●	○	○	◐	●	○
Lemons	7	◐	○	◐	●	○	○	◐	●	○

... continued...

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

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Kiwiberries	7	○	○	●	◐	○	●	○	●	○
Finger limes	7	○	○	●	◐	○	●	○	●	○
Boysenberries	7	○	○	●	●	◐	○	○	●	○
Blackcurrants	7	○	○	●	●	◐	○	○	●	○
Apricots	7	◐	○	●	●	○	○	○	●	○
Pears	6	◐	○	◐	●	○	○	○	●	○
Papaya/Pawpaw	6	○	○	●	●	○	○	○	●	○
Nashi	6	○	○	●	●	○	○	○	●	○
Figs	6	○	○	◐	●	○	○	◐	●	○
Plums	5	○	○	◐	●	○	○	○	●	○
Passionfruit	5	○	○	◐	●	○	○	○	●	○
Grapefruit	5	○	○	◐	●	○	○	○	●	○
Feijoa	5	○	○	◐	●	○	○	○	●	○
Cherimoya	5	○	○	◐	●	○	○	○	●	○
Juniper berries	5	○	○	◐	●	○	○	○	●	○
Tamarillo	4	○	○	○	●	○	○	○	●	○

... continued

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/Māori/Pacific socio-cultural connections
Sapote/Casimiroa	4	○	○	○	●	○	○	○	●	○
Guava	4	○	○	○	●	○	○	○	●	○
Loquat	3	○	○	○	◐	○	○	○	●	○
Elderberries	3	○	○	○	◐	○	○	○	●	○
Caramb/Star Fruit	3	○	○	○	◐	○	○	○	●	○

BIO-ECON SCORECARD 17/24

INCREASE BIOMASS ★★★★

- Small volumes currently
- Wild collection supports carbon farming in native forestry

INCREASE VALUE ADD ★★★★

- Creates a clear point-of-difference in export markets for New Zealand products that include them

BUILD RESILIENCE ★★★☆☆

- Creates regional interest and diversification; supports unique regional narratives

REDUCE AG GHG EMISSIONS ★★★☆☆

- Indirectly by supporting carbon farming in native forestry

REPLACE FOSSIL FUELS ★☆☆☆☆

- Opportunities exist to burn byproducts and waste
- Lack of scale is the issue

RETHINK WASTE ★★☆☆☆

- Numerous opportunities
- Lack of scale is the issue

DEMAND SIDE

MARKET SITUATION 4/5

- Product is a “catch-all” for plants native to New Zealand and primarily wild collected
- There is no standard New Zealand or global definition and international comparisons are not easily possible (e.g. is tea a “native botanical” of China?)
- Currently, New Zealand produces very small quantities of a handful of native species (beyond mānuka), including kawakawa, harakeke and mamaku
- Key species are untouched by modern breeding and modern standardised production systems at-scale do not exist
- While the sector is undeveloped and volumes are small, it “punches above its weight” in terms of assisting product differentiation (e.g. gin)

DRIVERS OF GROWTH 4/5

- Growth of LOHAS (lifestyles of health and sustainability) shoppers
- Ongoing consumer demand for new, different flavours and ingredients
- Demand for unique and compelling product stories
- Growth in disposable income among some segments of the population
- Growth in premium segment across most FMCG categories

“ELEVATOR PITCH”

New Zealand can scale up production of various native botanicals by moving from wild collection to commercial scale production. This growth will occur hand-in-hand with growing demand from numerous related sectors that use these crops as distinct and differentiated inputs.

SUPPLY SIDE: NEW ZEALAND 12/16

LEVERAGEABLE NZ FACTORS

- Range of unique plants not available elsewhere
- Distinct Māori knowledge and experience with select high potential plants
- Robust and innovative natural health products industry
- Capabilities in plant breeding
- Track record of new crop development
- Trail breaking success of mānuka creating a path for kawakawa, harakeke, mamaku and numerous others
- Clear capabilities in developing new and innovative processed foods and beverages

SOURCES OF VALUE CREATION

- Research into traditional herbal remedies and rongoā (plant-based medicines)
- Standardised measurement of functional properties in specific plants (e.g. healing properties of mamaku)
- Use as a signature ingredient in numerous value-added products to create a real point of difference (e.g. gin)
- Isolation of distinctive flavours and fragrances attractive to global users

WHAT YOU WOULD NEED TO BELIEVE

- Global consumers will learn to recognize and pronounce numerous Māori words (e.g. pūwhā, kūmarahou)
- NZ botanicals have a range of functional benefits that deliver outcomes to consumers
- NZ botanicals can meet and exceed the performance of existing competitors
- Numerous native botanicals can be grown commercially (or harvested in quantity)
- Interest in native botanicals is not a fad

VALUE CHAIN LINKAGES

Nutraceutical mnfg.	XXX
Soft drink mnfg.	X
Alcoholic spirits mnfg.	XX
Cosmetics mnfg.	XX
Household products mnfg.	X
Various processed foods	X

BIO-ECON SCORECARD 10/24

INCREASE BIOMASS ★ ★ ☆ ☆

- Long lived vine crop
- Produces fruit and pruning waste
- New varieties need more area

INCREASE VALUE ADD ★ ★ ☆ ☆

- Industry still primarily focused on fresh fruit for export
- Growing other uses identified

BUILD RESILIENCE ★ ★ ☆ ☆

- Important in key regions
- Growing opportunities in Northland

REDUCE AG GHG EMISSIONS ☆ ☆ ☆ ☆

- Pressures to reduce fertiliser use

REPLACE FOSSIL FUELS ★ ☆ ☆ ☆

- Pruning waste for biofuel

RETHINK WASTE ★ ★ ★ ☆

- Wide range of opportunities to extract more value from existing streams

DEMAND SIDE 3/5

MARKET SITUATION

- Native to SE China; first commercial production occurred in New Zealand
- Production highly consolidated; top six countries are 94% of global production: China (51%), NZ 14%, Italy (12%), Greece (7%), Iran (7%), Chile (4%)
- Chinese production large and growing; diverse range of species, including NZ IP
- NZ dominates the premium segment due to high quality and distinct IP-controlled varieties with quality, taste and shelf-life
- NZ has 2,846 producers on 3,237 orchards using 13,610 ha to produce 184m trays of fruit
- NZ production now ~50% green/50% gold; 5% of all fruit are organic

DRIVERS OF GROWTH 3/5

- Very low per capita consumption globally
- Still relatively new, rare and exotic fruit to many/most global consumers and markets
- Distinct appearance
- Development of new varieties with attractive characteristics (e.g. sweet, low hair, new colours)
- Growing demand for premium fresh fruit
- Counter-seasonal supply for Northern Hemisphere markets

“ELEVATOR PITCH”

New Zealand pioneered the domestication of the Chinese Gooseberry and has since developed multiple IP-controlled varieties. The large and well organised NZ industry can continue to grow by selling more to premium consumers, particularly in Asia.

SUPPLY SIDE: NEW ZEALAND 13/16

LEVERAGEABLE NZ FACTORS

- Category leader; product developed, named and improved by New Zealand
- Climate highly suited to kiwifruit
- Plentiful water in key growing regions
- Large packhouses at scale; packhouse sector consolidating into fewer, larger
- Integrated, well organised industry
- Strong grower control of post farmgate activities (packhouses and marketer)
- Proven capabilities at new variety development
- Monopsony export marketer outside Australia

SOURCES OF VALUE CREATION

- New species (around ~60 species in wider genus); not all controlled by Zespri
- Kiwiberries (non-monopsony)
- Scaling red varieties to a similar volume as gold varieties
- New gold varieties with better consumer attributes
- Leveraging Zespri brand into value-added products (e.g. juice)
- Kiwifruit derived nutraceuticals (e.g. using kiwifruit enzymes)

WHAT YOU WOULD NEED TO BELIEVE

- NZ can maintain control of IP-controlled varieties, particularly in China
- Highly coordinated industry structure can be maintained
- Competition from other Southern Hemisphere suppliers will remain limited
- NZ immigration laws will continue to enable an adequate supply of guest workers

VALUE CHAIN LINKAGES

F&V packhouses	XXX
Juice processors	XX
Nutraceuticals	X
Soil amendments	X

BIO-ECON SCORECARD		14 24
INCREASE BIOMASS	★ ★ ★ ☆	
- Trees planted for nuts create huge amounts of biomass		
INCREASE VALUE ADD	★ ★ ☆ ☆	
- High value nut with a range of uses - Essential component in some pesto recipes		
BUILD RESILIENCE	★ ★ ★ ☆	
- Supporting regional growth		
REDUCE AG GHG EMISSIONS	★ ★ ★ ☆	
- Large carbon sequestering tree crop with a valuable nut harvest		
REPLACE FOSSIL FUELS	★ ★ ☆ ☆	
- Potential to burn pinecone byproducts for heat/energy		
RETHINK WASTE	★ ☆ ☆ ☆	
- Hypothetically has similar opportunities to other pines		

DEMAND SIDE		
MARKET SITUATION		3 5
<ul style="list-style-type: none"> - ~30 pines varieties produce edible seeds/nuts of which ~20 are traded across borders - No reliable global production or trade data is available (HS080290 other nuts) - Key exporters are China, Pakistan, Spain, Italy and Turkey - Disease problems impacting many growing regions outside NZ - Basically single champion industry at this point - Pinoli - with 500,000 trees on 540ha in the Wairau Valley, Marlborough - Pinoli have "factory-scale driers (to pop the cones open, releasing the kernels) and nutcrackers to remove the shells" 		

DRIVERS OF GROWTH		3 5
<ul style="list-style-type: none"> - Widespread use in Asia and Europe (though in relatively small quantities) - Unique flavour - Iconic ingredient in some recipes - Multiple positive health research findings (health oil profile, may act as a natural appetite suppressant, reduces coronary heart disease (CHD)) - Premium nut with very high prices - Rise in healthy snacking 		

"ELEVATOR PITCH"	In New Zealand, pine nuts deliver a high value crop and carbon credits making it an ideal crop if supply and demand can be managed to maintain a premium for local production.	
SUPPLY SIDE: NEW ZEALAND		
13 16		
LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION	
<ul style="list-style-type: none"> - Capabilities in plant breeding - Track record of new crop development - Passionate champions in Pinoli's founders, Andy Wiltshire and Lee Paterson, who planted their first orchard of Mediterranean stone pines (also known as Pinus pinea) in 1998 - Climate change driven legislation supporting a shift to tree crops - Phytosanitary barriers preventing introduction of diseases 	<ul style="list-style-type: none"> - Retail branding and direct selling rather than bulk sales in competition with imports - Packaging land, genetics and forest establishment as a service to carbon investors 	

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES	
<ul style="list-style-type: none"> - New Zealand pine nuts can compete beyond niche with imports from China, etc. - Further automation can be developed and brought to harvesting and processing to increase productivity - Emissions Trading Scheme (ETS) requirements and commercial plantation requirements can be successfully managed - Will not ultimately form a farming bubble like other tree crops (e.g. avocados in AU) 	<ul style="list-style-type: none"> Sauces (e.g. pesto) Snacks Baking Processed foods 	<ul style="list-style-type: none"> XX X X XX

BIO-ECON SCORECARD 16/24

INCREASE BIOMASS ★★★★

- Produces massive amounts of biomass per hectare under the right conditions (30-50t)

INCREASE VALUE ADD ★☆☆☆

- Numerous small opportunities; nothing transformative at this point in industry development

BUILD RESILIENCE ★★★★

- Creates new opportunities in northern regions of the country
- Getting ahead of climate change

REDUCE AG GHG EMISSIONS ★★☆☆

- Can sequester 10-30t of carbon per hectare per year

REPLACE FOSSIL FUELS ★★☆☆

- Very large volumes imported
- Local production would reduce total environmental footprint

RETHINK WASTE ★★★☆☆

- Excellent cattle feed
- Comes in natural packaging

DEMAND SIDE 3/5

MARKET SITUATION

- Global consumption flat at 12.4kg/capita; 75% dessert; 25% cooking (plantains)
- Global production 119,209kt; primarily India, China, Indonesia, Philippines, Americas and Africa; no developed country in top 20 producers
- All globally production is effectively clones; significant disease issues and risks exist
- Global trade 24,105kt growing at 3% pa; global trade dominated by a small number of large traders (e.g. Dole, Chiquita)
- Small scale production of bananas is emerging in Northern regions of New Zealand, particularly Northland
- New Zealand imported 84,711t worth US\$70.2m, primarily from Ecuador (77%), Mexico (14%) and the Philippines (9%)

DRIVERS OF GROWTH 4/5

- Mild, inoffensive flavour
- World's most popular fruit
- Year round supply
- Convenient; comes in natural packaging; ideal snack/lunchbox fruit
- Relatively low price per kg due to large scale production in low wage countries
- Long shelf life due to ability to transport green and ripen on arrival in market
- Consolidated and efficient post-farmgate marketers at scale (e.g. Dole)

"ELEVATOR PITCH"

NZ can leverage proven capabilities in premium fruit to replace 15-30% of existing banana imports with domestic production enabled by climate change and non-cavendish varieties.

SUPPLY SIDE: NEW ZEALAND 10/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
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- Proven capabilities in new fruit development
- Fruit breeding capabilities
- Long history of garden/hobby scale production
- Mid-long term climate change projections favour sub-tropicals in North of NZ
- Relatively large domestic demand currently almost completely filled by imports

- Non-cavendish varieties with more flavour (albeit with lower yields)
- Unique, different products for high-end restaurants and hotels
- Numerous value-added opportunities for second grade fruit
- Numerous uses for flowers and other biomass

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES	
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- A significant number of NZ consumers are willing to pay a premium for domestic fruit
- NZ consumers are willing to try new varieties with a new, potentially less attractive or traditional appearance
- NZ can grow bananas at commercial scale
- Success at the farmers market can be extended to retail (including related costs)

F&V packhouses	XXX
Fruit processing	X

BIO-ECON SCORECARD 14/24

INCREASE BIOMASS ★★★★★

- Produces massive amounts of biomass per hectare under the right conditions (30-40t)

INCREASE VALUE ADD ★☆☆☆☆

- Presence of crown key point-of-diff
- Most processed products are mature and global commodities

BUILD RESILIENCE ★★★★★

- Creates new opportunities in northern regions of the country
- Getting ahead of climate change

REDUCE AG GHG EMISSIONS ★★★★★

- Sequester 7-20t of carbon per hectare per year

REPLACE FOSSIL FUELS ★★★★★

- Very large volumes imported
- Local production would reduce total environmental footprint

RETHINK WASTE ★★★★★

- Mulch, compost, fibre
- Scale small currently

DEMAND SIDE

MARKET SITUATION 2/5

- Global consumption 2.8g/capita and growing ~4%pa
- Global production 27,808kt; export fruit production concentrated in a small number of countries in Asia (Philippines, Indonesia, China & Thailand) and the Americas (Costa Rica, Brazil, Mexico, Colombia)
- Global trade 8,591kt (or ~30%) growing at 1%pa long term
- Small scale production of pineapples is developing in Northland, New Zealand
- New Zealand imported 8,340t worth US\$8.5m, primarily from the Philippines (74%) and Ecuador (23%)
- All imports into New Zealand must have their crown removed and be sprayed with methyl bromide on arrival

DRIVERS OF GROWTH 5/5

- Rich, sweet flavour
- Unique, iconic appearance
- Long marketing association with tropical climates, vacations and special occasions
- Used extensively as a flavour across numerous product categories
- Scalable production in low wage regions
- Long shelf life and transportation friendly enabling global distribution
- Year-round supply

“ELEVATOR PITCH”

New Zealand’s existing small-scale pineapple pioneers centred in Northland can continue to grow through selling a “crown on” pineapple to premium domestic consumers replacing imports.

SUPPLY SIDE: NEW ZEALAND 12/16

LEVERAGEABLE NZ FACTORS

- Rich volcanic soils in some regions
- Mid/long term climate change projections favouring sub-tropicals in some regions
- Ongoing arrival of new immigrants with enthusiasm to try new crops and products “from home”
- Imported pineapples must-have iconic green crown removed; domestic fruit can keep this in place as a point of difference
- Hobby-scale production ongoing
- Proven success in new fruit development
- Strong fruit breeding capabilities

SOURCES OF VALUE CREATION

- Numerous cultivars exist with different characteristics; most not available in NZ
- Unique, differentiated products for hotels and other hospitality channels
- Numerous value-added opportunities for second grade fruit
- Pre-cut, pre-packaged fruit for convenience shoppers
- Creation of a unique, differentiated pineapple and associated brand (similar to Zespri gold)

WHAT YOU WOULD NEED TO BELIEVE

- A significant number of NZ consumers are willing to pay a premium for NZ-grown pineapples
- NZ grown pineapples can compete at commercial scale with imports
- Varieties available in NZ can achieve necessary yields
- NZ can consistently deliver the sunlight required for sweetness

VALUE CHAIN LINKAGES

F&V packhouses	XXX
Juice manufacturers	X

BIO-ECON SCORECARD

16
24

INCREASE BIOMASS



- Long lived vine crop
- Produces fruit and pruning waste
- Long term growth with more upside

INCREASE VALUE ADD



- High value primary product
- Further opportunities (e.g. champagne competitor)

BUILD RESILIENCE



- Regions beyond Marlborough have upside if they can find 'their' wine
- Should have 5 major regions not 1

REDUCE AG GHG EMISSIONS



- Pressures to reduce fertiliser use
- Replacing sheep with grapes (e.g. Marlborough) may lower net (?)

REPLACE FOSSIL FUELS



- Conceptual; alcohol more valuable elsewhere

RETHINK WASTE



- Numerous opportunities exist to squeeze more value out of secondary, by and waste products

DEMAND SIDE

MARKET SITUATION

2
5

- 7.3m ha of grapes producing 72.7m t of grapes, of which 47% or 34.1m t used to make 26.2m litres of wine
- Most major traditional producers have flat-to-falling area; strong China growth to 2015, leveled out since then (~85% of Chinese grapes are table; ~15% wine)
- Declining global consumption overall, particularly in large historical producer/consumers (e.g. France)
- Highly fragmented industry; top ten countries are ~70% of global production
- Typically merchandised at the country or regional level (e.g. NZ or Marlborough)
- New Zealand has 39,935ha of wine grapes producing 457,000t of fruit

DRIVERS OF GROWTH

3
5

- Stalling consumption growth in traditional markets; shifting from volume to value
- Attractive taste
- Mildly addictive (alcohol)
- Wide range of varieties and styles
- Status symbol able to support a range of price points
- Able to deliver a wide range of taste profiles
- Chinese consumers embracing wine, particularly red wines

"ELEVATOR PITCH"

New Zealand has a long history of success in producing and selling world class wines. New Zealand is well positioned to drive production growth and value, particularly as smaller regions develop unique styles.

SUPPLY SIDE: NEW ZEALAND

12
16

LEVERAGEABLE NZ FACTORS

- Similar in size to Italy
- Mild, maritime climate similar to France
- Sunlight hours similar to Spain
- Proven capabilities in growing wine grapes
- Global reputation for Sauvignon Blanc from Marlborough
- Numerous wine regions of all sizes spread across the country
- Modern, professional industry making New World style wines at scale
- Large scale wine processing and bottling facilities

SOURCES OF VALUE CREATION

- Further developing unique New Zealand styles and flavours
- Better utilisation of secondary products, byproducts and waste from grapes
- Developing a distinct "champagne" or "cognac" type product able to compete with France
- Developing a "grappa" style product from grape pomace

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can maintain high prices rather than experiencing an Australian-style collapse due to overproduction
- Regions beyond Marlborough can create material growth
- New Zealand can develop a clear #2 wine beyond Sauvignon Blanc
- The world market will continue to demand high value wines at premium prices

VALUE CHAIN LINKAGES

Wineries	XXX
Spirits manufacturers	X
Nutraceuticals	X
Soil amendments	X
Oil & fat processing	?

BIO-ECON SCORECARD 13/24

INCREASE BIOMASS ★ ★ ☆ ☆

- Large trees that produce a lot of biomass (fruit, pruning, leaves)
- Growing but now facing challenges

INCREASE VALUE ADD ★ ★ ☆ ☆

- Fresh is biosecure; local uncompetitive against most processed/value-add imports

BUILD RESILIENCE ★ ★ ★ ☆

- Important in key regions
- Growing opportunities in Northland

REDUCE AG GHG EMISSIONS ★ ★ ☆ ☆

- Pressures to reduce fertiliser use
- Tree crop

REPLACE FOSSIL FUELS ★ ☆ ☆ ☆

- Pruning waste for biofuel

RETHINK WASTE ★ ★ ★ ☆

- Opportunities to extract more value from existing streams where it makes business sense

DEMAND SIDE

MARKET SITUATION 3/5

- Relatively new fruit in cultivation; Hass variety (80% of global) in 1926
- Global area 858,152ha growing at 6.8%pa and production 8,685kt growing at 7.9%pa
- Global production dominated by Central and South America
- World market exists, but until recently New Zealand and Australia did not participate; Chile has recently gained access to Australia
- NZ area 4,869ha growing at 2%pa and production 38kt growing at 5.9%pa
- NZ is 0.6% of global area and 0.4% of global production
- Australia currently accounts for ~75% of NZ exports by volume

DRIVERS OF GROWTH 5/5

- Rich, creamy butter-like flavour
- Healthy superfood; perception as health food containing healthy oils/health 'halo'
- Highly versatile; growing usage in salads, sandwiches breakfast item and other meals
- Widespread usage in foodservice (e.g. "smashed avocado on toast" brunch)
- Improved supply chain handling leading to better quality to the final consumer
- Better availability year-round at more consistent prices

"ELEVATOR PITCH"

Like kiwifruit in the 1980's, the NZ avocado industry can emerge from current industry 'growing pains' stronger, smarter and more productive. Key export markets, particularly in Asia will buy NZ avocados once costs and prices adjust to the new reality.

SUPPLY SIDE: NEW ZEALAND 8/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Strong, proven farming capabilities targeting export horticulture - Biosecurity preventing low cost competition in domestic market and increasing returns into Australia - Clean, green image; consistent, trusted supplier of quality produce - Breeding capabilities available at Plant & Food Research - Narrow seasonal window available to NZ prior to Chilean main supply into Australia - Seasonally opposite to Peruvian production 	<ul style="list-style-type: none"> - Improving yields - Removing costs and increasing overall farm-to-market efficiency - Implementing higher productivity / lower cost growing systems at scale - Developing new markets beyond Australia - Developing IP-controlled varieties - Reducing biannual bearing - Consolidation to increase scale and reduce total system/chain costs - Adding more value to byproducts, coproducts and waste

WHAT YOU WOULD NEED TO BELIEVE

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES
- New Zealand avocado growers can compete in non-biosecure markets	F&V packhouses XXX
- NZ production costs can adjust down in response to new realities	Oil & fat processing X
- New Zealand can compete with Chile	Nutraceuticals X
- Logistics and shipping challenges can be overcome in a cost effective manor	Convenience/ready-meals X
- New Zealand avocado exporters can match or exceed the pick-to-plate shelf life achieved by Chile or Peru	

BIO-ECON SCORECARD 10/24

INCREASE BIOMASS ★☆☆☆

- Large trees that produce nut meat, shells, pruning and leaves

INCREASE VALUE ADD ★★★☆☆

- Extensive use in confectionery and other processed foods and bev

BUILD RESILIENCE ★★☆☆☆

- A clear opportunity, but yet to get beyond tertiary/hobby scale

REDUCE AG GHG EMISSIONS ★★☆☆☆

- Tree crop

REPLACE FOSSIL FUELS ★☆☆☆☆

- Significant amounts imported in processed forms

RETHINK WASTE ★☆☆☆☆

- Shells can be burned for bioenergy at processing site

DEMAND SIDE

MARKET SITUATION 3/5

- Global area of 1.1-1.5m hectares and an annual value of US\$2-3b
- Major producers are Turkey, Italy, the United States (Oregon), Azerbaijan and Georgia; all have favourable climate and suitable growing conditions
- Clear global processed hazelnut leader Ferrero Group consists of 107 companies and 32 manufacturing plants worldwide, selling in over 170 countries, with 34,374 employees and revenue of €12.7b in 2022 (+10.4%)
- Growing production in Australia driven by investment by Ferrero Group
- New Zealand currently has ~278ha of hazelnuts spread primarily across Canterbury, Waikato and Hawke's Bay

DRIVERS OF GROWTH 4/5

- Health aura or halo around nuts, particularly as a source of protein
- Nutty, rich flavour; attractive texture
- Strong aromatic components (e.g. 2,5-dimethyl-4-hydroxy-3(2H)-furanone)
- Versatility in pairing with other flavours
- Widespread and growing use in numerous foods (e.g. spreads, confectionery, baked goods, non-dairy milks, snacks)

"ELEVATOR PITCH"

There is a strong case that hazelnuts are the nut most suited to New Zealand. At the same time, hazelnuts are highly versatile and act as a headline ingredient in a wide range of value-added food and beverage products. With a focused strategy the industry can grow.

SUPPLY SIDE: NEW ZEALAND 9/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Large supply of renewable water on a per capita and per sqkm basis - Proven capability in tree crops - Strong plant breeding capabilities - Reputation and capabilities in food science and food processing - Growing industry cohesion and organisation (Hazelnut Growers' Association of New Zealand) 	<ul style="list-style-type: none"> - New, higher productivity cultivars and rootstocks - Increasing labour productivity - Increasing yields - Improved production systems - Confectionery (e.g. chocolate coated) - Premium gift packs - Alternative milks and other alternative dairy products

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can scale in hazelnuts
- Recent area declines can be reversed
- New Zealand can move beyond a niche product targeting local supply and take on global competition from countries like Turkey and Azerbaijan

VALUE CHAIN LINKAGES

Chocolate confectionery	XXX
Snacks	XXX
Dairy substitutes	XXX
Baked goods	XXX
Spreads	XXX

BIO-ECON SCORECARD 12/24

INCREASE BIOMASS ★☆☆☆

- Mature sector
- Challenges in Hawke's Bay from recent weather events

INCREASE VALUE ADD ★★★☆☆

- To date, industry has focused on fresh; other uses an afterthought
- Clear nascent health platform

BUILD RESILIENCE ★★☆☆☆

- Need to recover and reevaluate some sites following weather events
- New varieties for new regions

REDUCE AG GHG EMISSIONS ★★☆☆☆

- Tree crop
- Pressures to reduce fertiliser use

REPLACE FOSSIL FUELS ☆☆☆☆

- Fermented second grade fruit worth more as cider

RETHINK WASTE ★★★★

- Extensive opportunities exist to find more value in windfall, pruning and packhouse streams, incl. biogas

DEMAND SIDE 3/5

MARKET SITUATION

- Global consumption flat at 8.5kg/capita
- Global production 86,531kt, dominated by China (47%); US (5%), Turkey (5%) and wide range of other producers
- Most consumed or processed "at home"; global trade ~13,000kt (15% of prod.)
- Over 7,500 known cultivars; top ten account for ~75% of global production (excluding China); 2/10 top species accounting for ~20% developed in NZ
- New Zealand has 10,396ha spread across 990 orchards producing 402,000t (2020)
- Exports 50% Asia; 25% Europe; 25% rest
- Exports are primarily NZ developed varieties (Royal Gala 33%, Braeburn 12%, Jazz 8%; Envy 8%; Pacific Queen 7%)

DRIVERS OF GROWTH 3/5

- Sweet flavour
- Health perceptions ("An apple a day keeps the doctor away")
- Ongoing development of new branded varieties with significantly different appearance and flavour
- Year round availability; shelf life extensions from 1-MCP (ethylene inhibitor)
- Convenient, comes in own packaging
- Multi-use crop: fruit, juice, cider, snack, sauce, flavour

"ELEVATOR PITCH"

NZ is regularly identified as the global leader in apple innovation and productivity. In addition, NZ has proven capabilities in developing attractive new IP-controlled varieties. The industry can continue to grow through focusing on unique, high quality fruit for key export markets.

SUPPLY SIDE: NEW ZEALAND 11/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Mild, temperate climate well-suited to apple growing - Counter-seasonal production to Northern Hemisphere regions - High yields/high productivity - Skilled grower base delivering world class results - Industry dominated by a small number of large processors; ongoing emergence of integrated grower-packer-shipper firms - Long history of developing successful new varieties that achieve global traction 	<ul style="list-style-type: none"> - New IP-controlled varieties - Ongoing industry consolidation driving scale and reducing costs - Ongoing yield and other productivity gains - Cider - Nutraceutical extracts - Stronger leveraging of health associations

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES								
<ul style="list-style-type: none"> - Industry will recover strongly from recent flood damage in Hawke's Bay - NZ can continue to compete with other Southern Hemisphere producers (e.g. Chile) - NZ can continue to develop and launch new apple varieties that succeed in the market 	<table border="1"> <tr> <td>F&V packhouses</td> <td>XXX</td> </tr> <tr> <td>Juice processors</td> <td>XX</td> </tr> <tr> <td>Cider mnfr.</td> <td>X</td> </tr> <tr> <td>Nutraceuticals</td> <td>X</td> </tr> </table>	F&V packhouses	XXX	Juice processors	XX	Cider mnfr.	X	Nutraceuticals	X
F&V packhouses	XXX								
Juice processors	XX								
Cider mnfr.	X								
Nutraceuticals	X								

BIO-ECON SCORECARD		12 24
INCREASE BIOMASS	★ ★ ☆ ☆	
<ul style="list-style-type: none"> - Large, long lived trees that produce olives, pruning and leaves - Unclear ability to scale strongly 		
INCREASE VALUE ADD	★ ★ ☆ ☆	
<ul style="list-style-type: none"> - Oli and table olives are key current uses; other opportunities exist (e.g. nutraceuticals) 		
BUILD RESILIENCE	★ ★ ★ ☆	
<ul style="list-style-type: none"> - Supports diversification across much of country - Significant existing oil imports 		
REDUCE AG GHG EMISSIONS	★ ★ ☆ ☆	
<ul style="list-style-type: none"> - Tree crop 		
REPLACE FOSSIL FUELS	★ ☆ ☆ ☆	
<ul style="list-style-type: none"> - Pruning can be burned for bioenergy at processing site 		
RETHINK WASTE	★ ★ ☆ ☆	
<ul style="list-style-type: none"> - Numerous opportunities exist; scale is the issue 		

DEMAND SIDE		
MARKET SITUATION		2 5
<ul style="list-style-type: none"> - Global area of 10m hectares producing 23m tonnes of olives - Key products are oil (~80%) and preserved/table (~20%) - Global production of 3.4m tonnes of olive oil of which 2.2m tonnes worth US\$8.5b is exported - Major producers cluster around Mediterranean and have grown olives for thousands of years (Spain, Italy, Greece, Turkey, Tunisia) - Massive area growth in last five years (+2m ha) leading to production growth (+5m tonnes) - New Zealand has ~300 growers with 2,130ha producing 1,500t in 2020; ~40 olive mills and 400t oil produced 		
DRIVERS OF GROWTH		5 5
<ul style="list-style-type: none"> - Strong flavour and aroma of oil - Versatility in cooking - Perception as a healthy oil with health benefits - Growing demand for vegetable oils - Premium positioning of olive oil - Ingredient in cosmetics, pharmaceuticals, soaps, oil lamps 		

"ELEVATOR PITCH"	Olives were introduced to New Zealand in the early 1800s and the climate has proven suitable for them. However, despite ~200 years of experience, the country currently only has a small area in olives. This can change with a new focus on the best genetics, the best planting, harvesting and processing systems.							
SUPPLY SIDE: NEW ZEALAND								
LEVERAGEABLE NZ FACTORS		9 16						
<ul style="list-style-type: none"> - Large supply of renewable water on a per capita and per sqkm basis - At least twelve olive growing regions across the country - Proven capability in tree crops - Strong plant breeding capabilities - Reputation and capabilities in food science and food processing - Growing industry cohesion and organisation (Olives NZ) 		SOURCES OF VALUE CREATION <ul style="list-style-type: none"> - New, higher productivity cultivars and rootstocks - Increasing labour productivity - Increasing yields - Improved production systems - Replacing the 4.1m litre domestic deficit (demand vs. local supply) - Gift packaging - Premium single estate oils with provenance - Kitchenware (jugs, bottles, dipping bowls) - Cosmetic and pharmaceutical products 						
WHAT YOU WOULD NEED TO BELIEVE		VALUE CHAIN LINKAGES						
<ul style="list-style-type: none"> - New Zealand olive growers can transition from decline to growth - New Zealand can make numerous improvements across all parts of the olive value chain leading to global competitiveness - New Zealand can compete with heavily subsidised producers in other markets - New Zealand can demand a premium 		<table border="1"> <tr> <td>Oil processing</td> <td>XXX</td> </tr> <tr> <td>Dressings and sauces</td> <td>XX</td> </tr> <tr> <td>Baked goods</td> <td>XX</td> </tr> </table>	Oil processing	XXX	Dressings and sauces	XX	Baked goods	XX
Oil processing	XXX							
Dressings and sauces	XX							
Baked goods	XX							

BIO-ECON SCORECARD 9/24

INCREASE BIOMASS ★☆☆☆

- Large trees that produce nut meat, shells, pruning and leaves

INCREASE VALUE ADD ★★★☆☆

- Extensive use in alternative dairy
- Major snack nut

BUILD RESILIENCE ★★☆☆☆

- A clear opportunity, but yet to get beyond hobby scale
- Growing volumes imported

REDUCE AG GHG EMISSIONS ★★☆☆☆

- Tree crop

REPLACE FOSSIL FUELS ★☆☆☆☆

- Shells can be burned for bioenergy at processing site
- Significant amounts imported

RETHINK WASTE ☆☆☆☆☆

- Numerous opportunities would exist if we could figure out how to farm it commercially

DEMAND SIDE 4/5

MARKET SITUATION

- Long history of small scale production
- Modern industry emerged in California ~1900 with development of new high productivity cultivars and modern, mechanised farming systems
- Global production 3,994kt (in shell) from 2.3m hectares; top five producers 80%; USA (57%), Spain (10%), Australia (5%), Iran (4%) and Turkey (3%)
- Water pressure on production across all major producers, particularly California and Australia
- New Zealand produces small amounts of almonds at hobby scale across multiple regions; commercial production at scale not yet in place

DRIVERS OF GROWTH 4/5

- Appealing, well liked, relatively neutral flavour; delivery vehicle for other flavours
- Flexible biomass with multiple uses
- Ongoing decline of formal meals and growth of all-day snacking
- Research around health properties of almonds
- Almond milk does not contain phyto-estrogens (unlike soy)

“ELEVATOR PITCH”

NZ can meet growing global demand by taking on the US and Australia in almonds and winning thanks to proven capabilities in tree crops and plentiful available water.

SUPPLY SIDE: NEW ZEALAND 9/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Large supply of renewable water on a per capita and per sqkm basis - Proven capability in tree crops, particularly nectarines and peaches - Strong plant breeding capabilities - Reputation in dairy milk - Proven capabilities in dairy milk processing 	<ul style="list-style-type: none"> - Confectionery (e.g. chocolate coated) - Premium gift packs - Alternative milks and other alternative dairy products - Fresh domestic supply providing stronger, more distinct flavour

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES								
<ul style="list-style-type: none"> - Almonds suit NZ’s moist, maritime climate - NZ can move rapidly down the cost curve and meet the quality adjusted world price for almonds - New, higher productivity genetics can be introduced through biosecurity - Current hobby production can be scaled up to commercial, export competitive scale - US/AU production systems can be adapted to NZ conditions 	<table border="1"> <tr> <td>F&V packhouses</td> <td>XXX</td> </tr> <tr> <td>Snack manufacturers</td> <td>X</td> </tr> <tr> <td>Confectionery mnfr.</td> <td>X</td> </tr> <tr> <td>Alternative dairy processors</td> <td>X</td> </tr> </table>	F&V packhouses	XXX	Snack manufacturers	X	Confectionery mnfr.	X	Alternative dairy processors	X
F&V packhouses	XXX								
Snack manufacturers	X								
Confectionery mnfr.	X								
Alternative dairy processors	X								

BIO-ECON SCORECARD	8 24
INCREASE BIOMASS ★★☆☆	
- Small, but has been growing in an absolute sense	
INCREASE VALUE ADD ★☆☆☆	
- Numerous opportunities exist; none clearly transformative	
BUILD RESILIENCE ★☆☆☆	
- Important in Otago - Narrow climatic window of opportunity (before Chile)	
REDUCE AG GHG EMISSIONS ★★☆☆	
- Tree crop - Pressures to reduce fertiliser use	
REPLACE FOSSIL FUELS ☆☆☆☆	
- Scale in byproducts the challenge - Fruit airfreighted to China - No obvious circular solutions	
RETHINK WASTE ★★☆☆	
- Opportunities to extract more value from existing streams where it makes business sense	

DEMAND SIDE	
MARKET SITUATION 4 5	
- Numerous varieties exist	
- Global production of 2,732kt from 451,064ha; production growing at 3%pa	
- Top 10 countries are 78% of production; Turkey (25%), USA (13%), Chile (12%)	
- Global trade US\$4.2b for 967kt fresh fruit (35% crosses borders in fresh form)	
- New Zealand has 92 cherry growers across 1,080ha producing 4,721t of fruit	
- New Zealand exports 5,771t for US\$94m	
- Central Otago accounts for ~90% of New Zealand cherry exports	
- Industry is vertically integrated, with most key growers also packing and exporting	
DRIVERS OF GROWTH 3 5	
- Bright red colour and sweet flavour	
- Easy to eat; comes in its own packaging	
- Strong cultural and seasonal associations	
- Premium positioning through relatively high prices and narrow seasonal availability	
- Rapidly growing demand for counter-seasonal cherries from “Greater China” (Mainland, Hong Kong, Taiwan)	
- Suits Asian gifting culture, in particular around Chinese New Year	

“ELEVATOR PITCH”	NZ can continue to succeed in cherries by focusing on delivering premium fruit to Asia during a narrow seasonal window that it shares only with Tasmania.	
SUPPLY SIDE: NEW ZEALAND	11 16	
LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION	
- Able to deliver high quality fruit	- Industry consolidation to increase scale in packhouses and operations	
- Consistent, trusted supplier of fresh fruit	- Leverage existing expertise in orchard management skills and systems	
- Counter-seasonal production to major Northern Hemisphere suppliers in a narrow seasonal window	- Improve cool chain management efficiencies	
- Limited range of competitors in Southern Hemisphere seasonal window (Chile; Australia)	- Target high value markets in Asia	
- Cool chain management capabilities	- Extend counter-seasonal window through variety, technology and geography	
- Orchard management skills and systems	- Clearer product differentiation like NZ apples or kiwifruit	
- Capabilities to (1) research factors improving the quality of the fruit and (2) develop new, differentiated varieties	- Improved gifting offer	
	- Better use of byproducts	
WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES	
- Cost effective labour can continue to be sourced during peak harvest time	F&V packhouses	XXX
- Airfreight into China can continue to be sourced in critical windows	Juice manufacturing	X
- China will continue to be willing to pay a large premium for cherries in a narrow window only NZ and AU can supply	Nutraceuticals	?
	Alcoholic spirits	?

BIO-ECON SCORECARD 10/24

INCREASE BIOMASS ★☆☆☆

- Significant biomass produced per hectare (10-20t/ha of cherry fruit)

INCREASE VALUE ADD ★☆☆☆

- Product would be premium speciality, not processing grade

BUILD RESILIENCE ★★☆☆

- Critical raw material to NZ
- Getting ahead of climate change
- Opportunity Auckland/Northland

REDUCE AG GHG EMISSIONS ★★☆☆

- Tree crop

REPLACE FOSSIL FUELS ★★☆☆

- Large volumes imported
- Local would be reduced footprint
- Biofuel explored for byproduct

RETHINK WASTE ★★☆☆

- Coffee grinds already an issue
- Outer cherry used in animal feed
- Numerous other opportunities

DEMAND SIDE

MARKET SITUATION 3/5

- Global consumption 1.2kg/capita; +16% growth between 2015-2020
- Global production 9,917kt from 11.3m hectares
- Global trade 8,942kt worth US\$36b at an average of US\$4.03/kg
- Strong growth in Chinese per capita coffee consumption (from a low base) leading to growing demand
- Global expansion of Starbucks shifting markets from quantity to quality
- Growing demand for specialty coffees from distinct regions with unique stories
- New Zealand imports 21,677t worth US\$138m at US\$6.37/kg; imports growing quantity, price (quality) and value

DRIVERS OF GROWTH 4/5

- Mildly addictive stimulant that is legal
- Greater workforce participation; working longer hours
- Busy lifestyles leading consumers to demand convenient energy boost (caffeine + sugar = energy)
- Growing appreciation for regional flavour differences between producers
- Ongoing growth of café culture
- China shifting from tea to coffee

"ELEVATOR PITCH"

New thinking and a changing environment are enabling the emergence of premium coffee growing in NZ targeting the domestic market initially.

SUPPLY SIDE: NEW ZEALAND 8/16

LEVERAGEABLE NZ FACTORS

- Rich volcanic soils in some regions
- Mid/long term climate change projections favouring sub-tropicals in some regions
- Ongoing arrival of new immigrants with enthusiasm to try crops "from home"
- Hobby scale production ongoing
- Cafes seeking a point of difference
- Strong coffee culture; local appreciation of quality coffee
- Large number of innovative firms passionate about great coffee
- Large number of coffee roasters of all sizes and scale

SOURCES OF VALUE CREATION

- Developing distinct NZ coffee flavours from distinct volcanic soils (e.g. Kona)
- Use in processed foods as a NZ flavour (e.g. ice cream, liqueurs)
- Processing and packaging innovation to enable line extensions (e.g. capsules)
- Feeding fruit through animals (e.g. civet)
- Stand-alone retail and foodservice on-site at farm

WHAT YOU WOULD NEED TO BELIEVE

- It is possible to achieve commercial coffee yields under NZ conditions
- New Zealand can produce a distinctive coffee that stands-out in the market
- A significant percent of consumers will pay a premium for NZ grown coffee
- High labour productivity can be achieved
- NZ can move rapidly down the cost/experience curve and match the quality adjusted world price

VALUE CHAIN LINKAGES

Coffee roasters	XXX
Various processed foods	X
Bioactives extraction	?
Alcoholic spirits mnfg.	?
Soil amendments	?

DRAGON FRUIT (PITAYA/PITAHAYA)

BIO-ECON SCORECARD 9/24

INCREASE BIOMASS ★ ★ ★ ☆

- Six years to commercial yields
- 20-30t per hectare
- Unclear ultimate demand

INCREASE VALUE ADD ★ ☆ ☆ ☆

- Numerous small opportunities; nothing transformative at this point in industry development

BUILD RESILIENCE ★ ★ ★ ☆

- Getting ahead of climate change
- Opportunity Auckland/Northland

REDUCE AG GHG EMISSIONS ★ ☆ ☆ ☆

- Water efficient cactus

REPLACE FOSSIL FUELS ☆ ☆ ☆ ☆

-

RETHINK WASTE ★ ☆ ☆ ☆

- Comes in natural packaging

DEMAND SIDE 3/5

MARKET SITUATION 3/5

- Native to Central America; cultivated in Asia and elsewhere
- Limited global data currently available
- Top producers are Vietnam, Colombia and China; other producers include Thailand, the Philippines, Mexico, the US, and Israel
- Vietnam has ~40,000ha producing ~1.2m tonnes valued at US\$895.7m (2017) (or \$0.74/kg)
- Pitaya cultivation has been increasing globally due to the rising popularity and demand for this exotic fruit
- Small number of pioneering growers in New Zealand

DRIVERS OF GROWTH 3/5

- Unique, iconic appearance will suited to foodservice
- White and red flesh varieties
- Frequent use in fruit salads to bring colour and interest
- Mild inoffensive flavour
- Antioxidant content
- Use in smoothies and other beverages
- Acceptance of a fruit irradiation enabling more imports (potential fruit fly host)

"ELEVATOR PITCH"

"The idea of having some new, more pest and disease-tolerant [dragon fruit] varieties that eat better, have great colour, texture and better eating characteristics, we think that's a real opportunity that might turn into a great addition to New Zealand's horticulture scene." Peter Landon-Lane, Chair, VentureFruit, Feb 2023

SUPPLY SIDE: NEW ZEALAND 10/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Proven capabilities in new fruit development - Fruit breeding capabilities - History of garden/hobby scale production - Mid-long term climate change projections favour sub-tropicals in North of NZ - A number of pioneering producers have emerged - Identified by Plant & Food Research as a potential growth opportunity 	<ul style="list-style-type: none"> - Biosecurity supporting domestic prices - Selling genetics to new growers - Unique, different products for high-end restaurants and hotels - Numerous value-added opportunities for second grade fruit - Numerous potential uses other parts of the total biomass

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES	
- New Zealand can scale production	Fruit packhouses	XX
- NZ can grow dragon fruit at commercial scale and make a return compared to other land uses	Processed fruit	X
- NZ consumers are willing to try and buy new fruit in material quantities as the industry scales		
- New Zealand developed IP protected varieties with "a sweeter, more aromatic flavour... and a crisp dense texture" can demand and maintain a premium		

BIO-ECON SCORECARD

10
24

INCREASE BIOMASS



- Good biomass production under the right conditions (8-10t/ha)
- Unclear ability to scale

INCREASE VALUE ADD



- Difficult to compete beyond premium, specialty tea

BUILD RESILIENCE



- Creates high interest, high visibility business in regions
- Significant imports

REDUCE AG GHG EMISSIONS



- Long lived tree/bush

REPLACE FOSSIL FUELS



- Local production could have a lower overall footprint than imports

RETHINK WASTE



- Tea bags are already an issue

DEMAND SIDE

MARKET SITUATION

3
5

- Global consumption 0.94kg/capita growing at 2%pa
- Global production 28,192kt in raw leaf form; top 6 are 90%; China (49%), India (19%), Kenya (8%), Turkey (5%), Sri Lanka (5%), Vietnam (4%)
- Global trade 2,547kt (~30% crosses borders in raw equivalent)
- Growing demand for specialty and unique tea from distinctive regions
- New Zealand consumes 0.71kg/capita; per capita consumption relatively stable
- NZ imports ~4,000t of tea
- New Zealand has proven capability to produce small amounts of tea
- NZ produced tea is competitive on price

DRIVERS OF GROWTH

3
5

- Mildly addictive
- Strong cultural associations
- Low cost per serve relative to other beverage solutions
- Convenient hot drink
- Health associations with green tea; growing understanding of bio-actives in tea
- New packaging forms
- Growing demand for premium teas

“ELEVATOR PITCH”

New Zealand has a small but growing tea industry as a result of a handful of pioneers. Existing small-scale success in New Zealand tea production can be expanded through innovation around distinctive new ingredients targeting premium consumers everywhere.

SUPPLY SIDE: NEW ZEALAND

8
16

LEVERAGEABLE NZ FACTORS

- Climate suited to premium tea production
- Rich, well-suited soils in some regions
- Mid/long term climate change
- Range of unique native botanicals suitable for addition into teas
- Large supply of renewable water on a per capita and per sqkm basis
- Ongoing arrival of new immigrants with enthusiasm to try new crops and products “from home”
- Large number of cafes looking for point of difference

SOURCES OF VALUE CREATION

- Developing a unique, signature New Zealand tea flavour
- Standalone retail and foodservice co-located with production
- Ready-to-drink (RTD) beverages
- Adding functional ingredients to form “tea-ceuticals”
- Premium gift packs targeting tourists and select Asian markets
- New forms of packaging (e.g. Ti Ora)

WHAT YOU WOULD NEED TO BELIEVE

- A significant percent of New Zealand consumers will change their tea buying behaviour
- New Zealand can achieve commercial yields and scale to compete
- New Zealand could build a premium position in highly discerning global markets

VALUE CHAIN LINKAGES

Coffee & tea mnfr.	XXX
Soft drink mnfr.	X
Native botanicals	XX
Mānuka	X
Nutraceuticals	?

BIO-ECON SCORECARD 11/24

INCREASE BIOMASS ★★☆☆

- Large trees that produce nut meat, shells, pruning and leaves
- Unclear ability to scale strongly

INCREASE VALUE ADD ★★☆☆

- Numerous opportunities exist

BUILD RESILIENCE ★★☆☆

- Supports diversification
- Significant existing nut imports

REDUCE AG GHG EMISSIONS ★★☆☆

- Tree crop

REPLACE FOSSIL FUELS ★☆☆☆

- Shells can be burned for bioenergy at processing site

RETHINK WASTE ★☆☆☆

- Numerous opportunities exist
- Lack of scale is the issue

DEMAND SIDE

MARKET SITUATION 3/5

- Numerous varieties and cultivars exist
- Global production 3,500kt (in shell) from 1,137,788ha; production growing at 2.4%pa; China (33%), USA (21%), Iran (11%) and Turkey (9%) lead
- Growing global trade; about 1/3 of volume crosses borders (in-shell equivalent)
- New Zealand has 455ha spread across ~70 commercial growers
- New Zealand has a trade deficit in walnuts, importing 952t shelled worth US\$5.6m and exported 9t worth US\$61k
- The US accounts for 83% of NZ imports

DRIVERS OF GROWTH 3/5

- Distinctive flavour relative to other nuts
- Consumer perception of nuts as a healthy snack
- Known health properties (e.g. healthy fats) creating a health "halo" around walnuts
- Ongoing research supporting the health properties of walnuts
- Ongoing decline of formal meals and growth of all-day snacking

"ELEVATOR PITCH"

New Zealand's emerging walnut industry can continue to grow by delivering a high quality, premium product to discerning consumers.

SUPPLY SIDE: NEW ZEALAND 7/16

LEVERAGEABLE NZ FACTORS

- Large supply of renewable water on a per capita and per sqkm basis
- Proven capability in tree crops
- Strong plant breeding capabilities
- Reputation and capabilities in food science and food processing
- Growing industry cohesion and organisation (NZ Walnut Industry Group)

SOURCES OF VALUE CREATION

- New, higher productivity cultivars and rootstocks
- Increasing labour productivity
- Increasing yields
- Improved production systems
- Reinventing a slightly stale and traditional product for the next generation
- Confectionery (e.g. chocolate coated)
- Premium gift packs
- Alternative milks and other alternative dairy products

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand production can compete with other producers as scale increases
- The economic case for planting walnuts stacks up on its own relative to other land uses
- Current small scale production can be scaled up to significant quantities
- Newer, higher yielding genetics can be introduced through biosecurity

VALUE CHAIN LINKAGES

Snack manufacturers	XX
Various processed foods	X
Confectionery mnfr.	X
Oil & fat processors	X

BIO-ECON SCORECARD 5/24

INCREASE BIOMASS ★☆☆☆

- Growth industry long term

INCREASE VALUE ADD ★☆☆☆

- Fresh is biosecure; local struggles against most imported processed/value-add

BUILD RESILIENCE ★★☆☆

- Supporting diversification in a number of regions
- Improved competitiveness needed

REDUCE AG GHG EMISSIONS ☆☆☆☆

- Pressures to reduce fertiliser use

REPLACE FOSSIL FUELS ☆☆☆☆

-

RETHINK WASTE ★☆☆☆

- Opportunities to extract more value from existing streams where it makes business sense

DEMAND SIDE 4/5

MARKET SITUATION 4/5

- Relatively new fruit in cultivation; first commercial production in 1916
- Global production of 1,113kt from 163,741ha; top 10 producers 96% of global production; USA (32%), Peru (20%), Canada (13%), Chile (11%)
- Global trade 460kt worth US\$2.8b (~40% crosses borders)
- New Zealand has 80 blueberry growers across 680ha producing 3,640t of fruit
- New Zealand domestic market NZ\$35m; exports 2,860t worth US\$48m
- New Zealand currently over-reliant on biosecure Australia (86%) as key export market; all other markets small

DRIVERS OF GROWTH 4/5

- New cultivars with higher yields that will grow in a wider range of climates
- Massive production growth in South America enabled by new irrigation
- Convenient snack or dessert
- Premium, luxury berry
- Seasonal usage and gift giving
- Strong positioning as a healthy "superfood"
- Ongoing research on the health properties of blueberries (e.g. anthocyanins)

"ELEVATOR PITCH"

NZ can continue to scale up blueberry production by continuing to reduce production costs through productivity gains while targeting high value export markets in Asia.

SUPPLY SIDE: NEW ZEALAND 10/16

LEVERAGEABLE NZ FACTORS

- Strong, proven farming capabilities targeting export horticulture
- Biosecurity preventing low cost competition in domestic market and increasing returns into Australia
- Clean, green image; consistent, trusted supplier of quality produce
- Breeding capabilities available at Plant & Food Research
- Counter-seasonal
- Consistent, trusted supplier of quality fruit
- Well-suited to many parts of New Zealand

SOURCES OF VALUE CREATION

- Improve cold chain efficiencies and technology
- Extend the counter-seasonal supply window through variety, technology and/or geography
- Consolidate industry to achieve scale
- Invest in new IP-controlled varieties being developed in New Zealand by Plant & Food Research

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can transition from a high cost domestic focused industry into a high productivity export sector
- High and growing labour costs can be managed
- New Zealand can compete with Chile
- Logistics and shipping challenges can be overcome in a cost effective manner
- More land with required peaty soils can be brought into production

VALUE CHAIN LINKAGES

F&V packhouses	XXX
Various processed foods	X
Juice manufacturing	X
Nutraceuticals	?

BIO-ECON SCORECARD 8/24

INCREASE BIOMASS ★ ★ ☆ ☆

- Long lived vine crop
- Produces fruit and pruning waste
- Long produced in low quantities

INCREASE VALUE ADD ★ ☆ ☆ ☆

- High value primary product
- Processed (e.g. raisins) challenging as mature with large competitors

BUILD RESILIENCE ★ ★ ☆ ☆

- Rapid growth of wine grapes has created new scale and skills for regions with the right conditions

REDUCE AG GHG EMISSIONS ☆ ☆ ☆ ☆

- Pressures to reduce fertiliser use

REPLACE FOSSIL FUELS ★ ★ ☆ ☆

- Very large volumes imported
- Local has reduced footprint
- Alcohol more valuable elsewhere

RETHINK WASTE ★ ☆ ☆ ☆

- Need to feed any waste into wine grape streams to leverage scale there

DEMAND SIDE

MARKET SITUATION 3/5

- 7.3m ha of grapes producing 72.7m t of grapes, of which 41% or 29.8m t table
- Top producers are: China, India, Turkey, USA, Italy and Chile
- Global table grape production trending flat-to-up over past twenty years
- Key exporters are primarily global top 5 and counter-seasonal Southern Hemisphere (Chile, Peru, Australia, South Africa)
- NZ has 48ha of table grapes
- NZ typically imports 10-15kt of table grapes worth US\$30-40m annually
- One of New Zealand's largest food imports by volume; four countries currently supply in any quantity through biosecurity (e.g. US, Australia, Chile, Peru)

DRIVERS OF GROWTH 3/5

- Sweet, inoffensive flavour; often seedless
- Proven production systems that scale to meet growing demand
- Relatively long shelf-life enabled by varieties and cold chain management
- Easy to judge quality
- Growth in snacking
- Demand for natural, healthy foods
- Convenience snack for lunchboxes

"ELEVATOR PITCH"

Using capabilities developed in the last twenty years, New Zealand can restart table grape production targeting the domestic market and select high value export markets.

SUPPLY SIDE: NEW ZEALAND 9/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
-------------------------	---------------------------

- | | |
|---|--|
| <ul style="list-style-type: none"> - Large and growing production of wine grapes; strong management skills and systems - Proven fruit growing capabilities - Long history of table grape production, albeit at low scale - Consistent, trusted supplier of fresh fruit - Counter-seasonal production to major Northern Hemisphere suppliers in a narrow seasonal window - Capabilities to (1) research factors improving the quality of the fruit and (2) develop new, differentiated varieties | <ul style="list-style-type: none"> - Differentiated, more highly flavoured varieties rather than Thompsons seedless - Grapes with functional characteristics - Grape-derived nutraceuticals - Fresh chilled grape juice - Raisins/sultanas/currants |
|---|--|

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES
--------------------------------	----------------------

- | | | | | | | | |
|--|---|----------------|-----|---------------------|---|----------------|---|
| <ul style="list-style-type: none"> - NZ capabilities in wine grapes can be leveraged to drive success in table grapes - A significant percent of consumers will pay a premium for NZ grown grapes - Select regions of NZ get enough sunshine hours to consistently ripen fruit - NZ production costs can compete with those of growers in Australia and California - High labour productivity can be achieved | <table border="1"> <tbody> <tr> <td>F&V packhouses</td> <td>XXX</td> </tr> <tr> <td>Juice manufacturers</td> <td>X</td> </tr> <tr> <td>F&V processors</td> <td>X</td> </tr> </tbody> </table> | F&V packhouses | XXX | Juice manufacturers | X | F&V processors | X |
| F&V packhouses | XXX | | | | | | |
| Juice manufacturers | X | | | | | | |
| F&V processors | X | | | | | | |

BIO-ECON SCORECARD 6/24

INCREASE BIOMASS ★ ★ ☆ ☆

- Produced hops and significant pruning plant matter
- Unclear ability to scale strongly

INCREASE VALUE ADD ☆ ☆ ☆ ☆

- Important ingredient in beer
- Nutraceuticals and cosmetics

BUILD RESILIENCE ★ ★ ☆ ☆

- Strong in Nelson
- New regions may be possible

REDUCE AG GHG EMISSIONS ★ ☆ ☆ ☆

- Perennial vine

REPLACE FOSSIL FUELS ☆ ☆ ☆ ☆

-

RETHINK WASTE ★ ☆ ☆ ☆

- Most waste currently composted on farm
- Opportunities to explore extracts

DEMAND SIDE

MARKET SITUATION 2/5

- Globally there are 61,559ha producing 129,479t of hops for 175b l of beer
- Global beer consumption is flat-to-down; shift to "less but better"
- Germany is the global leader with ~1/3 of global production, the US ~1/3 and the rest of Europe 1/5th
- The top ~5 breweries account for 2/3 of global production; the top 40 = 90%; long tail of small regional and microbreweries
- Most hops are sold on forward contracts
- NZ has 30 hops growers on 920 ha producing 1,525t and accounts for 1.2% of global area and 0.8% of production
- Global demand is growing driven by China, other developing Asia and Africa

DRIVERS OF GROWTH 2/5

- Population growth in Africa
- Income growth in China and other developing Asia
- Growing interest in new beer styles and flavours; more story about key ingredients
- Growth of microbreweries
- Emerging research on bio-active components in hops (e.g. sleep)
- Loosening religious restrictions on alcohol in some markets (but not others)

"ELEVATOR PITCH"

NZ has a successful and well regarded hops sector that supports domestic and international customers. At the same time, there is growing research around the bio-active properties of hops. The sector can continue to grow if it maintains a focus on innovation.

SUPPLY SIDE: NEW ZEALAND 10/16

LEVERAGEABLE NZ FACTORS

- Similar in size to Italy
- Mild, maritime climate similar to parts of Germany, Oregon or Czech Republic
- Proven capabilities in growing distinct, high quality hops for export markets
- Capabilities in new variety development
- Unique terroir
- Industry concentrated in Upper South Island
- Cohesive, farmer-owned cooperative doing primary processing

SOURCES OF VALUE CREATION

- Development of unique New Zealand varieties
- Further industry consolidation
- Further value-adding in New Zealand (e.g. beer kits)
- Hops-based bioactives
- New regions that produce unique characteristics

WHAT YOU WOULD NEED TO BELIEVE

- There is significant additional unmet demand for NZ hops
- NZ hops has enough distinct characteristics to maintain comparative advantage
- Demand for premium micro-brewed beers in not a fad

VALUE CHAIN LINKAGES

Beer manufacturing	XXX
Malt production	XXX
Nutraceuticals	X
Bio-extraction	X
Barley	X

BIO-ECON SCORECARD 7/24

INCREASE BIOMASS ☆☆☆☆

- Stable secondary industry

INCREASE VALUE ADD ★★☆☆

- Fresh is biosecure; local struggles against most processed/value-add

BUILD RESILIENCE ☆☆☆☆

- Important, even iconic, in some regions
- Often shrinking not growing

REDUCE AG GHG EMISSIONS ★★☆☆

- Tree crop
- Pressures to reduce fertiliser use

REPLACE FOSSIL FUELS ☆☆☆☆

- Scale in byproducts is the challenge (e.g. vs. Brazil)

RETHINK WASTE ★★☆☆

- Opportunities to extract more value from existing streams where it makes business sense

DEMAND SIDE

MARKET SITUATION 3/5

- Global consumption 17.3kg/capita and growing at 1%pa
- Global production 143,574kt; 70% oranges and mandarins; major producers are Brazil, Mexico, China
- Growing demand, particularly in Asia
- Citrus make up about half of global fruit trade by value
- Numerous species and hybrids exist; small number of large, large number of small
- Water pressures in major citrus producing regions (e.g Australia, California)
- New Zealand has 316 citrus growers across 1,660ha producing 29,743t of fruit, primarily oranges, mandarins and lemons

DRIVERS OF GROWTH 3/5

- Strong consumer acceptance of fruit, however consumption is already high
- Changing diets; growth of new cuisines, particularly those that use citrus
- Health halo, particularly historical association with vitamin C
- Growth of convenient, easy-peel varieties
- Ongoing development of new varieties and cultivars (e.g. finger limes)
- Year round availability through varieties and seasonal windows

“ELEVATOR PITCH”

NZ can build on past successes in citrus by continuing to rapidly adopt to changing consumer demand.

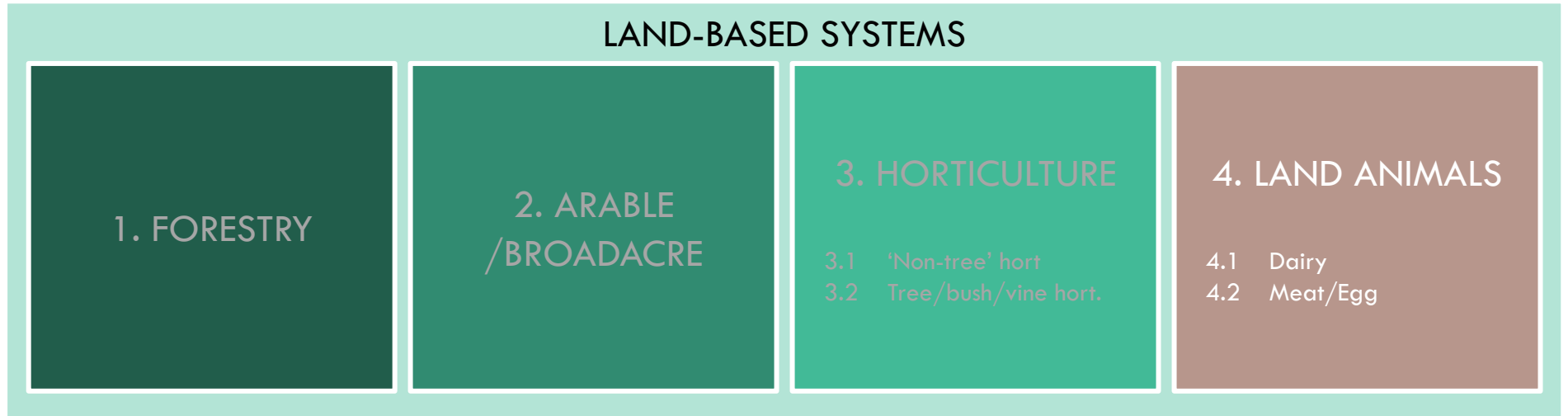
SUPPLY SIDE: NEW ZEALAND 7/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Climate suited to many citrus species - Able to deliver high quality fruit - Consistent, trusted supplier of fresh fruit - Biosecurity limiting competition in domestic market primarily to US & AU - Counter-seasonal production to major Northern Hemisphere - Cool chain management capabilities - Orchard management skills and systems - Capabilities to (1) research factors improving the quality of the fruit and (2) develop new, differentiated varieties 	<ul style="list-style-type: none"> - Adapting quickly to changing consumer demand patterns (e.g. limes) - Introduction of new species for unique flavours (e.g. Yuzu) - New regions, particularly those enabled by climate change - Consolidation of farming to increase scale and reduce costs - Research into unique bio-actives with functional benefits - New varieties for specific purposes (e.g. essential oils) - New irrigation schemes

WHAT YOU WOULD NEED TO BELIEVE

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES
- New Zealand growers can continue to make ongoing productivity gains	F&V packhouses XXX
- Competition from imports will remain limited and manageable (primarily from US and AU)	Juice manufacturing XXX
- Subdivisions, particularly in Northland, will not continue to remove land from citrus	Various processed foods XXX
- Cost effective labour can continue to be sourced during peak harvest time	Essential oils ?
	Bioactives extraction ?
	Alcoholic spirits mfg. ?
	Soil amendments ?

II.4. LAND ANIMAL SYSTEMS (MEAT, DAIRY, EGGS)



New Zealand produces a limited range of animal-based biomaterials at any scale

PRELIMINARY IDENTIFICATION OF BIOMASS PRODUCTION SYSTEMS: ANIMAL-BASED

Global agricultural industry with no farming activity identified in New Zealand	Hobby/Micro currently in New Zealand	Emerging/Tertiary Agricultural Industry	Secondary Agricultural Industry	Major Agricultural Industry
Donkey/Ass Guinea pig Antelope (various) Zebra Reindeer Kangaroo Alligator Crocodile Camel Yak Mink Badger Others	Geese Llama Alpaca Insects Pheasant Partridge Quail Elk Bison Rabbit Guinea Fowl Pigeons/Squab Wallaby Ferret	Water Buffalo Ostrich Emu Turkey Duck	Horse	Cattle Sheep Chicken Pig Goat Deer Honeybee
Non-domesticated wild species present in New Zealand	Species only wild collected (hunted) in New Zealand			
Pūkeko Kiwi Kea Kiore (the Polynesian rat) Sparrow Others	Possum Muttonbird Himalayan tahr			

Seven animal-based farming systems emerged from “Screen 0”...

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/ Māori/Pacific socio-cultural connections
Chicken	13	●	●	●	●	●	●	○	◐	○
Cattle	12	●	●	●	●	●	◐	○	◐	○
Pigs	11	◐	◐	●	●	●	○	●	◐	○
Honeybee	10	◐	○	●	●	◐	●	○	●	○
Sheep	10	●	●	◐	●	○	○	◐	●	○
Goat	10	◐	◐	●	●	○	●	○	●	○
Insects	10	○	●	◐	◐	◐	◐	◐	●	◐
Turkey	9	◐	○	●	●	●	○	○	●	○
Water buffalo	6	○	○	◐	●	○	◐	○	●	○
Possum	5	●	◐	○	○	○	○	○	●	○
Duck	5	◐	○	●	◐	○	○	○	◐	○
Quail	4	○	○	◐	◐	○	○	○	●	○
Deer	4	◐	○	○	◐	○	○	○	●	○
Pheasant	3	○	○	◐	◐	○	○	○	◐	○
Muttonbird	3	◐	○	○	○	○	○	○	○	●
Horse	3	○	○	○	●	○	○	○	◐	○

... continued

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/Māori/Pacific socio-cultural connections
Guinea Fowl	3	○	○	◐	◐	○	○	○	◐	○
Geese	3	◐	○	○	◐	○	○	○	◐	○
Wallaby	2	○	○	○	◐	○	○	○	◐	○
Rabbit	2	○	○	○	◐	○	○	○	◐	○
Pigeons/Squab	2	○	○	○	◐	○	○	○	◐	○
Partridge	2	○	○	○	◐	○	○	○	◐	○
Ostrich	2	○	○	○	○	○	○	○	●	○
Llama	2	○	○	○	○	○	○	○	●	○
Himalayan tahr	2	○	○	○	○	○	○	○	●	○
Emu	2	○	○	○	○	○	○	○	●	○
Elk	2	○	○	○	○	○	○	○	●	○
Alpaca	2	○	○	○	○	○	○	○	●	○
Bison	1	○	○	○	○	○	○	○	◐	○
Ferret	0	○	○	○	○	○	○	○	○	○

BIO-ECON SCORECARD 15/24

INCREASE BIOMASS ★★★★★

- Do not produce significant biomass directly; support large amounts of biomass indirectly (e.g. pollination)

INCREASE VALUE ADD ★★★★★

- Outputs highly valuable
- Enabler of other value added products (e.g. cosmetics)

BUILD RESILIENCE ★★★★★

- Supports numerous regions, particularly across the North Is.
- Creates high value rural jobs

REDUCE AG GHG EMISSIONS ★☆☆☆☆

- Supports lower emissions ag (e.g. through pollination of fruit crops)

REPLACE FOSSIL FUELS ☆☆☆☆☆

- Honey too valuable to used for biofuels

RETHINK WASTE ★★★★★

- Very little bee product is wasted
- Opportunities in wider system

DEMAND SIDE

MARKET SITUATION 3/5

- Honeybees produce honey, other products and provide pollination services
- Pollination by honeybees is essential to modern horticulture
- Honey is a US\$6.9b global industry; small relative to sugar crops (US\$162b)
- New Zealand is about 1% of global honey production and 1% of export volume, but 11% of global trade value
- NZ achieves a dramatically higher average price (e.g. 10x China) than other countries due to high demand for limited supply of mānuka honey
- NZ has a large and well-developed industry; large producers now dominate

DRIVERS OF GROWTH 4/5

- Natural sweetener
- Honey, in general, is well recognised in many cultures as a health product
- Ingredient in savoury dishes, sauces, baked products and a wide range of other foods
- Proven science around unique properties of New Zealand mānuka honey
- Widespread and growing use of mānuka honey in medicinal and cosmetic products

“ELEVATOR PITCH”

New Zealand is the only country that can produce significant quantities of mānuka honey. Global awareness of and demand for this unique honey can continue to grow. However, the industry is currently in the middle of a transition from volume to value.

SUPPLY SIDE: NEW ZEALAND 12/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Unique source of mānuka honey (mānuka is the New Zealand Māori people’s name for <i>Leptospermum scoparium</i>); Australia also has this tree, but unclear rights, if any, to the name - Only country with large stands of mānuka - Reputation for food safety - Proven ability to supply high quality honey and products - Consolidating industry with strong emerging leaders - Ongoing stream of value added products being developed 	<ul style="list-style-type: none"> - Drive and expand protection of cultural use of Mānuka name (imitate French protection of Champagne) - Build on science and research into Mānuka honey’s properties - Hive-to-spoon tracking of bee products - Research into monoflorals beyond mānuka (e.g. Kānuka) - Continued industry consolidation - Continued “premiumification” of mānuka honey by driving up average retail price per kg (e.g. lozenges, cosmetics)

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES								
<ul style="list-style-type: none"> - High UMF/MGO honey production can increase as it requires large stands of Mānuka trees and all easily accessible stands are gone - The impact of changing climate impacting flowering can be managed - Varroa can continue to be managed - Other bee diseases will remain out of the country or under control 	<table border="1"> <tr> <td>Honey processing</td> <td>XXX</td> </tr> <tr> <td>Nutraceuticals</td> <td>XX</td> </tr> <tr> <td>Cosmetics</td> <td>X</td> </tr> <tr> <td>Various processed foods</td> <td>X</td> </tr> </table>	Honey processing	XXX	Nutraceuticals	XX	Cosmetics	X	Various processed foods	X
Honey processing	XXX								
Nutraceuticals	XX								
Cosmetics	X								
Various processed foods	X								

BIO-ECON SCORECARD 12/24

INCREASE BIOMASS ★ ★ ☆ ☆

- Fast growing
- Improving efficiency

INCREASE VALUE ADD ★ ★ ☆ ☆

- Flexible meat source
- Significant use in meals, etc.

BUILD RESILIENCE ★ ★ ☆ ☆

- Large in key regions with factories

REDUCE AG GHG EMISSIONS ★ ★ ☆ ☆

- Significantly lower methane per kg than cattle or sheep

REPLACE FOSSIL FUELS ★ ★ ☆ ☆

- Chicken waste is concentrated and can be digested for energy on site
- Bioplastics from feathers, etc.

RETHINK WASTE ★ ★ ☆ ☆

- Almost all of the animal and its waste can be used

DEMAND SIDE 4/5

MARKET SITUATION

- Globally 73.8b meat birds killed in 2021 producing 121,588kt of meat worth US\$191.1b globally and 8.1b laying hens producing 86,388kt worth US\$113.5b
- Most countries now use modern production systems; all growth from modern systems
- Genetics dominated by a few large firms: Cobb Vantress, Aviagen/Ross, Hy-line, etc.
- Long term global consumption growth across all markets
- NZ chicken meat production is on track to exceed lamb production before 2030
- NZ is totally isolated from the world market by biosecurity (other than very highly processed egg products)
- NZ prices and firm profitability are high

DRIVERS OF GROWTH 4/5

- Neutral, mild flavour perceived as healthy meat option; eggs a protein source
- Globally chicken is the second highest produced species after pork; showing the strongest growth by species
- Low cost due to high productivity, high efficiency of production systems; rapid genetic improvement by drawing from global breeding pools
- Convenient, versatile protein source for many consumers
- Not sacred to any major god or religion

“ELEVATOR PITCH”

The NZ chicken industry will continue to grow in the foreseeable future driven by strong, fundamental demand drivers.

SUPPLY SIDE: NEW ZEALAND 9/16

LEVERAGEABLE NZ FACTORS

- New Zealand has a modern chicken industry; two large Tegel (NZX) and Ingham's (ASX) and two strong second tier firms (Brink's and Turk's); highly profitable
- No chicken imports allowed into NZ
- Achieve world-leading feed conversion ratios (FCR) due to lack of key poultry diseases
- GM-free, low/no antibiotic use, cage-free
- Well organised and highly consolidated industry with high productivity
- Highly regulated, strong food safety systems

SOURCES OF VALUE CREATION

- Improving access to bio-secure Australian market beyond fully cooked
- Innovation and convenience
- Packaging innovation for convenience, easy open
- Product innovation (single-serve)
- Meal solutions (snack, dinner)
- Circular economy from on-farm production of energy from available manure
- Adding more value to coproducts and byproducts

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand will maintain extreme levels of biosecurity on poultry
- NZ consumer will continue to demand chicken and eggs
- Key poultry diseases will not enter the country
- Ongoing changes to animal welfare regulations can be delivered at an acceptable cost to the consumer

VALUE CHAIN LINKAGES

Poultry processing	XXX
Egg packhouses	XXX
Animal feed mnfg.	XXX
Pet food mnfr.	XXX
Various processed foods	X
Ready-meats/convenience	X
Bio-energy	XX

BIO-ECON SCORECARD 6/24

INCREASE BIOMASS ★☆☆☆

- Uses significant biomass to produce relatively little output (cf. FCR)
- Low efficiency farm animal

INCREASE VALUE ADD ★★☆☆

- Goat infant formula growing
- Further opportunities exist for milk
- Meat not as premium as lamb

BUILD RESILIENCE ★☆☆☆

- Creating new regional employment on farms and in processing plants, particularly in Waikato

REDUCE AG GHG EMISSIONS ☆☆☆☆

- Small current numbers mask emissions similar to sheep (particularly with intensive feeding)

REPLACE FOSSIL FUELS ★☆☆☆

- Waste is concentrated under current NZ farming systems but not that much in an absolute sense

RETHINK WASTE ★☆☆☆

- Almost all of the animal can be used in theory
- Scale of current industry the issue

DEMAND SIDE

MARKET SITUATION 3/5

- Animal numbers in long term growth, particularly across dryer regions
- 6,398kt of meat produced by ~500m animals; 20,725kt of milk
- Most goat meat and milk production at family scale outside modern systems
- Secondary meat and dairy animal across all Western, developed markets
- European production concentrated primarily in Southern parts of Europe (Greece, Spain, Romania, France, Italy)
- NZ produces 175,000 goats annually for meat
- NZ has ~66,000 milking does producing ~62.3m litres of milk

DRIVERS OF GROWTH 4/5

- Growing incomes in developing countries, particularly Asia
- Growing global incidence of allergies; growth of bovine (cow) dairy allergies
- Declining birth rate in China; increased investment per child
- Food safety scares in China; lack of trust by Chinese consumers in Chinese food
- Growing global Muslim population
- Importance of gifting in Asian cultures

“ELEVATOR PITCH”

New Zealand is achieving success in goat farming through focusing on dairy milk production for goat-based infant formula, a product it pioneered. The success can continue if the industry focuses on increasing productivity, reducing costs and maintaining product differentiation.

SUPPLY SIDE: NEW ZEALAND 11/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Temperate climate - Modern, efficient farming sector - Proven capabilities at dairy production and dairy processing - Growing strength in infant formula; 95% of goat milk now used in infant formula - Open access spray dryer at Food Waikato - Post-farmgate dairy processing centered around for firms - Research capabilities in animals and dairy 	<ul style="list-style-type: none"> - New, improved genetics improving productivity - Constant, ongoing productivity increases to increase competitiveness while reducing costs

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES
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- Industry can continue to source skilled labour, particularly for dairy goats	Dairy processors	XXX
- Intensive, contained feeding of dairy goats can continue to “fly under the radar”	Meat processors	XXX
- Industry can reduce costs as it scales to close competitiveness gap with Europe	Infant formula mnfr.	XXX
- New genetics can be sourced and continue to enter the country through biosecurity	Animal feed mnfr.	XX
	Pet food processing	XX

BIO-ECON SCORECARD 13/24

INCREASE BIOMASS ★ ★ ☆ ☆

- Unclear scalable model suited to NZ; competition for “waste” from other users (e.g. animal feed)

INCREASE VALUE ADD ★ ★ ☆ ☆

- Numerous ideas, proposals and trials; unclear sustainable consumer demand

BUILD RESILIENCE ★ ★ ☆ ☆

- Conceptually can replace imported animal feed; unclear economics

REDUCE AG GHG EMISSIONS ★ ★ ★ ☆

- Can support reduction in landfill emissions; unclear ability to scale to material outcomes

REPLACE FOSSIL FUELS ☆ ☆ ☆ ☆

- High intensity, relatively high energy production systems overall

RETHINK WASTE ★ ★ ★ ★

- Can potentially be fed on a wide range of waste biomass

DEMAND SIDE

MARKET SITUATION 2/5

- Long history of farming certain insects (e.g. Cochineal into red dye (e.g. in Coca-Cola)
- Extremely limited global data; clearly large production in China and other parts of Asia (e.g. Thailand)
- Global market estimated in 2019 at US\$112m with a 30% CAGR
- High but rapidly falling prices; potentially an “insect winter” approaching
- Currently 10,000t produced (2020)
- Recently a “hot” investment area attracting attention from venture capital
- Thousands of start-ups across Anglo-European
- New Zealand currently has less than five firms

DRIVERS OF GROWTH 2/5

- Venture funding driven by simplistic growth narratives (“if we just get 1% of global protein it will be huge”)
- Concept is “catnip” for government funding seeking trendy topics that solve multiple problems (e.g. waste, methane)
- Innovative food firms in categories or regions unencumbered by excessive regulations (e.g. pet food) seeking a new flavour to generate publicity

“ELEVATOR PITCH”

Insects are hot and promoters worldwide are making a lot of noise to draw in customers and investors. New Zealanders are plucky innovators that love to take on the world, and sometimes win. What could go wrong?

SUPPLY SIDE: NEW ZEALAND 7/16

LEVERAGEABLE NZ FACTORS

- Reputation for food safety
- Research capabilities in animals
- Large agricultural-based economy with entrepreneurial spirit
- Strong competencies in stainless steel fabrication
- Small group of hardy pioneers (including experienced veterans of pioneers that have shut down)
- Government seeking circular economy solutions

SOURCES OF VALUE CREATION

- Government funding
- Exiting early in the hype cycle
- Licensing technology from well financed start-ups elsewhere
- Buying distressed start-ups at less than book value

WHAT YOU WOULD NEED TO BELIEVE

- Government regulations can be navigated
- New Zealand can compete with China as scale increases and prices fall
- Scalable production systems can be developed that will make a commercial return at post-hype prices
- Sufficient feedstock exists
- Production will ultimately occur in New Zealand, rather than large population centres

VALUE CHAIN LINKAGES

Municipal waste	XXX
Fruit and veg proc. waste	XXX
Other insect edible waste streams	XX

BIO-ECON SCORECARD 6/24

INCREASE BIOMASS ☆☆☆☆

- Uses significant biomass to produce relatively little output (cf. FCR*)
- Major existing biomass

INCREASE VALUE ADD ★★☆☆

- Delivers both milk and meat
- Enables numerous downstream uses
- Further opportunities exist

BUILD RESILIENCE ★☆☆☆

- Major regional employment on farms and in processing plants

REDUCE AG GHG EMISSIONS ☆☆☆☆

- Part of the problem currently
- Emissions per kg need to come down dramatically

REPLACE FOSSIL FUELS ★☆☆☆

- Waste not concentrated under current NZ farming systems
- Bioenergy opportunities at plant

RETHINK WASTE ★★☆☆

- Almost all of the animal can be used in theory; most is in practice
- Numerous current uses/linkages

DEMAND SIDE

MARKET SITUATION 3/5

- Global demand for beef and dairy is massive and growing; supply constrained
- Global beef production growing more slowly than chicken or pork; beef is ~33% of global meat trade value
- Global per capita dairy consumption growing at 1% pa; dairy trade flows from milk surplus to milk deficit regions
- NZ produces an amount of cattle products similar to other peer countries (e.g. Italy, UK); small population, so most exported
- NZ is the #1 dairy exporter by value and the #4 beef exporter by value
- If McDonalds was a country, it would probably be the second largest buyer of NZ cattle-based products

DRIVERS OF GROWTH 4/5

- Nutritionally complete food
- Rich, natural, high fat flavour
- High in protein; some perceptions as healthy though with mixed messages
- Growing demand for protein – both meat and dairy - from developing markets
- Growing income in developed countries
- Changing food consumption patterns; Westernisation of diet (e.g. fast food)

“ELEVATOR PITCH”

Just as industrial alcohol has not destroyed the global wine industry, vat-grown factory foods will not replace natural beef and dairy products made from real milk. At the same time, New Zealand can maintain production through matching the productivity gains achieved elsewhere.

SUPPLY SIDE: NEW ZEALAND 9/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Low yield, low cost farming system - Large farms relative to many global competitors - Highly consolidated industry post-farmgate with strong farmer ownership - Large biomass processors at scale - Global low cost dairy producer with large surplus available for export; dairy cull-based meat as a byproduct - Trusted food safety systems - Latent reputation as a trusted dairy supplier with many global consumers 	<ul style="list-style-type: none"> - Telling a better sustainability story - Increased supplementary feeding - Ongoing farm consolidation - Increasing animal productivity (e.g. Colorado 4x milk per cow/year) - New technologies improving farm productivity (e.g. drones)

WHAT YOU WOULD NEED TO BELIEVE

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES
- Domestic anti-cow lobby will not squeeze the industry into extinction	Meat processors XXX
- Cattle methane emissions can be managed through a range of techniques	Dairy processors XXX
- Nitrate runoff to waterways can be managed through better farm management	Petfood processors XXX
- Consumer demand for real, natural meat and dairy products will continue	Infant formula XXX
	Sports nutrition/nutrionals XXX
	Maize farming X
	Other processed foods XXX

*FCR = Feed Conversion Ratio

BIO-ECON SCORECARD 8/24

INCREASE BIOMASS ☆☆☆☆

- Uses significant biomass to produce relatively little output (cf. FCR)
- Least efficient major farm animal

INCREASE VALUE ADD ★☆☆☆

- Not used as flexibly as pigs; more extensive use elsewhere (e.g. Asia)
- Further opportunities exist in milk

BUILD RESILIENCE ★★☆☆

- Major regional employment on farms and in processing plants
- Shearing cost exceeds wool value

REDUCE AG GHG EMISSIONS ☆☆☆☆

- Part of the problem currently
- Emissions per kg need to come down dramatically

REPLACE FOSSIL FUELS ★★☆☆

- Waste not concentrated under current NZ farming systems
- Bioenergy opportunities at plant

RETHINK WASTE ★★★☆☆

- Almost all of the animal can be used in theory; most is in practice
- Numerous current users/linkages

DEMAND SIDE 1/5

MARKET SITUATION

- Global sheep system = US\$30b; meat US\$24b while wool is US\$6.0b
- Global meat production 9,960kt from 617m animals
- Global sheep meat consumption is falling due to high prices versus other meats
- Global wool production 1,920kt; global production in decline for 30+ years
- Global wool consumption is falling driven by lower demand for wool products
- New Zealand is the largest sheep meat exporter by value (#2 by volume)
- New Zealand is the 3rd largest wool producer after China and Australia
- New Zealand animal numbers in decline for ~30 years

DRIVERS OF GROWTH 1/5

- Meat has a strong flavour
- Wool is a natural fibre
- Price of close substitutes for both meat and wool are decreasing putting pressure on both prices and demand
- China is the dominant market for both sheep meat and wool
- Economic growth in China increasing demand for sheep meat; growing popularity of hot pot style restaurants
- China has increased their flock

“ELEVATOR PITCH”

Sheep have historically been at the centre of the “New Zealand story” and the New Zealand economy was built on sheep for much of the 20th Century. A rethink and a new focus can reposition the sheep industry for profitable growth through a focus on value not volume.

SUPPLY SIDE: NEW ZEALAND 10/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - An environment ideally suited to sheep - Proven capabilities in sheep breeding - Large efficient meat processors at scale - Highly consolidated wool scouring - Proven capabilities in merino - Improving meat yields through higher lambing rates and larger animals; flat to declining wool yields as a result - Global reputation as a quality supplier of sheep-based products 	<ul style="list-style-type: none"> - Increasing wool/sheep to Australian levels - Ongoing shift to meat-optimised breeds; breeding for one variable (meat) rather than two (wool and meat) - Adding more value to secondary products, byproducts and waste streams - Further industry consolidation, particularly in meat processing - Omega Lamb project delivering a superior experience to the final consumer

WHAT YOU WOULD NEED TO BELIEVE VALUE CHAIN LINKAGES

- Shearing costs per kg (driven by minimum wage) exceeding wool value per kg (driven by price of substitutes) will not shift production to self-shedding sheep	Meat processors	XXX
	Wool scourers	XXX
	Yarn mnfr.	XXX
- Constant, ongoing industry decline can be slowed or turned around	Carpet mnfr.	?
	Cosmetics	?
- Constant, ongoing industry overcapacity can be managed gracefully	Nutraceuticals	X

BIO-ECON SCORECARD 7/24

INCREASE BIOMASS ☆☆☆☆

- NZ farming system inefficient and under pressure from imports that can't be kept out with biosecurity

INCREASE VALUE ADD ★★☆☆

- The most value added meat (on a value added per kg basis)
- Further opportunities exist

BUILD RESILIENCE ★☆☆☆

- Smell issues; industry shrinking
- Growing imports

REDUCE AG GHG EMISSIONS ★☆☆☆

- Significantly lower methane per kg than cattle or sheep

REPLACE FOSSIL FUELS ★☆☆☆

- Waste not concentrated under current NZ farming systems
- Bioenergy opportunities at plant

RETHINK WASTE ★★☆☆

- Almost all of the animal can be used in theory; most is in practice
- Lack of scale is the issue

DEMAND SIDE

MARKET SITUATION 1/5

- Growing global pork production (3%pa) and consumption (1%pa)
- US\$297b global industry; 66% in China
- China recovering from African Swine Fever
- Top 5 producing firms now all Chinese
- Improving genetics and better farming systems are driving productivity increases
- Major exporters: Spain, US, Germany, Denmark, Canada, Netherlands
- China is largest producer and importer; Japan and S. Korea also large importers
- NZ competitiveness declining; regulation, low yields, inefficient farming systems
- Growing imports as new suppliers gain access (e.g. Germany, Poland, Spain)

DRIVERS OF GROWTH 4/5

- Rich, distinct flavour
- Highly versatile food source; total carcass is usable in various ways
- High per capita consumption in some cultures (e.g. China, Pacific Islands)
- Highly efficient, scalable production systems
- Excellent feed conversion ratios
- Low cost meat relative to beef and lamb
- Forbidden in two major global religions

"ELEVATOR PITCH"

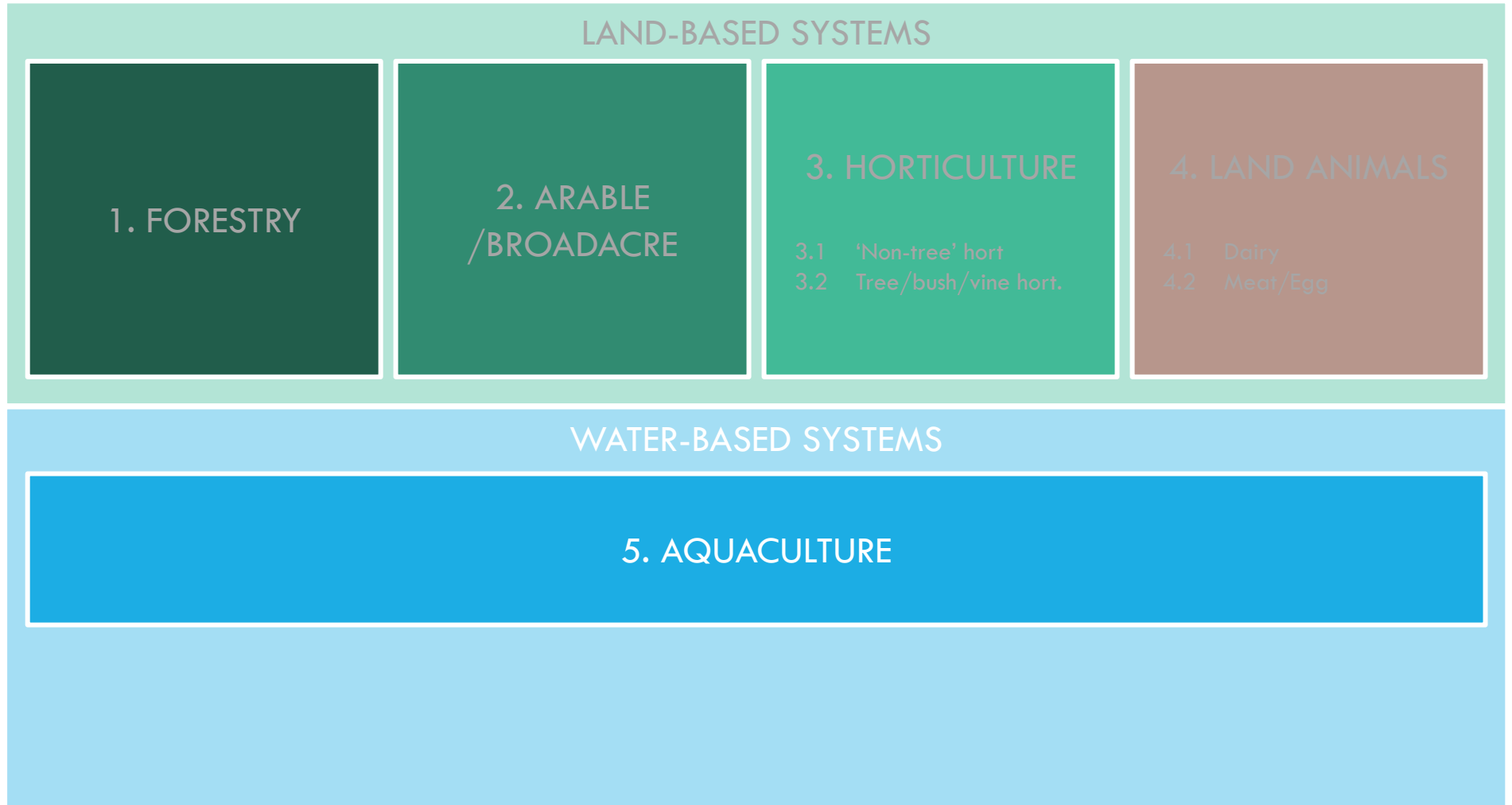
New Zealand has growing pork consumption. However, growing imports are displacing domestic pig production. A ground-up rethink and a new strategy could restart industry growth.

SUPPLY SIDE: NEW ZEALAND 6/16

LEVERAGEABLE NZ FACTORS	SOURCES OF VALUE CREATION
<ul style="list-style-type: none"> - Mild climate - Historically industry was isolated from competition by biosecurity - Biosecure environment free of many key major pig diseases - Growing free range production creating a point of difference - Access to global genetics through biosecurity (unlike AU) - Highly consolidated post-farmgate processing and value-adding sectors - Changing demographics that favour more pig consumption going forward 	<ul style="list-style-type: none"> - Larger farms with lower production costs; every Top 100 global pig producing firm has more sows than all of NZ - Improving productivity through genetics, feed and management systems - Developing unique, signature bacon, ham and smallgoods products - Circular economy-based savings from manure based bio-energy

WHAT YOU WOULD NEED TO BELIEVE	VALUE CHAIN LINKAGES								
<ul style="list-style-type: none"> - Biosecurity severely limiting the import of fresh pork will remain in place - Commercial pig farming will continue to be possible in New Zealand - New Zealand pig farmers can continue to meet growing domestic regulations and remain competitive with imports - New Zealand consumer would prefer not to export animal welfare concerns 	<table border="1"> <tr> <td>Meat processing</td> <td>XXX</td> </tr> <tr> <td>Petfood processing</td> <td>XX</td> </tr> <tr> <td>Bio-energy</td> <td>X</td> </tr> <tr> <td>Soil amendments</td> <td>X</td> </tr> </table>	Meat processing	XXX	Petfood processing	XX	Bio-energy	X	Soil amendments	X
Meat processing	XXX								
Petfood processing	XX								
Bio-energy	X								
Soil amendments	X								

11.5. AQUACULTURE (ANIMALS & PLANTS)



New Zealand produces a limited range of aquaculture-based biomaterials at any scale

PRELIMINARY IDENTIFICATION OF BIOMASS PRODUCTION SYSTEMS: AQUACULTURE-BASED

Global agricultural industry with no farming activity identified in New Zealand	Hobby/Micro currently in New Zealand	Emerging/Tertiary Agricultural Industry	Secondary Agricultural Industry	Major Agricultural Industry
<ul style="list-style-type: none"> Shrimp Tilapia Prawns Barramundi Yesso scallops Chilean mussels Channel catfish Coho salmon European seabass Red swamp crawfish Numerous others 	<ul style="list-style-type: none"> Giant Malaysian River Prawn (<i>Macrobrachium rosenbergii</i>) Kahu/Haku/Yellowtail Amberjack/Kingfish (<i>Seriola lalandi</i>) Seaweed (Var. sp.) Spirulina (<i>Arthrospira</i> sp.) Tio/Chilean oyster/Bluff oysters (<i>Ostrea chilensis</i>)* 	<ul style="list-style-type: none"> Abalone/Paua (<i>Haliotis</i> Sp.) 	<ul style="list-style-type: none"> Pacific/Japanese Oyster (<i>Magallana gigas</i>) NZ Scallop (<i>Pecten novaezelandiae</i>**) 	<ul style="list-style-type: none"> Greenshell Mussel (<i>Perna canaliculus</i>) Chinook/King Salmon (<i>Oncorhynchus tshawytscha</i>)
Non-domesticated wild species present in New Zealand	Species farmed in peer group but only fished in New Zealand			
<ul style="list-style-type: none"> Hoki Spiny red rock lobster (crayfish) Numerous others 	<ul style="list-style-type: none"> Brown trout (<i>Salmo trutta</i>) Rainbow trout (<i>O. Mykiss</i>) Atlantic salmon (<i>Salmo salar</i>) Blue mussels (<i>Mytilus edulis</i>) Carp (15 species) NZ rock oyster/Sydney rock oysters (<i>S. cucullate</i>) 			

* disease issues ended farming; ** struggling/failing

Three aquaculture-based farming systems emerged from “Screen 0”

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/ Māori/Pacific socio-cultural connections
Gr. mussels	13	●	●	●	●	◐	○	○	●	●
Seaweed (aqua.)	11	◐	○	●	○	◐	●	◐	●	●
Microalgae	11	○	○	●	◐	●	●	●	●	○
Rainbow trout	8	○	○	●	●	◐	●	○	◐	○
Brown trout	8	●	○	●	●	●	○	○	○	○
Atlantic salmon	8	○	○	●	●	●	○	◐	◐	○
Kingfish	7	○	○	◐	◐	◐	○	○	●	●
King salmon	7	●	●	◐	◐	○	○	○	◐	○
Blue mussels	7	○	○	◐	●	○	○	○	●	●
P. oysters	7	◐	◐	◐	●	○	○	○	●	○
Abalone/Pāua	7	○	◐	◐	◐	○	○	○	●	●
NZ Scallop	4	○	○	◐	○	○	○	○	◐	●
NZ rock oyster	4	○	○	○	○	○	○	○	●	●
Fr. prawns	4	○	○	●	◐	○	○	○	◐	○
Carp	4	◐	○	◐	◐	○	◐	○	○	○
Bluff Oyster	3	○	○	○	○	○	○	○	◐	●

BIO-ECON SCORECARD 15/24

INCREASE BIOMASS ★★★★★

- Under ideal conditions, creates huge amounts of biomass per hectare (10-30 t/ha)

INCREASE VALUE ADD ★★★★★

- Numerous potential value added uses exist

BUILD RESILIENCE ★★★★★

- If we could farm it at any scale, it could create regional jobs

REDUCE AG GHG EMISSIONS ★★★★★

- Seaweed can be used in feed and on soil to reduce animal emissions

REPLACE FOSSIL FUELS ★☆☆☆☆

- Conceptual; lab scale; difficult to see working in practice under NZ conditions; will use energy as well

RETHINK WASTE ★☆☆☆☆

- Relatively small amounts currently wild harvested are used fully

DEMAND SIDE 2/5

MARKET SITUATION

- "Seaweed" encompasses 10,000 different species; seven species (98% of production) are farmed globally
- On a global basis wild collection of seaweed is flat; growth is from aquaculture
- Global seaweed aquaculture production is almost exclusively in E/SE Asia (99.5%): China (57.4%) and Indonesia (28.8%) dominate labour intensive aquaculture
- Korea seaweed production is 1.8m tonnes and is similar to Japan in their use of advanced technology
- Average farmgate value of US\$0.41 per kg; most seaweeds sell for <\$1/kg (this is low)
- NZ currently has an industry based on wild collection (size unclear 78t/yr or 1-2kt/yr)
- First commercial aquaculture "EcoPark" started in Bluff by subsid. of CH4 Global

DRIVERS OF GROWTH 4/5

- Relatively fast growing
- Created value from estuaries and shallow waters with high nutrient loads in countries with low environmental protection
- Low cost, labour intensive but high productivity production systems
- Extensive use as a low cost feedstock in numerous industrial processes
- Growing knowledge around health benefits of various species
- Can act to clean marine environment

"ELEVATOR PITCH"

New Zealand can identify specific specie(s) of seaweed than can be differentiated in the market leading to a market premium that exceeds the high relative cost of New Zealand production. At the same time, high productivity, mechanised production systems can be invented.

SUPPLY SIDE: NEW ZEALAND 10/16

LEVERAGEABLE NZ FACTORS

- 10th largest coastline of any country; large surface area in rivers, lakes and estuaries
- Isolated South Pacific location
- Numerous species of seaweed in NZ waters
- Scientific research capabilities, particularly around aquaculture
- Proven ability to conduct efficient aquaculture systems at scale
- Wider seafood industry participants are primarily long-term owners
- Hot right now; generating extensive noise and hype leading to government funding

SOURCES OF VALUE CREATION

- Invention of mechanised farming systems across the total supply chain (e.g. Korea and Japan)
- Numerous opportunities to add value across a wide range of value-added products
- Carbon farming
- Research into bioactive properties of unique New Zealand species

WHAT YOU WOULD NEED TO BELIEVE

- Environmental regulations can be managed at commercial scale
- Domestic production can compete with imports beyond specialised niches
- Seaweed is not just another farming fad that will fade once implementation begins
- Highly mechanised, high productivity farming systems can be developed
- These hypothetical farming systems can compete at scale with Chinese production

VALUE CHAIN LINKAGES

Soil amendments	X
Animal feed	?
Nutraceuticals	?
Cosmetics	?
Pharmaceuticals	?
Biofuel	?

BIO-ECON SCORECARD 14/24

INCREASE BIOMASS ★★★★★

- Under ideal conditions, creates huge amounts of biomass per hectare (10-50 t/ha)

INCREASE VALUE ADD ★★★★★

- Numerous potential value added uses exist in theory

BUILD RESILIENCE ★★★★★

- If we could farm it at any scale, it could create regional jobs

REDUCE AG GHG EMISSIONS ★★★★★

- Microalgae can be used in some types of aquaculture feed

REPLACE FOSSIL FUELS ★★★★★

- Conceptual; lab scale; difficult to see working in practice under NZ conditions; need development

RETHINK WASTE ★★★★★

- Very limited waste under ideal conditions

DEMAND SIDE

MARKET SITUATION 2/5

- Numerous species: chlorella, spirulina, etc.
- Global production around 25,000t in 2018 (UN FAO); growing off this low base
- Production in aquaculture a niche industry
- Production concentrated in Asia; China is around a third of global production
- Production systems that are taking share are primarily low tech (e.g. polythene lined trenches in rice paddies)
- The Chinese government has identified microalgae as a key strategic industry and is investing in R&D and growth
- Primary use is aquaculture feed and cosmetics; biofuel trials
- Small scale operators in NZ

DRIVERS OF GROWTH 4/5

- Government funding (US, China, etc.)
- Fast growing
- Replacement of high capital American production systems with low cost, labour intensive production systems in developing Asia increasing volumes and driving down prices
- Growing knowledge around potential usages

“ELEVATOR PITCH”

New Zealand’s small microalgae farming sector can continue to grow and develop a system and product that can compete with Chinese production in polythene lined trenches in rice paddies.

SUPPLY SIDE: NEW ZEALAND 10/16

LEVERAGEABLE NZ FACTORS

- Large surface area in rivers, lakes and estuaries
- Isolated South Pacific location
- Numerous species available (plus endemic species)
- Scientific research capabilities, particularly around aquaculture
- Proven ability to conduct efficient aquaculture systems at scale
- Wider seafood industry participants are primarily long-term owners
- Hot right now; generating extensive noise and hype leading to government funding

SOURCES OF VALUE CREATION

- Invention of scalable, mechanised farming systems that work in developed, temperate climate countries
- Numerous opportunities to add value across a wide range of value-added products
- Research into bioactive properties of unique New Zealand species

WHAT YOU WOULD NEED TO BELIEVE

- Environmental regulations can be managed at commercial scale
- Domestic production can compete with imports beyond specialised niches
- Microalgae is not just another farming fad that will fade once challenges emerge
- Lessons have been learned from the failure of past high capital ventures
- These hypothetical farming systems can compete at scale with Chinese production

VALUE CHAIN LINKAGES

Animal feed	X
Nutraceuticals	X
Cosmetics	X
Pharmaceuticals	?
Biofuels	?

BIO-ECON SCORECARD 11/24

INCREASE BIOMASS ★★☆☆

- Largest biomass from aquaculture by a long way
- Growth has stalled; new area hard

INCREASE VALUE ADD ★★★☆

- Significant value in oil and other bioactives already being exploited
- More opportunities exist

BUILD RESILIENCE ★★☆☆

- Creates regional employment, both at sea and on land

REDUCE AG GHG EMISSIONS ☆☆☆☆

-

REPLACE FOSSIL FUELS ☆☆☆☆

-

RETHINK WASTE ★★★★★

- Much has been achieved
- More can be done (e.g. shells)

DEMAND SIDE

MARKET SITUATION 2/5

- Mussels are produced from both wild capture and aquaculture; global mussel production is ~75% blue, ~25% green
- Global mussel market \$4.7b
- Mussel aquaculture is centered in China (44.3%), Chile (17.0%), and Europe (24.6%); large expansions in mussel aquaculture in China and Chile
- NZ is a second tier producer that accounts for 4% of mussel aquaculture; mussel production appears to have plateaued in the 80-100kt range
- NZ plateau a supply side issue at home
- The New Zealand mussel industry has a farmgate value of \$559m and an export value of \$333m

DRIVERS OF GROWTH 4/5

- Rich flavour
- Attractive in-shell presentation
- Research validating health-giving properties of greenshell mussels
- Growth of LOHAS (lifestyles of health and sustainability) shoppers
- Aging population seeking natural solutions to health concerns/issues
- Pets as “child substitutes” in petfood sector
- Pressure on shellfish supply in many markets

“ELEVATOR PITCH”

New Zealand pioneered greenshell mussel farming in the 1950's. Subsequently scientists have identified bioactive components with therapeutic properties, particularly around joint health. The recent stall in production is a temporary event and the sector will return to growth.

SUPPLY SIDE: NEW ZEALAND 10/16

LEVERAGEABLE NZ FACTORS

- 10th largest coastline of any country
- Isolated South Pacific location
- Country the size of Italy with the population of Singapore
- Scientific research capabilities, particularly around mussels and marine bioactives
- Proven aquaculture systems at scale
- Large and mature industry with primarily long-term owners/participants
- Ongoing breeding program delivering results

SOURCES OF VALUE CREATION

- Further research into unique properties
- Continuous productivity gains across all key variables
- Better utilisation of secondary products, byproducts and waste streams
- Development of complex, multi-layer farming systems increasing total yield

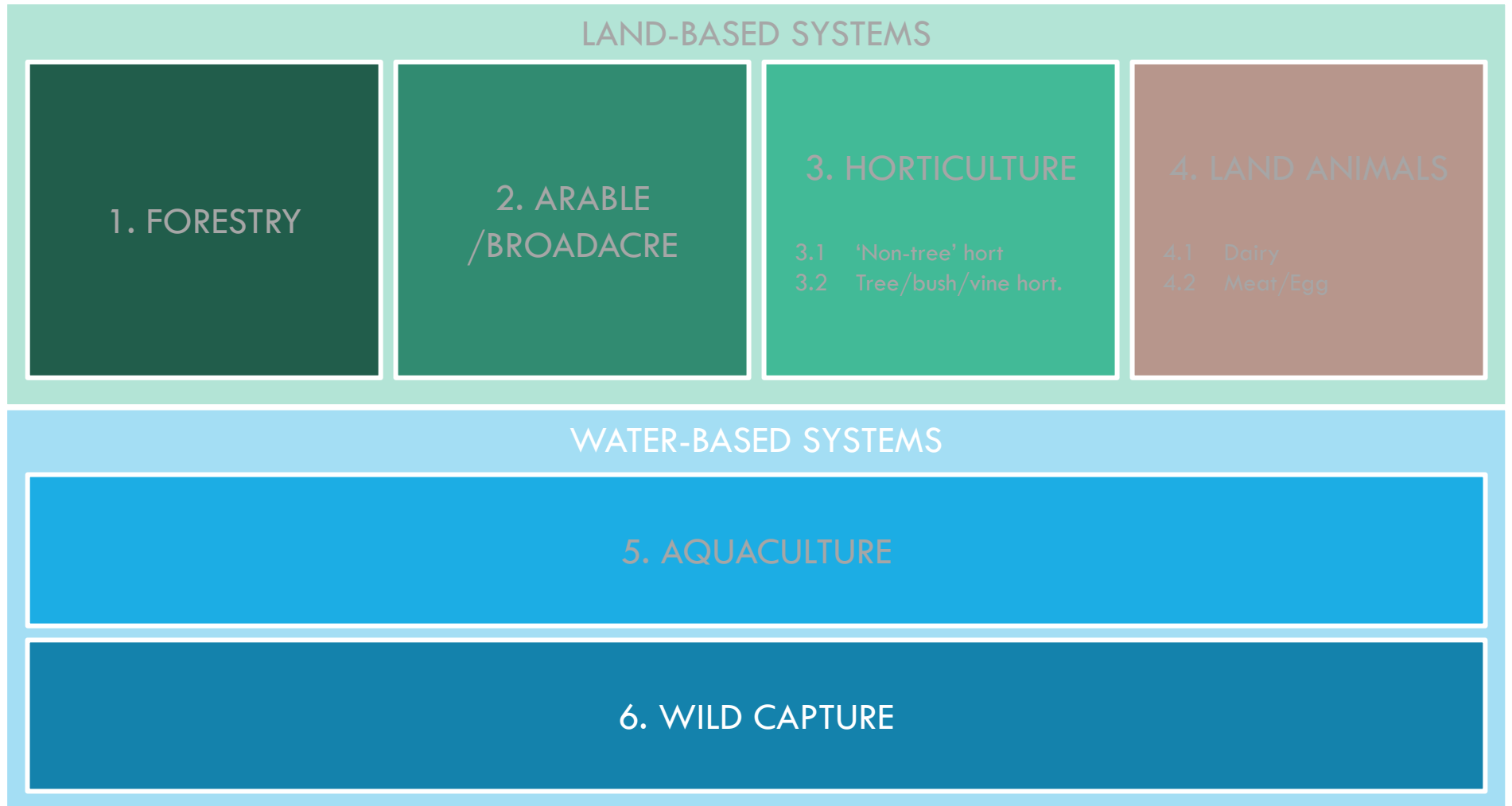
WHAT YOU WOULD NEED TO BELIEVE

- NZ greenshell mussels have unique properties that allow them to remain differentiated to other varieties
- Production of mussels in NZ can remain competitive with other regions (e.g. Chile)
- Government regulations will remain manageable for mussel farmers
- Emerging supplements industry regulations will not inhibit innovation

VALUE CHAIN LINKAGES

Seafood processors	XXX
Nutraceutical mnfr.	XXX
Marine bioactive processors	XXX
Pet food manufacturers	XX

11.6. WILD CAPTURE FISHERIES



New Zealand captures a huge range of seafood, however there are a small number of large species and a large number of smaller species

PRELIMINARY IDENTIFICATION OF BIOMASS PRODUCTION SYSTEMS: WILD CAPTURE SEAFOOD

	Emerging/Tertiary/Bycatch Seafood Species (Under 10kt)	Secondary Seafood Species (10-99kt)	Major Seafood Species (100kt+)
	Rock lobster "crayfish" (3,946t in 2020)	Wellington flying/arrow squid (41,929t in 2020)	Blue grenadier/Hoki (105,220t in 2020)
~350+ species Not analysed further	Another ~290+ marine fish species (each under 10kt)* (Total 109,346t in 2020)	Jack and horse mackerels nei (37,356t in 2020)	
	Another ~27 mollusc species (each under 10kt) (Total 3,485t in 2020)	Snoek/"Barracouta" (20,637t in 2020)	
	Another ~17 crustacean species (each under 10kt) (Total 401t in 2020)	Pink cusk-eel/Ling (16,336t in 2020)	
	All seaweeds (combined total 579t in 2020)	Southern blue whiting (13,375t in 2020)	
	10+ sea urchins and other misc. aquatic animals species (each under 10kt) (Total 1,038t in 2020)	Oreo dories (10,512t in 2020)	
10+ aquatic mammals primarily bycatch (e.g. NZ fur seal, NZ sea lions) (Total 241 head in 2020)	"Bycatch" collectively ~60,000t (estimate) of which ~30,000t is currently landed (before implementation of new regulations)**		

* including diadromous; ** very rough Coriolis estimate from industry interviews and modelling; includes in-shore and deepwater; no accurate or "n-complete" source identified; if you dispute this, send your data and analysis to tmorris@coriolisresearch.com

Only one wild capture-based systems emerged from “Screen 0”

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Currently large biomass harvested	Huge waste streams; clear, material coproduct /byproduct opportunities	Clear global consumer demand macro-drivers	Proven, scalable farming systems in developed countries	Material production growth in NZ peer group countries	Material growth in NZ (in a relative sense)	Significant volume imported directly (or clear substitutes)	Clear social licence to operate from NZ public	Traditional/ Māori/Pacific socio-cultural connections
Bycatch	12	●	●	●	○	●	●	○	●	●
Hoki	9	●	●	●	○	○	○	○	●	●
Southern blue whi.	8	●	●	●	○	○	○	○	●	●
Oreo/John Dories	8	●	●	●	○	○	○	○	●	●
Ling	8	●	●	●	○	○	○	○	●	●
Jack Mackerel	8	●	●	●	○	○	○	○	●	●
Crayfish	8	●	●	●	○	○	○	○	●	●
Barracouta/snoek	8	●	●	●	○	○	○	○	●	●
Arrow squid	8	●	●	●	○	○	○	○	●	●
Rock lobster “crayfish”	6	●	○	●	○	○	○	○	●	●
Seaweed (wild)	6	○	○	●	○	○	○	○	●	●

BIO-ECON SCORECARD 12/24

INCREASE BIOMASS ★ ★ ★ ☆

- Changing government regulations will cause more to be landed
- Total catch will continue to fall

INCREASE VALUE ADD ★ ★ ★ ★

- Currently going to meal; sorting a huge range of fish is the issue
- Pet food is the clear opportunity

BUILD RESILIENCE ☆ ☆ ☆ ☆

- Industry consolidating; employment falling; volumes declining
- Can support animal feed inc. aqua.

REDUCE AG GHG EMISSIONS ☆ ☆ ☆ ☆

-

REPLACE FOSSIL FUELS ★ ☆ ☆ ☆

- Fishing vessels use fossil fuels
- Some opportunity to replace imports

RETHINK WASTE ★ ★ ★ ★

- Opportunities to develop new uses beyond fish meal and pet food
- Animal/aquaculture feed opps.

DEMAND SIDE 2/5

MARKET SITUATION

- New Zealand has a highly controlled and regulated wild catch seafood industry
- NZ has a declining landed seafood wild catch; 364kt in 2020 vs. 430kt in 2017
- Falling production driven by changing estimates of sustainable annual catch (and one off impact of COVID)
- Bycatch are unwanted fish discarded at sea (due to low/no value) rather than landed by commercial fishing operations
- Commonly associated with trawl fisheries (also other fisheries)
- New regulation in New Zealand will require this bycatch to be landed
- Estimates for the size of New Zealand's bycatch vary

DRIVERS OF GROWTH 4/5

- Growing government regulation of wild catch seafood industry in New Zealand
- Growing demand in some markets for sustainably produced seafood
- Increasing consumer demand for seafood when supplies are declining in many regions due to overfishing
- Aquaculture production growth, particularly in Asia, driving demand for fish feed
- Pets as child substitutes (ingredients in petfood)

"ELEVATOR PITCH"

Changes to New Zealand wild catch fishing regulations will trigger a significant increase in landed bycatch. Biomaterial previously dumped at sea will now be landed creating numerous opportunities for growth.

SUPPLY SIDE: NEW ZEALAND 8/16

LEVERAGEABLE NZ FACTORS

- One time increase in landed catch being forced by government
- 10th largest coastline of any country
- Numerous species of fish and other aquatic animals in NZ waters
- Scientific research capabilities, particularly around marine species and environments
- Proven ability to fish efficiently at scale aquaculture
- Large, efficient and consolidated seafood processors at scale
- Wider seafood industry participants are primarily long-term owners

SOURCES OF VALUE CREATION

- Extraction of high value biomaterials from low/no value bycatch
- Development of new bioactives
- Petfood ingredients
- Feed milling targeting aquaculture

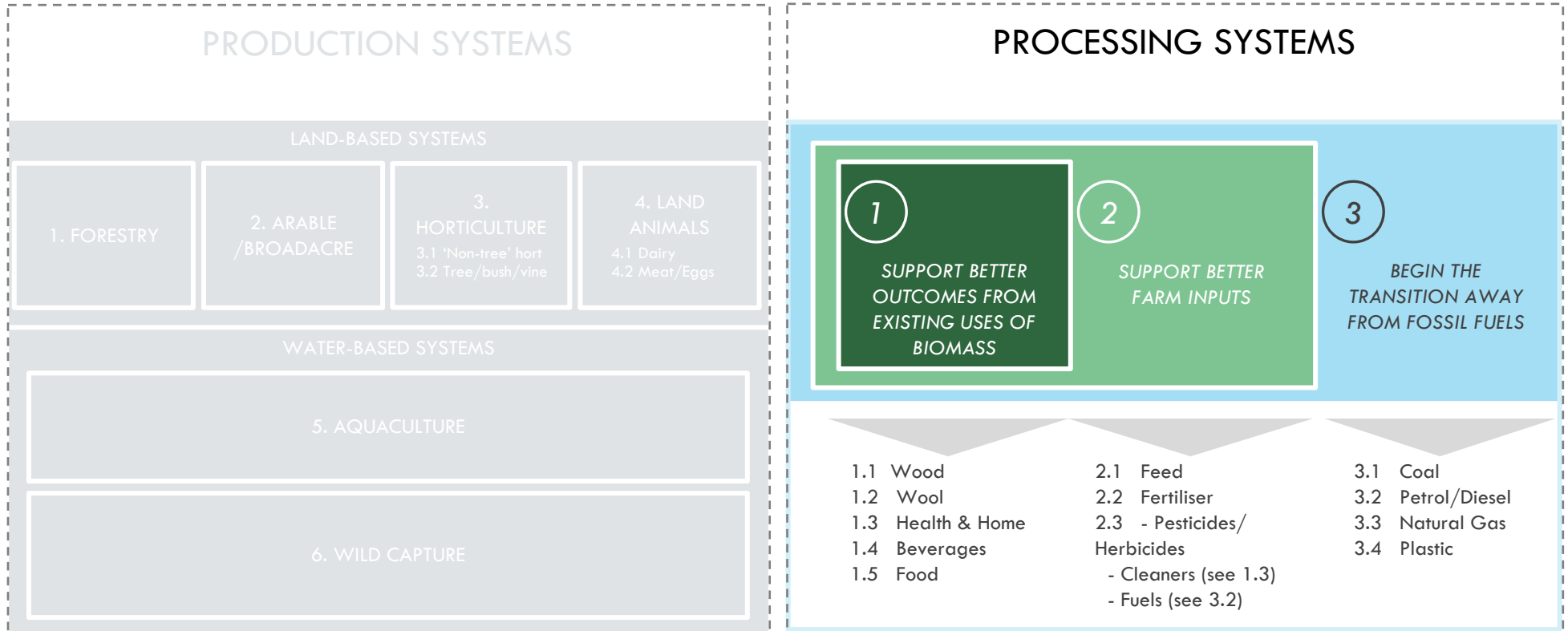
WHAT YOU WOULD NEED TO BELIEVE

- These species, which were previously dumped at sea, have any value
- Profitable uses for bycatch can be identified and developed in a relatively short time
- Sorting a large number of small species under real world conditions makes economic sense; efficiency and complexity can be managed

VALUE CHAIN LINKAGES

Seafood processors	XXX
Marine bioactives	X
Pet food manufacturers	XXX
Animal feed mnfg.	?
Nutraceuticals	?
Soil amendments	?

THE ONE HUNDRED: PRODUCTION AND PROCESSING SYSTEMS



There are three broad and interrelated objectives for biomass processing systems in the shift to a more bioeconomy

WHAT ARE OUR OBJECTIVES FOR OUR BIOMASS PROCESSING SYSTEMS?



III.1 SUPPORTING BETTER OUTCOMES FROM EXISTING USES OF BIOMASS

WHAT ARE OUR OBJECTIVES FOR OUR BIOMASS PROCESSING SYSTEMS?

1 SUPPORT BETTER
OUTCOMES FROM
EXISTING USES OF
BIOMASS

- 
- 1.1 Wood
 - 1.2 Wool
 - 1.3 Health & Home
 - 1.4 Beverages
 - 1.5 Food

III.1.1 WOOD

WHAT ARE OUR OBJECTIVES FOR OUR BIOMASS PROCESSING SYSTEMS?

1 SUPPORT BETTER
OUTCOMES FROM
EXISTING USES OF
BIOMASS

1.1 Wood

1.2 Wool

1.3 Health & Home

1.4 Beverages

1.5 Food

Four wood processing platforms emerged from “Screen 0”

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Growing number of firms in NZ	Growing employment in NZ	Large employer in NZ	NZ produces ingredients or precursors	Global leaders achieve large gross margins	Defensible with barriers to entry	Clear growth platform in peer group countries	Signif. volume imported (or clear substit.)	Complex value chain drawing in numerous diverse inputs	High levels of ongoing innovation occurring
Forestry-based biochemicals	11	●	●	○	●	●	●	●	●	○	●
Paperboard/packaging mnfg.	10	○	○	●	●	●	○	●	●	●	●
Veneer/ply/eng	10	○	○	●	●	●	○	●	●	●	●
Reconstit. wood product mnfg.	10	○	●	●	●	●	●	○	○	●	●
Wooden structural fitting/component	8	○	●	●	●	●	○	○	○	○	●
Prefab wooden buildings	9	●	●	●	●	○	○	●	○	●	●
Pulp & paper	8	●	○	●	●	●	○	○	●	●	○
Log sawmilling	6	○	○	●	●	●	●	○	○	○	○
Timber resawing & dressing	6	○	●	●	●	○	○	○	○	○	○
Sanitary paper mnfg.	6	●	○	●	●	○	○	○	●	○	○
Other converted paper mnfg.	6	○	○	●	●	●	○	○	●	●	○
Other wood product mnfg.	5	○	○	●	●	○	○	●	○	○	○
Paper stationery mnfg.	5	●	○	○	●	○	○	○	●	●	○
Paper bag mnfg.	4	●	○	○	●	○	○	○	●	○	○
Wood chipping	2	○	○	○	●	○	○	○	○	○	○

RECONSTITUTED WOOD PRODUCT MNFG.

TOTAL SCORE

36/50

INTERNATIONAL STANDARD CODES

ANZSIC	1494
NACE (European Union)	16.2
NAICS (North America)	3212

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

20
26

“ELEVATOR PITCH”

The building industry is constantly seeking new solutions that (1) increase performance, (2) increase productivity and (3) reduce costs. Engineered wood can deliver on all three and support a shift to healthy more environmentally friendly buildings.

BIO-ECON SCORECARD

16
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Modest growth in last twenty years
- Significant growth is possible

COMPLEX WITH MULTIPLE INPUTS ★★☆☆

- Complexity in process

BUILDS SYSTEM RESILIENCE ★☆☆☆

- Supports regional jobs

UNLOCK AG EMISSIONS RED ★★☆☆

- Supports plantation forestry

REPLACE FOSSIL FUELS ★★★★★

- Replacing emissions and energy-intensive concrete and steel
- Can use waste in on-site bioenergy

RETHINK WASTE ★★★★★

- Supports use of whole tree
- Biodegradable
- Further opportunities to do more

PLATFORM DEFINITION

ANZSIC 1494: “Manufacturing wood boards and sheets from reconstituted wood fibres such as wood chips, sawdust, wood shavings, slabwood or off-cuts. Also included are units that manufacture laminations of timber and non-timber materials (including decorative plastic laminates on boards/substrates).

- Chip board manufacturing
- Corestock manufacturing
- Fibreboard manufacturing
- Hardboard manufacturing
- Laminations of timber and non-timber materials manufacturing
- Medium density fibreboard (MDF) manufacturing
- Oriented strand board (OSB) manufacturing
- Particleboard manufacturing

LEVERAGEABLE NZ FACTORS

- Shortage of houses
- High and growing cost of construction
- Pressures to control costs and improve industry productivity
- Significant consumer wealth in housing sector; reinvesting in appreciating assets
- Forestry research capabilities
- Large supply of low cost raw materials

SOURCES OF VALUE CREATION

- Forest Stewardship Council (FSC)
- Continued product innovation, particularly targeting new uses
- Premium market niches
- Differentiated products for specialised applications
- Higher quality, more demanding applications
- Improving industry productivity

NZ INDUSTRY METRICS

Uses ANZSIC 1494

Geographic units	21
Unit growth (00-22)	-3
Unit growth CAGR (00-22)	-1% pa
Employee count	1,100
Employee growth since 2000	+200
Empl. growth CAGR (00-22)	1% pa

Importers and wholesalers will be classified elsewhere

POTENTIAL NZ BIOMASS USED

Wood chips	XXX
Sawdust	XXX
Other wood and byproducts	XX
Resins	X
Adhesives	X

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand pinus radiata can take further market share, particularly against other sources/types of wood
- The business case for expansion in New Zealand stacks up against other options
- Housing will not be impacted by the unwinding of the baby boom supercycle
- Opportunities and challenges with immigration will be resolved

VENEER, PLYWOOD & ENGINEERED WOOD MNFG.

TOTAL SCORE

34/50

INTERNATIONAL STANDARD CODES

ANZSIC	1493
NACE (European Union)	16.2
NAICS (North America)	3212-1

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

19
26

“ELEVATOR PITCH”

Veneer and plywood products add value to New Zealand wood and help support the shift to a sustainable bioeconomy. Engineered structural timber is an economically viable option for medium height buildings in New Zealand

BIO-ECON SCORECARD

15
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Conceptually, yes
- In practice, industry is shrinking

COMPLEX WITH MULTIPLE INPUTS ★☆☆☆

- Complexity in process

BUILDS SYSTEM RESILIENCE ★☆☆☆

- Supports regional jobs

UNLOCK AG EMISSIONS RED ★★☆☆

- Supports plantation forestry

REPLACE FOSSIL FUELS ★★★★★

- Replacing energy-intensive drywall/sheetrock
- Can use waste in on-site bioenergy

RETHINK WASTE ★★★★★

- Supports use of whole tree
- Biodegradable
- Further opportunities to do more

PLATFORM DEFINITION

- Manufacturing veneers and plywood:
- Core, plywood or veneer, manufacturing
 - Glue laminated lumber (Glulam) manufacturing
 - Laminated veneer lumber (LVL) manufacturing
 - Cross laminated timber (CLT)
 - Plywood manufacturing
 - Veneer manufacturing [ANZSIC]

Note that ANZSIC separates “manufacturing wood boards and sheets from reconstituted wood fibres such as wood chips, sawdust, wood shavings, slabwood or off-cuts. Also included are units that manufacture laminations of timber and non-timber materials (including decorative plastic laminates on boards or other substrates)” into another code [1494]

LEVERAGEABLE NZ FACTORS

- Shortage of houses
- High and growing cost of houses
- Pressures to control costs and improve industry productivity
- Significant consumer wealth in housing sector; reinvesting in appreciating assets
- Forestry research capabilities

SOURCES OF VALUE CREATION

- Forest Stewardship Council (FSC)
- Premium market niches
- Differentiated products for specialised applications
- Higher quality, more demanding applications
- Improving industry productivity
- Building capability in mid-rise timber construction

NZ INDUSTRY METRICS

Uses ANZSIC 1493

Geographic units	15
Unit growth (00-22)	-18
Unit growth CAGR (00-22)	-3.5% pa
Employee count	1,000
Employee growth since 2000	-1,000
Empl. growth CAGR (00-22)	-3.1% pa

Importers and wholesalers will be classified elsewhere

POTENTIAL NZ BIOMASS USED

Pinus radiata	XXX
Other minor trees	X
Resins	XX
Other adhesives	X

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand pinus radiata can take further market share, particularly against other sources/types of wood
- Building to medium height with engineered structural wood products will remain a viable option vs. alternatives
- The business case for expansion in New Zealand stacks up against other options
- Industry has shrunk firm numbers and employment by ~50% since 2000; despite this, a turnaround is possible
- Housing will not be impacted by the unwinding of the baby boom supercycle

INTERNATIONAL STANDARD CODES

ANZSIC	1812 (catch all)
NACE (European Union)	20.13 (catch all)
NAICS (North America)	3251-99 (catch all)

PLATFORM DEFINITION

ANZSIC is a catch-all: "basic organic chemicals, including wood or gum chemicals (e.g. organic tanning extracts and charcoal briquettes); high grade activated charcoal and/or carbon black; organic dyes and pigments. This class also includes units mainly engaged in manufacturing organic acids and industrial alcohols such as ethanol, methanol, ethylene glycol and ether."

We take a narrow focus here on extracting usable biochemical products from forestry products.

NZ INDUSTRY METRICS

<i>Uses ANZSIC 1812 (basic organic chemicals)</i>	
Geographic units	27
Unit growth (00-22)	+15
Unit growth CAGR (00-22)	4% pa
Employee count	380
Employee growth since 2000	+130
Empl. growth CAGR (00-22)	2% pa
Sawmilling and wood processing classified elsewhere.	

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

16
26

"ELEVATOR PITCH"

New Zealand has a large amount of byproducts from sawmilling and wood processing and an even larger amount of forestry waste left at the plantation. Scientific research could be translated into profitable commercial applications.

LEVERAGEABLE NZ FACTORS

- Forestry research capabilities
- Large supply of low cost raw materials
- Large amounts of logging waste left on plantation
- Range of passionate innovators pushing the forestry biochemical extraction concept

SOURCES OF VALUE CREATION

- Government highly interested in finding a solution to a clear problem leading to readily available government funding
- IP protection around any discoveries of value

POTENTIAL NZ BIOMASS USED

Logging waste	XXX
Wood byproduct	XXX

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can maintain ownership and benefit from any technology it develops in this space (cf. LanzaTech)
- New Zealand has the concentrated volumes of input feedstock available in specific locations to support these potential processes

BIO-ECON SCORECARD

12
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Hypothetically yes, if the science and economics come together

COMPLEX WITH MULTIPLE INPUTS ★★☆☆

- Multiple complex, unproven processes at various stages of development

BUILDS SYSTEM RESILIENCE ★☆☆☆

- Potential to displace some imported raw materials

UNLOCK AG EMISSIONS RED ★★☆☆

- Supports forestry

REPLACE FOSSIL FUELS ★★☆☆

- Some fractionates may potentially replace some fossil fuel based products

RETHINK WASTE ★★☆☆

- Hypothetically yes, if the science and economics come together

CORRUGATED PAPERBOARD/PAPERBOARD CONTAINER

TOTAL SCORE

28/50

INTERNATIONAL STANDARD CODES

ANZSIC	1521
NACE (European Union)	17.21
NAICS (North America)	3222

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

12
26

“ELEVATOR PITCH”

New Zealand's growing demand for innovative packaging can translate into growing demand for corrugated paperboard and paperboard containers.

BIO-ECON SCORECARD

13
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Conceptually, yes
- In practice, industry is shrinking

COMPLEX WITH MULTIPLE INPUTS ★☆☆☆

- Some types of packaging are reasonably complex

BUILDS SYSTEM RESILIENCE ★☆☆☆

- Supports regional jobs

UNLOCK AG EMISSIONS RED ★★☆☆

- Supports plantation forestry

REPLACE FOSSIL FUELS ★★★★★

- Replacing plastics and similar with wood based solutions

RETHINK WASTE ★★★★★

- Supports use of whole tree
- Biodegradable

PLATFORM DEFINITION

ANZSIC C152100 Corrugated Paperboard and Paperboard Container Manufacturing: “This class consists of units mainly engaged in manufacturing corrugated paperboard containers, sheeting or solid paperboard containers.

Primary activities

- Corrugated paperboard container manufacturing
- Corrugated paperboard manufacturing
- Paperboard container manufacturing”

LEVERAGEABLE NZ FACTORS

- Growth of online shopping
- Growing production and export of value added food, beverage and FMCG products needing packaging
- Growing demand for environmentally friendly packaging
- Flexible, fast moving, innovative manufacturers

SOURCES OF VALUE CREATION

- Forest Stewardship Council (FSC)
- Targeted solutions for specific problems
- Efficient and profitable solutions for small production runs
- Improving industry productivity

NZ INDUSTRY METRICS

Uses ANZSIC 1521

Geographic units	33
Unit growth (00-22)	-.9
Unit growth CAGR (00-22)	-1.1% pa
Employee count	1,750
Employee growth since 2000	-350
Empl. growth CAGR (00-22)	-0.8% pa

Importers and wholesalers will be classified elsewhere

POTENTIAL NZ BIOMASS USED

Paperboard	XXX
Adhesives	?
Ink	?

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand manufactured solutions can continue to compete with imported products
- The current decline of the sector (e.g. closing mills) is not terminal
- The sector can shift to growth

III.1.2 WOOL

WHAT ARE OUR OBJECTIVES FOR OUR BIOMASS PROCESSING SYSTEMS?

1 SUPPORT BETTER
OUTCOMES FROM
EXISTING USES OF
BIOMASS

1.1 Wood

1.2 Wool

1.3 Health & Home

1.4 Beverages

1.5 Food

A wide range of wool and other fibre processing platforms were evaluated, but only one emerged from “Screen 0”

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Growing number of firms in NZ	Growing employment in NZ	Large employer in NZ	NZ produces ingredients or precursors	Global leaders achieve large gross margins	Defensible with barriers to entry	Clear growth platform in peer group countries	Signif. volume imported (or clear substit.)	Complex value chain drawing in numerous diverse inputs	High levels of ongoing innovation occurring
Natural home insulation Mnfg.	10	●	●	○	●	●	●	●	○	●	●
Wool fractionates	10	○	○	○	●	○	●	●	●	○	●
Carpet/ Floor Covering Mnfg.	8	○	○	●	●	●	●	○	●	○	●
Cut & Sewn Textile Product Mnfg.	7	○	○	●	●	○	○	●	●	○	●
Synthetic Fibre Textile Mnfg.	6	○	○	○	○	●	●	○	●	○	●
Clothing Mnfg.	6	○	○	●	●	○	○	○	●	○	●
Leather Tanning, Fur Dressing and Leath. prod. Mnfg.	5	○	○	●	●	○	●	○	●	○	○
Natural textile manufacturing	5	○	○	●	●	○	○	○	●	○	○
Rope, Cordage and Twine Mnfg.	5	●	○	○	●	●	○	○	●	○	○
Wool scouring	5	○	○	●	●	●	●	○	○	○	○
Knitted Product Manufacturing	5	○	○	●	●	○	○	○	●	○	○
Textile Finishing/ Oth. Tex Mnfg.	5	○	○	●	●	○	●	○	●	○	○
Footwear Mnfg.	4	○	○	○	●	○	○	○	●	○	○

INTERNATIONAL STANDARD CODES

ANZSIC [NO CLEAR CODE]	None
NACE (European Union)	-
NAICS (North America)	-

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

22
26

“ELEVATOR PITCH”

Rather than primarily exporting large but falling quantities of raw, greasy wool, primarily to China, New Zealand instead could turn it into a natural insulation product targeting high value customers at home and in key export markets willing to pay a premium.

BIO-ECON SCORECARD

14
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- Theoretically yes

COMPLEX WITH MULTIPLE INPUTS ☆☆☆

- One or two main inputs typically

BUILDS SYSTEM RESILIENCE ★☆☆☆

- Potential to displace some imported raw materials

UNLOCK AG EMISSIONS RED ★☆☆☆

- Potentially supports wool price during any required transition

REPLACE FOSSIL FUELS ★★★★★

- Replaces products made from fossil fuels
- Reduces energy requirements

RETHINK WASTE ★★★★★

- Can add value to a wide range of wool and other fibrous wastes

PLATFORM DEFINITION

It is unclear where natural home insulation (e.g. wool, hemp) is classified currently.

Plastic based insulation (e.g. from recycled bottles) is classified as “1913 Polymer foam product manufacturing” while glass fibre or mineral wool insulation” is “2090 Other Non-metallic mineral product manufacturing. Both are huge ‘catch-all’ categories.

LEVERAGEABLE NZ FACTORS

- Large sheep population (though with declining numbers)
- Major wool producer and exporter
- Wool scouring sector at scale
- Latent global reputation as a source of natural product in general and wool specifically
- Small industrial hemp industry
- Range of passionate innovators pushing the natural insulation concept

SOURCES OF VALUE CREATION

- Improved marketing; better market research and customer segmentation
- Building a stronger, more compelling sales pitch
- Changing regulations
- Lobbying government to use product in new government builds

NZ INDUSTRY METRICS

Not currently formally defined by ANZSIC or measured by StatisticsNZ.

Likely spread across at least two existing classifications given above.

POTENTIAL NZ BIOMASS USED

Wool	XXX
Hemp	XX
Recycled denim, etc.	X
Flax	X
Cellulose	X

WHAT YOU WOULD NEED TO BELIEVE

- A significant percent of the population will be willing to pay a premium for natural solutions
- Natural wool or wool/hemp blend products can achieve cut through against other environmentally friendly solutions (e.g. recycled plastic)
- Now that hemp binder made in NZ is Brandz approved, demand will increase

INTERNATIONAL STANDARD CODES

ANZSIC	1812 (catch all)
NACE (European Union)	20.13 (catch all)
NAICS (North America)	3251-99 (catch all)

PLATFORM DEFINITION

ANZSIC is a catch-all: "basic organic chemicals, including wood or gum chemicals (e.g. organic tanning extracts and charcoal briquettes); high grade activated charcoal and/or carbon black; organic dyes and pigments. This class also includes units mainly engaged in manufacturing organic acids and industrial alcohols such as ethanol, methanol, ethylene glycol and ether."

We take a narrow focus here on fractionating wool.

NZ INDUSTRY METRICS

Uses ANZSIC 1812

Geographic units	27
Unit growth (00-22)	+15
Unit growth CAGR (00-22)	4% pa
Employee count	380
Employee growth since 2000	+130
Empl. growth CAGR (00-22)	2% pa
Wool scouring [1311] and fur dressing [1320] classified elsewhere	

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

16
26

"ELEVATOR PITCH"

New Zealand is the largest exporter of lamb meat by value, the second largest exporter of wool by volume and the largest exporter of lanolin by volume. At the same time, global demand for wool is collapsing (down -50% in 30 years). New uses for wool are possible and this is a space where New Zealand can win.

LEVERAGEABLE NZ FACTORS

- Large sheep population (though with declining numbers)
- Major wool producer and exporter
- Wool scouring sector at scale
- Latent global reputation as a source of wool specifically
- Range of passionate innovators pushing the wool fractionates concept
- Dedicated research teams at Lincoln University

SOURCES OF VALUE CREATION

- Government funding
- IP protection around any discoveries of value
- Develop into high value products (e.g. natural dyes)

POTENTIAL NZ BIOMASS USED

Wool XXX

WHAT YOU WOULD NEED TO BELIEVE

- Falling global demand for wool which is occurring for a range of reasons will continue to suppress demand and prices releasing low cost feedstock
- Despite shearing costs now exceeding wool value, farmers will continue to shear their sheep rather than shift to self-shedding
- Wool makes more sense as a feedstock than competing sources of biomass
- Feeding an animal plants in order to fractionate the wool makes more sense than fractionating plants

BIO-ECON SCORECARD

8
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Speculative and unproven against competing solutions

COMPLEX WITH MULTIPLE INPUTS ★★★☆

- Process is potentially complex

BUILDS SYSTEM RESILIENCE ☆☆☆☆

- May assist regions with significant sheep

UNLOCK AG EMISSIONS RED ☆☆☆☆

-

REPLACE FOSSIL FUELS ★★★☆

- Some fractionates may potentially replace some fossil fuel based products

RETHINK WASTE ☆☆☆☆

-

III.1.3 HEALTH & HOME

WHAT ARE OUR OBJECTIVES FOR OUR BIOMASS PROCESSING SYSTEMS?

1 SUPPORT BETTER
OUTCOMES FROM
EXISTING USES OF
BIOMASS

1.1 Wood

1.2 Wool

1.3 Health & Home

1.4 Beverages

1.5 Food

Four post-farmgate consumer FMCG/CPG, health & home processing platforms emerged from “Screen 0”

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Growing number of firms in NZ	Growing employment in NZ	Large employer in NZ	NZ produces ingredients or precursors	Global leaders achieve large gross margins	Defensible with barriers to entry	Clear growth platform in peer group countries	Signif. volume imported (or clear substit.)	Complex value chain drawing in numerous diverse inputs	High levels of ongoing innovation occurring
Nutraceuticals (Vitamins, Minerals and Supplements Manufacturing)	18	●	●	◐	◐	●	●	●	●	●	●
Cosmetics & Toiletries Manufacturing	17	●	◐	◐	◐	●	●	●	●	●	●
Soap, Cleaning Compound and Household Cleaning Products	15	●	○	◐	◐	●	●	◐	●	●	●
Essential Oils Extraction	12	◐	◐	○	●	●	◐	●	◐	◐	◐
Tobacco Product Manufacturing	7	○	○	○	○	●	○	○	●	◐	●

INTERNATIONAL STANDARD CODES

ANZSIC [NO CLEAR CODE]	Multiple
NACE (European Union)	21.2 (part)
NAICS (North America)	3254 (part)

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

24
26

“ELEVATOR PITCH”

New Zealand can continue to grow its nutraceuticals industry through a focus on innovation and new products targeting export markets, particularly high value markets in Asia.

BIO-ECON SCORECARD

17
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Often processes large quantities to get a small amount of target and large amounts of further byproduct

COMPLEX WITH MULTIPLE INPUTS ★★★★★

- All classes of biomaterial
- Ingredients range from common to extremely rare

BUILDS SYSTEM RESILIENCE ★★☆☆

- Knits together products from all regions and sectors
- Many compounds imported (e.g. C)

UNLOCK AG EMISSIONS RED ★☆☆☆

- Can support carbon farming of native forests and other alternative land uses

REPLACE FOSSIL FUELS ★★☆☆

- Traditionally large FF content (e.g. coal tar into B1)

RETHINK WASTE ★★★★★

- Huge and proven ability to create value from low value byproducts
- Much more can be done

PLATFORM DEFINITION

In the current NZ standard industry classification, nutraceuticals are primarily captured as pharmaceuticals [1841] or “other food manufacturing not elsewhere classified” [1199]. Some products will be made as byproducts in other platforms. [Coriolis]

“Nutraceutical is a broad term describing foods, food ingredients, and dietary supplements that provide specific health or medical benefits.” [Science Direct]

LEVERAGEABLE NZ FACTORS

- Wide range of unique native plants with potential application in nutraceuticals
- Global recognition of mānuka honey as a natural health product
- Demonstrated ability to penetrate and grow sales into key Asian markets
- Passionate and growing group of champions driving growth of NZ sector
- Recognised and trusted supplier of natural and healthy products
- Strong group of contract manufacturers

SOURCES OF VALUE CREATION

- Nutraceutical/supplements combinations for multiple benefits
- Targeted functional food ingredients
- Marketing single source, sustainable, and other soft benefits/claims
- Traceability
- Direct/online platform sales systems and management
- Daigou channels

NZ INDUSTRY METRICS

Not currently formally defined by ANZSIC or measured by StatisticsNZ.

Spread across a number of existing classifications, including other foods not elsewhere classified [1199] and pharmaceuticals [1841]. Other platforms will also produce these as byproducts. Some firms may be packaging services [7320]. Sales and marketing firms will be other grocery wholesaling [3609] or pharmaceutical and toiletry goods wholesaling [3720].

Clearly a large and growing sector for New Zealand that has attracted global investment.

POTENTIAL NZ BIOMASS USED

Native botanicals	XXX
Sheep (byproducts)	XX
Cattle (byproducts)	XX
Fruit byproducts	X
Dairy	X
Beekeeping products	X
Mānuka	XX
Pinus radiata	X
Other waste streams	XX
Yeast/bacteria	X

WHAT YOU WOULD NEED TO BELIEVE

- Upcoming changes to industry regulations will not ‘throw out the baby with the bathwater’ and ‘regulate industry to death’ particularly innovation/NPD* around new bio-extracts
- New Zealand can continue to identify and develop new products that create cut through in a crowded market
- New Zealand will continue to be able to access the Chinese market through formal and informal channels

*NPD New Product Development

INTERNATIONAL STANDARD CODES

ANZSIC	1852
NACE (European Union)	20.42
NAICS (North America)	3256-20

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

24
26

“ELEVATOR PITCH”

NZ has all the required ingredients to continue to build a natural cosmetics industry targeting discerning, high income consumers in major export markets.

BIO-ECON SCORECARD

16
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Often processes large quantities to get a small amount of target and large amounts of further byproduct

COMPLEX WITH MULTIPLE INPUTS ★★★★★

- All classes of biomaterial
- Ingredients range from common to extremely rare

BUILDS SYSTEM RESILIENCE ★★☆☆

- Supports smaller regional brands
- Knits together products from all regions and sectors

UNLOCK AG EMISSIONS RED ★☆☆☆

- Can support carbon farming of native forests and other alternative land uses

REPLACE FOSSIL FUELS ★★★★★

- Traditionally large ff content
- Bio-cosmetics replace fossil fuel based ingredients

RETHINK WASTE ★★★★★

- Huge and proven ability to create value from low value byproducts
- Much more can be done

PLATFORM DEFINITION

- Manufacturing cosmetic and toiletry prep.
- After-shave lotion manufacturing
 - Barrier cream manufacturing
 - Cosmetic deodorant manufacturing
 - Depilatory manufacturing
 - Eye shadow manufacturing
 - Face cream and lotion manufacturing
 - Hair preparation manufacturing
 - Lip balm manufacturing
 - Lipstick manufacturing
 - Mascara manufacturing
 - Nail polish preparation manufacturing
 - Perfume manufacturing
 - Shaving preparation manufacturing
 - Sunscreen preparation manufacturing
 - Talcum powder manufacturing
 - Toilet lanolin manufacturing [ANZSIC]

LEVERAGEABLE NZ FACTORS

- Wide range of unique native plants with potential applications in cosmetics
- Global recognition of mānuka honey as a natural cosmetic ingredient
- Largest global supplier of lanolin
- Demonstrated ability to penetrate and grow sales into key Asian markets
- Passionate and growing group of champions driving growth of NZ sector
- Recognised and trusted supplier of natural and healthy products

SOURCES OF VALUE CREATION

- Leveraging deep Mātauranga Māori knowledge and insights into platform
- Expanding into new areas like cosmeceuticals and pet cosmetics
- Existing strong daigou channel in place taking NZ to China and other markets

NZ INDUSTRY METRICS

Uses ANZSIC 1852

Geographic units	168
Unit growth (00-22)	+108
Unit growth CAGR (00-22)	5% pa
Employee count	880
Employee growth since 2000	+270
Empl. growth CAGR (00-22)	2% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be pharmaceutical/toiletry goods wholes. [3720].

POTENTIAL NZ BIOMASS USED

Forestry (native bush)	XXX
Sheep (byproducts)	XX
Cattle (byproducts)	XX
Fruit byproducts	X
Dairy	X
Other waste streams	?

WHAT YOU WOULD NEED TO BELIEVE

- NZ firms have the required branding, marketing and selling skills needed to win in highly competitive global markets
- Local firms will maintain ownership and invest long term rather than sell out to global multinationals who lose focus

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1899
NACE (European Union)	20.53
NAICS (North America)	3259-98 (part)

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

20
26

“ELEVATOR PITCH”

New Zealand growers and producers need to wake up to the incredible opportunity presented by essential oils made from unique New Zealand flora.

BIO-ECON SCORECARD

19
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- Often processes large quantities to get a small amount of target and large amounts of further byproduct

COMPLEX WITH MULTIPLE INPUTS ★★★★★

- Almost any plant or animal products (e.g. ambergris; civit; musk; castoreum) can serve as input

BUILDS SYSTEM RESILIENCE ★★★★★

- Supports rural production
- Growing demand

UNLOCK AG EMISSIONS RED ★★★★★

- Can support carbon farming of native forests and other alternative land uses

REPLACE FOSSIL FUELS ★★★★★

- Extraction can be powered by burning own waste

RETHINK WASTE ★★★★★

- Huge and proven ability to create value from low value byproducts
- Much more can be done

PLATFORM DEFINITION

In the current NZ standard industry classification, essential oils extraction is captured in “other basic chemical manufacturing not elsewhere classified” [1899] which also includes embalming compounds, concrete additives and numerous others. [Coriolis]

This platform is defined as the tighter NACE:

- “Manufacture of essential oils including:
- manufacture of extracts of natural aromatic products
 - manufacture of resinoids
 - manufacture of mixtures of odoriferous products for the manufacture of perfumes or food.” [NACE]

LEVERAGEABLE NZ FACTORS

- Unique range of plant species native to New Zealand an available nowhere else on earth
- Proven farming capabilities
- Large supplies of byproducts from existing biomaterials systems
- Significant horticultural science capabilities
- Proven track record in plant breeding and domestication

SOURCES OF VALUE CREATION

- Leveraging deep Mātauranga Māori knowledge and insights into platform
- Identification of new oils from NZ unique species beyond Māori knowledge
- Investment in increased scale in processing
- Leveraging new species for year round use of processing assets; potentially via contract extraction/packing

NZ INDUSTRY METRICS

No data available.

Classified in wide ranging “other” category (1899 Other Basic Chemical Product Manufacturing Not Elsewhere Classified).

POTENTIAL NZ BIOMASS USED

Mānuka	XXX
Native botanicals	XX
Citrus	XX
Lavender	?
Rosemary	?
Various mints	?
Numerous herbs	?
Floral crops	?
Other biomaterials	?

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can build an essential oils industry able to compete in export markets
- New Zealand can build-on Māori traditional knowledge and scientific plant research capabilities to identify a range of compelling essential oils in unique local plants
- Recent investment in large essential oil facility in Otago will be replicated

SOAP, SIMILAR, HOUSEHOLD CLEANING PRODUCTS

TOTAL SCORE

38/50

INTERNATIONAL STANDARD CODES

ANZSIC	1851
NACE (European Union)	20.41
NAICS (North America)	3256-11/12

PLATFORM DEFINITION

Manufacturing cleaning compounds, including toothpastes, soaps and other detergents, surface active agents, polishes and speciality cleaning preparations.

- Denture cleaner manufacturing
- Detergent manufacturing
- Dishwashing detergent manufacturing
- Disinfectant manufacturing
- Emulsifier manufacturing
- Glycerine manufacturing
- Hypochlorite-based bleach manufacturing
- Laundry detergent manufacturing
- Penetrant manufacturing
- Peroxide preparation manufacturing
- Polish manufacturing
- Scouring compound manufacturing
- Soap manufacturing
- Toothpaste manufacturing [ANZSIC]

NZ INDUSTRY METRICS

Uses ANZSIC 1851

Geographic units	129
Unit growth (00-22)	+60
Unit growth CAGR (00-22)	3% pa
Employee count	960
Employee growth since 2000	-340
Empl. growth CAGR (00-22)	-1% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be pharmaceutical/toiletry goods wholes. [3720].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

19
26

"ELEVATOR PITCH"

Many global consumers are seeking natural household cleaners to ensure their family's health and safety. New Zealand has all the required ingredients to continue to build a natural household cleaners industry targeting discerning, high income consumers in major export markets seeking safe, healthy, sustainable solutions.

LEVERAGEABLE NZ FACTORS

- Wide range of unique native plants with potential application in cosmetics
- Global recognition of mānuka oil as a antibacterial ingredient
- Demonstrated ability to penetrate and grow sales into key Asian markets
- Passionate and growing group of champions driving growth of NZ sector
- Recognised and trusted supplier of natural and healthy products

SOURCES OF VALUE CREATION

- Leveraging deep Mātauranga Māori knowledge and insights into platform
- Existing strong daigou channel in place taking NZ to China and other markets
- Leveraging science capabilities
- Leveraging contract manufacturers

POTENTIAL NZ BIOMASS USED

Sheep (byproducts)	XXX
Cattle (byproducts)	XX
Forestry (native bush)	XX
Eucalyptus	X
Fruit byproducts	X
Dairy	X
Bee products	X
Olives	?
Vegetable oils	?
Other waste streams	?

WHAT YOU WOULD NEED TO BELIEVE

- NZ firms have the required branding, marketing and selling skills needed to win in highly competitive global markets
- Local firms will maintain ownership and invest long term rather than sell out to global multinational who lose focus

BIO-ECON SCORECARD

19
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- Major user of animal fats and vegetable oils
- Demand the issue beyond ingred.

COMPLEX WITH MULTIPLE INPUTS ★★★★★

- Almost any plant or animal products with the right characteristics can serve as input

BUILDS SYSTEM RESILIENCE ★★★★★

- Supports smaller regional brands
- Knits together products from all regions and sectors; mostly imports

UNLOCK AG EMISSIONS RED ☆☆☆

-

REPLACE FOSSIL FUELS ★★★★★

- Traditionally large FF content
- Bio-cleaners replace fossil fuel based ingredients


RETHINK WASTE ★★★★★

- Huge and proven ability to create value from low value byproducts
- Much more can be done

III.1.4 BEVERAGES

WHAT ARE OUR OBJECTIVES FOR OUR BIOMASS PROCESSING SYSTEMS?

1 SUPPORT BETTER
OUTCOMES FROM
EXISTING USES OF
BIOMASS

- 
- 1.1 Wood
 - 1.2 Wool
 - 1.3 Health & Home
 - 1.4 Beverages
 - 1.5 Food

A wide range of post-farmgate beverage processing platforms emerged from “Screen 0”

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Growing number of firms in NZ	Growing employment in NZ	Large employer in NZ	NZ produces ingredients or precursors	Global leaders achieve large gross margins	Defensible with barriers to entry	Clear growth platform in peer group countries	Signif. volume imported (or clear substit.)	Complex value chain drawing in numerous diverse inputs	High levels of ongoing innovation occurring
Alcoholic Spirits Manufacturing	17	●	●	◐	●	●	●	●	●	◐	◐
Wineries	16	●	●	●	●	◐	◐	●	●	◐	◐
Soft drink Manufacturing	14	●	●	◐	◐	◐	●	●	◐	◐	◐
Beer Breweries	13	●	●	●	●	◐	◐	◐	◐	○	◐
Bottled Water Manufacturing	11	●	●	○	●	◐	◐	●	◐	○	○
Cider	7	◐	◐	○	●	◐	◐	◐	○	○	○
Ice Manufacturing	4	○	○	○	●	◐	◐	○	○	○	○

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1214 (part)
NACE (European Union)	11.02
NAICS (North America)	3121-30

PLATFORM DEFINITION

ANZSIC definition includes cider, perry, mead, wine vinegar and alcoholic beverages not elsewhere classified (e.g Sake)

This platform is defined as the tighter NACE:

- Manufacture of wine from grape
- manufacture of wine
 - manufacture of sparkling wine
 - manufacture of wine from concentrated grape must [NACE]

NZ INDUSTRY METRICS

Uses ANZSIC 1214 (inc. cider, other)

Geographic units	450
Unit growth (00-22)	+258
Unit growth CAGR (00-22)	4% pa
Employee count	3,850
Employee growth since 2000	+1500
Empl. growth CAGR (00-22)	2% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be liquor & tobacco product wholes. [3606].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

24
26

"ELEVATOR PITCH"

In the last 50 years, Marlborough has gone from sheep paddocks to a world renowned maker of a unique wine style from a unique terroir. While Marlborough may be approaching environmental limits, numerous other regions have real potential for growth if they can create a real point-of-difference to the consumer.

LEVERAGEABLE NZ FACTORS

- Temperate climate highly conducive to premium wine production: "The climate of Burgundy with the sunlight of Spain"
- New World producer unconstrained by traditions or excessive regulation
- Proven skills and capabilities in making award winning wines
- Large range of firms of all sizes, from small family owned to multinationals

SOURCES OF VALUE CREATION

- Industry consolidation to drive scale
- Wine regions beyond Marlborough
- Convenient packaging forms (e.g. single serve, premium magnum, novel)
- Gift packaging targeted at specific market
- Organic/biodynamic
- Fortified, brandy, cognac, vermouth
- Cellar door sales and wine tourism

POTENTIAL NZ BIOMASS USED

Grapes	XXX
Sulfites	?
Flavours	?

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand wine regions beyond Marlborough can find "their grape/their wine" and make a differentiated wine that stands out in the world market

BIO-ECON SCORECARD

12
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Demand not supply is the issue

COMPLEX WITH MULTIPLE INPUTS ☆☆☆☆

- Need to move beyond being a 'one trick pony' (Marlborough SB)

BUILDS SYSTEM RESILIENCE ★★★★★

- Strongly supports regional identity
- Still significant import exposure

UNLOCK AG EMISSIONS RED ★☆☆☆

- Waste streams can go to animal feeds or soil amendments

REPLACE FOSSIL FUELS ☆☆☆☆

- Primarily glass and cardboard

RETHINK WASTE ★★★★★

- Large amounts of byproduct currently going to low value add uses

INTERNATIONAL STANDARD CODES

ANZSIC	1213
NACE (European Union)	11.01
NAICS (North America)	3121-40

PLATFORM DEFINITION

"Units mainly engaged in the fermentation, distillation or blending of fortified spirits for human consumption, including brandy, fortified spirits, liqueurs manufacturing and spirit-based mixed drinks." [ANZSIC]

"Manufacture of distilled, potable, alcoholic beverages: whisky, brandy, gin, liqueurs etc.; manufacture of drinks mixed with distilled alcoholic beverages; blending of distilled spirits; production of neutral spirits." [NACE]

NZ INDUSTRY METRICS

Uses ANZSIC 1213

Geographic units	120
Unit growth (00-22)	+105
Unit growth CAGR (00-22)	10% pa
Employee count	580
Employee growth since 2000	+230
Empl. growth CAGR (00-22)	2% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be liquor & tobacco product wholes. [3606].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

20
26

"ELEVATOR PITCH"

New Zealand's burgeoning spirits sector has exploded over the past decade through innovative ingredients and numerous new entrants. Growth can continue both by displacing imports in the domestic market and through a better focus on exports.

LEVERAGEABLE NZ FACTORS

- Low cost whey alcohol
- Wide range of unique botanicals
- Picturesque scenery well-suited to marketing
- Rapidly growing industry driving product development, improvement and innovation
- Available domestic market; long history of domestic consumption

SOURCES OF VALUE CREATION

- Investment in lowering costs through increased scale
- Improved distribution / lower distribution costs
- Research into properties of native botanicals
- Alco-ceuticals
- Development of a signature New Zealand spirit

POTENTIAL NZ BIOMASS USED

Whey alcohol	XXX
Wheat and other grains	XXX
Wine	XX
Native botanicals	X
Dairy	X
Flavours	?
Sugar/sweeteners	?

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand gins can create and sustain a point-of-difference such that long-term export success is possible
- Recent interest in premium spirits represents a long term trend rather than a fad

BIO-ECON SCORECARD

15
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Brand driven; need to keep supply and demand in balance

COMPLEX WITH MULTIPLE INPUTS ★★☆☆

- Almost anything with carbs can be made into alcohol

BUILDS SYSTEM RESILIENCE ★★☆☆

- Regional identity & differentiation
- Growing use of native botanicals

UNLOCK AG EMISSIONS RED ★☆☆☆

- Waste streams can go to animal feeds or soil amendments

REPLACE FOSSIL FUELS ★★☆☆

- Stepping stone to bio-ethanol
- Primarily glass and cardboard

RETHINK WASTE ★★★★★

- Can turn byproducts into high value product (e.g. pomace into grappa)

STANDARD INDUSTRY CODE

ANZSIC	1212
NACE (European Union)	11.05
NAICS (North America)	312120

PLATFORM DEFINITION

"This class consists of units mainly engaged in manufacturing beer, ale, stout or porter." [ANZSIC]

"Establishments primarily engaged in brewing beer, ale, lager, malt liquors, and nonalcoholic beer." [NAICS]

"Manufacture of malt liquors, such as beer, ale, porter and stout. This class also includes manufacture of low alcohol or non-alcoholic beer." [NACE]

NZ INDUSTRY METRICS

Uses ANZSIC 1212

Geographic units	204
Unit growth (00-22)	+141
Unit growth CAGR (00-22)	5% pa
Employee count	2,150
Employee growth since 2000	+1,100
Empl. growth CAGR (00-22)	3%

Contract packers may be packaging services [7320]. Sales and marketing firms will be liquor & tobacco product wholes. [3606].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

18
26

"ELEVATOR PITCH"

New Zealand brewing has undergone a renaissance with new entrants shaking up the sector on the back of the global shift to "less but better" premium microbrews. Now it is ready to shift strongly to export markets, building a sustainable position with high quality, differentiated products that leverage pure New Zealand ingredients.

LEVERAGEABLE NZ FACTORS

- Large supply of renewable water on a per capita and per sqkm basis
- Producer and exporter of all key inputs (barley, hops)
- Reputation for premium hops
- Proven brewing capabilities
- Multiple new hop varieties developed
- Strong, coherent industry organised around cooperative

SOURCES OF VALUE CREATION

- Investments in lowering costs and improving scale
- Developing a critical mass in key export markets (a "New Zealand shelf")
- New flavours, formulations and styles of beers
- Beer-based ready-to-drink (RTDs)
- Flavoured "Radler-type" beers
- Leveraging fermentation capabilities into genetically modified bacteria

POTENTIAL NZ BIOMASS USED

Barley	XXX
Hops	XX
Yeast	X

WHAT YOU WOULD NEED TO BELIEVE

- Ongoing growth in microbrews will continue
- New Zealand brewers can achieve cut through in a crowded global market
- New Zealand brewers can create a sustainable point-of-difference

BIO-ECON SCORECARD

12
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Demand not supply is the issue
- Market shifting to 'less but better'

COMPLEX WITH MULTIPLE INPUTS ☆☆☆☆

-

BUILDS SYSTEM RESILIENCE ★★★★★

- Strongly supports regional identity
- Explosion of microbreweries
- Still significant import exposure

UNLOCK AG EMISSIONS RED ★☆☆☆

- Brewing dregs a major animal feed (significant imports)

REPLACE FOSSIL FUELS ★★☆☆

- More can be done with bioenergy
- Primarily cans and glass
- Extensive logistics footprint

RETHINK WASTE ★★★★★

- Large amounts of byproduct currently going to low value add uses

SOFT DRINK MNFG. (NON-ALCOHOLIC BEVERAGES)

TOTAL SCORE

26/50

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1211
NACE (European Union)	11.07
NAICS (North America)	3121-11

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

15
26

"ELEVATOR PITCH"

New Zealand has seen an explosion in new and innovative non-alcoholic beverage firms in the past twenty years. The time has come for these firms to look beyond the regional markets of Australia and the Pacific islands to Asia and beyond.

BIO-ECON SCORECARD

11
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Takes processing grade fruit

COMPLEX WITH MULTIPLE INPUTS ★☆☆☆

- Becoming more complex

BUILDS SYSTEM RESILIENCE ★☆☆☆

- Regional employment, particularly in fruit growing regions

UNLOCK AG EMISSIONS RED ☆☆☆☆

-

REPLACE FOSSIL FUELS ★★☆☆

- High visibility; can drive change
- Bioplastics for packaging
- Extensive logistics footprint

RETHINK WASTE ★★☆☆

- More opportunities exist around non-export grade fruit of all types

PLATFORM DEFINITION

ANZSIC uses a catch-all of "manufacturing aerated or carbonated soft drinks, mineral or purified waters, fruit drinks (less than 100 percent pure juice), concentrated cordials, syrups or non-alcoholic brewed beer or cider" (incl. ice manufacturing).

This platform is defined as the tighter NAICS: "Manufacturing soft drinks and artificially carbonated waters" [NAICS] excluding "purifying and bottling water (including naturally carbonated)."

LEVERAGEABLE NZ FACTORS

- Wide range of unique botanical ingredients (e.g. kawakawa; Mānuka honey) and signature fruits (e.g. kiwifruit; blackcurrants; feijoa)
- Reputation for food safety
- Picturesque scenery well-suited to marketing imagery
- Rapidly growing industry driving product development, improvement and innovation
- Available domestic market

SOURCES OF VALUE CREATION

- Investment increasing productivity and decreasing costs through scale targeting export
- Beverages with functional health properties (e.g. honey based drinks)
- Boutique "crafted" beverages using premium or unique ingredients
- High end cocktail/bartender targeted products
- Uniquely NZ flavours with functional health benefits (kawakawa, horopito)

NZ INDUSTRY METRICS

Uses ANZSIC 1211 (inc. ice, water, cordial)

Geographic units	162
Unit growth (00-22)	+93
Unit growth CAGR (00-22)	4% pa
Employee count	1,800
Employee growth since 2000	+550
Empl. growth CAGR (00-22)	2% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be other grocery wholes. [3609].

POTENTIAL NZ BIOMASS USED

Processed fruit	XXX
Sweeteners/substitutes	XXX
Flavours	X
Native botanicals	X
Nutraceuticals	X
Coffee/Tea	X

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand manufacturers can sustain ongoing innovation in a highly competitive market (where there is a strong advantage to larger firms with trucks on the road)
- High cost shipping (on a per litre basis) can be managed/overcome
- Broad distribution can be achieved in export markets

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1211 (catch-all)
NACE (European Union)	11.07 (catch-all)
NAICS (North America)	3121-12

PLATFORM DEFINITION

ANZSIC includes all non-alcoholic drinks (other than fruit juices), including soft drinks and bottled water, and ice manufacturing under a single code.

This platform is defined as the tighter NACE: "Purifying and bottling water (including naturally carbonated)." [NAICS]

NZ INDUSTRY METRICS

Uses ANZSIC 1211 (inc. soft drinks and cordial)

Geographic units	162
Unit growth (00-22)	+93
Unit growth CAGR (00-22)	4% pa
Employee count	1,800
Employee growth since 2000	+550
Empl. growth CAGR (00-22)	2% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be other grocery wholes. [3609].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

20
26

"ELEVATOR PITCH"

New Zealand has all the ingredients required to build a much stronger position in bottled water.

LEVERAGEABLE NZ FACTORS

- Beautiful country with picturesque scenery suitable for packaging and marketing
- Large supply of renewable water on a per capita and per sqkm basis
- Vast aquifers; thousands of springs
- Unique New Zealand flavours
- Proven success in category
- Leverage reputation in other food, & beverage categories (e.g. dairy, honey)

POTENTIAL NZ BIOMASS USED

Artesian water (arguably a resource rather than a biomass)	XXX
Flavours	X
Processed fruits	X

SOURCES OF VALUE CREATION

- Input falls from the sky
- Achieving volume to achieve efficient distribution models
- Look towards high value, high growth markets beyond China (e.g. Canada, Japan)

WHAT YOU WOULD NEED TO BELIEVE

- While bottled water export represent 0.00004% of annual renewable water, there is huge media attention and noise; growth would require a change in societal attitudes and opinions
- New Zealand can carve out a unique, differentiated position in bottled water despite having "shown up late" relative to France, Italy and other leaders
- New Zealand water marketers can move beyond just "Brand NZ"

BIO-ECON SCORECARD

2
24

CAN ABSORB LARGE QUANTITIES



- Not a biomass as such

COMPLEX WITH MULTIPLE INPUTS



- Water

BUILDS TOTAL SYSTEM RESILIENCE



- Regional jobs at bottling sites
- Significant imports

UNLOCK AG EMISSIONS RED



REPLACE FOSSIL FUELS



- Mixture of plastic and glass packaging

RETHINK WASTE



- Opportunities to move to more environmentally friendly packaging

III.1.5 FOOD

WHAT ARE OUR OBJECTIVES FOR OUR BIOMASS PROCESSING SYSTEMS?

1 SUPPORT BETTER
OUTCOMES FROM
EXISTING USES OF
BIOMASS

- 
- 1.1 Wood
 - 1.2 Wool
 - 1.3 Health & Home
 - 1.4 Beverages
 - 1.5 Food

A wide range of post-farmgate food processing platforms emerged from “Screen 0”...

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Growing number of firms in NZ	Growing employment in NZ	Large employer in NZ	NZ produces ingredients or precursors	Global leaders achieve large gross margins	Defensible with barriers to entry	Clear growth platform in peer group countries	Signif. volume imported (or clear substit.)	Complex value chain drawing in numerous diverse inputs	High levels of ongoing innovation occurring
Infant Nutrition / Toddler Milk	17	●	●	●	●	●	●	●	●	●	●
Sports Nutrition / Weight Control	17	●	●	●	●	●	●	●	●	●	●
Biscuits, Cookie, Cracker, Muesli Bar Mnf.	16	●	●	●	●	●	●	●	●	●	●
Pet (Dog and Cat) Food Mnf.	15	●	●	●	●	●	●	●	●	●	●
Dairy substitutes	14	●	●	○	●	●	●	●	●	●	●
Ice Cream and Frozen Dessert Manufacturing	14	●	●	●	●	●	●	●	●	●	●
Chocolate Confectionery	13	●	●	●	●	●	●	●	●	●	●
Snack Food Manufacturing	13	○	○	●	●	●	●	●	●	●	●
Coffee & Tea Manufacturing	13	●	●	●	○	●	●	●	●	○	●
Meat Substitutes / Meat Analogues	13	●	●	○	●	●	●	●	●	●	●
Marine Byproducts	13	●	●	○	●	●	●	●	●	●	●
Meat Byproducts	13	●	●	●	●	●	●	●	○	●	●
Baby Food (non IF)	13	●	●	●	●	●	●	●	○	●	●

... continued...

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Growing number of firms in NZ	Growing employment in NZ	Large employer in NZ	NZ produces ingredients or precursors	Global leaders achieve large gross margins	Defensible with barriers to entry	Clear growth platform in peer group countries	Signif. volume imported (or clear substit.)	Complex value chain drawing in numerous diverse inputs	High levels of ongoing innovation occurring
Frozen Specialty Food Mnfg.	13	●	◐	◐	●	◐	◐	◐	◐	●	◐
Dough, Flour/ Baking Mixes and Ing. Mnfg.	12	●	●	◐	●	◐	◐	○	◐	◐	◐
Animal (x Poultry) Slaughtering & Processing	11	●	●	●	●	○	◐	◐	◐	○	○
Breakfast Cereal Manufacturing	11	◐	◐	◐	●	◐	◐	○	●	◐	◐
Mayonnaise, Dressing, and Other Prepared Sauce Mnfg.	11	◐	◐	◐	◐	◐	●	◐	◐	◐	◐
Fluid Milk /Chilled Dairy Mnfg.	10	◐	◐	●	●	○	◐	◐	◐	○	◐
Cheese & Whey Manufacturing	10	●	●	●	●	○	◐	○	◐	○	○
Pastry/Cakes, Frozen Cakes, Pies, and Other Pastries Manufacturing	10	◐	◐	◐	●	◐	●	○	◐	◐	○
Non-chocolate Confectionery	10	●	◐	◐	○	◐	●	◐	●	○	○
Fats and Oils Refining/Blending	9	◐	◐	◐	◐	◐	◐	◐	●	○	○

... continued...

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Growing number of firms in NZ	Growing employment in NZ	Large employer in NZ	NZ produces ingredients or precursors	Global leaders achieve large gross margins	Defensible with barriers to entry	Clear growth platform in peer group countries	Signif. volume imported (or clear substit.)	Complex value chain drawing in numerous diverse inputs	High levels of ongoing innovation occurring
Dry, Condensed, and Evaporated Dairy Prod. Mnfg.	9	●	●	●	●	○	◐	○	○	○	○
Cultivated Meat	9	●	●	○	◐	○	◐	●	○	○	●
Precision Fermentation	9	●	●	○	◐	○	◐	●	○	○	●
BHS/Cured Meats/Meat Proc. from Carcass	8	○	●	◐	●	◐	◐	○	◐	○	○
Creamery butter Manufacturing	8	◐	◐	●	●	○	○	○	○	●	○
Spice and Extract Manufacturing	8	○	○	◐	○	◐	◐	◐	●	◐	◐
Potato Processing & Preserving	8	○	○	◐	●	◐	◐	◐	◐	○	◐
Oilseed Processing	8	◐	○	○	◐	◐	◐	●	●	○	○
Specialty Canning	7	○	○	◐	●	◐	◐	○	◐	○	◐
Poultry Processing	7	○	●	●	◐	○	◐	◐	○	○	○
Commercial Bakeries	7	◐	○	●	●	◐	◐	○	○	○	○
F&V Packhouses, other packaging ("packing/crating")	7	◐	○	●	●	○	◐	○	◐	○	○

... continued

SCREEN 0: IS IT LARGE AND/OR GROWING? RELATIVE SCORING OF IDENTIFIED SYSTEMS

Type	Overall	Growing number of firms in NZ	Growing employment in NZ	Large employer in NZ	NZ produces ingredients or precursors	Global leaders achieve large gross margins	Defensible with barriers to entry	Clear growth platform in peer group countries	Signif. volume imported (or clear substit.)	Complex value chain drawing in numerous diverse inputs	High levels of ongoing innovation occurring
Frozen Fruit, Juice, and Veg. Mnfg.	7	○	◐	◐	●	◐	◐	○	◐	○	○
Wet Corn Milling and Starch Mnfg.	7	○	○	◐	●	◐	●	○	◐	○	○
Seafood Product Prep. and Pack.	6	○	○	●	●	◐	○	○	◐	○	○
Cane sugar Processing	6	◐	◐	◐	○	○	◐	○	●	○	○
Rendering & Meat Byproducts	6	○	○	◐	●	◐	●	○	○	○	○
Fruit/Vegetable Canning	6	○	○	◐	●	◐	◐	○	◐	○	○
Dry Pasta/ similar mnfg.	5	○	○	○	●	◐	◐	○	◐	○	○
Margarine & sim. edible fats mnfg.	5	○	○	◐	○	◐	◐	○	◐	○	◐
Malt Mnfg.	5	○	○	◐	●	◐	◐	○	○	○	○
Tortilla Mnfg.	4	○	◐	○	○	◐	◐	◐	○	○	○
Flour Milling	4	○	○	◐	●	○	◐	○	○	○	○
Beet Sugar Mnfg.	3	○	○	○	○	○	◐	○	●	○	○
Flav. Syrup/Conc.	3	○	○	○	◐	◐	◐	○	○	○	○
Dried/ Dehy. Food	3	○	○	○	●	◐	○	○	○	○	○
Rice Milling	2	○	○	○	○	○	○	○	●	○	○

STANDARD INDUSTRY CODE

ANZSIC [NO CLEAR CODE]	None
NACE (European Union)	10.86 (part)
NAICS (North America)	None

PLATFORM DEFINITION

In the current NZ standard industry classification, nutraceuticals are primarily captured as pharmaceuticals or "other food manufacturing not elsewhere classified". Some products will be byproducts of other platforms. [Coriolis]

"The industry of sports nutrition beverages started in the 1960s as an answer to athletes' hydration and recovery needs after exercise. New ingredient technologies tied to research in sports nutrition eased the launch of multiple beverage offerings to the market, thus creating a whole new industry dedicated to addressing the nutritional needs of athletes." [Science Direct]

NZ INDUSTRY METRICS

Not currently formally defined by ANZSIC or measured by StatisticsNZ.

Spread across at least two existing classifications, including milk processing [1131] and pharmaceuticals [1841]. Contract packers may be packaging services [7320]. Sales and marketing firms will be other grocery wholesaling [3609], dairy product wholesaling [3603] or pharmaceutical and toiletry goods wholesaling [3720].

Clearly a large and growing sector for New Zealand that has attracted global investment.

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

23
26

"ELEVATOR PITCH"

New Zealand is building a sports nutrition platform on the back of existing dairy capabilities. With growing global demand, particularly as Chinese consumers enter the category, New Zealand is well positioned for further growth based on exports.

LEVERAGEABLE NZ FACTORS

- Global low cost dairy producer with large surplus available for export
- Trusted food safety systems
- Iconic/unique New Zealand ingredients and flavours (e.g. gold kiwifruit)
- Large supply of whey as a byproduct of cheese production
- Strong consumer recognition of "Brand NZ" in dairy
- History of innovation in milk fractions (e.g. lactoferrins)

POTENTIAL NZ BIOMASS USED

Whey	XXX
Sweeteners & substitutes	XX
Flavours	X
Nutraceuticals	X
Pea protein isolate	?
Soy protein isolate	?
Oat products	?
Other plant biomass	?
Antioxidants	?

SOURCES OF VALUE CREATION

- Extensible platform into a wide range of related products (e.g. beverages, nutraceuticals)
- Building a plant protein isolate production facility in NZ

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can compete in export markets outside whey-based proteins
- Existing capabilities in dairy can extend to plant proteins in export markets
- New Zealand can compete with the low cost (China) and high quality (Europe) plant-based proteins available on the market

BIO-ECON SCORECARD

15
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- Large global market
- NZ still a significant supplier of whey to overseas producers

COMPLEX WITH MULTIPLE INPUTS ★★★★★

- Seeking point-of-difference
- Starting to draw in unique NZ
- Flexible, extensible

BUILDS SYSTEM RESILIENCE ★★☆☆

- Driver for new plant proteins from arable crops

UNLOCK AG EMISSIONS RED ★☆☆☆

- Supports milk value in any needed dairy industry transition
- Supports plant protein isolate plant

REPLACE FOSSIL FUELS ☆☆☆☆

- Processing/blending primarily uses electricity
- Bioplastics for packaging

RETHINK WASTE ★★★★★

- Current core products (whey, collagen) were waste streams
- Additional opportunities exist

INTERNATIONAL STANDARD CODES

ANZSIC	1120 (part)
NACE (European Union)	10.41 (part)
NAICS (North America)	3117-10 (part)

PLATFORM DEFINITION

ANZSIC classified marine bioactives as part of "processing fish or other seafoods."
 "Processes include skinning or shelling, grading, filleting, boning, crumbing, battering and freezing of the seafood. This class also includes units mainly engaged in operating vessels which gather and process fish or other seafoods."

This focuses on the tighter seafood byproduct rendering or what the NAICS describes as "processing marine fats and oils". NACE classifies this under "manufacture of oils and fats" including "extraction of fish and marine mammal oils".

NZ INDUSTRY METRICS

Uses ANZSIC 1121 (inc. all seafood processing)

Geographic units	126
Unit growth (00-22)	-51
Unit growth CAGR (00-22)	-2% pa
Employee count	3,850
Employee growth since 2000	-2,350
Empl. growth CAGR (00-22)	-2% pa

Does not include fishing [041] or aquaculture [020].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

23
26

"ELEVATOR PITCH"

New Zealand has a successful seafood production and processing industry that produces a large amount of byproducts and 'waste*'. New Zealand firms both have done and can do more to create value from these secondary streams, particularly bycatch.

LEVERAGEABLE NZ FACTORS

- Major seafood producer and exporter; large, professional set of seafood processors
- Unique species producing unique extracts (e.g. greenshell mussels)
- Strong reputation for food safety and food security
- Relatively consolidated, efficient industry
- Capabilities in marine science
- Significant new quantities of bycatch being landed due to changing regulations

POTENTIAL NZ BIOMASS USED

Greenshell mussels	XXX
Hoki	XXX
Other wild catch seafood	XXX
Chinook/King salmon	XX
Landed bycatch	XX
Seaweed	X
Microalgae	X

SOURCES OF VALUE CREATION

- Focused science to identify activity in specific large waste streams
- New product development targeting new waste streams
- Industry consolidation to increase scale
- Improvements in robotics to increase productivity
- Further separation and fractionation of byproducts and waste streams

WHAT YOU WOULD NEED TO BELIEVE

- Demand for key marine bio-extracts will continue to remain strong and support high prices
- Other larger, growing seafood producers with aquaculture friendly regulations will not enter the category (e.g. Chile)
- New Zealand can continue to find new health and other benefits in existing species
- Fishing vessels can maintain the bycatch in a state that is necessary/required for particular extractions

BIO-ECON SCORECARD

15
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- Conceptually yes, though often very little is extracted and more byproduct is passed on in the chain

COMPLEX WITH MULTIPLE INPUTS ★★★★★

- Most firms focus, but hundreds of material species exist in NZ waters

BUILDS SYSTEM RESILIENCE ★★☆☆

- Can add value in regions (e.g. Nelson/Tasman)

UNLOCK AG EMISSIONS RED ★☆☆☆

- Needs to become part of the solution

REPLACE FOSSIL FUELS ☆☆☆☆

-

RETHINK WASTE ★★★★★

- Astoundingly rich biomaterials as byproducts; 50 years behind dairy in fractionation and value adding

* Remaining raw materials

INTERNATIONAL STANDARD CODES

ANZSIC	1111
NACE (European Union)	10.11
NAICS (North America)	3116-13

PLATFORM DEFINITION

ANZSIC does not split out meat byproducts into a separate code. NAICS breaks it out into 3116-13 Meat byproducts processing and rendering: This industry comprises establishments primarily engaged in rendering animal fat, bones, and meat scraps." "An animal rendering fact you may find surprising is that people use rendered animal products every day in soaps, paints, varnishes, lubricants, caulking compounds, candles, cleaners, paints, polishes, rubber products, plastics, fertilisers, and even explosives. Many people just do not realise how many ways these products made with rendered goods can be valuable for other applications. Renderers use materials such as fats, proteins, and oils to create all these products." <https://nrga.org/about-us/facts/> "One-third to one-half of each animal produced... is not consumed by humans. These raw materials are subjected to rendering processes resulting in many useful products. Meat and bone meal, meat meal, poultry meal, hydrolyzed feather meal, blood meal, fish meal, and animal fats are the primary products resulting from the rendering process. The most important and valuable use for these animal by-products is as feed ingredients for livestock... aquaculture, and [pets]." http://assets.nationalrenderers.org/essential_rendering_overview.pdf

NZ INDUSTRY METRICS

Uses ANZSIC 1111 (inc. all meat processing)

Geographic units	291
Unit growth (00-22)	+75
Unit growth CAGR (00-22)	1% pa
Employee count	25,400
Employee growth since 2000	+1,700
Empl. growth CAGR (00-22)	0.3% pa

Sales and marketing firms will be meat, poultry, smallgoods wholes. [3720].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

21
26

"ELEVATOR PITCH"

New Zealand has a successful meat processing industry that produces a large amount of byproducts and 'waste'. New Zealand firms can do more to create value from these secondary streams.

LEVERAGEABLE NZ FACTORS

- Major beef and lamb meat producer and exporter; large, professional set of meat processors and renderers
- Strong reputation for food safety and food security
- Relatively consolidated, efficient industry
- Capabilities in meat science, dairy science and plant breeding
- Capable group of existing companies

SOURCES OF VALUE CREATION

- Further industry consolidation to increase scale
- Improvements in robotics to increase productivity
- Further separation and fractionation of coproducts, byproducts and waste streams

POTENTIAL NZ BIOMASS USED

Cattle	XXX
Sheep	XXX
Deer	X
Pigs	X
Goats	X
Chicken	X
Other specialty	X

WHAT YOU WOULD NEED TO BELIEVE

- Value added uses in New Zealand can compete with demand from developing countries
- Cattle and sheep numbers will either remain stable or decline at a manageable rate
- Processing animals for export in New Zealand will continue to make sense (rather than exporting minimally prepared carcasses)

BIO-ECON SCORECARD

16
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- Numerous firms spread across the country

COMPLEX WITH MULTIPLE INPUTS ★★★★★

- Multiple species fractionated into complex byproducts

BUILDS SYSTEM RESILIENCE ★☆☆☆☆

- Major regional employer

UNLOCK AG EMISSIONS RED ★☆☆☆☆

- Needs to become part of the solution

REPLACE FOSSIL FUELS ★★★★★

- Opportunities to use biofuels at processing sites (e.g. fermenting gut contents)

RETHINK WASTE ★★★★★

- Astoundingly rich biomaterials as byproducts; 50 years behind dairy in fractionation and value adding

VEGETABLE OILS/FATS AND OILS REFINING/BLENDING

TOTAL SCORE

37/50

INTERNATIONAL STANDARD CODES

ANZSIC	1150
NACE (European Union)	10.41
NAICS (North America)	3112-25/3119-91

PLATFORM DEFINITION

Manufacturing crude vegetable or animal oil, fat, cake or meal, margarine, compound cooking oil or fat, blended table or salad oil, or refined or hydrogenated oil or fat not elsewhere classified.

- Animal oil, refined, manufacturing
- Cotton seed oil manufacturing
- Deodorised vegetable oil manufacturing
- Edible oil or fat, blended, manufacturing
- Fish or other marine animal oil or meal mfg.
- Lard, refined, manufacturing
- Margarine manufacturing
- Olive oil manufacturing
- Tallow, refined, manufacturing
- Vegetable oil, meal or cake manufacturing [ANZSIC]

NZ INDUSTRY METRICS

Uses ANZSIC 1150

Geographic units	48
Unit growth (00-22)	+6
Unit growth CAGR (00-22)	1% pa
Employee count	450
Employee growth since 2000	+120
Empl. growth CAGR (00-22)	1% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be other grocery wholes. [3609].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

19
26

"ELEVATOR PITCH"

Historically New Zealand has primarily processed animal fats. The growth of the New Zealand processed foods industry (e.g. infant formula) has increased demand for vegetable oils. At the same time, new oilcrops are being trialled, particularly in Canterbury. Global peers support that New Zealand can have major vegetable oil industry.

LEVERAGEABLE NZ FACTORS

- Major beef and lamb meat producer and exporter
- Large, professional set of meat processors and renderers
- Strong reputation for food safety and food security
- Small scale production of vegetable oils

SOURCES OF VALUE CREATION

- Investment in scaling up production to increase productivity and reduce costs targeting exports
- Oils from specialty crops (e.g. common linseed)
- Nutraceutical oils from plants, land animals and seafood
- Natural processing methods (e.g. cold press)

POTENTIAL NZ BIOMASS USED

Cattle fat	XXX
Sheep fat	XXX
Other animal fats	XX
Fish/Shellfish oils	XX
Olives	X
Sunflowers	?
Soybeans	?
Canola	?
Microalgae	?

WHAT YOU WOULD NEED TO BELIEVE

- The business case for processing New Zealand grown oilcrops into vegetable oils and animal feed stacks up
- Existing small scale vegetable oil production can successfully scale up and become globally competitive

BIO-ECON SCORECARD

18
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Further capital required at some point

COMPLEX WITH MULTIPLE INPUTS ★★☆☆

- Wide range of plants and animals as potential inputs

BUILDS SYSTEM RESILIENCE ★★★★★

- Supports regional emergence of oilseed crops
- Major import currently

UNLOCK AG EMISSIONS RED ★☆☆☆

- Support shift to crops
- Animal feed a byproduct

REPLACE FOSSIL FUELS ★★★★★

- Stepping stone to biodiesel
- Bioplastics for packaging
- Bioenergy for processing

RETHINK WASTE ★★★★★

- Vegetable oil creates protein (alt meat) and animal feed

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1192 (part)
NACE (European Union)	10.92
NAICS (North America)	3111-11

PLATFORM DEFINITION

ANZSIC includes both pet and farm animals under a single code.

This platform is defined as the tighter NACE: "Manufacture of prepared pet foods, including prepared feeds for pets, including dogs, cats, birds, fish etc." [NACE]

NZ INDUSTRY METRICS

Uses ANZSIC 1192 (inc. farm animal feeds)

Geographic units	156
Unit growth (00-22)	+69
Unit growth CAGR (00-22)	3% pa
Employee count	1,650
Employee growth since 2000	+890
Empl. growth CAGR (00-22)	4% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be other grocery wholes. [3609].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

23
26

"ELEVATOR PITCH"

New Zealand's fast growing and innovative pet food industry has a real opportunity to carve out a strong premium position in global markets by targeting upmarket consumers pampering their "new best friend" in the post-Covid world.

LEVERAGEABLE NZ FACTORS

- Major beef and lamb meat producer and exporter
- Large, professional set of meat processors and renderers
- Strong reputation for food safety and food security
- Pioneered freeze dried petfood category
- Wide range of unique or signature ingredients (e.g. greenshell mussels, lamb, possum, king salmon, Mānuka honey, venison)

POTENTIAL NZ BIOMASS USED

Cattle	XXX
Sheep	XXX
Chicken	XXX
Hoki	XXX
Seafood bycatch	XXX
Venison	X
Processed vegetables	XX
Grains	XX
Vitamins & minerals	?
Antioxidants	?

SOURCES OF VALUE CREATION

- Investment in lowering costs through increased scale
- Line extensions into pet healthcare, skincare, nutraceuticals, etc.
- Research and development of pet nutraceuticals
- Targeted health benefits
- Track and trace marketing
- Premium ingredients and positioning (e.g. K9 Natural Beef and Hoki feast)

WHAT YOU WOULD NEED TO BELIEVE

- A significant share of global consumers would pay a premium for pet food from New Zealand

BIO-ECON SCORECARD

14
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- Chinese demand growing at double digits

COMPLEX WITH MULTIPLE INPUTS ★★★★★

- Leading premium brands pull together diverse ingredients to tell a clear story to the buyer

BUILDS SYSTEM RESILIENCE ★★☆☆☆

- Strongly supports regional meat and seafood sectors
- Creates regional jobs

UNLOCK AG EMISSIONS RED ☆☆☆☆☆

- Supports meat and seafood value in any needed industry transition

REPLACE FOSSIL FUELS ☆☆☆☆☆

- Significant use of heat energy (e.g. canning)

RETHINK WASTE ★★★★★

- Massive ability to absorb meat and seafood waste streams

ALTERNATIVE DAIRY (PLANT-BASED SUBSTITUTES/ANALOGUES)

TOTAL SCORE

36/50

INTERNATIONAL STANDARD CODES

ANZSIC [NO CLEAR CODE]	1199 (catch-all)
NACE (European Union)	10.89 (catch-all)
NAICS (North America)	?

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

20
26

"ELEVATOR PITCH"

Growing demand for dairy substitutes – particularly plant-based milks - creates an opportunity for New Zealand. New Zealand can build a vibrant alternative dairy sector based on new ingredients and multiple formats and forms leading to an industry supplying New Zealand & export markets.

BIO-ECON SCORECARD

16
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Small currently
- Theoretically potentially large
- Unclear if NZ can win at exports

COMPLEX WITH MULTIPLE INPUTS ★★★★★

- Complex processed foods, particularly beyond milk analogues

BUILDS SYSTEM RESILIENCE ★★★☆

- Supports multiple other emerging opportunities
- Supports any dairy/meat transition

UNLOCK AG EMISSIONS RED ★★★★★

- Shifts demand from dairy to plant based substitutes

REPLACE FOSSIL FUELS ★☆☆☆

- Bioplastics for packaging

RETHINK WASTE ★★★☆

- Part of a complex network needed to avoid waste from plant protein extraction

PLATFORM DEFINITION

In the current NZ standard industry classification, dairy substitutes are captured in "other food manufacturing not elsewhere classified" [1199]

"A dairy substitute is any food or beverage that is used as a replacement for traditional dairy products, such as milk, cheese, yogurt, and butter. These substitutes are typically made from plant-based sources, such as soy, almond, coconut, or rice milk, and are often fortified with nutrients like calcium and vitamin D to mimic the nutritional profile of dairy products. Dairy substitutes may also be made from other sources, such as oats, nuts, or seeds, and may come in various forms, including cream, cheese, and yogurt alternatives. ."

LEVERAGEABLE NZ FACTORS

- Reputation as a dairy supplier in some markets, particularly in Asia
- Major dairy producer and exporter; large, professional set of dairy processors at global scale
- Strong reputation for food safety and food security
- Emerging group of innovative firms passionate about dairy substitutes
- Capabilities in dairy science, food science and plant breeding

SOURCES OF VALUE CREATION

- Industry consolidation during current market conditions to drive scale
- Improving scale and lowering costs of smaller NZ processors

NZ INDUSTRY METRICS

No data available.

Classified in wide ranging "other" category (1199 Other Food Product Manufacturing Not Elsewhere Classified).

POTENTIAL NZ BIOMASS USED

Oats	XX
Soy	?
Peas	?
Nuts	?
Sweeteners	X
Vegetable oils	?
Stabilisers	X
Vitamins & minerals	?
Other additives	?

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand is not 'arriving late to the party'
- NZ firms can create products with the desired characteristics at the right price
- Strength in low-cost ingredient pastoral-system-based dairy can support success in highly processed, branded, pre-packaged foods
- Large NZ dairy-based firms able to leverage their markets with plant-based offers; alternatively, small firms can grow rapidly and exploit this opportunity

INFANT FORMULA / WIDER DAIRY NUTRITIONALS

TOTAL SCORE

35/50

STANDARD INDUSTRY CODE

ANZSIC [NO CLEAR CODE]	1133 (part)
NACE (European Union)	10.86 (part)
NAICS (North America)	3515-14 (part)

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

22
26

"ELEVATOR PITCH"

Over the past twenty years, New Zealand has built a billion dollar infant formula platform on the back of existing dairy capabilities. Further growth will require (1) a shift from everyday to specialised products (e.g. medical formulas targeting specific conditions) and (2) improved in-market sales and marketing, particularly to doctors.

BIO-ECON SCORECARD

13
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- Large global market
- NZ still a significant supplier of milk powder to overseas producers

COMPLEX WITH MULTIPLE INPUTS ★★★★★

- Huge range of ingredients, from simple to highly complex
- Multiple systems (e.g. goat dairy)

BUILD TOTAL SYSTEM RESILIENCE ★★☆☆

- Regional employment
- Supports new systems (e.g. vegetable oils, soy, goat)

UNLOCK AG EMISSIONS RED ★☆☆☆

- Supports milk value in any needed dairy industry transition

REPLACE FOSSIL FUELS ★☆☆☆

- Direct production from milk (rather than powder) is energy intensive
- Opportunities for solid biofuels

RETHINK WASTE ★☆☆☆

- Opportunities to move to more environmentally friendly packaging

PLATFORM DEFINITION

In the current NZ standard industry classification, infant formula is captured under the catch-all "Cheese and Other Dairy Product Mfg." [Coriolis]

- Europe uses a interesting different catch-all: Manufacture of foods for particular nutritional uses:
- infant formulae, follow-up milk and similar
 - baby foods
 - low-energy foods for weight control
 - dietary foods for special medical purposes
 - low-sodium foods, including sodium-free salts
 - gluten-free foods
 - foods intended to meet the expenditure of intense muscular effort, especially for sports
 - foods for persons suffering from diabetes [NACE]

LEVERAGEABLE NZ FACTORS

- Global low cost dairy producer with large surplus available for export
- Trusted food safety systems
- Latent reputation with many consumers as a trusted dairy supplier
- History of innovation in milk fractions (e.g. lactoferrins)
- Grass-fed
- Largest global supplier of ingredients used by others (i.e. milk powder)

SOURCES OF VALUE CREATION

- Convenient packaging (e.g. single serve)
- Specialised, medical formula
- Ready to drink UHT product
- "Fresh" ready-to-drink product, airfreighted to market
- Range of children's products leveraging brand identity (e.g. yoghurt)
- Dairy nutritionals
- Sheep and goat milk infant formula

NZ INDUSTRY METRICS

Not currently formally defined by ANZSIC or measured by StatisticsNZ.

Spread across at least two existing classifications, including milk processing [1131] and pharmaceuticals [1841]. Some firms may be packaging services [7320]. Sales and marketing firms will be other grocery wholesaling [3609], dairy product wholesaling [3603] or pharmaceutical and toiletry goods wholesaling [3720].

A large and growing sector for New Zealand that has attracted significant global investment.

POTENTIAL NZ BIOMASS USED

Cattle milk solids	XXX
Sweeteners & substitutes	XX
Goat milk solids	X
Sheep milk solids	X
Vegetable oils/LCPUFAs	?
Vitamins & minerals	?
Emulsifiers	?
Antioxidants	?
Soy protein isolate	?

WHAT YOU WOULD NEED TO BELIEVE

- China and regularly changing Chinese rules can be navigated
- Growth into traditional, slow growth markets dominated by large multinationals is possible

BABY FOOD (NON-INFANT FORMULA)

TOTAL SCORE

33/50

INTERNATIONAL STANDARD CODES

ANZSIC	1140
NACE (European Union)	10.86
NAICS (North America)	3114-22

PLATFORM DEFINITION

ANZSIC classified this as part of "Fruit & Vegetable Processing": "manufacturing canned, bottled, preserved, quick frozen or dried fruit (except sun-dried) and vegetable products. Also included are units mainly engaged in manufacturing dehydrated vegetable products, soups, sauces, pickles and mixed meat and vegetable products" including "Baby food, canned or bottled, manufacturing (except milk based)".

NACE uses "Manufacture of homogenised food preparations and dietetic food"

NAICS uses "Specialty Canning"

NZ INDUSTRY METRICS

Uses ANZSIC 1110 (inc. other F&V processing)

Geographic units	153
Unit growth (00-22)	+36
Unit growth CAGR (00-22)	1% pa
Employee count	4,650
Employee growth since 2000	-1,050
Empl. growth CAGR (00-22)	-1% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be other grocery wholes. [3609].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

24
26

"ELEVATOR PITCH"

New Zealand is a trusted supplier of food to mothers, particularly meat and dairy. In the last 20 years the country has built a strong position in dairy-based infant formula. Baby foods beyond formula are a strong platform in NZ but only modest in export markets. Growth is possible.

LEVERAGEABLE NZ FACTORS

- Low cost, globally competitive producer of centre of the plate meat and seafood as well as dairy products
- Competitive producer of some root crops (e.g. potatoes, carrots)
- Investment by major global multinational leaders (e.g. Kraft Heinz, McCain)
- Strong group of fast moving and innovative local producers
- Capabilities in efficient, small run production

SOURCES OF VALUE CREATION

- Better sales and marketing
- Stronger branding and positioning
- Improved formulations with stronger health claims
- Developing a clearer point-of-difference against global competitors

POTENTIAL NZ BIOMASS USED

Cattle	XXX
Sheep	XXX
Root crops	XXX
Vegetables	XXX
Apples	XXX
Other fruit	XXX
Peas	XXX
Squash	XXX
Oils & fats	XX

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can create a sustainable point-of-difference in export markets
- New Zealand can compete and take share from large multinationals

BIO-ECON SCORECARD

9
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Demand not supply is the challenge

COMPLEX WITH MULTIPLE INPUTS ★★☆☆

- Numerous inputs, but relatively mature technology in most cases

BUILDS SYSTEM RESILIENCE ☆☆☆☆

UNLOCK AG EMISSIONS RED ☆☆☆☆

REPLACE FOSSIL FUELS ★☆☆☆

- Historically uses glass; more foil pouches emerging

RETHINK WASTE ★★★★★

- Further opportunities to use processing grade fruit, vegetables and meat

ALTERNATIVE MEAT (PLANT-BASED SUBSTITUTES/ANALOGUES)

TOTAL SCORE

31/50

INTERNATIONAL STANDARD CODES

ANZSIC [NO CLEAR CODE]	1199 (catch-all)
NACE (European Union)	10.89 (catch-all)
NAICS (North America)	?

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

15
26

“ELEVATOR PITCH”

New Zealand has a large beef and lamb meat processing industry and is a major exporter of primal cuts of meats targeting further processors in-market. Growing interest in meat substitutes in developed markets creates an opportunity for New Zealand if it can execute.

BIO-ECON SCORECARD

16
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Small currently
- Theoretically potentially large
- Unclear if NZ can win at exports

COMPLEX WITH MULTIPLE INPUTS ★★★★★

- Complex processed foods (some consumer pushback emerging)

BUILDS SYSTEM RESILIENCE ★★★☆☆

- Supports multiple other emerging opportunities
- Supports any dairy/meat transition

UNLOCK AG EMISSIONS RED ★★★★★

- Shifts demand from meat to plant based substitutes

REPLACE FOSSIL FUELS ★☆☆☆☆

- Bioplastics for packaging

RETHINK WASTE ★★★☆☆

- Part of a complex network needed to avoid waste from oilseeds

PLATFORM DEFINITION

In the current NZ standard industry classification, meat substitutes are captured in “other food manufacturing not elsewhere classified” [1199] [Coriolis]

“A meat alternative or meat substitute (also called plant-based meat) is a food product made from vegetarian or vegan ingredients, eaten as a replacement for meat. Meat alternatives typically approximate qualities of specific types of meat, such as mouthfeel, flavor, appearance, or chemical characteristics. Plant and fungus-based substitutes are frequently made with soy (e.g. tofu, tempeh), but may also be made from wheat gluten as in seitan, pea protein... or mycoprotein as in Quorn.” Wikipedia

LEVERAGEABLE NZ FACTORS

- Major beef and lamb meat producer and exporter; large, professional processors can leverage skills and existing markets
- Strong reputation for food safety and food security
- Emerging group of innovative firms passionate about meat substitutes
- Capabilities in meat science, food science and plant breeding
- Investment in category by poultry-firm Inghams “Lets Eat”

SOURCES OF VALUE CREATION

- Industry consolidation during current market conditions to drive scale
- Improving scale and lowering costs of smaller NZ processors

NZ INDUSTRY METRICS

No data available.

Classified in wide ranging “other” category (1199 Other Food Product Manufacturing Not Elsewhere Classified).

POTENTIAL NZ BIOMASS USED

Soy protein isolate	?
Pea protein isolate	?
Vegetable oils	?
Flavours	?
Processed vegetables	XX
Salt	X
Herbs	X
Antioxidants	?
Other additives	?

WHAT YOU WOULD NEED TO BELIEVE

- Recent category declines and challenges are temporary; product is not a fad
- NZ firms can create products with the desired characteristics at the right price
- Strength in low-cost ingredient pastoral-system-based beef and lamb can support success in highly processed, branded, pre-packaged foods
- Large NZ meat-based firms able to leverage their markets with plant-based offers

ANIMAL (EX. POULTRY) SLAUGHTERING & PROCESSING

TOTAL SCORE

29/50

INTERNATIONAL STANDARD CODES

ANZSIC	1111
NACE (European Union)	10.11
NAICS (North America)	3116-11

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

17
26

“ELEVATOR PITCH”

New Zealand has a successful cattle and sheep meat processing industry that serves both domestic and export markets. With environmental pressures coming on domestic animal numbers, the time is right for the industry to attempt to shift from volume-to-value.

BIO-ECON SCORECARD

12
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- At global scale
- Significant excess capacity an ongoing issue

COMPLEX WITH MULTIPLE INPUTS ☆☆☆☆

- Chains are single species

BUILDS SYSTEM RESILIENCE ★☆☆☆

- Major regional employer
- Some imports, particularly pork

UNLOCK AG EMISSIONS RED ☆☆☆☆

- Needs to become part of the solution

REPLACE FOSSIL FUELS ★★★★★

- Opportunities to use biofuels at processing sites (e.g. fermenting gut contents)

RETHINK WASTE ★★★★★

- Most waste goes to meat byproducts (see Stage I profile)

PLATFORM DEFINITION

[Excluding poultry, seafood, bacon, ham and corned meat] Slaughtering animals, boning, freezing, preserving or packing meat or canning meat, meat from abattoir byproducts and rendering lard/tallow:

- Abattoir operation (except poultry)
- Animal meat packing and freezing
- Animal oil or fat, unrefined, manufacturing
- Lard or tallow rendering
- Meat extract or essence manufacturing
- Meat manufacturing
- Meat or bone meal manufacturing
- Meat packing
- Meat, canned, manufacturing
- Meat, dehydrated, manufacturing
- Meat, frozen, manufacturing (except poultry)

LEVERAGEABLE NZ FACTORS

- Major beef and lamb meat producer and exporter; large, professional set of meat processors and renderers
- Strong reputation for food safety and food security
- Relatively consolidated, efficient industry
- Capabilities in meat science, dairy science and plant breeding

SOURCES OF VALUE CREATION

- Further industry consolidation to increase scale
- New modified atmosphere packaging technologies enabling case-ready
- Improved productivity in both food safety and quality control with generative AI
- Improvements in robotics to increase productivity
- Further separation and fractionation of coproducts, byproducts and waste streams

NZ INDUSTRY METRICS

Uses ANZSIC 1111

Geographic units	291
Unit growth (00-22)	+75
Unit growth CAGR (00-22)	1% pa
Employee count	25,400
Employee growth since 2000	+1,700
Empl. growth CAGR (00-22)	0.3% pa

Sales and marketing firms will be meat, poultry, smallgoods wholes. [3720].

POTENTIAL NZ BIOMASS USED

Cattle	XXX
Sheep	XXX
Deer	X
Pigs	X
Goats	X
Other specialty	X

WHAT YOU WOULD NEED TO BELIEVE

- Ongoing challenges with overcapacity, particularly in sheep, can be managed
- Cattle and sheep numbers will either remain stable or decline at a manageable rate
- Processing animals for export in New Zealand will continue to make sense (rather than exporting minimally prepared carcasses)

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1131 (part)
NACE (European Union)	10.51 (part)
NAICS (North America)	3115-11 (part)

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

17
26

“ELEVATOR PITCH”

Traditionally New Zealand only produced fluid milk and chilled (refrigerated) dairy products for domestic consumption due to packaging and transportation constraints. New packaging technologies (e.g. UHT), changing transport dynamics and changing market demand have opened up new markets to New Zealand fluid and chilled dairy.

BIO-ECON SCORECARD

12
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- At global scale
- NZ still a significant supplier of milk powder to overseas producers

COMPLEX WITH MULTIPLE INPUTS ★★☆☆

- Relatively simple
- Multiple systems (e.g. goat dairy)

BUILD TOTAL SYSTEM RESILIENCE ★☆☆☆

- Regional employment
- Can support new systems and shift to alt dairy

UNLOCK AG EMISSIONS RED ★★☆☆

- Needs to be part of the solution; can drive change

REPLACE FOSSIL FUELS ★★☆☆

- Opportunities for solid biofuels for processing heat

RETHINK WASTE ★☆☆☆

- Dairy produced very little ‘waste’ from processing; opportunities downstream (e.g. retail shelf life)

PLATFORM DEFINITION

New Zealand has perishable “chilled dairy” (exported in small quantities) and shelf-stable UHT milk (exported in large quantities).

In the current NZ standard industry classification, both are captured under the catch-all “Milk and Cream Processing” which excludes milk powder and other products [Coriolis]

The NAICS and NACE classifications have a similar issue.

Interestingly NAICS includes plant-based milk in dairy but ANZSIC and NACE classifies it as “other food products not elsewhere classified”.

LEVERAGEABLE NZ FACTORS

- Global low cost dairy producer with large surplus available for export
- Trusted food safety systems
- Grass-fed/pasture-based production systems
- Latent reputation with many consumers as a trusted dairy supplier
- Iconic/unique New Zealand ingredients and flavours (e.g. gold kiwifruit)

SOURCES OF VALUE CREATION

- Goat and sheep based product range
- New flavourings and dessert options
- Innovative packaging
- Recipe specific products
- Co-branded dessert products (e.g. “Made with Tatura cream”)
- Leveraging current position into plant-based milks

NZ INDUSTRY METRICS

Uses ANZSIC 1131 (fluid milk & cream)

Geographic units	42
Unit growth (00-22)	+27
Unit growth CAGR (00-22)	4.8% pa
Employee count	1,600
Employee growth since 2000	+300
Empl. growth CAGR (00-22)	0.9% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be dairy product wholes. [3720].

POTENTIAL NZ BIOMASS USED

Cattle milk solids	XXX
Sweeteners & substitutes	XX
Goat milk solids	X
Sheep milk solids	X
Flavours	?
Oats	X
Soy	?
Other plant materials	?

WHAT YOU WOULD NEED TO BELIEVE

- Dairy cattle numbers will either remain stable or decline at a manageable rate; alternatively increases in milk/cow will offset declining animal numbers
- Growth of plant-based milks can be managed

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1131 (part)
NACE (European Union)	10.51 (part)
NAICS (North America)	3115-11 (part)

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

20
26

"ELEVATOR PITCH"

New Zealand is the world's largest dairy exporter and a global low cost producer of dairy ingredients. Products are currently supplied primarily to the backdoor of factories owned by global multinationals and regional leaders. New Zealand can make more complex ingredients and even finished consumer products at home.

BIO-ECON SCORECARD

9
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- At global scale
- NZ still a significant supplier of milk powder to overseas producers

COMPLEX WITH MULTIPLE INPUTS ☆☆☆

- Relatively simple
- Multiple systems (e.g. goat dairy)

BUILD TOTAL SYSTEM RESILIENCE ☆☆☆

- Regional employment

UNLOCK AG EMISSIONS RED ★★☆☆

- Needs to be part of the solution; can drive change

REPLACE FOSSIL FUELS ★☆☆☆

- Milk drying is very energy intensive
- Many operators still use coal
- Opportunities for solid biofuels

RETHINK WASTE ★★☆☆

- Opportunities to move to more environmentally friendly packaging

PLATFORM DEFINITION

In the current NZ standard industry classification, dry/cond/evap milk mnfg. is captured under the catch-all "Cheese and Other Dairy Product Mnfg." [Coriolis]

This platform is defined as the tighter NAICS:

"manufacturing dry, condensed, and evaporated milk and dairy substitute products."

Interestingly NAICS includes alternative dairy in dairy but ANZSIC and NACE classifies it as "other food products not elsewhere classified".

LEVERAGEABLE NZ FACTORS

- Global low cost dairy producer with large surplus available for export
- Trusted food safety systems
- Latent reputation with many consumers as a trusted dairy supplier
- History of innovation in milk fractions (e.g. lactoferrin)
- Iconic/unique New Zealand ingredients and flavours (e.g. gold kiwifruit)

SOURCES OF VALUE CREATION

- Growth of dairy consumption in Asia
- On-going growth of foodservice; products targeting this channel
- Developing premium brands for retail
- Developing unique flavour profile
- Innovative packaging (e.g. convenience, improved freshness, single serve)
- Leveraging current position into plant-based dairy powders

NZ INDUSTRY METRICS

Uses ANZSIC 1131 (fluid milk & cream)

Geographic units	42
Unit growth (00-22)	+27
Unit growth CAGR (00-22)	4.8% pa
Employee count	1,600
Employee growth since 2000	+300
Empl. growth CAGR (00-22)	0.9% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be dairy product wholes. [3720].

POTENTIAL NZ BIOMASS USED

Cattle milk solids	XXX
Goat milk solids	X
Sheep milk solids	X
Flavours (e.g. chocolate)	X
Emulsifier (e.g. soy lecithin)	X
Sweeteners (e.g. lactose)	X

WHAT YOU WOULD NEED TO BELIEVE

- Global demand for dairy ingredients will continue to increase
- Environmental pressures on New Zealand dairy production can be managed efficiently and effectively
- Large New Zealand dairy firms can adapt to changing market conditions
- New Zealand dairy firms can succeed in consumer-ready dairy outside China and a handful of other markets

CHEESE & WHEY MANUFACTURING

TOTAL SCORE

28/50

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1133 (part)
NACE (European Union)	10.51 (part)
NAICS (North America)	3115-13

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

18
26

“ELEVATOR PITCH”

New Zealand has a large and successful cheese industry that produces whey as a coproduct. Changing global demand patterns driven by the Westernisation of the diet have led to increased demand for cheese and whey, particularly in Asia. New Zealand can continue to succeed.

BIO-ECON SCORECARD

10
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- At global scale
- NZ still a significant supplier of ingredient cheese

COMPLEX WITH MULTIPLE INPUTS ★☆☆☆☆

- Relatively simple inputs
- Multiple systems (e.g. goat dairy)

BUILD TOTAL SYSTEM RESILIENCE ★☆☆☆☆

- Regional employment
- Can support new systems and shift to alt dairy

UNLOCK AG EMISSIONS RED ★☆☆☆☆

- Needs to be part of the solution; can drive change

REPLACE FOSSIL FUELS ★★☆☆☆

- Opportunities for solid biofuels

RETHINK WASTE ★☆☆☆☆

- Cheese now produces very little ‘waste’ as such from processing
- Opportunities in packaging

PLATFORM DEFINITION

In the current NZ standard industry classification, cheese and whey mnfg. is captured under the catch-all “Cheese and Other Dairy Product Mnfg.” [Coriolis]

This platform is defined as the tighter NAICS: “(1) manufacturing cheese products (except cottage cheese) from raw milk and/or processed milk products and/or (2) manufacturing cheese substitutes from soybean and other nondairy substances.”

Interestingly NAICS includes alternative dairy in dairy but ANZSIC and NACE classifies it as “other food products not elsewhere classified”.

Whey is a byproduct of cheese making.

LEVERAGEABLE NZ FACTORS

- Global low cost dairy producer with large surplus available for export
- Trusted food safety systems
- Latent reputation with many consumers as a trusted dairy supplier

SOURCES OF VALUE CREATION

- Growth of dairy consumption in Asia
- On-going demand for foodservice products (e.g. Mozzarella cheese for pizzas)
- Develop premium brands for retail
- Develop unique flavour profile
- Innovative packaging (e.g. convenience, improved freshness, single serve)
- Matching the quality and premium achieved by Italy, Netherlands or Spain

NZ INDUSTRY METRICS

Uses ANZSIC 1133 (inc. other dairy)

Geographic units	159
Unit growth (00-22)	+93
Unit growth CAGR (00-22)	4% pa
Employee count	11,900
Employee growth since 2000	+5,400
Empl. growth CAGR (00-22)	3% pa

Sales and marketing firms will be dairy product wholes. [3720].

POTENTIAL NZ BIOMASS USED

Cattle milk solids	XXX
Goat milk solids	X
Sheep milk solids	X
Salt	X
Emulsifiers	?
Other additives	?

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can take share from global leaders in pizza cheese (e.g. Saputo, Leprino)
- New Zealand can increase quality and product differentiation to compete more directly with premium European cheeses

ICE CREAM AND FROZEN DESSERT MANUFACTURING

TOTAL SCORE

27/50

INTERNATIONAL STANDARD CODES

ANZSIC	1113-20
NACE (European Union)	10.52
NAICS (North America)	3115-20

PLATFORM DEFINITION

Manufacturing ice cream or frozen confectionery:

- Ice cream manufacturing
- Confections, frozen manufacturing
- Fruit ice, frozen, manufacturing
- Gelato manufacturing
- Sorbet manufacturing [ANZSIC]

Similar to: "Manufacturing ice cream, frozen yogurts, frozen ices, sherbets, frozen tofu, and other frozen desserts (except bakery products)." [NAICS]

NZ INDUSTRY METRICS

Uses ANZSIC 1113-20

Geographic units	39
Unit growth (00-22)	+18
Unit growth CAGR (00-22)	3% pa
Employee count	690
Employee growth since 2000	+220
Empl. growth CAGR (00-22)	2% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be other grocery wholes. [3609].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

20
26

"ELEVATOR PITCH"

Farmer owned dairy cooperative historically ignored ice cream. With new entrants and new owners, the NZ ice cream industry is now innovating and growing rapidly. NZ can leverage low cost dairy and innovation to build a strong position in export market.

LEVERAGEABLE NZ FACTORS

- Global low cost dairy producer with large surplus available for export
- Trusted food safety systems
- Latent reputation with many consumers as a trusted dairy supplier
- Iconic/unique New Zealand ingredients and flavours (e.g. gold kiwifruit)
- Tip Top now owned by #1 global ice cream firm Froneri rather than farmers

SOURCES OF VALUE CREATION

- Shift away from "cheap and cheerful" bulk packs to smaller premium tubs and novelty/stick products
- Shift to "less but better" improving margins
- Improving scale and lowering costs at smaller NZ processors

POTENTIAL NZ BIOMASS USED

Milk products	XXX
Processed fruits	XX
Sweeteners & substitutes	XX
Chocolate/confectionery	X
Flavours	?
Nuts	?
Vegetable oils	?
Pea/Soy protein	?
Salt	X
Emulsifiers/other additives	?

WHAT YOU WOULD NEED TO BELIEVE

- Dairy is a significant component of cost
- New Zealand capabilities in dairy can be leveraged into non-dairy
- New Zealand manufacturers can sustain ongoing innovation in a highly competitive market
- Latent New Zealand reputation for dairy can translate into ice cream

BIO-ECON SCORECARD

7
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Relatively consolidated globally
- Mature domestic market
- Opportunities in exports not infinite

COMPLEX WITH MULTIPLE INPUTS ★★★☆

- Growing diversity of ingredients
- Novelty ('stick') products more complex than tub

BUILDS SYSTEM RESILIENCE ☆☆☆☆

- Only vaguely and indirectly

UNLOCK AG EMISSIONS RED ☆☆☆☆

-

REPLACE FOSSIL FUELS ★☆☆☆

- Processing primarily uses electricity
- Bioplastics for packaging

RETHINK WASTE ★☆☆☆

- Can rethink some ingredients
- Opportunities to move to more environmentally friendly packaging

BISCUIT, COOKIE, CRACKER, MUESLI BAR MNFG.

TOTAL SCORE

24/50

INTERNATIONAL STANDARD CODES

ANZSIC	1173
NACE (European Union)	10.61 (part)
NAICS (North America)	3118-21

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

19
26

"ELEVATOR PITCH"

The ongoing global "rise of snacking" shows no signs of slowing. At the same time, New Zealand has a long history of developing and marketing successful baked snacks. Other countries (e.g. Denmark) demonstrate that continued success is possible by focusing on differentiated products with strong messaging.

BIO-ECON SCORECARD

5
24

CAN ABSORB LARGE QUANTITIES

- Demand not supply the issue
- Stable, domestic focused, mature

COMPLEX WITH MULTIPLE INPUTS

- Uses a diverse range of ingredients

BUILDS SYSTEM RESILIENCE

- Only vaguely and indirectly

UNLOCK AG EMISSIONS RED

-

REPLACE FOSSIL FUELS

- Significant use of heat energy
- Processing primarily uses electricity
- Bioplastics for packaging

RETHINK WASTE

- Can rethink some ingredients
- Opportunities to move to more environmentally friendly packaging

PLATFORM DEFINITION

Manufacturing biscuits from factory based premises:

- Biscuit dough manufacturing (factory based)
- Biscuit manufacturing (except pet food biscuits; factory based)
- Ice cream cone or wafer manufacturing (factory based) [ANZSIC]

Manufacturing cookies, crackers, and other products, such as ice cream cones. [NAICS]

LEVERAGEABLE NZ FACTORS

- Trusted food safety systems
- Iconic/unique New Zealand ingredients and flavours (e.g. gold kiwifruit)
- Modern grain processing sector
- Large supply of dairy products
- Sustainable agricultural production
- Innovative and competitive processors with track record of new product development

SOURCES OF VALUE CREATION

- Healthy snacking
- Shift to "less but better" improving margins
- Improving scale and lowering costs of smaller NZ processors
- Co-branding leveraging other iconic NZ brands (e.g. Anchor, Zespri, Jazz, etc.)

NZ INDUSTRY METRICS

Uses ANZSIC 1173

Geographic units	33
Unit growth (00-22)	+18
Unit growth CAGR (00-22)	4% pa
Employee count	1,050
Employee growth since 2000	+330
Empl. growth CAGR (00-22)	2% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be other grocery wholes. [3609].

POTENTIAL NZ BIOMASS USED

Wheat flour	XXX
Sweeteners & substitutes	XXX
Vegetable oils/fats	XX
Chocolate/confectionery	X
Dairy products	X
Oats, other grain prod.	X
Flavours	?
Nuts (various)	?
Salt	X
Antioxidants	?

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand baked goods firms can carve out clear, defensible niches in large and highly competitive markets

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1162 (part)
NACE (European Union)	10.61 (part)
NAICS (North America)	3112-30

PLATFORM DEFINITION

In the current NZ standard industry classification, breakfast cereal manufacturing is captured in the catch-all code “cereal, pasta and baking mix manufacturing” [1162]

This platform is defined as the tighter NAICS: “manufacturing breakfast cereal foods”

NZ INDUSTRY METRICS

Uses ANZSIC 1162 (inc. pasta and other)

Geographic units	39
Unit growth (00-22)	+15
Unit growth CAGR (00-22)	2% pa
Employee count	660
Employee growth since 2000	+20
Empl. growth CAGR (00-22)	0.1% pa

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

15/26

“ELEVATOR PITCH”

Consumers worldwide are following the lead of Western countries in shifting to consuming breakfast cereals. At the same time, consumers in many developed markets are shifting to less-but-better premium cereals. The intersection of these two forces creates an opportunity for New Zealand to package together a range of local ingredients.

LEVERAGEABLE NZ FACTORS

- Range of unique or signature ingredients (e.g. Mānuka honey, Sungold kiwifruit)
- Beautiful scenery suited for marketing material; association with natural
- Strong capabilities in oats, specialty grains and seeds (e.g. linseed)
- Trusted country of origin Flexible and innovative manufacturers
- Quiet track record of success in numerous niche products and categories

SOURCES OF VALUE CREATION

- Ongoing shift to “less-but-better”
- Premium products targeting adults
- Competitive supply of specialty grains
- Investment in scaling up production to increase productivity and reduce costs targeting exports
- Westernisation of diets, particularly in developed Asian urban regions
- All-in-one dairy and cereal solutions

POTENTIAL NZ BIOMASS USED

Wheat	XXX
Oats	XXX
Processed fruit	XX
Dairy ingredients	X
Nutraceuticals	?
Sweeteners	?
Flavours	?
Other additives	?

WHAT YOU WOULD NEED TO BELIEVE

- Premium New Zealand breakfast cereals can standout and demand a premium in competitive export market

BIO-ECON SCORECARD

9/24

CAN ABSORB LARGE QUANTITIES ★☆☆☆

- Demand not supply the issue
- Modest export success to date

COMPLEX WITH MULTIPLE INPUTS ★★☆☆

- Brings together a rich variety of ingredients

BUILDS SYSTEM RESILIENCE ★★☆☆

- Significant imports
- Some potential to support new and emerging crops

UNLOCK AG EMISSIONS RED ☆☆☆☆

- Support high value uses of arable crops

REPLACE FOSSIL FUELS ★☆☆☆

- Bioplastics for packaging

RETHINK WASTE ★☆☆☆

- Can rethink some ingredients
- Opportunities to move to more environmentally friendly packaging

INTERNATIONAL STANDARD CODES

ANZSIC	None
NACE (European Union)	None
NAICS (North America)	None

PLATFORM DEFINITION

Not formally defined or measured by ANZSIC, NAICS or NACE. Likely classified in Other Food Product Manufacturing

"Precision fermentation refers to a process in which microorganisms, such as yeast or bacteria, are genetically engineered and utilized as living factories to produce specific proteins, enzymes, or other valuable compounds in a controlled fermentation environment. By precisely modifying the genetic code of these microorganisms, scientists can optimize their metabolic pathways to efficiently produce target molecules. This approach offers a sustainable and scalable alternative to traditional methods of production, enabling the creation of various products ranging from food ingredients to pharmaceuticals, with potential benefits such as reduced environmental impact and improved resource utilization."

NZ INDUSTRY METRICS

Not currently formally defined by ANZSIC or measured by StatisticsNZ.

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

17
26

"ELEVATOR PITCH"

The world has 136 precision fermentation startups that have attracted US\$3.7b since 2013, as well as at least 100 additional major companies working on it. The industry appears to now be going through a shakeout. New Zealand appears to have a handful of firms working on precision fermentation (Daisy Lab, Fonterra, New Fish, Miruku and BioSouth). We could have more.

LEVERAGEABLE NZ FACTORS

- Reputation for food safety
- Research capabilities in pastoral animals, specifically cattle and sheep
- Large agricultural-based economy with entrepreneurial spirit
- Strong competencies in stainless steel fabrication
- Government seeking low methane options for existing pastoral agriculture

SOURCES OF VALUE CREATION

- Government funding
- Developing and selling specific IP rather than producing proteins
- Exiting early in the hype cycle
- Licensing technology from well financed start-ups elsewhere

POTENTIAL NZ BIOMASS USED

Sugars/starch	XXX
Nitrogen sources (amino acids, peptides, or ammonium salts)	X
Trace elements	X
Vitamins	X
Minerals	X

WHAT YOU WOULD NEED TO BELIEVE

- Products can be manufactured at scale and with a cost of ingredients to be commercially viable
- Consumer will welcome highly processed foods produced from numerous different genetically modified bacteria
- New Zealand can "win" despite arriving "late in the game" and lacking firms, patents, or significant funding (e.g. relative to the EU or US)

BIO-ECON SCORECARD

9
24

CAN ABSORB LARGE QUANTITIES



- New Zealand does not produce typical feedstocks (e.g sugar)

COMPLEX WITH MULTIPLE INPUTS



- At the edge of human scientific and technical capabilities

BUILDS SYSTEM RESILIENCE



- Would appear to increase the need for imported feedstocks if it succeeds

UNLOCK AG EMISSIONS RED



- Hypothetically if it works at scale it might displace some cows in the future; not obviously low footprint

REPLACE FOSSIL FUELS



- Non-GM bacteria can already make ethanol (aka. alcohol)

RETHINK WASTE



- Like other fermented products, it produces a waste stream

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1199 (catch-all)
NACE (European Union)	10.89 (catch-all)
NAICS (North America)	3114-12

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

17
26

“ELEVATOR PITCH”

New Zealand produces a wide range of specialty frozen foods, including dinners, entrees, side dishes, pizzas and non-dairy desserts, across a robust group of processors of all sizes. This sector can continue to grow.

BIO-ECON SCORECARD

6
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Demand is the issue not supply
- More opportunities in export to sell the meal not the ingredients

COMPLEX WITH MULTIPLE INPUTS ★★★☆

- Basically pulling together a complete meal

BUILDS SYSTEM RESILIENCE ☆☆☆☆

- Only vaguely and indirectly

UNLOCK AG EMISSIONS RED ☆☆☆☆

-

REPLACE FOSSIL FUELS ☆☆☆☆

- Bioplastics for packaging
- Bioenergy for some processes

RETHINK WASTE ★☆☆☆

- Can rethink some ingredients
- Opportunities to move to more environmentally friendly packaging

PLATFORM DEFINITION

In the current NZ standard industry classification, frozen specialty are captured in “other food manufacturing not elsewhere classified” [1199] [Coriolis]

This platform is defined as the tighter NAICS:

“manufacturing frozen specialty foods (except seafood), such as frozen dinners, entrees, and side dishes; frozen pizza; frozen non-dairy whipped topping; and frozen waffles, pancakes, and French toast.”

LEVERAGEABLE NZ FACTORS

- Low cost, globally competitive producer of centre of the plate meat and seafood
- Competitive producer of some root crops
- Investment by major global multinational leaders (e.g. Kraft Heinz, McCain)
- Strong group of fast moving and innovative local producers
- Capabilities in efficient, small run production

SOURCES OF VALUE CREATION

- Continued product innovation
- Unique New Zealand flavours
- Healthy meals
- Meals for specific medical conditions
- Industry consolidation to drive scale
- Improving scale and lowering costs at NZ processors

NZ INDUSTRY METRICS

No data available.

Classified in wide ranging “other” category (1199 Other Food Product Manufacturing Not Elsewhere Classified).

POTENTIAL NZ BIOMASS USED

Cattle	XXX
Lamb	XXX
Poultry	XXX
Seafood	XXX
Dairy products	XXX
Processed vegetables	XXX
Vegetables oils	?
Flavours	X
Salt	?
Other additives	?

WHAT YOU WOULD NEED TO BELIEVE

- Relatively high labour costs (relative to other suppliers) can be managed
- Low scale per item or per production line can be overcome

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1199 (part)
NACE (European Union)	10.83
NAICS (North America)	3119-20

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

17/26

“ELEVATOR PITCH”

New Zealand has a vibrant and innovative coffee and tea processing industry that produces high quality products. Other countries (e.g. Italy) demonstrate that continued success is possible by focusing on differentiated products with strong messaging.

BIO-ECON SCORECARD

6/24

CAN ABSORB LARGE QUANTITIES ★☆☆☆

- Could theoretically take domestic share of tea and coffee were these to take off

COMPLEX WITH MULTIPLE INPUTS ★☆☆☆

- Not traditionally
- Becoming more complex

BUILDS SYSTEM RESILIENCE ★★☆☆

- Growing use of native botanicals
- Could get ‘on board’ with domestic tea and coffee to support growth

UNLOCK AG EMISSIONS RED ☆☆☆☆

-

REPLACE FOSSIL FUELS ☆☆☆☆

- Bioplastics for packaging

RETHINK WASTE ★★☆☆

- Opportunities in coffee grounds and tea bags; reverse supply chain the key issue

PLATFORM DEFINITION

ANZSIC includes this platform under “other food manufacturing not elsewhere classified”

This platform is defined as the tighter NACE: “Processing of tea and coffee

- decaffeinating and roasting of coffee
- production of coffee products:
 - ground coffee
 - soluble coffee
 - extracts and concentrates of coffee
- manufacture of coffee substitutes
- blending of tea and mate
- manufacture of extracts and prep. based on tea packing of tea including packing in tea-bags
- manufacture of herb infusions (mint, etc.)” [NACE]

LEVERAGEABLE NZ FACTORS

- Large number of coffee roasters of all sizes and scale
- Large number of innovative firms passionate about great tea/coffee
- Emerging domestic small-scale tea and coffee production
- Strong coffee culture; local appreciation of quality coffee
- Bell Tea now owned by #1 global coffee firm JDE rather than a grocers co-op

SOURCES OF VALUE CREATION

- Developing unique, signature New Zealand flavours
- Standalone retail and foodservice co-located with production
- Ready-to-drink (RTD) beverages
- Adding functional ingredients
- Premium gift packs targeting tourists and select Asian markets
- New forms of packaging (e.g. Ti Ora)

NZ INDUSTRY METRICS

No data available.

Classified in wide ranging “other” category (1199 Other Food Product Manufacturing Not Elsewhere Classified).

POTENTIAL NZ BIOMASS USED

Dairy products	XX
Sugar & sweeteners	XX
Tea	X
Native botanicals	X
Coffee	?
Flavours	?

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can produce distinctive coffee and/or tea products that stand out in the market
- A significant percent of consumers will pay a premium for NZ grown ingredients

INTERNATIONAL STANDARD CODES

ANZSIC [PARTIAL CODE]	1191
NACE (European Union)	10.89
NAICS (North America)	3119-19

PLATFORM DEFINITION

ANZSIC splits what industry would call "salty snacks" or "savory snacks" into multiple codes including "potato and other crisp mfg. (inc. tortilla mfg.)" [1191], "confectionery mfg." [1182] and "other food product mfg. not elsewhere classified" [1199].

This platform is defined as the tighter NAICS code: "(1) salting, roasting, drying, cooking, or canning nuts; (2) processing grains or seeds into snacks; (3) manufacturing peanut butter; and (4) manufacturing potato chips, corn chips, popped popcorn, pretzels (except soft), pork rinds, and similar snacks."

The data presented below only captures some of (4) in the ANZSIC

NZ INDUSTRY METRICS

Uses ANZSIC 1191 (excludes snack nut prod.)

Geographic units	3
Unit growth (00-22)	+0
Unit growth CAGR (00-22)	0% pa
Employee count	400
Employee growth since 2000	-370
Empl. growth CAGR (00-22)	-3% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be other grocery wholes. [3609].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

15
26

"ELEVATOR PITCH"

There is a long-term shift underway from fixed, often formal meals to ongoing grazing and snacking. A wide range of innovative New Zealand firms currently participate successfully in this category targeting primarily the domestic market. A shift to export markets is possible.

LEVERAGEABLE NZ FACTORS

- Huge potential to produce nuts (though results to date are hobby scale)
- Large number of nut processors and packers at scale
- Range of distinct potential ingredients (nuts and seeds)
- Recognised food safety

SOURCES OF VALUE CREATION

- Scale and available capacity at domestic processors and packers
- Using New Zealand unique flavours

POTENTIAL NZ BIOMASS USED

Potatoes	XXX
Maize	XXX
Wheat	XXX
Nuts	?
Seeds	?
Sweet potato	X
Salt	X
Flavours	?
Pig products	X
Other additives	?

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can successfully develop a unique product with demand in export markets (e.g. Australia, Asia)

BIO-ECON SCORECARD

7
24

CAN ABSORB LARGE QUANTITIES ★☆☆☆

- Growing domestic market
- Some exports opportunities

COMPLEX WITH MULTIPLE INPUTS ★★☆☆

- More diversity and complexity than 'meets the eye'

BUILDS SYSTEM RESILIENCE ★☆☆☆

- Can support a shift to domestic vegetable oils

UNLOCK AG EMISSIONS RED ★☆☆☆

- Supports tree nuts

REPLACE FOSSIL FUELS ★☆☆☆

- Bioplastics for packaging

RETHINK WASTE ★☆☆☆

- Can rethink some ingredients
- Opportunities to move to more environmentally friendly packaging

CULTIVATED MEAT (CELL-BASED MEAT)

TOTAL SCORE

21/50

INTERNATIONAL STANDARD CODES

ANZSIC	None
NACE (European Union)	None
NAICS (North America)	None

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

15
26

"ELEVATOR PITCH"

Total global production of lab grown meat across 156+ startups is likely smaller than a single day of production at a large New Zealand meat plant. Despite this, more than 680 groups have invested in the sector. New Zealand currently appears to have one firm in the space and could have more with vision and focus.

BIO-ECON SCORECARD

6
24

CAN ABSORB LARGE QUANTITIES

- New Zealand does not produce typical feedstocks

COMPLEX WITH MULTIPLE INPUTS

- At the edge of human scientific and technical capabilities

BUILDS SYSTEM RESILIENCE

-

UNLOCK AG EMISSIONS RED

- Hypothetically if it works at scale it might displace some meat in the future; not obviously low footprint

REPLACE FOSSIL FUELS

-

RETHINK WASTE

-

PLATFORM DEFINITION

Not formally defined or measured by ANZSIC, NAICS or NACE. Likely classified in Human Pharmaceutical and Medicinal Product Manufacturing

"Cultivated meat," also known as "cell-based meat," is produced through a process that involves growing real animal muscle tissue from animal cells in a lab rather than raising and slaughtering whole animals. The cultivation process typically requires a sterile laboratory environment and specialized equipment to ensure the growth and multiplication of cells in a controlled and safe manner. Nutrient-rich culture media, bioreactors, scaffolds, and appropriate tissue engineering techniques are employed to facilitate the development of the muscle tissue.

LEVERAGEABLE NZ FACTORS

- Reputation for food safety
- Research capabilities in pastoral animals, specifically cattle and sheep
- Large agricultural-based economy with entrepreneurial spirit
- Strong competencies in stainless steel fabrication
- Small group of hardy pioneers
- Government seeking low methane options for existing pastoral agriculture

SOURCES OF VALUE CREATION

- Government funding
- Exiting early in the hype cycle
- Licensing technology from well financed start-ups elsewhere

NZ INDUSTRY METRICS

Not currently formally defined by ANZSIC or measured by StatisticsNZ.

POTENTIAL NZ BIOMASS USED

Sugars	XXX
Amino acids	XX
Vitamins	X
Minerals	X

WHAT YOU WOULD NEED TO BELIEVE

- Flesh can be grown without an immune system at scale in sterile conditions at a price comparable to actual meat
- FSANZ regulations can be navigated
- Scalable, commercial production systems can be developed
- New Zealand capabilities in traditional meat transfer into this space
- NZ can "show up late" and somehow win
- Production will ultimately occur in New Zealand, rather than large population centres

Comment: A recent paid forecasting "tournament" found "the aggregated probabilities from our panel include a 54% probability that less than 100,000 metric tons of cultured meat (where >51% of the "meat" is produced directly from animal cells) will be produced and sold at any price in a 12-month period before the end of 2051" or in other words the global market will be less than half the size of the current New Zealand chicken industry.

CHOCOLATE CONFECTIONERY MANUFACTURING

TOTAL SCORE

21/50

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1182
NACE (European Union)	10.82
NAICS (North America)	3113-51/52

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

16
26

"ELEVATOR PITCH"

New Zealand has a vibrant and innovative chocolate confectionery industry that can produce innovative, high quality products. Other countries (e.g. Switzerland) demonstrate that continued success is possible by focusing on differentiated products with strong messaging.

BIO-ECON SCORECARD

5
24

CAN ABSORB LARGE QUANTITIES ★☆☆☆

- Stable, mature domestic market
- Export opportunities

COMPLEX WITH MULTIPLE INPUTS ★☆☆☆

- Uses a diverse range of ingredients
- Growth in plant-based options

BUILDS SYSTEM RESILIENCE ★☆☆☆

- Some support of named regional ingredients (e.g. Whittaker's)
- Supporting regional growth

UNLOCK AG EMISSIONS RED ☆☆☆

-

REPLACE FOSSIL FUELS ★☆☆☆

- Opportunities for solid bioenergy
- Bioplastics for packaging

RETHINK WASTE ★☆☆☆

- Can rethink some ingredients
- Opportunities to move to more environmentally friendly packaging

PLATFORM DEFINITION

ANZSIC mixes together chocolate and non-chocolate confectionery ("sugar confectionery")

This platform is defined as two tighter NAICS codes: "shelling, roasting, and grinding cacao beans and making chocolate cacao products and chocolate confectioneries" and "confectionery manufacturing from purchased chocolate" [NAICS]

But excluding "manufacture of sugar confectionery: caramels, cachous, nougats, fondant, white chocolate, chewing gum, fruit, nuts, fruit peels and other parts of plants in sugar and confectionery lozenges and pastilles"

LEVERAGEABLE NZ FACTORS

- High quality dairy inputs
- Latent reputation with many consumers as a trusted dairy supplier
- Iconic/unique New Zealand ingredients and flavours (e.g. gold kiwifruit)
- Sustainable production systems

SOURCES OF VALUE CREATION

- Convenient packaging (e.g. single serve,)
- Single origin cocoa products; provenance emphasis
- Liquor filled, New Zealand flavours
- Specific holiday themed products
- Targeted gift packaging
- Design your own bar/personalised
- Chain of retail outlets (e.g. Koko Black in Australia)

NZ INDUSTRY METRICS

Uses ANZSIC 1182 (inc. non-chocolate)

Geographic units	111
Unit growth (00-22)	+33
Unit growth CAGR (00-22)	2% pa
Employee count	1,900
Employee growth since 2000	+300
Empl. growth CAGR (00-22)	1% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be other grocery wholes. [3609].

POTENTIAL NZ BIOMASS USED

Milk solids	XXX
Processed fruits	X
Sweeteners & substitutes	?
Nuts	XXX
Flavours	?
Nuts	?
Vegetable oils	?
Pea/Soy protein	?
Salt	X
Emulsifiers/other additives	?

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can compete in luxury market against traditional European countries renowned for chocolate making
- Current lack of global scale (e.g. relative to Lindt) can be managed and overcome

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1172 (part)
NACE (European Union)	10.42
NAICS (North America)	3118-13

PLATFORM DEFINITION

In practice, New Zealand has perishable “fresh bakery” (not exported) and frozen bakery products (exported).

In the current NZ standard industry classification, both are captured under the catch-all “Cake and Pastry Manufacturing (factory based)” which excludes bread [Coriolis].

This platform is defined as the tighter NAICS:

“manufacturing frozen bakery products (except bread), such as cakes, pies, and doughnuts.”

NZ INDUSTRY METRICS

Uses ANZSIC 1172 (inc. non-frozen)

Geographic units	144
Unit growth (00-22)	-6
Unit growth CAGR (00-22)	-0.2% pa
Employee count	1,800
Employee growth since 2000	-350
Empl. growth CAGR (00-22)	-0.8% pa

Sales and marketing firms will be other grocery wholes. [3609].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

16
26

“ELEVATOR PITCH”

New Zealand’s growing capabilities in specialty grain products, valued added baked goods, processed fruits and frozen foods can be leveraged to target select value-added products into export markets.

LEVERAGEABLE NZ FACTORS

- Low cost dairy ingredients
- Flexible and innovative manufacturers
- Strong capabilities in specialty grains
- Quiet track record of success in numerous niche products and categories
- Historical experience in developing dairy “tariff busters” (e.g. frozen croissants [50% butter], flaky pastry apple turnovers with NZ apples for export)

SOURCES OF VALUE CREATION

- Investment in scaling up production to increase productivity and reduce costs targeting exports

POTENTIAL NZ BIOMASS USED

Wheat flour	XXX
Butter	XX
Other dairy products	XX
Egg	X
Flavourings	?
Salt	X
Soy protein isolates	?
Vegetable oils	?
Other additives	?

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand baked goods firms can carve out clear, defensible niches in large and highly competitive markets

BIO-ECON SCORECARD

5
24

CAN ABSORB LARGE QUANTITIES ★☆☆☆

- Stable, primarily domestic focused, mature
- Some exports, primarily high dairy

COMPLEX WITH MULTIPLE INPUTS ★★☆☆

- Uses a diverse range of ingredients
- More opportunities to differentiate

BUILDS SYSTEM RESILIENCE ☆☆☆☆

- Only vaguely and indirectly

UNLOCK AG EMISSIONS RED ☆☆☆☆

-

REPLACE FOSSIL FUELS ★☆☆☆

- Significant use of heat; primarily uses electricity; op. for bioenergy
- Bioplastics for packaging

RETHINK WASTE ★☆☆☆

- Can rethink some ingredients
- Opportunities to move to more environmentally friendly packaging

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1162 (part)
NACE (European Union)	10.72
NAICS (North America)	3118-24

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

15
26

“ELEVATOR PITCH”

New Zealand’s growing capabilities in specialty grain products and valued added baked goods can be leveraged to target select value-added products into export markets.

BIO-ECON SCORECARD

4
24

CAN ABSORB LARGE QUANTITIES

- Demand is the issue not supply
- Mature, traditional, domestic focused sector

COMPLEX WITH MULTIPLE INPUTS

- Uses a diverse range of ingredients
- More opportunities to differentiate

BUILDS SYSTEM RESILIENCE

- Only vaguely and indirectly

UNLOCK AG EMISSIONS RED

-

REPLACE FOSSIL FUELS

- Bioplastics for packaging
- Bioenergy for some processes (e.g. heat)

RETHINK WASTE

- Can rethink some ingredients
- Opportunities to move to more environmentally friendly packaging

PLATFORM DEFINITION

In the current NZ standard industry classification, breakfast cereal manufacturing is captured in the catch-all code “cereal, pasta and baking mix manufacturing” [1162]

This platform is defined as the tighter NAICS:

“(1) manufacturing dry pasta and/or (2) manufacturing prepared flour mixes or dough from flour ground elsewhere. The establishments in this industry may package the dry pasta they manufacture with other ingredients.

LEVERAGEABLE NZ FACTORS

- Low cost dairy ingredients
- Flexible and innovative manufacturers
- Strong capabilities in specialty grains
- Quiet track record of success in numerous niche products and categories
- Historical experience in developing dairy “tariff busters” (e.g. frozen croissants [50% butter], flaky pastry apple turnovers with NZ apples for export)

SOURCES OF VALUE CREATION

- Investment in scaling up production to increase productivity and reduce costs targeting exports

NZ INDUSTRY METRICS

Uses ANZSIC 1162 (inc. breakfast cereal)

Geographic units	39
Unit growth (00-22)	+15
Unit growth CAGR (00-22)	2% pa
Employee count	660
Employee growth since 2000	+20
Empl. growth CAGR (00-22)	0.1% pa

POTENTIAL NZ BIOMASS USED

Wheat flour	XXX
Egg	X
Flavours	?
Salt	X
Soy protein isolates	?
Vegetable oils	?
Butter, other dairy	X
Other additives	?

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand baked goods firms can carve out clear, defensible niches in large and highly competitive markets

NON-CHOCOLATE CONFECTIONERY

TOTAL SCORE

18/50

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1182
NACE (European Union)	10.82
NAICS (North America)	3113-40

PLATFORM DEFINITION

ANZSIC mixes together chocolate and non-chocolate confectionery ("sugar confectionery")

This platform is defined as "manufacture of sugar confectionery: caramels, cachous, nougats, fondant, white chocolate, chewing gum, fruit, nuts, fruit peels and other parts of plants in sugar and confectionery lozenges and pastilles" [NACE subcategory]

But excludes two NAICS codes: "shelling, roasting, and grinding cacao beans and making chocolate cacao products and chocolate confectioneries" and "confectionery manufacturing from purchased chocolate" [NAICS definitions]

NZ INDUSTRY METRICS

Uses ANZSIC 1182 (inc. chocolate)

Geographic units	111
Unit growth (00-22)	+33
Unit growth CAGR (00-22)	2% pa
Employee count	1,900
Employee growth since 2000	+300
Empl. growth CAGR (00-22)	1% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be other grocery wholes. [3609].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

16
26

"ELEVATOR PITCH"

There is a huge universe of confectionery products beyond chocolate. At the same time, there is a long-term shift underway from fixed, often formal meals to ongoing grazing and snacking. A wide range of innovative New Zealand firms make non-chocolate confectionery. Global leaders suggest significant export success is possible.

LEVERAGEABLE NZ FACTORS

- Trusted food safety systems
- Iconic/unique New Zealand ingredients and flavours (e.g. gold kiwifruit)
- Flexible and innovative manufacturers
- Quiet track record of success in numerous niche products and categories
- Low cost dairy ingredients

SOURCES OF VALUE CREATION

- Investment in scaling up production to increase productivity and reduce costs targeting exports
- Ongoing shift to "less-but-better"
- Premium products targeting adults
- Industry consolidation to drive scale

POTENTIAL NZ BIOMASS USED

Sweeteners/substitutes	XXX
Processed fruits	XXX
Flavours	?
Emulsifiers/other additives	?
Vegetable oils	?
Salt	X

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand confectionery firms can move beyond "me-too" products developed elsewhere to creating unique products that are difficult to duplicate

BIO-ECON SCORECARD

2
24

CAN ABSORB LARGE QUANTITIES

- Currently focused on stable, mature domestic market
- Exports almost untapped

COMPLEX WITH MULTIPLE INPUTS

- Defensibility through process complexity (and legacy brands)
- Limited ingredient innovation

BUILDS SYSTEM RESILIENCE

- Could do much better at supporting regional identity and local ingredients (cf. Italy, Spain)

UNLOCK AG EMISSIONS RED

-

REPLACE FOSSIL FUELS

- Bioplastics for packaging

RETHINK WASTE

- Opportunities to improve packaging

MAYONNAISE, DRESSING, OTHER PREP. SAUCE MNFG.

TOTAL SCORE

15/50

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1199
NACE (European Union)	10.84
NAICS (North America)	3119-41

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

12
26

"ELEVATOR PITCH"

There is an opportunity for a targeted approach by differentiated New Zealand sauces in specific niche segments that are unconsolidated. There may also be an opportunity to produce major, everyday sauces in NZ for export markets.

BIO-ECON SCORECARD

3
24

CAN ABSORB LARGE QUANTITIES



- Demand not supply the issue
- Modest export success to date

COMPLEX WITH MULTIPLE INPUTS



- Numerous plant and animal ingredients used and possible

BUILDS SYSTEM RESILIENCE



- Smaller firms often regional

UNLOCK AG EMISSIONS RED



-

REPLACE FOSSIL FUELS



- Bioplastics for packaging

RETHINK WASTE



- Can support novel ingredients
- Opportunities to move to more environmentally friendly packaging

PLATFORM DEFINITION

In the current NZ standard industry classification, breakfast cereal manufacturing is captured in the catch-all code "cereal, pasta and baking mix manufacturing" [1162]

This platform is defined as the tighter NAICS:

"Manufacturing mayonnaise, salad dressing, vinegar, mustard, horseradish, soy sauce, tartar sauce, Worcestershire sauce, and other prepared sauces (except tomato-based and gravy)." [NAICS]

LEVERAGEABLE NZ FACTORS

- Wide range of unique botanicals and signature ingredients
- Strong story and picturesque scenery will suited to marketing
- Rapidly growing industry driving product development, improvement and innovation (e.g. Culley's)
- Willingness to "adopt and make it their own" (cf. BBQ sauce)

SOURCES OF VALUE CREATION

- Investment increasing productivity and decreasing costs through scale targeting export
- Development of unique sauces with a strong brand and a clear point-of-difference to the consumer
- Dairy-based sauces

NZ INDUSTRY METRICS

No data available.

Classified in wide ranging "other" category (1199 Other Food Product Manufacturing Not Elsewhere Classified).

POTENTIAL NZ BIOMASS USED

Tomatoes	XXX
Processed fruit	XXX
Processed vegetables	XXX
Eggs	X
Dairy products	X
Vegetable oils	?
Flavours	?
Sweeteners	?
Other additives	?

WHAT YOU WOULD NEED TO BELIEVE

- New Zealand can develop an international identity in a specific subset of sauces (e.g. Texas=BBQ, Mexico=Hot Sauce; Jamaica=Jerk Sauce; UK=HP/L&P/etc.)

III.2 SUPPORTING BETTER FARM INPUTS

WHAT ARE OUR OBJECTIVES FOR OUR BIOMASS PROCESSING SYSTEMS?

1 SUPPORT BETTER
OUTCOMES FROM
EXISTING USES OF
BIOMASS

2 SUPPORT BETTER
FARM INPUTS

- 1.1 Wood
- 1.2 Wool
- 1.3 Health & Home
- 1.4 Beverages
- 1.5 Food

- 2.1 Feed
- 2.2 Fertiliser
- 2.3 Pesticides/Herbicides
- Fuels (see 3.2)

FEED MILLING: “ANIMAL FEED” FOR FARM ANIMALS

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1192 (part)
NACE (European Union)	10.91
NAICS (North America)	3111-19

PLATFORM DEFINITION

Note: NZ also imports animal feeds directly that do not pass through domestic processing

ANZSIC includes both pet and farm animals under a single code.

This platform is defined as the tighter NAICS: “Manufacturing animal food (except dog and cat) from ingredients, such as grains, oilseed mill products, and meat products” or NACE: “manufacture of prepared feeds for farm animals, including concentrated animal feed and feed supplements and preparation of unmixed (single) feeds for farm animals, includes: treatment of slaughter waste to produce animal feeds”. [NACE]

NZ INDUSTRY METRICS

Uses ANZSIC 1192 (inc. pet)	
Geographic units	156
Unit growth (00-22)	+69
Unit growth CAGR (00-22)	3% pa
Employee count	1,650
Employee growth since 2000	+890
Empl. growth CAGR (00-22)	4% pa
Contract packers may be packaging services [7320]. Sales and marketing firms will be other grocery wholes. [3609].	

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

22/26

“ELEVATOR PITCH”

New Zealand has large and growing demand for animal feeds to support intensive systems (poultry, pigs, sheep dairy, goat dairy) and at the same time is increasing feed per head to drive up output per head. Emission reduction pressures will support growing demand for emissions reducing options.

LEVERAGEABLE NZ FACTORS

- Major cattle and sheep farmer
- Large and growing use of supplementary feed in intensive and dairy systems
- Growing poultry production (on trend to exceed lamb w/in a decade)
- Strong reputation for food safety and food security
- Relatively consolidated, efficient industry
- Capabilities in meat science, dairy science and plant breeding

POTENTIAL NZ BIOMASS USED

Maize	XXX
Barley, wheat, other grains	XXX
Animal byproducts	XXX
Seafood byproducts	XXX
Brewing dregs	XXX
Dairy	X
Oils & fats	XX
Other waste streams	XXX
Seaweed	?

SOURCES OF VALUE CREATION

- Low emissions feed mixes
- Further industry consolidation to increase scale
- Improvements in robotics to increase productivity
- Further separation and fractionation of coproducts, byproducts and waste streams (in particular seafood products for aquaculture feed; processing waste to animal feed etc.)

WHAT YOU WOULD NEED TO BELIEVE

- Collective New Zealand myths and values around farming can be managed
- Changing regulatory landscape can be managed
- Growing animal feed stacks up against other land uses in enough areas
- Logistics of supply and demand between regions can be navigated (often cheaper to import from Sydney than across the Cook Strait)

BIO-ECON SCORECARD

21/24

CAN ABSORB LARGE QUANTITIES ★★★★★

- Can absorb almost any conceivable quantity of suitable biomaterials

COMPLEX WITH MULTIPLE INPUTS ★★★★★

- Almost any nutritional grain or waste stream can be and is used

BUILDS SYSTEM RESILIENCE ★★★★★

- Largest biomaterial import
- Significant import exposure and volatile pricing

UNLOCK AG EMISSIONS RED ★★★★★

- Animal GHG emissions can be controlled by changes in feed

REPLACE FOSSIL FUELS ★★★★★

- Large energy use; more can be done with onsite bioenergy from byproducts and waste

RETHINK WASTE ★★★★★

- Massive ‘waste’ sink; most food and beverage industry ‘waste’ is fed to animals

FERTILISER: SOIL AMENDMENTS/COMPOST MNFG.

TOTAL SCORE

40/50

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1831
NACE (European Union)	20.15
NAICS (North America)	3253

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

20
26

“ELEVATOR PITCH”

Chemical fertilisers are contributing to New Zealand GHG emissions and causing problems in groundwater and waterways. A lot of natural solutions have been put forward by avid proponents. A solution needs to be found that stacks up for the environment and the farmer.

BIO-ECON SCORECARD

20
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- Almost infinite ability to absorb biomaterials; getting the economics right is the challenge

COMPLEX WITH MULTIPLE INPUTS ★★☆☆

- Most products applied by volume are relatively basic chemicals or biomass byproducts and waste

BUILDS SYSTEM RESILIENCE ★★☆☆

- Any further shift to plant-based biomass will require more, not less fertilisers; no easy solution

UNLOCK AG EMISSIONS RED ★★★★★

- Fertiliser needs to go from being part of the problem to part of the solution; no easy solutions currently

REPLACE FOSSIL FUELS ★★★★★

- Ammonia production uses large amounts of natural gas; numerous other issues across chain

RETHINK WASTE ★★★★★

- Massive existing waste sink with further potential to take more

PLATFORM DEFINITION

- Manufacturing and mixing fertilisers:
- Ammonium phosphate manufacturing
 - Ammonium sulphate manufacturing
 - Animal and vegetable fertiliser manufacturing
 - Bonedust manufacturing
 - Bonemeal fertiliser manufacturing
 - Calcium sulphate manufacturing
 - Controlled release fertiliser preparation manufacturing
 - Fertiliser manufacturing n.e.c.
 - Fishmeal fertiliser manufacturing
 - Humic substance manufacturing
 - Nitrogenous fertiliser material manufacturing
 - Phosphate fertiliser material manufacturing
 - Potash fertiliser manufacturing
 - Potassium chloride fertiliser manufacturing
 - Prilled ammonium nitrate manufacturing
 - Sodium nitrate fertiliser manufacturing
 - Sulphuric lime manufacturing
 - Super phosphate manufacturing
 - Urea, fertiliser grade, manufacturing

LEVERAGEABLE NZ FACTORS

- Large, well organised industry
- Two large farmer owned bulk manufacturers (Ravensdown and Ballance); other new and emerging innovators in the sector
- Efficient national distribution networks
- Current government is motivated to deliver on emission reductions
- Skilled and capable farmers willing to change if the business case stacks up

SOURCES OF VALUE CREATION

- Large number of byproducts and waste streams looking for a home under tightening regulatory environment
- Potential tax incentives
- Potential grants and loans
- Potential agricultural subsidies
- Potential R&D funding

NZ INDUSTRY METRICS

Uses ANZSIC XXXX

Geographic units	84
Unit growth (00-22)	+24
Unit growth CAGR (00-22)	1.3% pa
Employee count	1,200
Employee growth since 2000	+210
Empl. growth CAGR (00-22)	3.9% pa

Sales and marketing firms will be other ag. products wholes. [3720].

POTENTIAL NZ BIOMASS USED

Food processing waste	XXX
Beverage processing waste	XXX
Bonedust/bonemeal	XXX
Seafood bycatch	XXX
Manure & urine	XXX
Forestry waste	XXX
Seaweed	X
Other waste streams	XX

WHAT YOU WOULD NEED TO BELIEVE

- Non-traditional solutions that are unproven at scale will work under New Zealand conditions
- The total end-to-end chain economics of bio-based solutions (e.g seaweed, compost, biochar) can compete with minerals
- Somewhere in New Zealand there are significant amounts of suitable biomass that are not returning to the land already (but can)

INTERNATIONAL STANDARD CODES

ANZSIC	1832
NACE (European Union)	20.2
NAICS (North America)	3253-20

PLATFORM DEFINITION

Formulation and preparation of pest control chemicals:

- Animal dip manufacturing
- Animal spray manufacturing
- Flyspray manufacturing
- Formulated pest control product manufacturing
- Fungicide manufacturing
- Insect repellent manufacturing
- Insecticide manufacturing
- Pesticide manufacturing n.e.c.
- Rat poison manufacturing
- Soil fumigant manufacturing
- Weedkiller manufacturing [ANZSIC]

NZ INDUSTRY METRICS

Uses ANZSIC XXXX

Geographic units	18
Unit growth (00-22)	+3
Unit growth CAGR (00-22)	0.8% pa
Employee count	95
Employee growth since 2000	-75
Empl. growth CAGR (00-22)	-2.6% pa

Contract packers may be packaging services [7320]. Sales and marketing firms will be other ag. products wholes. [3720].

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

10
26

“ELEVATOR PITCH”

While many families of pesticides and herbicides were initially identified from plants (and sometimes animals), almost all are now made from chemical raw materials in fossil fuel intensive processes. A shift to the circular bioeconomy will require new solutions.

LEVERAGEABLE NZ FACTORS

- Numerous unique plants that have not been researched extensively
- Large, modern agriculture sector that is generally well organised
- Current government is motivated to deliver on circular bioeconomy

SOURCES OF VALUE CREATION

- Lessons from case studies elsewhere (e.g. Tasmania)
- Large number of byproducts and waste streams looking for a home under tightening regulatory environment
- Potential tax incentives
- Potential grants and loans
- Potential agricultural subsidies
- Potential R&D funding

POTENTIAL NZ BIOMASS USED

Mānuka (oil)	XXX
Marigold	X
Eucalyptus (oil)	X
Tobacco	?
Garlic	?
Pyrethrum	?
Numerous others	?

WHAT YOU WOULD NEED TO BELIEVE

- A large number of bio-friendly solutions can be found for a vary large number of problems (numerous plants and animals)
- Bio-friendly solutions will not leave unacceptable residues
- Bio-friendly solutions will not cause other problems
- Bio-friendly solutions can compete with industrial solutions developed by multinationals and produced at scale
- New Zealand can ‘win’ in this space (rather than just importing solutions)

BIO-ECON SCORECARD

16
24

CAN ABSORB LARGE QUANTITIES ★☆☆☆

- Highly specialised ingredients, mostly chemicals today; typically specific plants (e.g. pyrethrum)

COMPLEX WITH MULTIPLE INPUTS ★★★★★

- Numerous inputs potentially from a wide range of plants

BUILDS SYSTEM RESILIENCE ★★★★★

- Large amounts currently imported
- Can support new bio crops

UNLOCK AG EMISSIONS RED ★★☆☆

- Herbicides and pesticides not even really ‘on the radar’

REPLACE FOSSIL FUELS ★★★★★

- Bio-friendly solutions may have a lower overall end-to-end footprint

RETHINK WASTE ★☆☆☆

- Possible to use of bioplastics in industrial packaging

III.3 BEGIN THE TRANSITION AWAY FROM FOSSIL FUELS

WHAT ARE OUR OBJECTIVES FOR OUR BIOMASS PROCESSING SYSTEMS?



REPLACING COAL WITH BIOMASS (E.G. WOOD PELLETS)

TOTAL SCORE

38/50

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODES]	2619
NACE (European Union)	In 35.11
NAICS (North America)	2211-17

PLATFORM DEFINITION

ANZSIC uses "2619 Other Electricity Generation: the generation of electricity using wind, solar, tidal, biomass not elsewhere classified and other methods of electricity generation not elsewhere classified."

NAICS is clearer: "2211-17 Operating biomass electric power generation facilities. These facilities use biomass (e.g., wood, waste, alcohol fuels) to produce electric energy. The electric energy produced in these establishments is provided to electric power transmission systems or to electric power distribution systems."

On site burning of waste (e.g. wood at a wood processing plant is not measure, but obviously large.

NZ INDUSTRY METRICS

Uses ANZSIC 2619 "Other electricity gen."

Geographic units	72
Unit growth (00-22)	63
Unit growth CAGR (00-22)	10% pa
Employee count	340
Employee growth since 2000	+255
Empl. growth CAGR (00-22)	7% pa

On-site, own-use operations are not classified or measured separately in ANZSIC. Firewood and wood pellet mnfg. classified elsewhere.

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

18
26

"ELEVATOR PITCH"

New Zealand used 1.2m tonnes of coal in 2022. 7% of this coal was used directly in ag/forestry/fishing and 75% in industry. While the wood processing sector has used wood residues for heat energy, other sectors of the bioeconomy still use significant coal for heat energy. With new thinking and new equipment, this situation can change.

LEVERAGEABLE NZ FACTORS

- Large areas in commercial plantation forestry
- Current government is motivated to deliver on waste reductions
- Extensive government funded R&D into new feedstocks and new production methods
- Positive growing conditions for biomass crops
- Significant areas of marginal land that could be suitable for biomass crops, without significantly impacting on current agricultural production

Wood	XXX
Sawdust	XXX
Wood pellets	XXX
Other wood waste	XXX
Other biomass byproducts and waste streams	XXX

SOURCES OF VALUE CREATION

- Untapped regional waste surpluses
- Co-location of new production/ manufacturing with sources of wood waste and complimentary processing (e.g. pulpmill and saw mill, or chemical extraction and wood construction
- Potential tax incentives
- Potential grants and loans
- Potential agricultural subsidies
- Potential R&D funding

WHAT YOU WOULD NEED TO BELIEVE

- Solutions can be found for sectors that do not directly produce a lot of excess biomass on-site
- Logistics challenges can be overcome to balance supply and demand by location and results in economic and positive return for all members of supply chain
- On-going supply of biomass will be available as input
- There are benefits vs electrification

BIO-ECON SCORECARD

20
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- Logistics and suitability of feedstock rather than demand limit scale and implementation

COMPLEX WITH MULTIPLE INPUTS ★☆☆☆☆

- Wood pellets from wood; Some modern facilities can burn multiple inputs giving flexibility

BUILDS SYSTEM RESILIENCE ★★★☆☆

- Reduces need for imported coal and other fossil fuels

UNLOCK AG EMISSIONS RED ★★★★★

- Supports plantation forestry

REPLACE FOSSIL FUELS ★★★★★

- Reduces need for coal and other fossil fuels

RETHINK WASTE ★★★★★

- Can potentially use almost any flammable biomass

REPLACING FOSSIL FUEL WITH BIOETHANOL/BIODIESEL

TOTAL SCORE

36/50

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODES]	1701/1709/1812
NACE (European Union)	19.20
NAICS (North America)	3251-93/99

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

17
26

“ELEVATOR PITCH”

Biofuels (bioethanol and biodiesel) are renewable fuels made from organic materials. Biofuels reduce greenhouse gas emissions, as they are produced from renewable resources and produce fewer emissions than fossil fuels. Despite a number of high profile failures, this sector is set for growth medium and long term in New Zealand; however there is no silver bullet.

BIO-ECON SCORECARD

19
24

CAN ABSORB LARGE QUANTITIES ★★☆☆

- Theoretically biofuels can absorb massive quantities; in practice, new capacity will be required to scale

COMPLEX WITH MULTIPLE INPUTS ★☆☆☆

- Relatively simple process and inputs (advanced biofuels more complex)

BUILDS SYSTEM RESILIENCE ★★★★★

- Reduces reliance on imported fuels, many from unstable regions

UNLOCK AG EMISSIONS RED ★★★★★

- Supports a shift to plant-based agriculture at scale

REPLACE FOSSIL FUELS ★★★★★

- Replaces petroleum and diesel (economic feasibility and volumes unknown at this stage)

RETHINK WASTE ★★★★★

- Biodiesel can use use vegetables oils and similar waste streams
- Other opportunities exist

PLATFORM DEFINITION

No clear ANZSIC code available for analysis.

ANZSIC uses multiple codes “petroleum refining and petroleum fuel manufacturing” [1701] which includes “blending petroleum fuel with ethanol”, “other petroleum and coal product manufacturing” [1709] which includes “processing of oil and grease stocks” and “Basic Organic Chemical Manufacturing” [1812] including “manufacturing ethanol and other industrial alcohols”

LEVERAGEABLE NZ FACTORS

- High arable crop yields (e.g. maize)
- Proven capability in alcohol and vegetable oil production and oil refining
- Current government is motivated to deliver on emission reductions
- Clear lessons available from numerous past failures (in NZ and elsewhere)
- Extensive government funded R&D into new feedstocks and new production methods

SOURCES OF VALUE CREATION

- Buying past failures at a low price
- Fuel standards requiring bioethanol/biodiesel component
- Potential tax incentives
- Potential grants and loans
- Potential agricultural subsidies
- Potential R&D funding
- Potential regulation

NZ INDUSTRY METRICS

No available Stats NZ data as there is no industry code.

There do not appear to be any bioethanol or biodiesel refineries in operation in New Zealand. Past failures include:

- Taranaki BioFuels
- Biodiesel New Zealand
- Aquaflow Bionomic Corporation
- New Zealand BioFuels
- Norske Skog Biofuels

POTENTIAL NZ BIOMASS USED

Maize	XXX
Wheat	XXX
Barley	XXX
Forestry ‘waste’	XXX
Tallow	XXX
Canola	?
Sunflowers	?
Soybeans	?
Waste oils/grease	?
Micro algae	?

WHAT YOU WOULD NEED TO BELIEVE

- Domestic production can compete with imports (e.g. from Brazil, Singapore or Indonesia)
- Multiple generations of New Zealand government will support market distorting policies across the lifespan of a refinery
- Other potential land and biomass uses will not provide higher returns (e.g. why make corn ethanol when you could make Jack Daniels?)
- New Zealand can scale up a crop to volumes that would make a material impact and have a feasible EROI*

* Energy Return on Investment (i.e. “to be useful the energy return on investment (EROI) needs to be above a range of 7 to 14. SCION estimates that the average EROI of corn ethanol is in the range of 2.6 to 2.8. Liquid biofuels’ EROI can range from less than 1 to 4 for more productive feedstock.” pers. comm. EECA)

CAPTURING METHANE FROM WASTE SOURCES

TOTAL SCORE

41/50

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODES]	2921 (part)
NACE (European Union)	35.21
NAICS (North America)	2211-17/5622-12

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

21
26

“ELEVATOR PITCH”

Mature technology exists to turn municipal food waste and other sources of biomass into sustainable, renewable clean energy. At the same time, a growing and changing regulatory environment puts pressure on waste management operators to find solutions.

BIO-ECON SCORECARD

20
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- Theoretically large
- Navigating regulations and collection logistics the key issue

COMPLEX WITH MULTIPLE INPUTS ★★☆☆

- There are a lot of inputs (different waste streams) but you are only collecting gas

BUILDS SYSTEM RESILIENCE ★★☆☆

- Addresses an issue across all regions of the country

UNLOCK AG EMISSIONS RED ★★★★★

- Methane being captured primarily comes from biomass

REPLACE FOSSIL FUELS ★★★★★

- Replaces fossil fuel based energy sources

RETHINK WASTE ★★★★★

- Creates highly valuable output from waste

PLATFORM DEFINITION

NACE includes in “manufacture of gas”
NAICS includes in “Biomass Electric Power Generation” or “Solid Waste Landfill”
ANZSIC uses a catch-all Waste Treatment and Disposal Services 2921: “the treatment or disposal of solid, liquid and other waste types (including hazardous). Also, included are units mainly engaged in operating landfills, combustors, incinerators, compost dumps and other treatment facilities (except sewage treatment), including waste transfer stations.”

- Garbage disposal service
- Hazardous waste treatment or disposal service
- Operating landfills
- Operating other waste treatment facilities
- Rubbish dump or tip operation
- Sanitary disposal service
- Septic tank pumping or cleaning service (except repairs and maintenance)”

LEVERAGEABLE NZ FACTORS

- Large amounts of municipal waste “looking for a home”
- Proven capability in alcohol and vegetable oil production and oil refining
- Current central government is motivated to deliver on emission reductions leading to regional governments looking for solutions
- Government funding for R&D

SOURCES OF VALUE CREATION

- Low emission hubs (a local landfill producing gas to nearby facilities)
- Government subsidies and grants
- Low cost loans
- R&D funding
- Long term contracts
- Potential regulation

NZ INDUSTRY METRICS

Uses ANZSIC 2921 (catch-all)

Geographic units	198
Unit growth (00-22)	-
Unit growth CAGR (00-22)	-% pa
Employee count	2,300
Employee growth since 2000	+1,660
Empl. growth CAGR (00-22)	6% pa

Not all units measured here capture methane. Some may be captured elsewhere (e.g. on site at a large processing facility)

POTENTIAL NZ BIOMASS USED

Municipal waste	XXX
Processing waste	XXX
Farm waste	XXX
Seafood waste	XXX
Meat waste	XXX
Other biomass waste streams	XXX

WHAT YOU WOULD NEED TO BELIEVE

- Logistics challenges can be overcome
- Technology will continue to prove robust under New Zealand conditions
- Technology continues to make sense at the small and local scale

INTERNATIONAL STANDARD CODES

ANZSIC	1821/1829
NACE (European Union)	20.16
NAICS (North America)	325211

WHY IS THIS A GOOD GROWTH PLATFORM FOR NEW ZEALAND?

19
26

“ELEVATOR PITCH”

New Zealand imports more than half a million tonnes of plastic annually (HS39). Bringing together New Zealand’s solid capabilities in biomass production and processing can enable the scale up of numerous small scale bioplastic innovators.

BIO-ECON SCORECARD

18
24

CAN ABSORB LARGE QUANTITIES ★★★★★

- Theoretically bioplastics can absorb large quantities; new capacity will be required to scale

COMPLEX WITH MULTIPLE INPUTS ★☆☆☆☆

- Relatively simple process and inputs; typically fermented simple sugars

BUILDS SYSTEM RESILIENCE ★★★★★

- Reduces reliance on imported plastic feedstocks

UNLOCK AG EMISSIONS RED ★★☆☆☆

- Supports a shift to plant-based agriculture at scale

REPLACE FOSSIL FUELS ★★★★★

- Plastic is a major user of fossil fuels

RETHINK WASTE ★★★★★

- Potential to leverage any high sugar/high carbohydrate byproduct and waste streams

PLATFORM DEFINITION

ANZSIC captures manufacture of plastic (as opposed to plastic products) under two codes.
1821 Synthetic Resin and Synthetic Rubber Manufacturing: manufacture of synthetic resins, non-vulcanisable elastomers and mixing and blending of resins and polymeric materials. This class also includes units mainly engaged in manufacturing synthetic rubbers and blends.
1829 Other Basic Polymer Manufacturing: manufacturing other basic polymers (except synthetic resins and synthetic rubbers). Included in this class are units mainly engaged in manufacturing cellulose (e.g. rayon and acetate) and non-cellulose (e.g. nylon, polyolefin and polyester) fibres and filaments.

LEVERAGEABLE NZ FACTORS

- High arable crop yields
- Proven capability in alcohol and vegetable oil production and oil refining
- Large existing plastic products industry
- Proven domestic demand
- Current government is motivated to deliver on waste reductions
- Extensive government funded R&D into new feedstocks and new production methods

SOURCES OF VALUE CREATION

- Targeting high profile plastics in the public eye (meat wrap rather than pipes)
- Specialised uses
- Potential tax incentives
- Potential grants and loans
- Potential agricultural subsidies
- Potential R&D funding
- Potential regulation

NZ INDUSTRY METRICS

Uses ANZSIC 1821+1829

Geographic units	60
Unit growth (00-22)	-168
Unit growth CAGR (00-22)	-3% pa
Employee count	630
Employee growth since 2000	-1,670
Empl. growth CAGR (00-22)	-6% pa

Manufacturers of plastic items, plastic importers and wholesalers will be classified elsewhere.

POTENTIAL NZ BIOMASS USED

Maize	XXX
Wheat	XXX
Barley	XXX
Potatoes	XXX
Other root crops	?
Sugarcane/Sugarbeet	?
Micro algae	?
Macro algae/Seaweed	?
Construction waste	?

WHAT YOU WOULD NEED TO BELIEVE

- Feedstocks wouldn’t just be imported
- Domestic production can compete with imports as the industry scales and moves down the cost curve
- New products can produce the required functionality and form
- New products can be cost competitive

APPENDICES

+ Glossary of terms

GLOSSARY OF TERMS

ANZSIC	AU/NZ Standard Industry Classification	kt	Thousand tonnes
b	Billion	MGO	methylglyoxal
CAGR	Compound Annual Growth Rate	m	Million
C/S America	Central & South America (Latin America)	mt	Tonne
CPG	Consumer Packaged Goods	NPD	New Product Development
E Asia	East Asia	n/a	Not available/not applicable
EECA	Energy Efficiency and Conservation Authority	NA/ME/CA	North Africa / Middle East / Central Asia
ETS	Emissions Trading Scheme	Nec/nes	Not elsewhere classified/not elsewhere specified
FMCG	Fast Moving Consumer Goods	N/C	Not calculable
FAO	Food and Agriculture Organisation of the United Nations	N.H	Northern Hemisphere
F&B	Food and Beverage	pa	Per Annum
FOB	Free on Board	PKE	Palm Kernel Expeller
FTA	Free Trade Agreement	R&D	Research and Development
F&V	Fruit and Vegetable	RTD	Ready to Drink
FTE	Full Time Equivalent	SE Asia	South East Asia
GM	Genetically Modified	S.H	Southern Hemisphere
GHG	Green House Gas	T	Tonne
HS Code	Harmonized Commodity Description and Coding System	UHT	Ultra Heat Treatment
Ha	Hectare	UMF	Unique Mānuka Factor
HFCS	High Fructose Corn Syrup	USP	Unique Selling Proposition
IP	Intellectual Property	VMS	Vitamins, Minerals and Supplements
JV	Joint venture		

