CORIOLIS
research·consulting·strategy

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

THIRTY OPPORTUNITIES

Emerging and future platforms in New Zealand's bioeconomy

FINAL STAGE II REPORT
JUNE 2023; v1.01

DISCLAIMER

GENERAL

The terms of this disclaimer (hereinafter referred to as 'Disclaimer') apply to this document, entitled 'Thirty Opportunities: Emerging and future platforms in New Zealand's bio-economy' (the Coriolis Report) and any later versions of this document. Please read this Disclaimer carefully. By accessing this document you agree to be bound by this Disclaimer.

USE OF THIS DOCUMENT

This document was prepared by Coriolis Ltd. (Coriolis) for our client and is based on information from a wide range of public sources deemed to be reliable and interviews with industry participants. Analyses and projections represent Coriolis's judgment, based on the data sources cited and are subject to the validity of the assumptions noted in this document. For purposes of the analysis in this document, Coriolis has relied upon and considered accurate and complete, and at the time of initial issuance of this document is not aware of any error in, data obtained from the sources cited but has not independently verified the completeness or accuracy of the data. All estimates and projections contained in this document are based on data obtained from the sources cited and involve elements of subjective judgment and analysis.

EXCLUSION OF LIABILITY

Neither Coriolis nor any of its agents or subcontractors shall be liable for any direct, indirect, special, incidental, consequential, punitive, or exemplary damages, including lost profits arising in any way from, including but not limited to, (i) the information provided in this document, and (ii) claims of third parties in connection with the use of this document. Projected market information, analyses and conclusions contained herein are based (unless sourced otherwise) on the information described above and on Coriolis' judgment, and should not be construed as definitive forecasts or guarantees of future performance or results. Neither Coriolis nor its officers, directors, shareholders, employees or agents accept any responsibility or liability with respect to this document.

Coriolis wishes to draw your attention to the following limitations of the Coriolis Report including any accompanying presentation, appendices and commentary (the Coriolis Commentary):

a. Coriolis has not been asked to independently verify or audit the information or material provided to it by, or on behalf of the Client, or any of the parties involved in the project;

b. the information contained in the Coriolis Report and any Coriolis Commentary has been compiled from information and material supplied by third party sources and publicly available information which may (in part) be inaccurate or incomplete;

c. Coriolis makes no representation, warranty or guarantee, whether express or implied, as to the quality, accuracy, reliability, currency or completeness of the information provided in the Coriolis Report and any Coriolis Commentary, or that reasonable care has been taken in compiling or preparing them;

d. the analysis contained in the Coriolis Report and any Coriolis Commentary are subject to the key assumptions, further qualifications and limitations included in the Coriolis Report and Coriolis Commentary, and are subject to significant uncertainties and contingencies, some of which, if not all, are outside the control of Coriolis; and

e. any Coriolis Commentary accompanying the Coriolis Report is an integral part of interpreting the Coriolis Report. Consideration of the Coriolis Report will be incomplete if it is reviewed in the absence of the Coriolis Commentary and Coriolis conclusions may be misinterpreted if the Coriolis Report is reviewed in absence of the Coriolis Commentary.

Coriolis is not responsible or liable in any way for any loss or damage incurred by any person or entity relying on the information in, and the Recipient unconditionally and irrevocably releases Coriolis from liability for loss or damage of any kind whatsoever arising from, the Coriolis Report or Coriolis Commentary including without limitation judgments, opinions, hypothesis, views, forecasts or any other outputs therein and any interpretation, opinion or conclusion that the Recipient may form as a result of examining the Coriolis Report or Coriolis Commentary.

The Coriolis Report and any Coriolis Commentary may not be relied upon by the Recipient, and any use of, or reliance on that material is entirely at their own risk. Coriolis shall have no liability for any loss or damage arising out of any such use.

LIMITATIONS

This work is based on secondary market research, analysis of information available (e.g. Statistics NZ), and a range of interviews with industry participants and industry experts. Coriolis have not independently verified this information and make no representation or warranty, express or implied, that such information is accurate or complete. In many cases regional data is incomplete or not available and therefore research includes significant modelling and estimates.

KEY CONTACTS FOR THIS REPORT

Virginia Wilkinson is a Director at Coriolis. Virginia is Coriolis' resident expert on consumer insights and market research. She has over fifteen years of experience in primary sector and food and fast moving consumer goods research. Virginia regularly conducts both primary and secondary research on food, fast moving consumer goods, retailing and foodservice across Australasia. You may contact her by e-mail on: vwilkinson@coriolisresearch.com

Tim Morris is a Director at Coriolis and is recognised as a leading expert and advisor to CEOs and stakeholders in strategy in food, fast moving consumer goods and retailing. Tim is a recognised expert globally in retailing, particularly in private label, with his work being quoted in numerous publications and college textbooks. He is head of Coriolis' retail and consumer goods practice. You may contact him by email on: tmorris@coriolisresearch.com

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.

COPYRIGHT

COVER IMAGE: DALL*E (Prompt: Taranaki, New Zealand covered in maize and the world's largest ethanol plant with Mount Taranaki in the background; date accessed: May 1, 2023)

CORIOLIS

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

THIRTY OPPORTUNITIES

Emerging and future platforms in New Zealand's bioeconomy

FINAL STAGE II REPORT

JUNE 2023

v1.01

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

Source: MBIE RFQ 8 Dec 2022

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

STAGE I – FINDING THE WAY

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

STAGE II – 30 OPPORTUNITIES

Developing thirty emerging and future opportunities in the New Zealand bioeconomy

THIS REPORT

SPORTS NUTRITION & WEIGHT MANAGEMENT

BIOCOSMETICS

MARINE BIOACTIVES

STAGE III – THREE HIGH POTENTIAL PLATFORMS

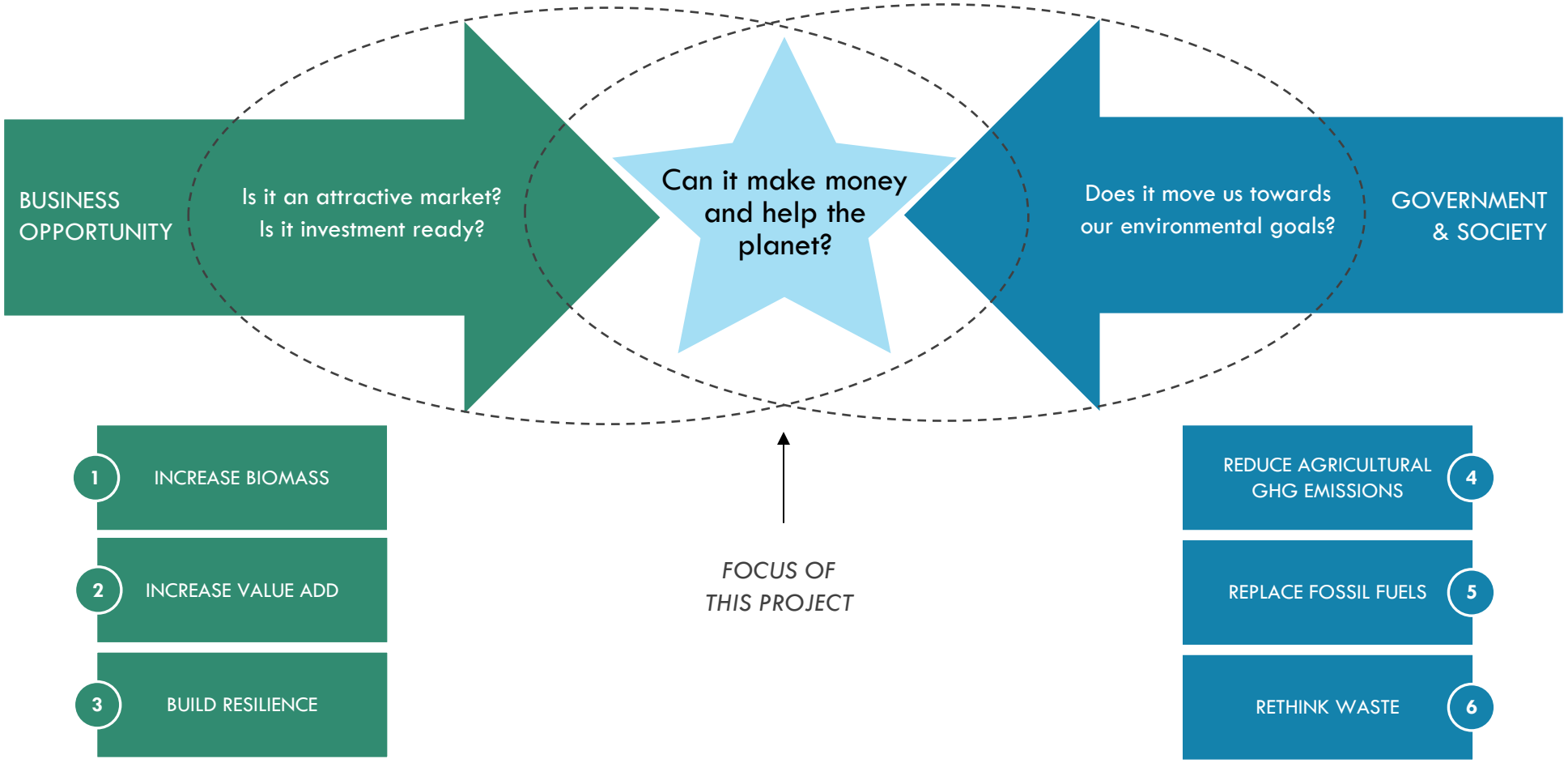
Detailed analysis to make the high level case for investment in three high potential platforms in the New Zealand bioeconomy

BACKGROUND & SUPPORTING MATERIAL

SITUATION & CAPABILITIES

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

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



Source: Coriolis analysis

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 52

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

NATIVE BOTANICALS

TOTAL SCORE 37/50

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

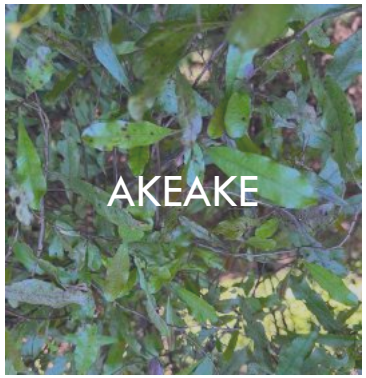
This platform scales up production of native botanicals for use in a wide range of biomass processing systems

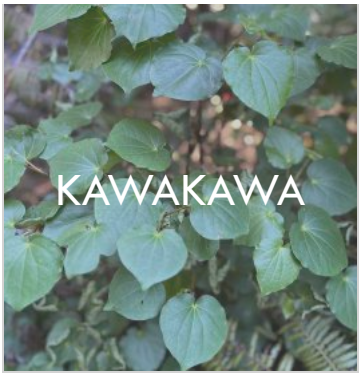
WHY DO WE CARE?

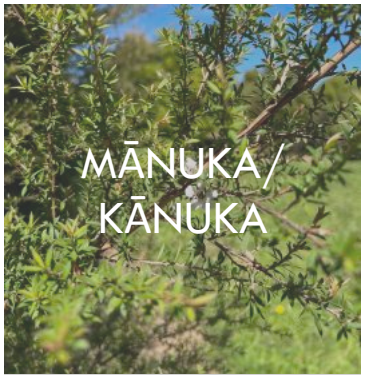
SITUATION	COMPLICATION	RESOLUTION
- New Zealand has a unique set of plants as a result of splitting off of the Gondwana supercontinent 85 million years ago - Many of these plants have unique flavours, tastes and active ingredients not available in plants from the Afro-Eur-Asian supercontinent, the Americas or Australia	- There are a large number of plants produced in small quantities; most/all production is wild collection (beyond mānuka) - Modern, high productivity, mechanised production systems have yet to be developed	- 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.

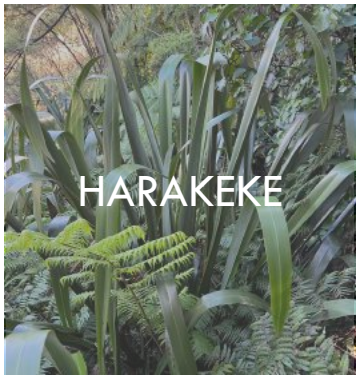
Conceptually, this opportunity uses native plant botanicals as in ingredient in a large range of products

WHAT IS THE CONCEPT?









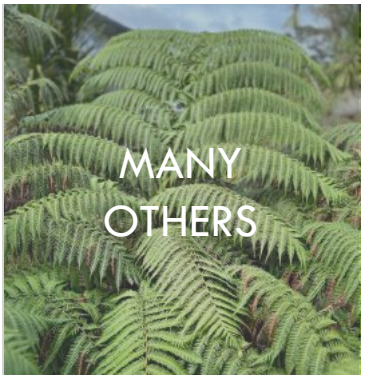
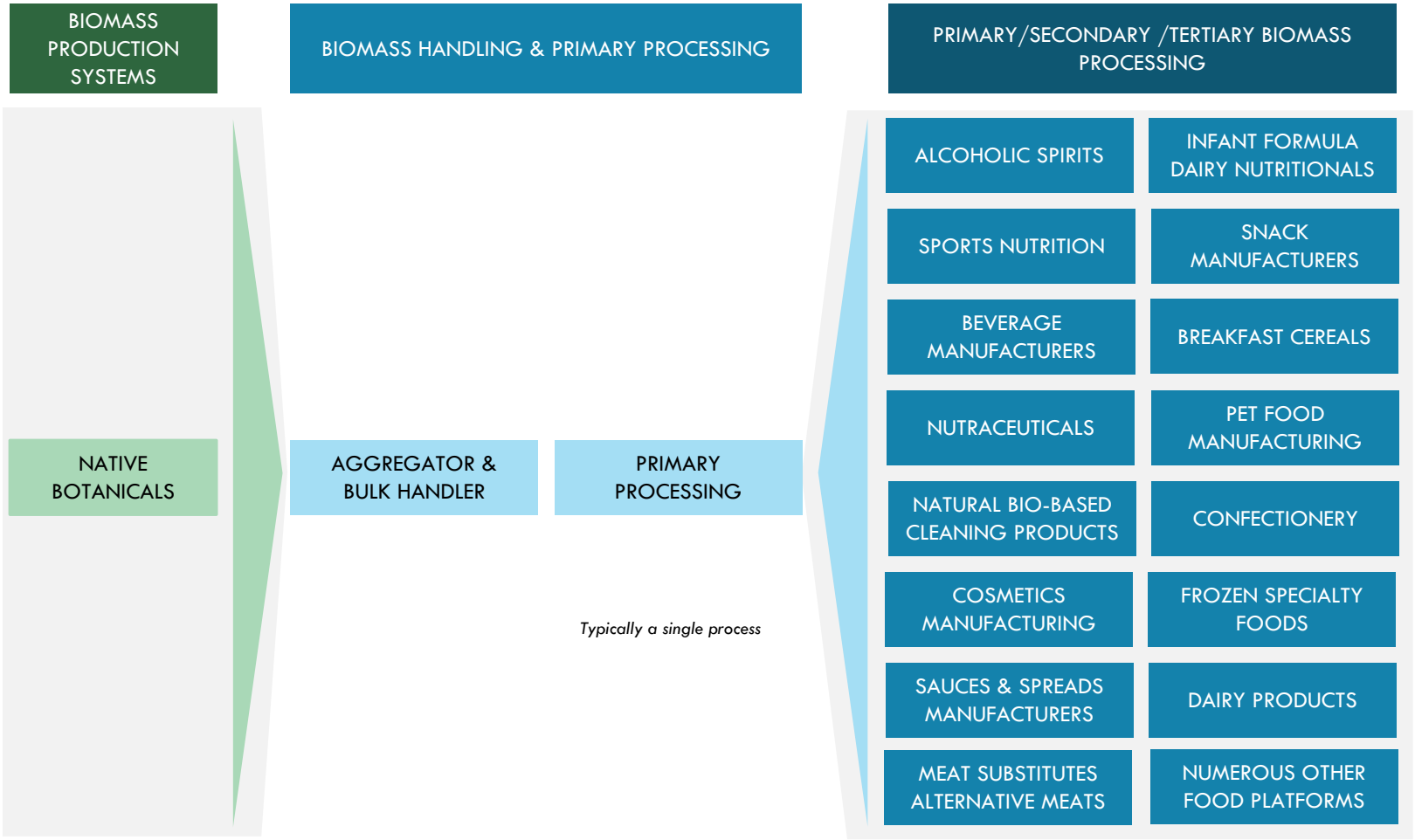


Photo credit: Wilkinson; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Native botanicals are a small, but critical ingredient in product differentiation for a huge range of New Zealand products in the market

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Native botanicals are used for their unique characteristics such as flavour or medicinal quality

WHAT CAN YOU DO WITH IT?

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Utilising native botanicals is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 INCREASING BIOMASS	- Potential to develop new farming systems increasing biomass of native botanicals - Full biomass utilisation in New Zealand
2 INCREASING VALUE-ADDED	- High value outputs (e.g. medicinal products, pharmaceuticals, nutraceuticals, cosmetics etc.)
3 BUILDING RESILIENCE	- Opportunity to incorporate Māori knowledge using Mātauranga Māori principles - Enhances cultural and social capital - Creates employment and industry in the regions - Increases health outcomes in general population
4 REDUCING AGRICULTURAL GHG EMISSIONS	- Wild harvest a low emission system - Potential for foraging and new farming systems to be developed as a low emission sustainable system
5 REPLACING FOSSIL FUELS	- Opportunity to replace fossil fuels in farming system with alternative sources - Opportunity to replace oil based ingredients with native botanicals - Potential for plastic-free packaging
6 RETHINKING WASTE	- Circular principles part of the production system or business model (e.g. mānuka used as solid biofuel) - Multiple uses for co-products

Native botanical production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Using regenerative practices often wild harvested
Sustainable farming/plantation systems

Low packaging/kg product design
Recyclable packaging
Efficient production

Converting byproducts to solid biofuel
Encouraging recycling/composting

Modern plant and equipment
Renewable energy use
Potential for field waste as heat energy (with Mānuka)

Reverse supply chain from major users

Potential for alternative energy sources in distribution
Reduced distribution distances in particular if industries co-located

No obvious opportunities

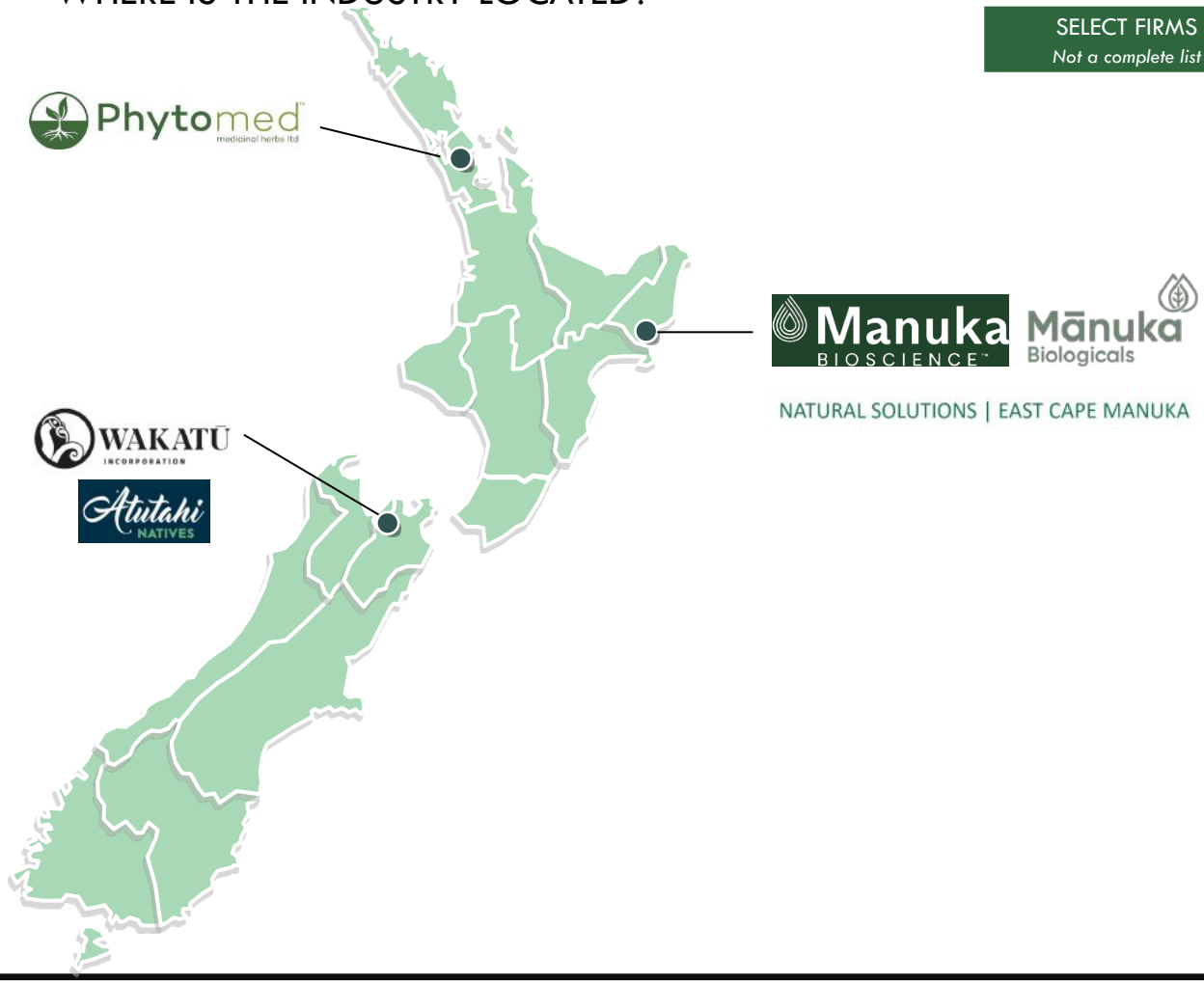
Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Native botanicals firms are located across the country

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- There are tens of small firms growing, foraging and using native botanicals, but only a handful at scale



SELECT FIRMS
Not a complete list

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

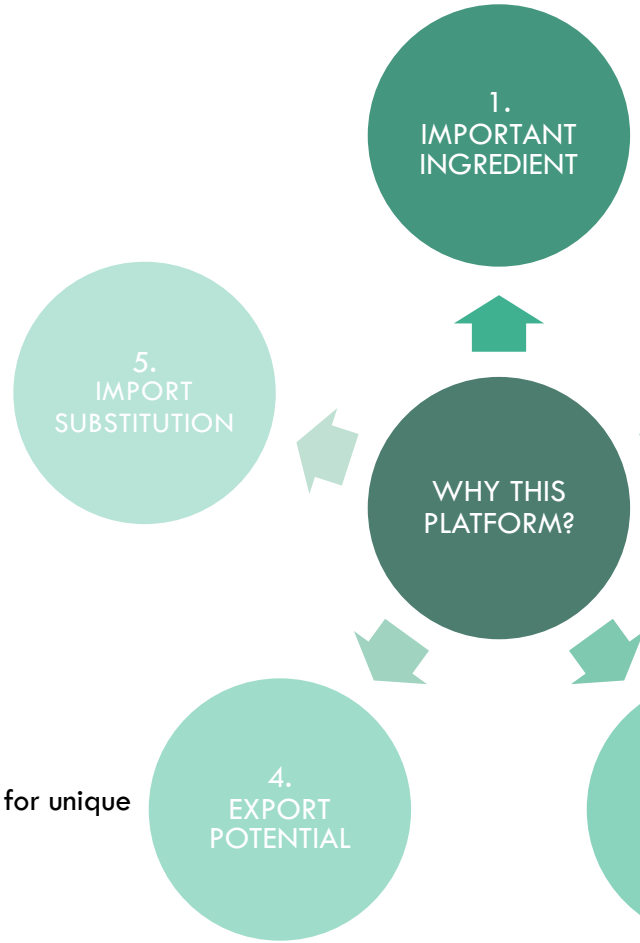
WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS	INDUSTRY ORGANISATIONS	UNIVERSITIES / RESEARCH	GOVERNMENT / CRI'S
- A number of land based organisations such as FOMA Te Tumu Paeroa have an interest in the use of native botanicals in both science and as a general food ingredient	- A range of organisations support firms that use these products	- A wide range of NZ Universities are researching topics within this wider platform	- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety) - Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- Native botanicals are unique to New Zealand
- Botanicals can be researched and IP protected

- Valuable input into many other high value categories (e.g. cosmetics, nutraceuticals, beverages)
- Creates new products and new categories
- Extensible platform

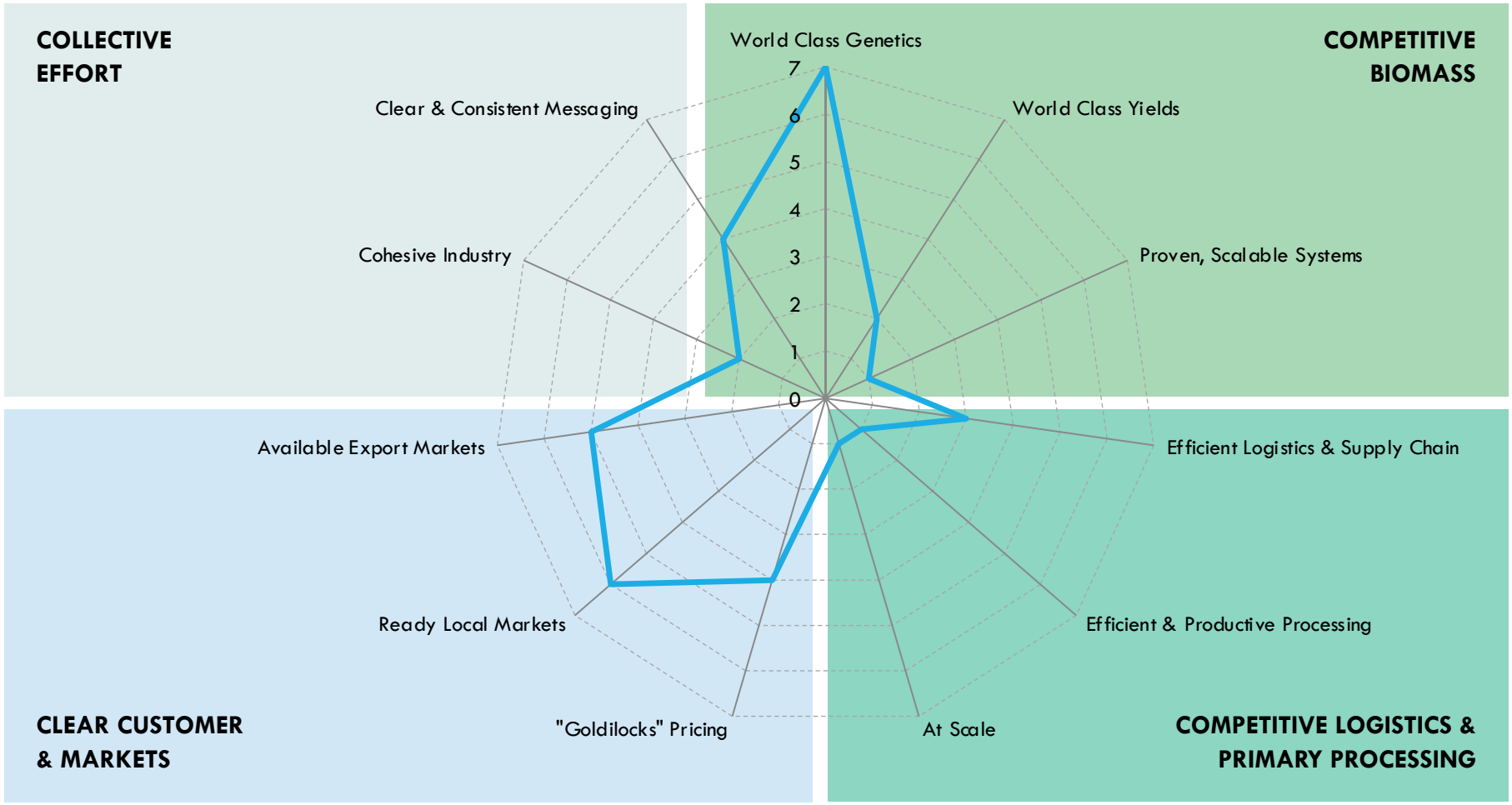
- Demonstrated capability to grow and develop unique botanicals (e.g. mānuka honey)

- Strong consumer demand for unique transparent products

- Substitute imports with premium products made with native botanicals (e.g. cosmetics, beverages)

Improvements are required to get the platform growth ready, most products are wild harvested

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

CORIOLIS

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

Can we grow products commercially?

- New Zealand has capabilities in growing crops and plantations, this was successfully extended to mānuka
- Can the success of mānuka be extended consistently across multiple other species
- As the industry scales it will be important to commercially farm native botanicals vs. wild harvesting

What is the timeframe and cost to achieve research around medicinal efficacy?

- Very time consuming to undertake scientific research
- Very costly to undertake scientific research and clinical trials

Which of all the native botanicals is the next mānuka?

- Why haven't we seen another mānuka emerge?

What are the Te Tiriti o Waitangi and wider Mātauranga Māori considerations?

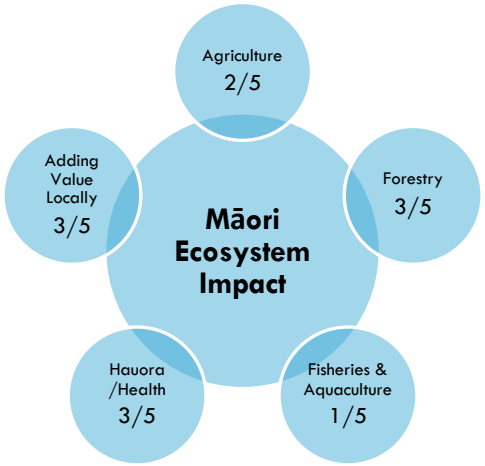
- How should the Wai 262 claim be considered?
- Frameworks should be developed so that projects meet the highest ethical standards of informed consents, access protocols and benefit sharing

Source: Coriolis analysis

Native Botanicals

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆ ☆ ☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆ ☆ ☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆ ☆
IS THE RISK MANAGEABLE?	☆ ☆

SPECIFICALLY FOR MĀORI, WHAT ARE THE MAIN CONSIDERATIONS?:

- Native botanicals align with interests in mātauranga Māori and traditional medicines. Ability to promote traditional knowledge / mātauranga Māori will always resonate with Māori groups.
- Māori commercial investors will be wary of the consumer product / marketing focus of the sector. Will be keen on supplying retail business with large global marketing footprint.
- Māori landowners are largely focused on forestry horticultural and farming with trusted and long-term returns. Would need to justify a shift or identify the opportunity for a new product.
- There may be some theoretical Intellectual Property/Wai262 issues for individual businesses wanting to pursue this including claims of cultural appropriation, recognition and protection mechanisms to ensure Māori communities retain roles and responsibilities as Kaitiaki

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆ ☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆ ☆ ☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆ ☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**65/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

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.

1 INVESTING IN DEVELOPING **FARMING SYSTEMS**

- Farming of native botanicals is in it's infancy
- Nearly all botanicals are wild harvested
- Implementing the latest in modern sustainable systems and incorporating principles of Mātaranga Māori

2 INVESTING IN EFFICACY **RESEARCH**

- Investing in scientific research around product efficacy, functionality and use

3 INVESTING IN **BRAND MANAGEMENT**

- Protect names and naming
- Resolution and management of names and use of Māori Rongoā*

**traditional Māori healing system*

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

MEDICINAL MUSHROOMS

TOTAL SCORE 35/50

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

- 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

SOURCES OF VALUE CREATION

- 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

- 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

VALUE CHAIN LINKAGES

Forestry (commercial pine)	XXX
Forestry (native bush)	XXX
Nutraceuticals	XXX
Soil amendments	XX

*PTSD = Post Traumatic Stress Disorder

This platform scales up medicinal mushroom production to develop high value products targeting health challenges

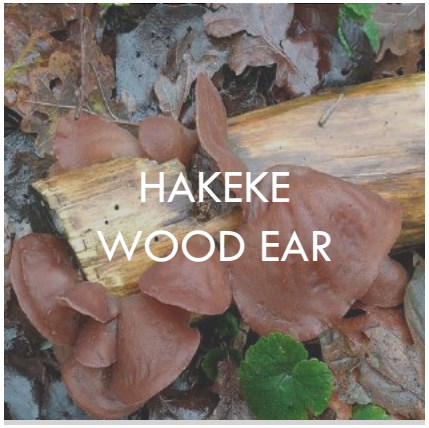
WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- There is growing global interest in the health giving properties of medicinal mushrooms - New Zealand has a somewhat unique set of mushrooms as a result of splitting from the Gondwana supercontinent 85 million years ago	- Very little research has been done on New Zealand medicinal mushrooms; most accounts of health properties are anecdotal	- 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

** https://www.businesswire.com/news/home/20191122005452/en/FDA-grants-Breakthrough-Therapy-Designation-to-Usona-Institutes-psilocybin-program-for-major-depressive-disorder*

Conceptually, this opportunity uses native mushrooms to produce medicinal mushroom extracts

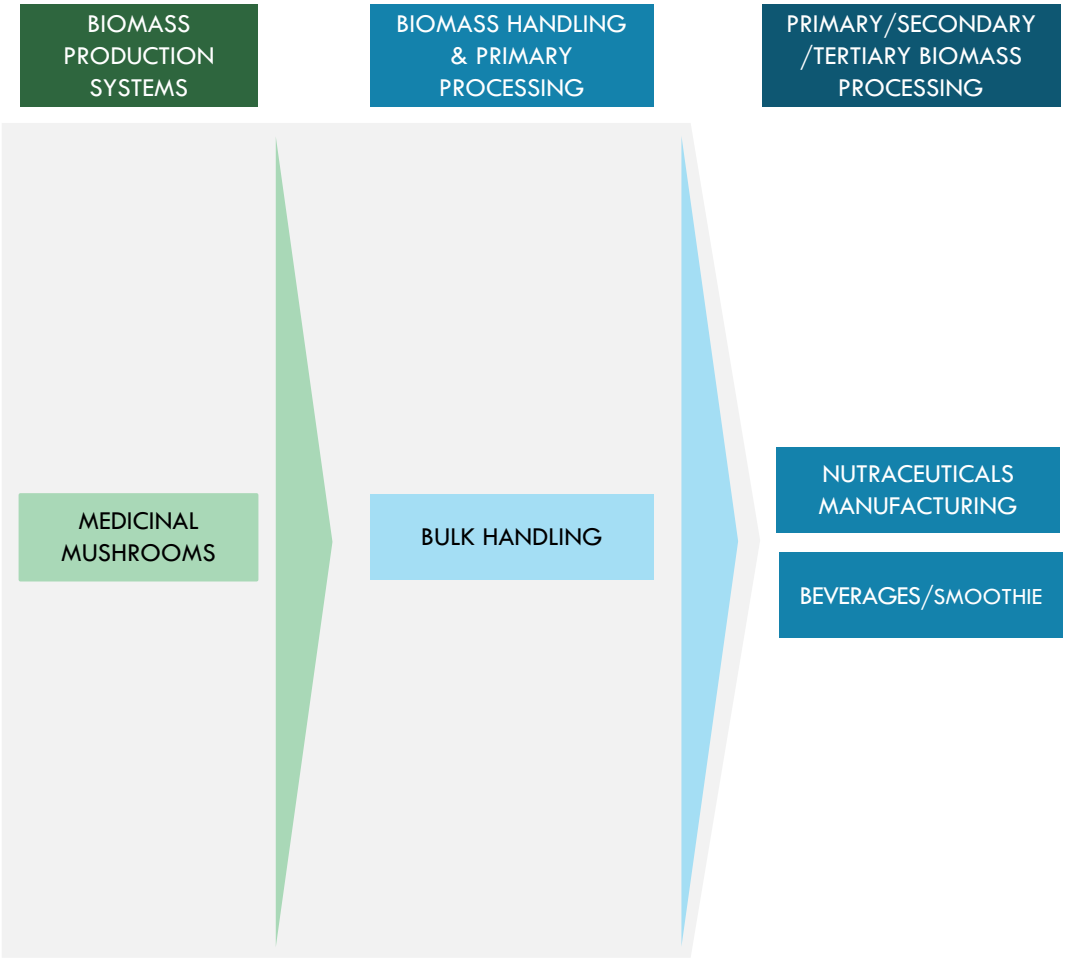
WHAT IS THE CONCEPT?



**Also known as NZ Lion's Mane (Hericium novae-zealandiae); Photo credit: Wikimedia CC ASA 0; Public Domain; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research*

The medicinal mushrooms platform, as it is currently configured, has extremely simple linkages into a narrow part of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Medicinal mushrooms are the key ingredient in a range of products

WHAT CAN YOU DO WITH IT?

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Medicinal mushrooms are in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Utilising a unique New Zealand biomass
2 **INCREASING VALUE-ADDED**	- High value output
3 **BUILDING RESILIENCE**	- Opportunity to incorporate Māori knowledge - Creates employment and industry in the regions - Higher wages available, skilled labour - Mental and physical health benefits
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- System is inherently a low emission sustainable system
5 **REPLACING FOSSIL FUELS**	- Opportunity to replace fossil fuels in production - Opportunity to use recyclable and sustainable packaging
6 **RETHINKING WASTE**	- Circular principles part of the production system or business model - Utilise wood chip and wood waste as growing medium

Medical mushroom production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

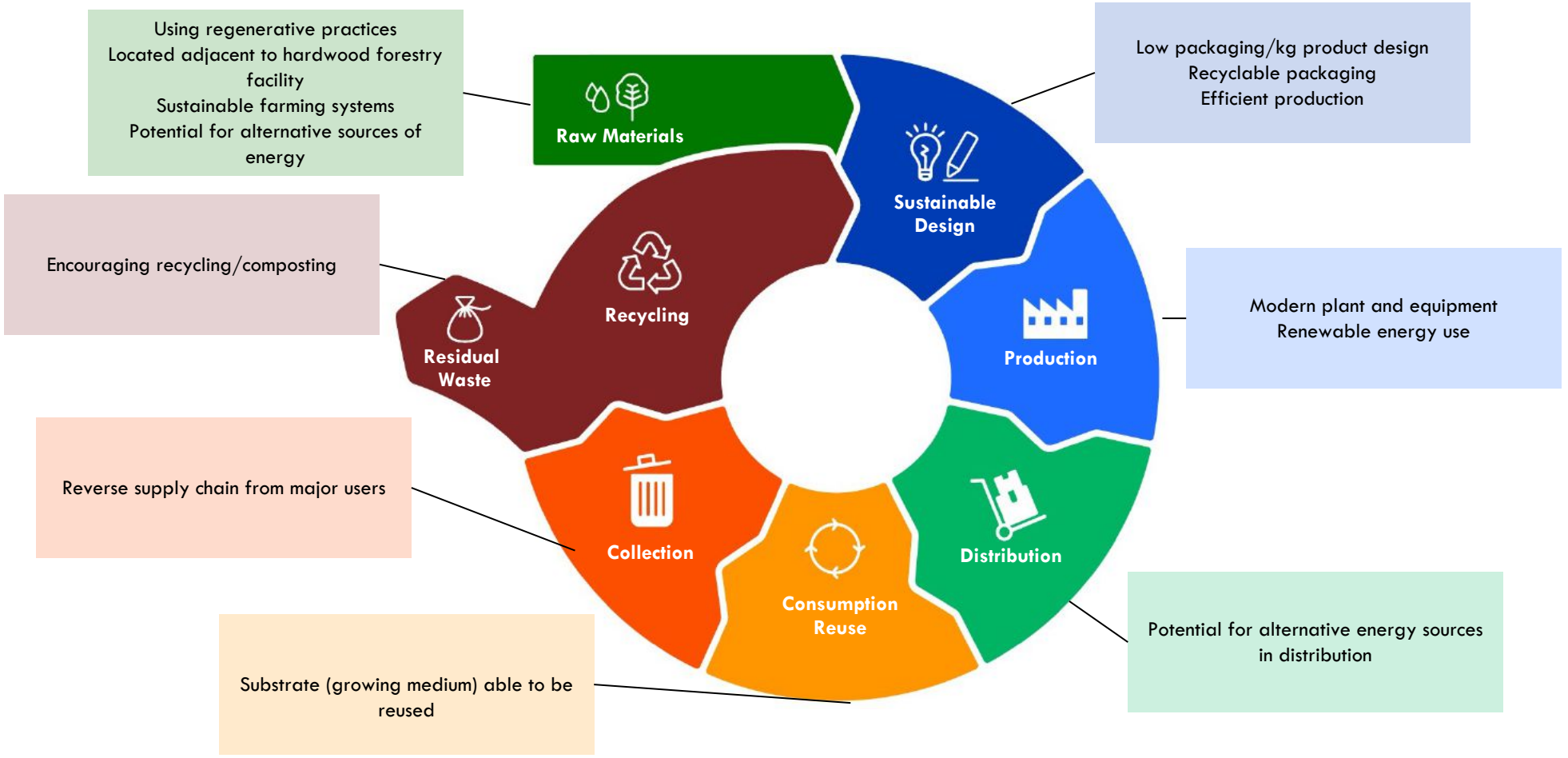


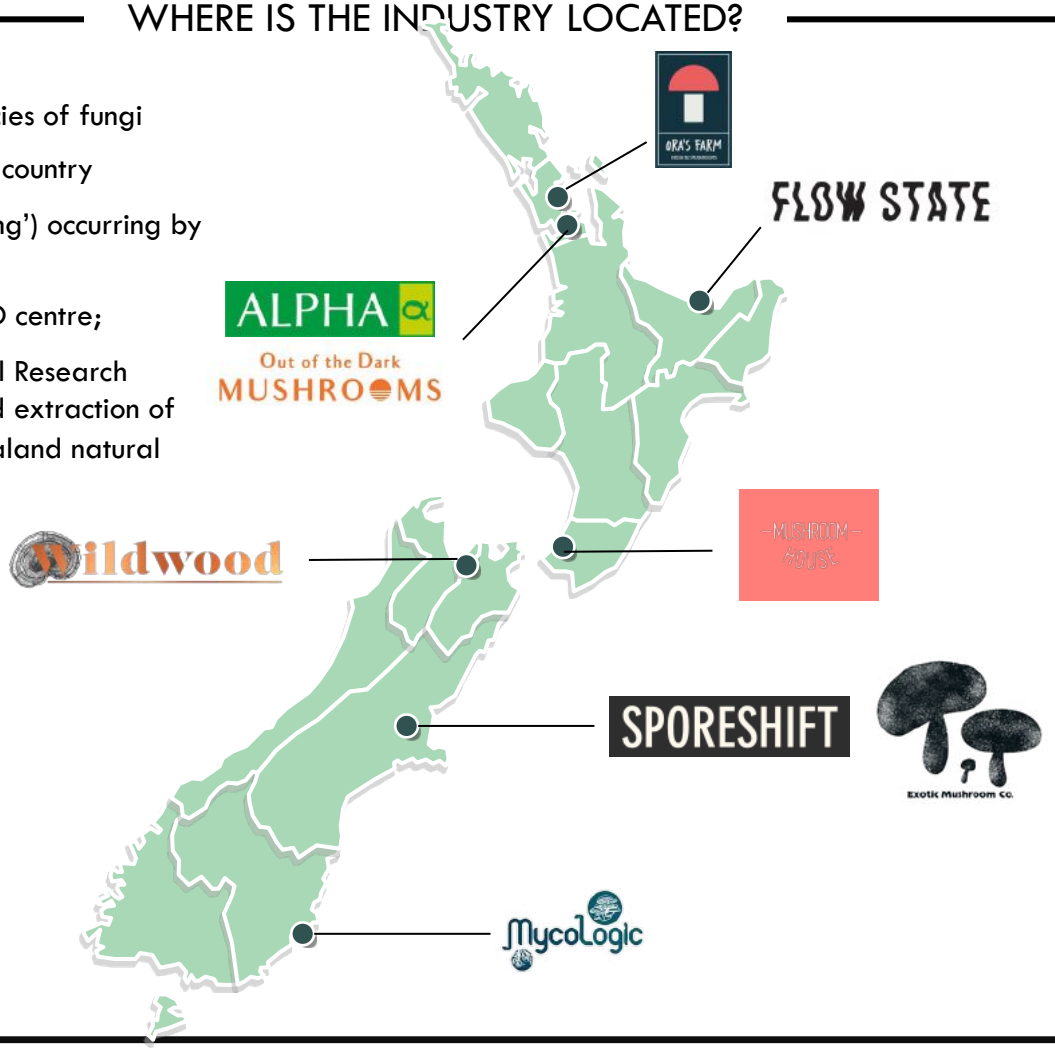
Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Mushrooms grow across New Zealand

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- New Zealand has over 22,000 species of fungi
- Fungi grow across all regions of the country
- Recreational wild collection ('foraging') occurring by members of the public
- Alpha Group have a Mushroom R&D centre;
- Alpha-Massey Natural Nutraceutical Research Centre is committed to the study and extraction of bioactive components from New Zealand natural plants and fungi.



SELECT FIRMS
Not a complete list

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

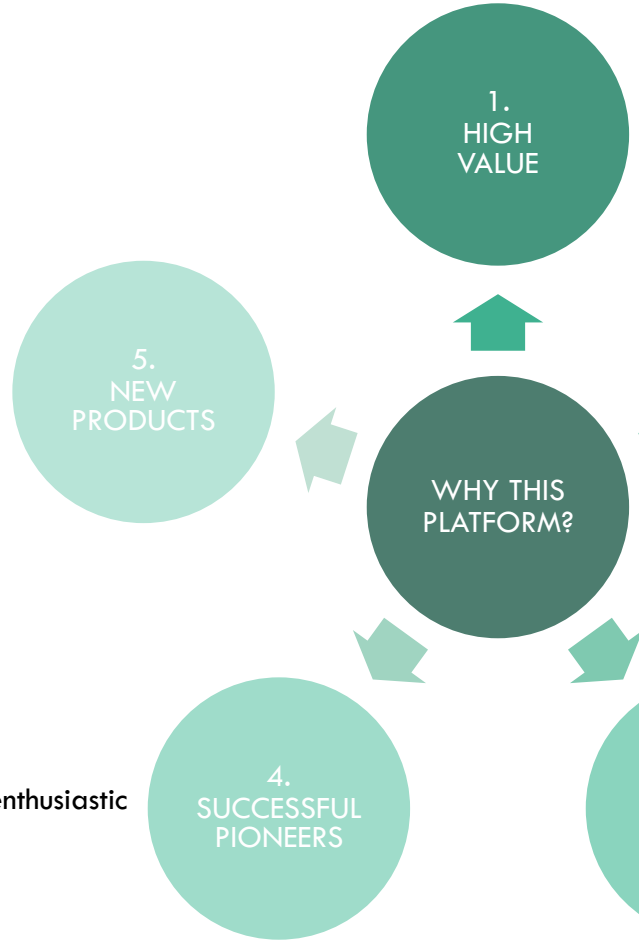
WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS	INDUSTRY ORGANISATIONS	UNIVERSITIES / RESEARCH	GOVERNMENT / CRI'S
- Kiwi Mushrooms are the commercial mushroom industry body	- A range of industry bodies advocate for the industry	- Universities are researching topics within this platform (e.g. mental health benefits)	- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety) - Crown Research Institutes

Source: various company and organisation websites; Coriolis analysis

There are strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- Medicinal mushrooms a high value output

- Strong and growing demand both domestically for natural health solutions
- Mental health a growing concern

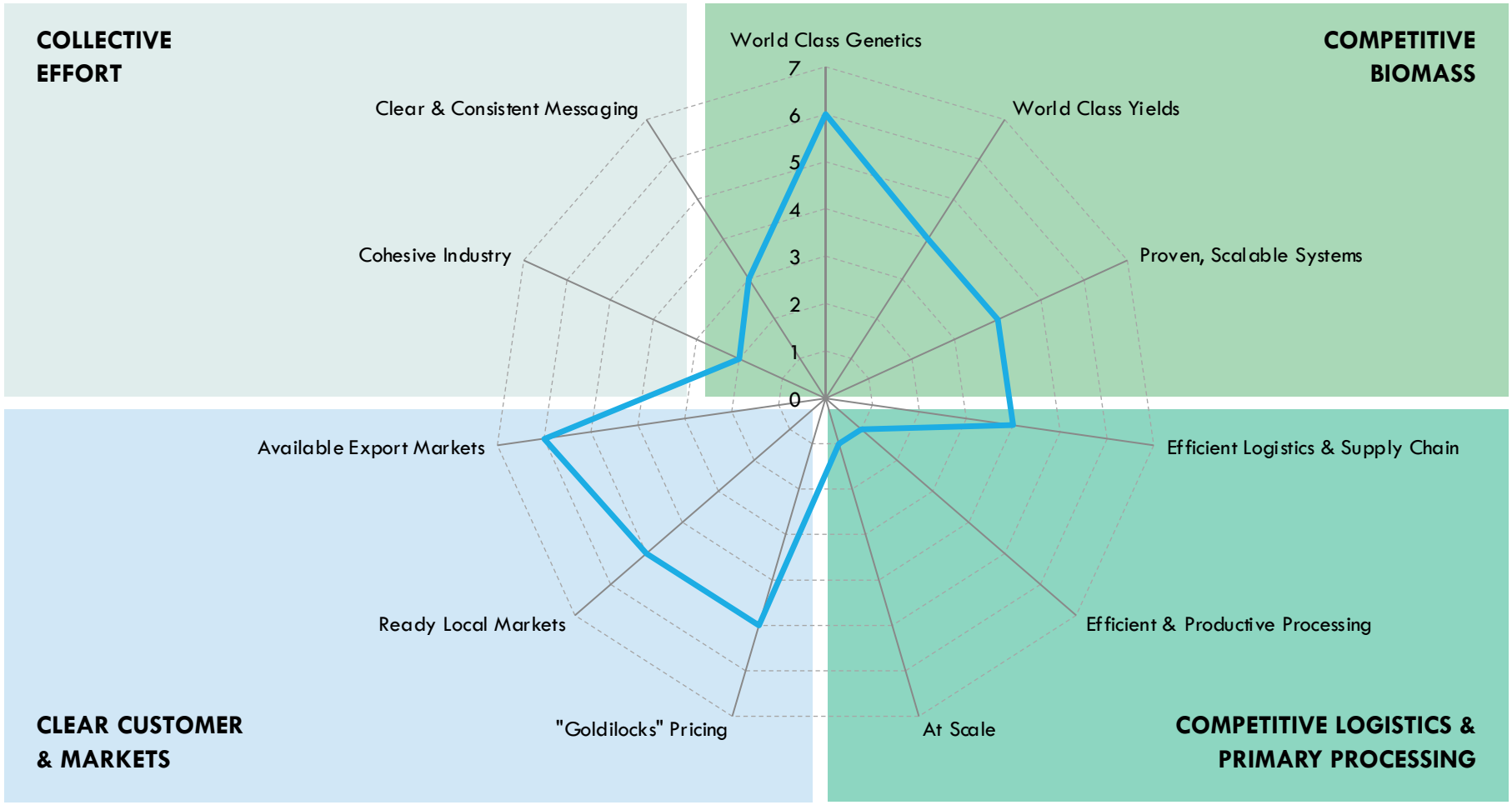
- Demonstrated capability to grow mushrooms in New Zealand
- Scale and efficiency in commercial edible mushrooms needs to be transferred to medicinal species

- Group of successful and enthusiastic pioneering firms

- New products (in particular in the unique-NZ psilocybin space) with high commercial value

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Note: The commercial edible mushroom sector in NZ is efficient and at scale, however the medicinal mushroom sector is behind; Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

Can NZ successfully develop a commercial industry at scale?

- New Zealand currently has efficient mushroom sector, can this extend into medicinal mushrooms?
- Can New Zealand achieve high yields across multiple species
- Is there a new technology or situation that makes this industry more viable?

How is the progress on functional benefits?

- New Zealand should produce research around the functional benefits of specific New Zeeland species

Why you? Why NZ? What is your unique selling proposition?

- How will the sector stand out and succeed?
- Is there commercial demand for New Zealand medicinal mushrooms?

Is the regulatory environment limiting the industry?

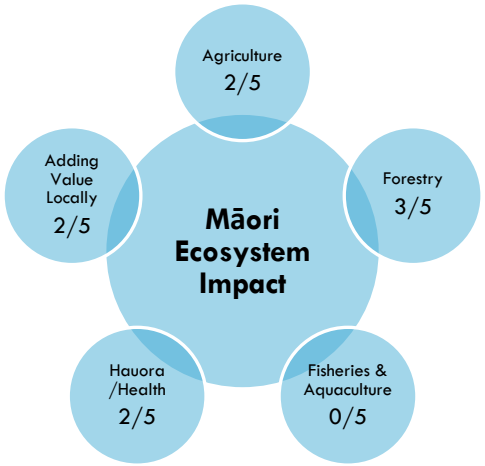
- Is the Dietary Supplements 1985 Act still relevant to the sector?
- Are we out of line with our partners (e.g. Australia and their Therapeutic Goods Act 1989)?
- Is the Hazardous Substances and New Organisms Act 1996 holding back the industry?

Source: Coriolis analysis

Medicinal Mushrooms

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆ ☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆ ☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Some players in the Māori economy have already looked at this previously – attracted by multiple uses of land / multiple revenues and potential high prices for mushrooms.
- No scale as yet will scare most Māori investors.
- Some traditional uses of mushrooms – no well-known medicinal use for mushrooms

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆ ☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆ ☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆ ☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**45 / 100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

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

1 INVESTING IN **SCALING-UP FARMING SYSTEMS**

- Larger farms with lower costs per tonne
- Implementing the latest in modern systems and processes

2 INVESTING IN INCREASING **PROCESSING CAPACITY**

- Expansion of existing operations
- New processing in new regions

3 INVESTING IN DEVELOPING **R&D**

- R&D into potential functional benefits and efficacy of NZ species
- Research into potential health claims
- NPD around product and packaging

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

SEAWEED

TOTAL SCORE 31/50

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

MARKET SITUATION 2/5

- "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	?

This platform scales up seaweed production for use as a feedstock in numerous biomass processing systems

WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- NZ currently has an industry based on wild collection (size unclear: 78t/yr of brown kelp and perhaps collection of 1-2kt/yr of all types (?)	- Global seaweed aquaculture production is almost exclusively in E/SE Asia (99.5%): China (57.4%) and Indonesia (28.8%) dominate labour intensive aquaculture - Seaweed is a relatively low value aquaculture crop, with an average farmgate value of US$0.41 per kg; most seaweeds sell for under a dollar/kilogram	- 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 adapted.

Conceptually, this opportunity uses seaweed (macroalgae) to make a range of products

WHAT IS THE CONCEPT?

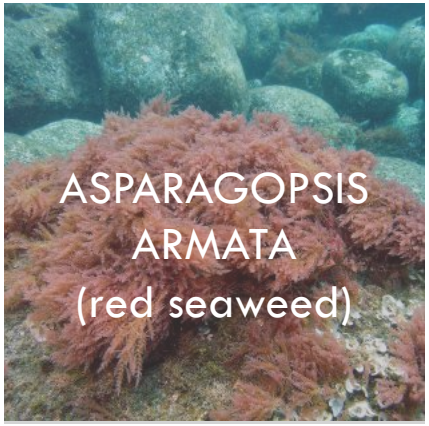
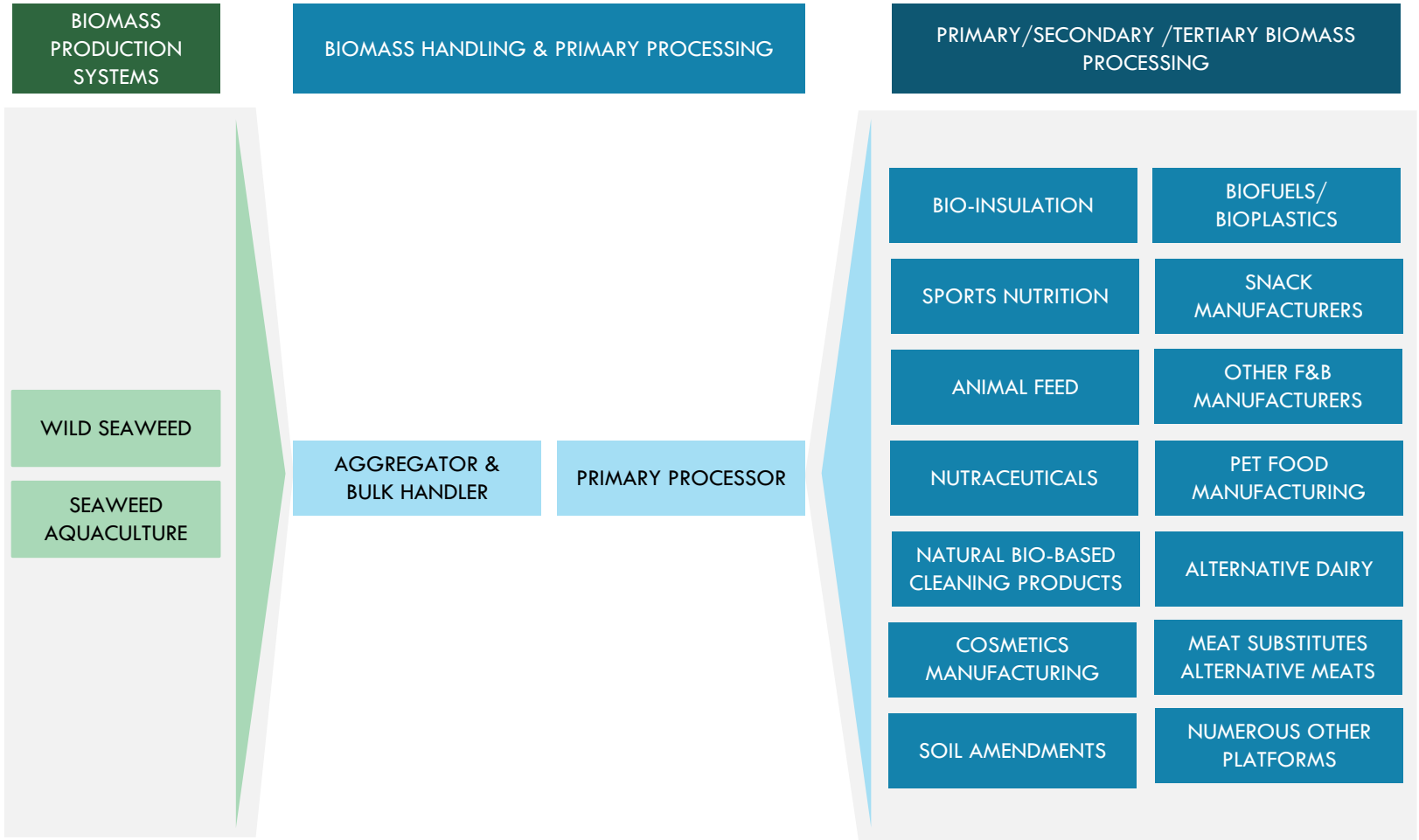


Photo credit: Wikimedia CCA 4.0; 3.0; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

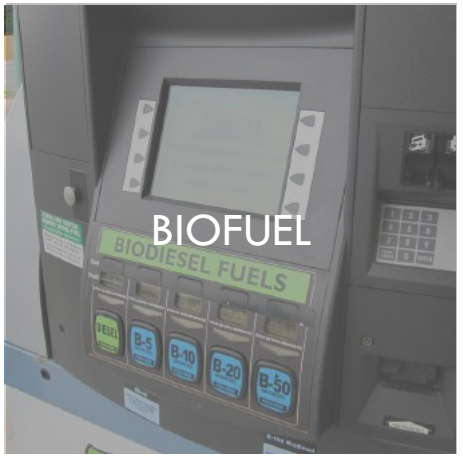
Despite only currently collecting a modest amount, NZ grown seaweed has a lot of ideas for how it could potentially connect into the wider bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Seaweed is a key ingredient in a range of products

WHAT CAN YOU DO WITH IT?



Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Seaweed is in line with the desired direction for the bioeconomy, it is a valuable carbon sink and resource to reduce methane emissions

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 INCREASING BIOMASS	- Utilising a unique New Zealand biomass - Potential feedstock crops achieve high biomass yields, fast growing - Potential biomass for biofuels, bioplastics (lack of scale likely an issue)
2 INCREASING VALUE-ADDED	- High value output produced across a broad range of products (cosmetics, natural health ingredient, non-toxic bioactives, methane reducing properties)
3 BUILDING RESILIENCE	- Distinctive product using Māori knowledge, resources or people - Opportunity to incorporate Māori knowledge - Creates employment and industry in the regions
4 REDUCING AGRICULTURAL GHG EMISSIONS	- Seaweed is regarded as a large carbon sink - Use on farms as soil amendment or ingredient in animal feed – as additive - significantly reducing ruminant methane emissions - Enhances environment providing shelter to marine animals
5 REPLACING FOSSIL FUELS	- Use as a feedstock for bioplastic - Opportunity to replace fossil fuels based products on farm (soil amendments vs fertilisers)
6 RETHINKING WASTE	- Circular principles part of the production system or business model - New systems design creates less waste - Processing byproducts and waste streams into high value products - High tech extraction systems able to extract more from less

Seaweed can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Plant based inputs vs fossil fuel based
Using regenerative practices
Potential for alternative energy machinery and equipment

Efficient production systems using biodegradable plastics in production (biogears*)
Potential for association with offshore wind energy generation

Encouraging recycling/composting

Co-grown with bivalves
Renewable energy use
Co-located with processing firms and ingredients suppliers

Reverse supply chain from major users

Reduced distribution distances in particular if industries co-located
Potential for alternative energy sources in distribution

Concentrated and dried powders

*bio-based ropes and production materials for aquaculture; Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Seaweed is wild harvested all around New Zealand with the key industry stakeholders primarily in the North, some trial aquaculture underway

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- The majority of the edible packaged seaweeds in New Zealand are imported
- 2020 fifty nine permit holders able to farm seaweed, primarily linked with other aquaculture activity (e.g. mussel farming in the Marlborough Sounds)

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- Federated Farmers of New Zealand support farmers and growers

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use these products

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities are researching topics within this platform
- University of Waikato Macroalgae Research Facility is based in Tauranga
- Cawthron operates the National Algae Research Centre

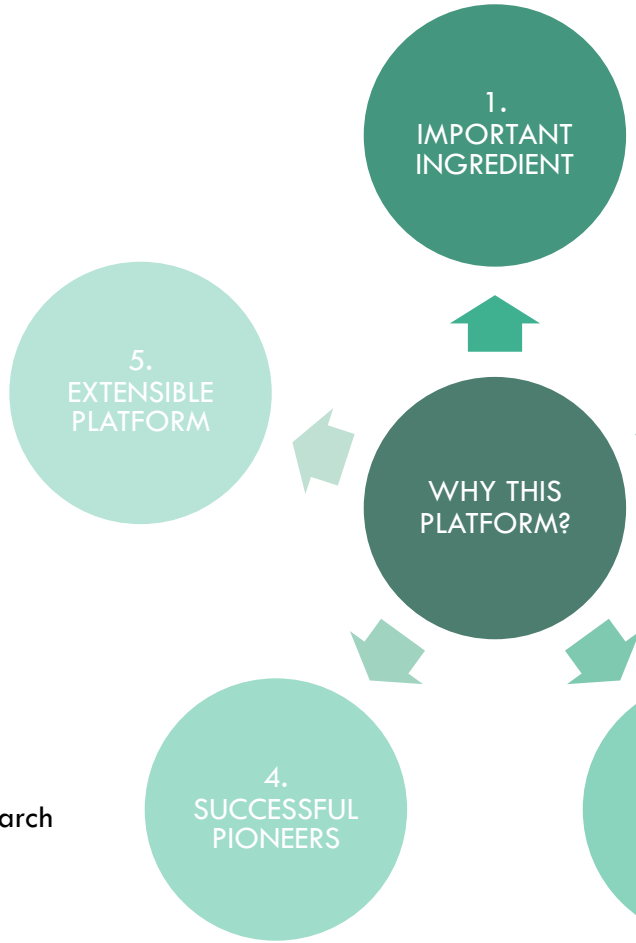
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM?



- Role to play in both soil health and animal health (in particular for reducing methane emissions)
- Seaweed a significant carbon sink

- Dependent on imports
- The majority of seaweed ingredients as food/agar are imported
- Opportunity to substitute imports

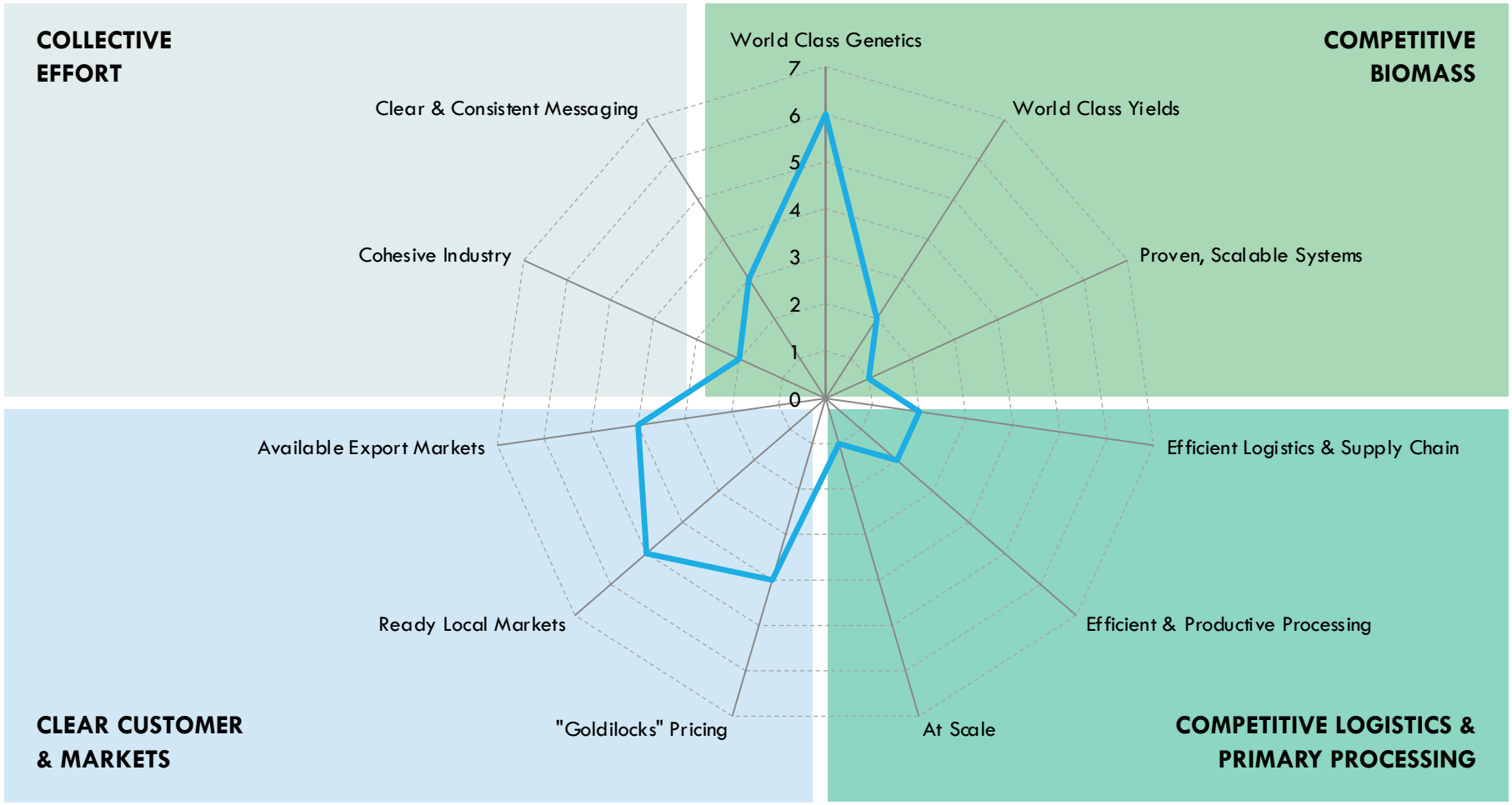
- Demonstrated capability to grow seaweed in New Zealand
- Early beginnings of commercial operations

- Strong group of successful pioneering firms and research agencies

- Significant number of uses for seaweed species
- Use as animal feed additive (another major import), cosmetics ingredient and other high value NZ unique products

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

How will you enter a mature global market with firms already at scale?

- New Zealand cannot compete with this group without high productivity, better farming systems, very high levels of mechanisation and a premium positioning
- Difficult to compete with cheap imports
- China, followed by Indonesia dominate production

What is a realistic timeframe for economic viability?

- Can production of seaweed be commercially viable long term without a significant increase in technologies
- When can we move beyond seaweed as a mussel bycatch?

What is your Unique Selling Proposition (USP)?

- How will we differentiate our seaweed vs the competition?

What are the Te Tiriti o Waitangi and wider Mātauranga Māori considerations?

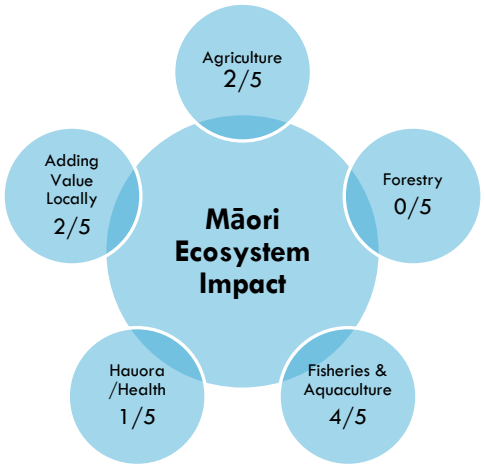
- Māori fisheries and aquaculture rights are recognised under the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992 and the Māori Commercial Aquaculture Claims Settlement Act 2004
- How should the Wai 262 claim be considered?
- Frameworks should be developed so that projects meet the highest ethical standards of informed consents, access protocols and benefit sharing

Source: Coriolis analysis

Seaweed

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆ ☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆ ☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆ ☆ ☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆ ☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Feed additives is attractive to predominant dairy, beef and sheep operations on Māori land.
- Real interest in Māori sector currently – Agrisea, Te Whanau a Apanui Marine Hub, Ngai Tahu are investigating.
- Marine space is a key asset in Māori economy – this could be leveraged with a sustained industry response
- No well known traditional use of seaweed other than karengo. Remu was used as kai and for storage.
- There are local communities who are interested in seaweed because of easy entry into industry i.e. resource available locally
- Agrisea, Cawthron, NIWA – scientists investigating seaweed uses
- Largest scary assumption for Māori commercial investors is whether this is a scalable industry. Worried that ultimately it is a commodity play where we will have to compete against extremely low-cost operators globally.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆ ☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆ ☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆ ☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆ ☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆ ☆ ☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**65/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

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.

1 INVESTING IN DEVELOPING **SPECIALISED PRODUCTS**

- Developing unique products
- R&D into potential unique fractionates and extracts
- Research into potential health claims from unique species

2 INVESTING IN INCREASING **PROCESSING CAPACITY**

- Expansion of existing operations
- New processing in new regions

3 INVESTING IN **DEVELOPING FARMING SYSTEMS**

- Developing and trialling different species
- Larger farms with lower costs per tonne
- Implementing the latest in modern systems for appropriate product

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

MICROALGAE

TOTAL SCORE 30/50

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	?

This platform scales up microalgae production for use in a wide range of biomass processing systems

WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- 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	- Production systems that are taking share are primarily low tech (e.g. polythene lined trenches in rice paddies)	- New Zealand's small microalgae farming sector can continue to grow and develop a system and high value niche product that can compete with Chinese production in polythene lined trenches in rice paddies

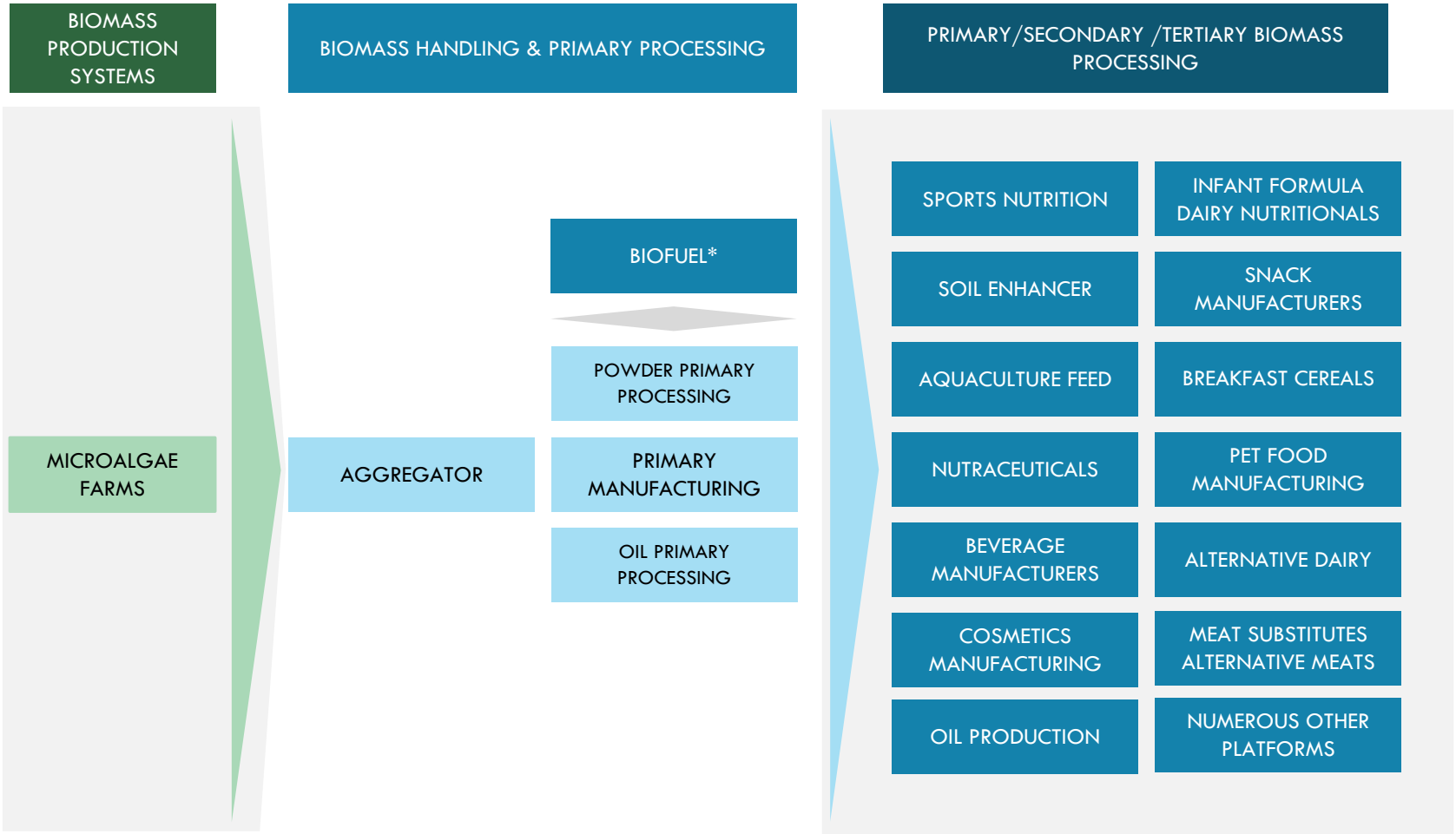
Conceptually, this opportunity uses microalgae to produce a range of supplements, compounds, animal feed and potentially biofuels

WHAT IS THE CONCEPT?

Photo credit: Wikimedia CCA 3.0 CSIRO; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Despite only producing a modest amount currently, NZ grown microalgae has a lot of ideas for how it could potentially connect into the wider bioeconomy

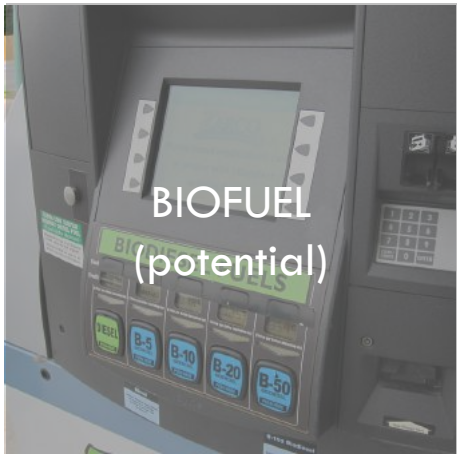
WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



** Current research shows the economics does not stack up*

Microalgae are a key ingredient and alternative in a range of products and services

WHAT CAN YOU DO WITH IT?



Source: various company websites; Coriolis analysis. Photo credit: CCA 4.0 Narke75; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Microalgae are in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 INCREASING BIOMASS	- Utilising a local New Zealand biomass in fresh and salt water (low volumes currently)
2 INCREASING VALUE-ADDED	- Potential for high value outputs (compounds, extracts etc.) - High protein content of 30-50% dry matter for microalgae
3 BUILDING RESILIENCE	- Creates employment and industry in the regions - Higher wages available, skilled labour - Products support a healthy diet and overall wellness objectives
4 REDUCING AGRICULTURAL GHG EMISSIONS	- Production system is a low emission sustainable system vs. comparable products (plant and animal) - Enhances environmental capital - Fix 1.8t of CO_2/t of dryweight bio-mass
5 REPLACING FOSSIL FUELS	- Potential for use as a biofuel (economics not yet stacking up) - Opportunity to replace fossil fuels on farm (soil amendments using microalgae)
6 RETHINKING WASTE	- Circular principles part of the production system or business model - Microalgae used in bioremediation - Multiple uses for compounds - High tech extraction systems able to extract more from less

Microalgae can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Using sustainable circular farming systems
Potential for biodiesel in processing

Recyclable/biodegradable packaging
Efficient production
Low energy production design
Incorporate bioremediation

Encouraging recycling/composting
Fed back into system or extracted

Modern processes and equipment
Renewable energy use
Co-located with waste treatment

Reverse supply chain from major users

Potential for alternative energy sources in distribution

Waste in processing re-used

Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Microalgae researchers, suppliers and firms are located across New Zealand

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- Microalgae research is focused on oil extraction, pharmaceutical compounds and alternative protein production

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use these products

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities are researching topics within this platform

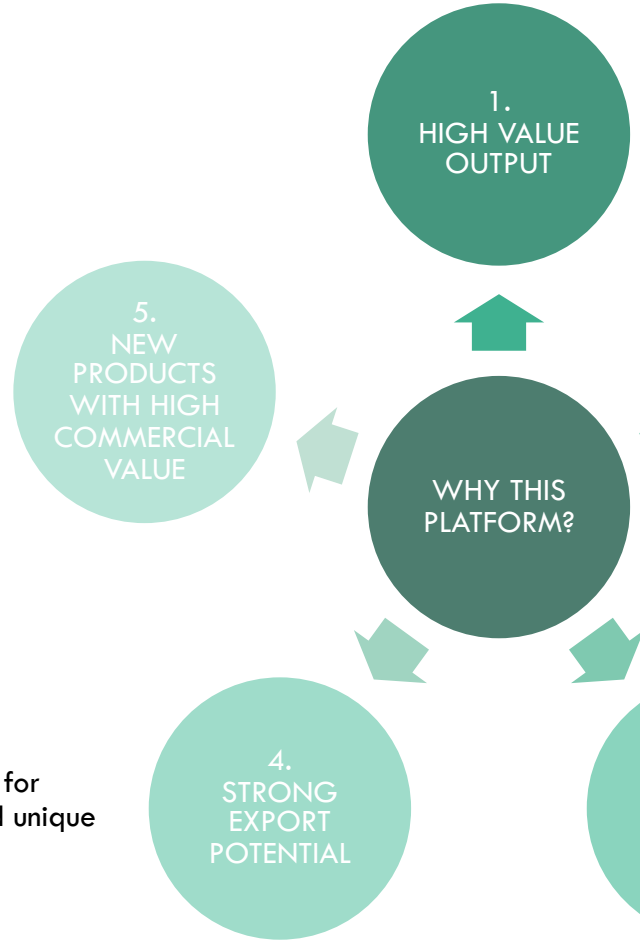
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM?



- Potential to create high value outputs, extracts and compounds

- High protein
- High oil content
- Unique functional benefits

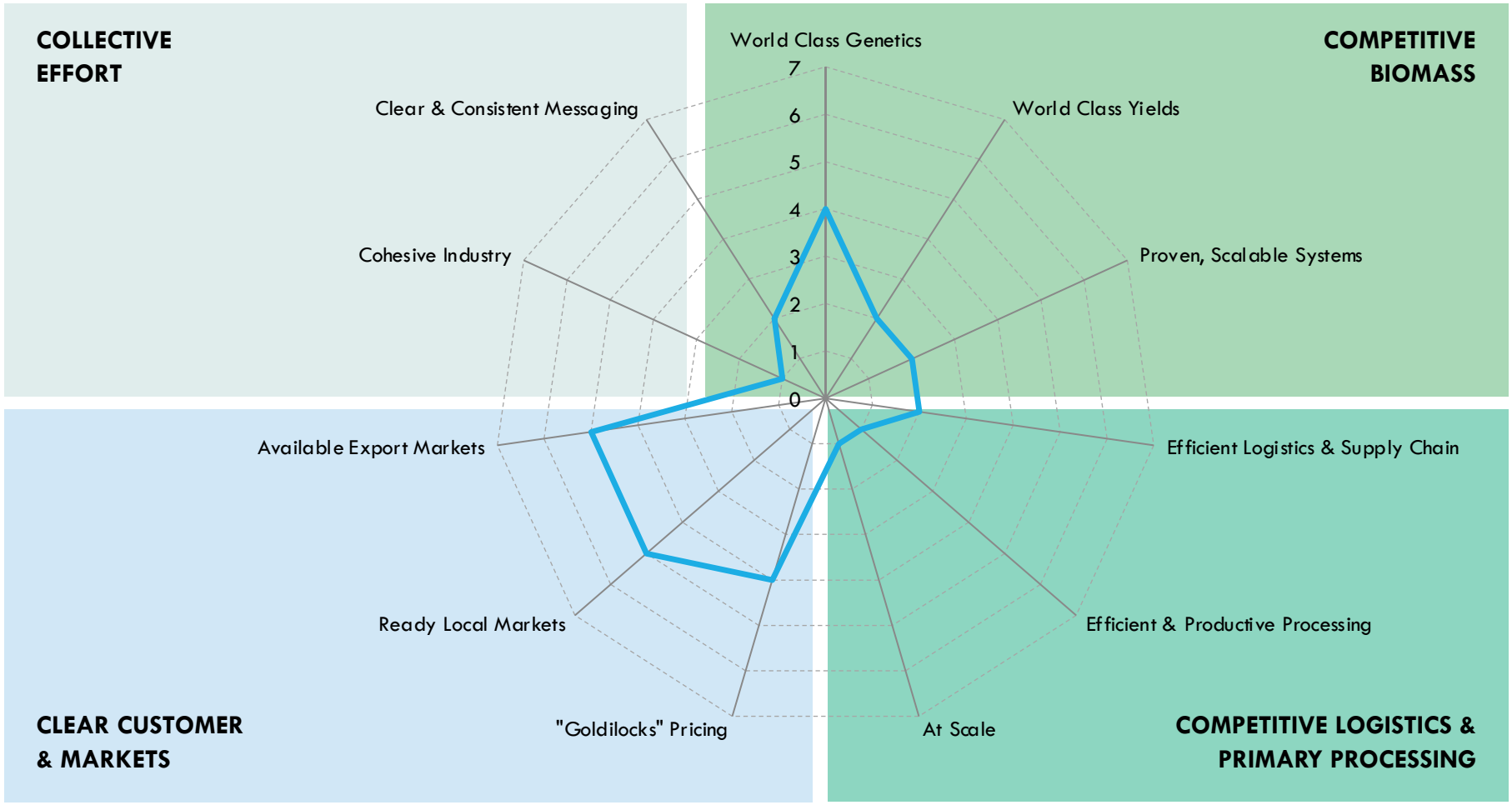
- Demonstrated capability to manufacture microalgae in New Zealand (e.g. Cawthron and Seadragon)

- Strong consumer demand for sustainably produced and unique functionality

- In particular unique IP around pharmaceutical products

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

Can New Zealand compete at scale?

- Cawthron is producing pilot scale volumes currently, can this scale up to produce both larvae feed and algae that produce bioactive compounds?
- How does NZ compete with cultivation and isolation of compounds?
- Roquette facility in France has the production capacity of 4-5,000 tonnes (2014) of fermented chlorella as a food ingredient

How does the industry respond to the low cell density?

- Microalgae are extremely low density; a barrier to commercial production
- What market is the most attractive given the low cell density?

Does NZ have the sunshine hours to make the scale required for biodiesel?

- Scale is required for microalgae to be viable for biofuels, animal feed etc.
- Natural sunshine has a lower expense than photobioreactors

Can we win?

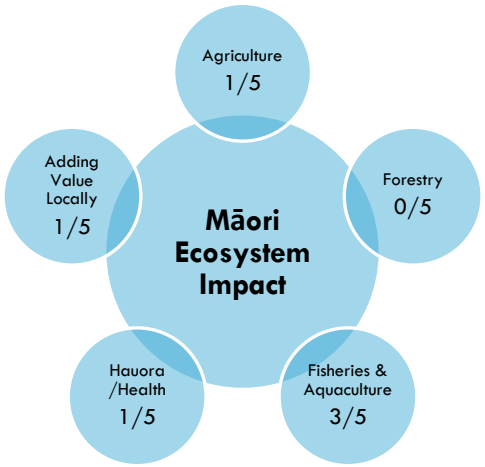
- Where should New Zealand focus to produce a competitive and unique product?
- Can we produce a product and be competitive?

Source: Coriolis analysis

Microalgae

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Very few players – unknown sector in the Māori economy.
- Low potential – would need to compete with imports
- No clear Māori involvement in this – who would lead this?
- Strong science R & D spend will raise questions with Māori investors – too early in commercialisation life cycle? What competitive advantage do we bring to it?

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆ ☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆ ☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**35/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION	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

1 INVESTING IN INCREASING **PROCESSING CAPACITY**

- Researching best systems for NZ conditions
- Building new and expanding existing processing
- Implementing the latest in modern systems

2 INVESTING IN **REDUCING COSTS**

- Engineering and research required to reduce cost of biomass production

3 INVESTING IN **R&D**

- R&D into potential new and unique extracts & compounds
- R&D into various microalgae by end use
- Research into potential functional benefits of unique NZ phytoplankton

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

PINEAPPLES

TOTAL SCORE 33/50

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

This platform scales up pineapple production in northern New Zealand

WHY DO WE CARE?

SITUATION

- 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

COMPLICATION

- Unlike key competitors, New Zealand has high cost labour and currently lacks scale

RESOLUTION

- 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

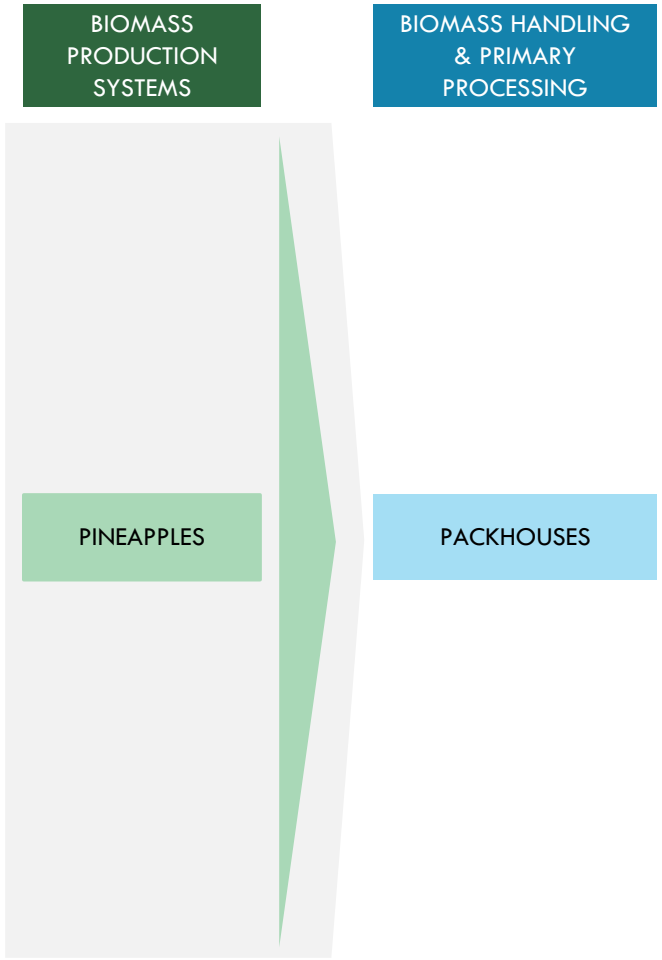
Conceptually, this opportunity is fresh pineapples

WHAT IS THE CONCEPT?

Photo credit: Wilkinson; DALL.E (Accessed May 2023)

The pineapple platform, as it is currently configured, has extremely simple linkages into a narrow part of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Pineapple is a key ingredient in a range of products, at this stage of pineapples evolution, fresh is the most attractive high value option

WHAT CAN YOU DO WITH IT?

FRESH

RETAIL READY PINEAPPLES

DRIED

PINEAPPLE POWDER BEVERAGE

RTD BEVERAGE

ALCOHOLIC SPIRIT

COSMETICS

SUPPLEMENT

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Pineapple production is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Crop achieves high biomass yields
2 **INCREASING VALUE-ADDED**	- Potential for high value outputs (requires scale to succeed)
3 **BUILDING RESILIENCE**	- Currently all fruit imported - Creates employment and industry in the regions (e.g. Northland) - Crop is climate friendly and suitable to warming conditions in Northland
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Low emission horticultural system - Opportunity to design for low input system (e.g. low chemical/organic) - Enhances environmental capital - Shorter supply chains to market (v.s. imports)
5 **REPLACING FOSSIL FUELS**	- Opportunity to replace fossil fuels on farm (soil amendments vs fertilisers) - Opportunity to use bioplastics, less plastic packaging
6 **RETHINKING WASTE**	- Circular principles part of the production system or business model - New systems design creates less waste (less packaging)

Pineapple production can be incorporated into a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Using regenerative practices
Sustainable farming systems
Potential for alternative energy farm vehicles

Low packaging/kg product design
Recyclable/biodegradable packaging
Efficient production key to design

Encouraging recycling/composting

Renewable energy use in packhouse

Reverse supply chain from major users

Potential for alternative energy sources in distribution
Reduced distribution distances in particular if industries co-located

Skins can be used as beverage (e.g. tepache)
Encouraging filtering and reuse

Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Pineapples grow around Whangarei in Northland, New Zealand

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- New Zealand has only one commercial pineapple grower with others dabbling with growing the fruit
- Selling primarily into the Whangarei Farmers Market

SELECT FIRMS
Not a complete list

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS	INDUSTRY ORGANISATIONS	UNIVERSITIES / RESEARCH	GOVERNMENT / CRI'S
- Tropical Fruit Growers of New Zealand	- Tropical Fruit Growers of New Zealand	- North Tec	- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety) - Crown Research Institute

Source: various company and organisation websites; Coriolis analysis

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS

- New Zealand firms and consumers use a lot of pineapples
- A critical ingredient in many other products (e.g. Hawaiian pizza)
- New to New Zealand

- Emerging pioneer based in Northland

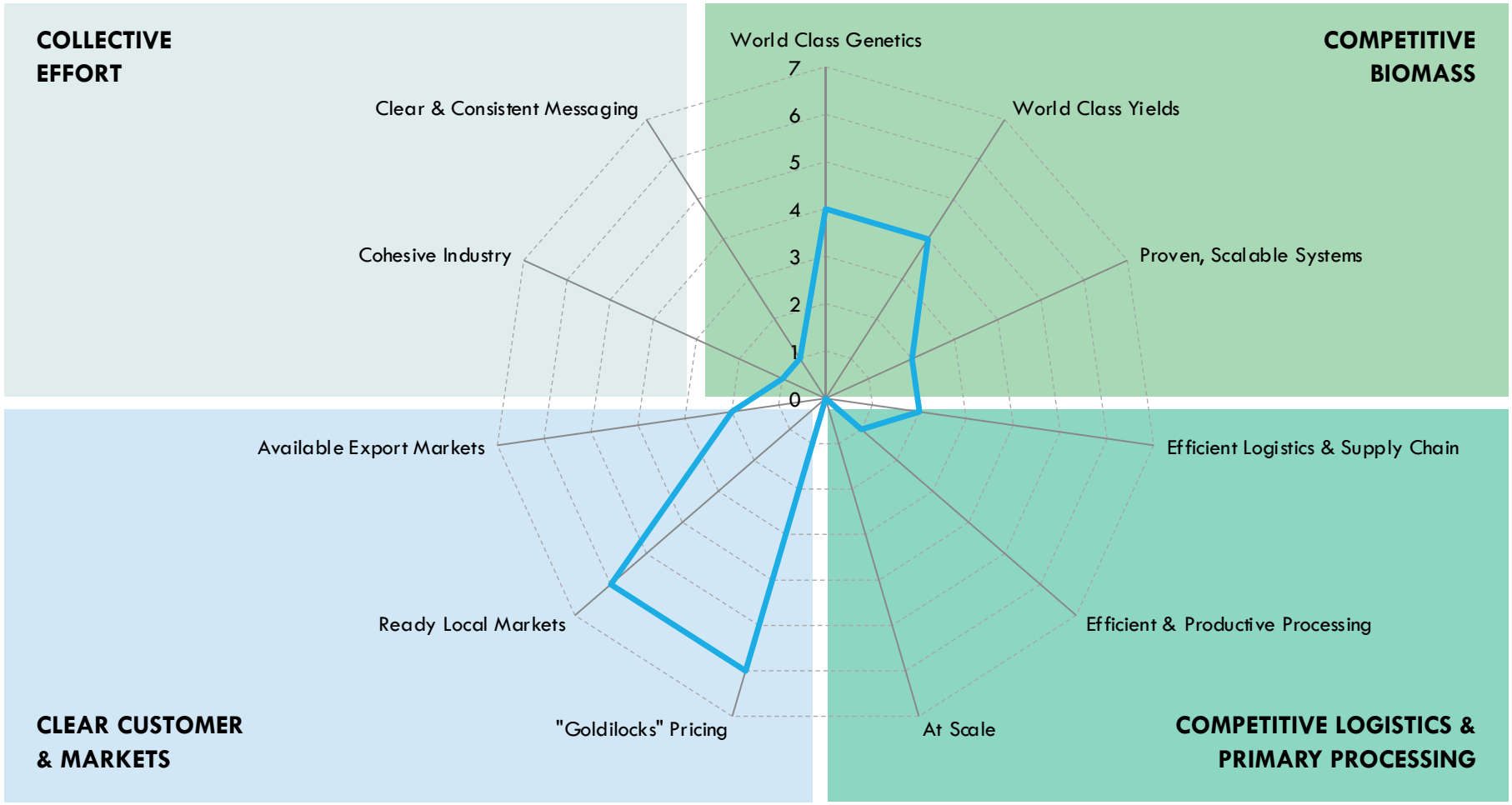
- Highly dependent on imports (99.9% imported)

- Beyond fresh, pineapples can be used dry, processed in a can, juiced as a flavour etc. for both snacking and as a key ingredient

- Demonstrated early-stage capability to grow pineapples in New Zealand

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

How big can this industry get?

- Is there a new technology or situation that makes this industry more viable in New Zealand?
- New Zealand achieves high yields; can these be delivered consistently across multiple species

How will you enter a mature global market with firms already at scale?

- New Zealand cannot compete with this group without high productivity, better farming systems, very high levels of mechanisation and a premium positioning
- Difficult to compete with cheap imports

What is your message to consumers? Why local pineapples?

- What is your story? If the industry is to achieve a premium it will need a story

Is there an opportunity for mechanisation?

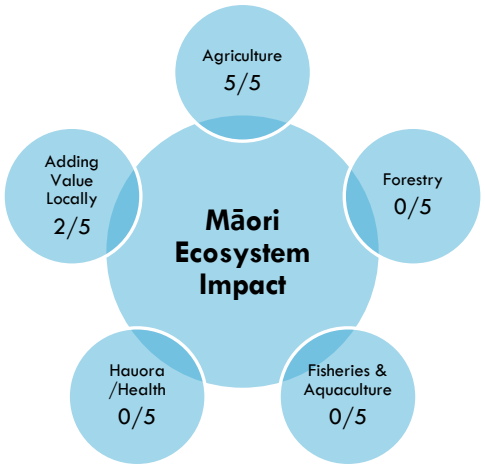
- Where are the opportunities to reduce production costs?

Source: Coriolis analysis

Pineapples

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Climate modelling potential with shifting regional climates particularly Northland becoming sub-tropical
- Northland Māori interests – movement into horticulture. Branding opportunity – potential to create a "crown on pineapple". Attractive to Northland tribes.
- Very little current importance in te Ao Māori – imported and not a taonga or protected species.
- Māori investors will want to know about market demand and crop exposure to pests / diseases. GE might be a potential solution but political and social licence to operate will be a barrier.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**45/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

New Zealand's existing small-scale pineapple pioneers centered in Northland can continue to grow through selling a "crown on" pineapple to premium domestic consumers replacing imports

1 INVESTING IN **SCALING-UP FARMING SYSTEMS**

- More farmers
- Larger farms with lower costs per tonne
- Implementing the latest in modern systems

2 INVESTING IN REDUCING TOTAL SYSTEM **PRODUCTION COSTS**

- Continuous reduction in costs is required
- Automation, mechanisation available?
- Costs across the chain need to be examined and challenged

3 INVESTING IN **IMPROVING PRODUCTIVITY**

- Northland farmers need to achieve world class yields to compete

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

BANANAS

TOTAL SCORE 33/50

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

MARKET SITUATION 3/5

- 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

- 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

SOURCES OF VALUE CREATION

- 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

- 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)

VALUE CHAIN LINKAGES

F&V packhouses	XXX
Fruit processing	X

This platform scales up banana production in northern New Zealand

WHY DO WE CARE?

SITUATION

- 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%)

COMPLICATION

- Unlike key competitors, New Zealand has high cost labour and currently lacks scale

RESOLUTION

- 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

Conceptually, this opportunity is growing bananas to produce primarily fresh bananas

WHAT IS THE CONCEPT?

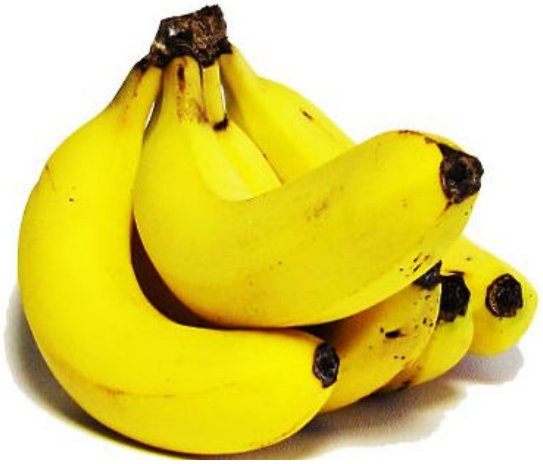
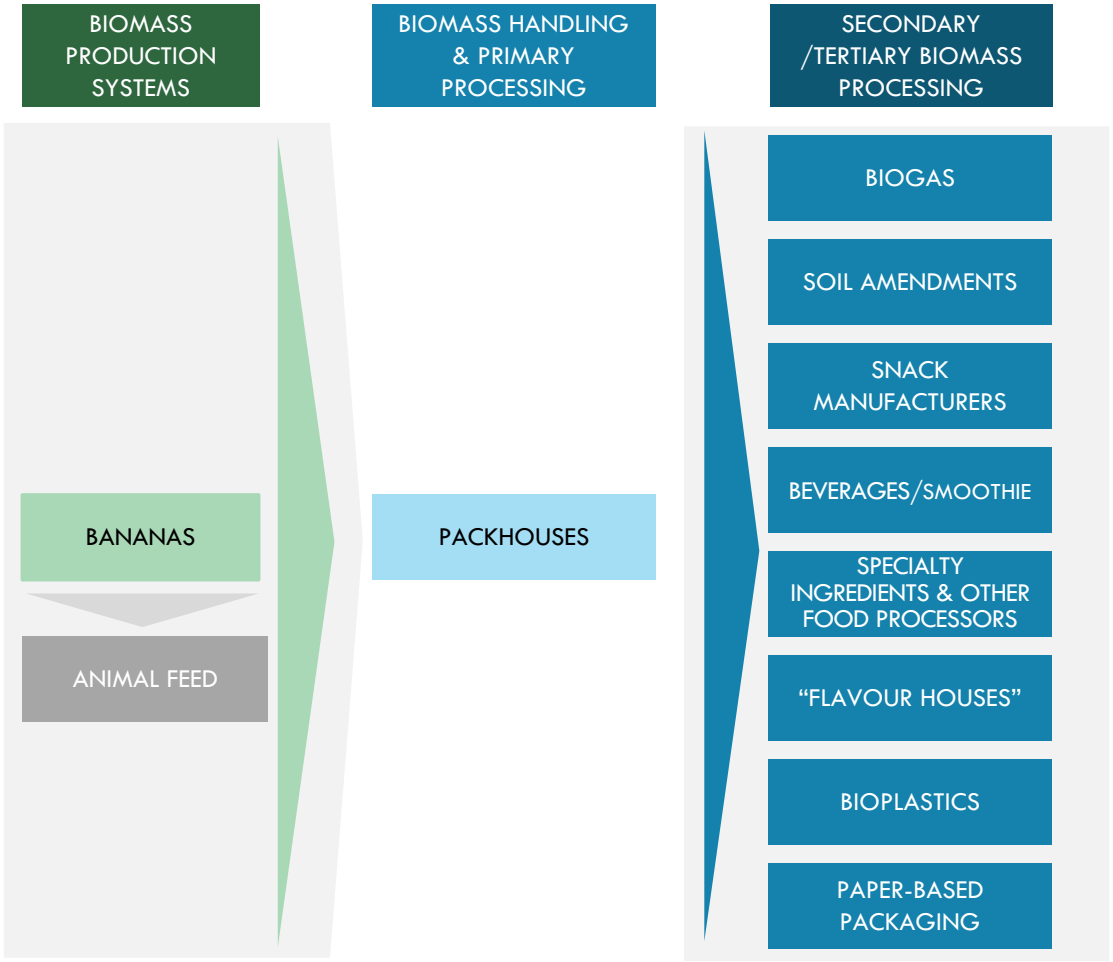


Photo credit: Wikimedia CC BY-SA 3.0 NW Indian Language Institute; CC BY-SA 4.0 Icarfly

The banana platform, as it is currently configured, has extremely simple linkages into primary processing, however secondary processing is possible

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



The banana plant has a range of uses; from fresh to a key ingredient and flavour in a range of products; at this stage fresh is the best option

WHAT CAN YOU DO WITH IT?

Photo credit: CC BY-SA 3.0 NW Indian Language Institute; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Banana production is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 INCREASING BIOMASS	- Crop fast growing and produces large biomass yields
2 INCREASING VALUE-ADDED	- Opportunity to develop new products and new varieties
3 BUILDING RESILIENCE	- Currently vast majority of fruit imported - Creates employment and industry in the regions (e.g. Northland, East Cape) - Crop is climate friendly and suitable to warming conditions in the north
4 REDUCING AGRICULTURAL GHG EMISSIONS	- Low emission horticultural system - Opportunity to design for low input system (e.g. low chemical/organic) - Enhances environmental capital - Shorter supply chains to market
5 REPLACING FOSSIL FUELS	- Opportunity to replace fossil fuels on plantation (soil amendments, animal manure vs fertilisers) - Opportunity to use bioplastics, less plastic packaging - Opportunity to use alternative sources of energy in production
6 RETHINKING WASTE	- Circular principles part of the production system or business model - New systems design creates less waste (less packaging) - Most of plant able to be utilised on-farm (bananas are heavy feeders)

Banana production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

High yields
Using regenerative practices
Sustainable farming systems
Animal feed (leaves/stems)
Use of flowers

Low packaging/kg product design
Recyclable/reduced packaging in particular on farm
Efficient production

Encouraging recycling of packaging
Composting of skins

Modern plant and equipment
Renewable energy use

Reverse supply chain from major users (e.g. crates and banana boxes)

Reduced distribution distances
Potential for alternative energy sources in distribution

Reduced serving sizes
Encouraging filtering and reuse

Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Bananas grow across the top of New Zealand

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- New Zealand companies farm bananas around Whangarei and the East Cape
- Many hobby farmers and private individuals grow bananas in the north

Many smaller growers

Tai Pukenga Ltd

SELECT FIRMS
Not a complete list

NOTE: Select firms only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- Tropical Fruit Growers of New Zealand
- Bananas of New Zealand Aotearoa (develop banana tissue cultures)

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use bananas in their products

UNIVERSITIES / RESEARCH

- Multiple research streams underway that touch on parts of this opportunity

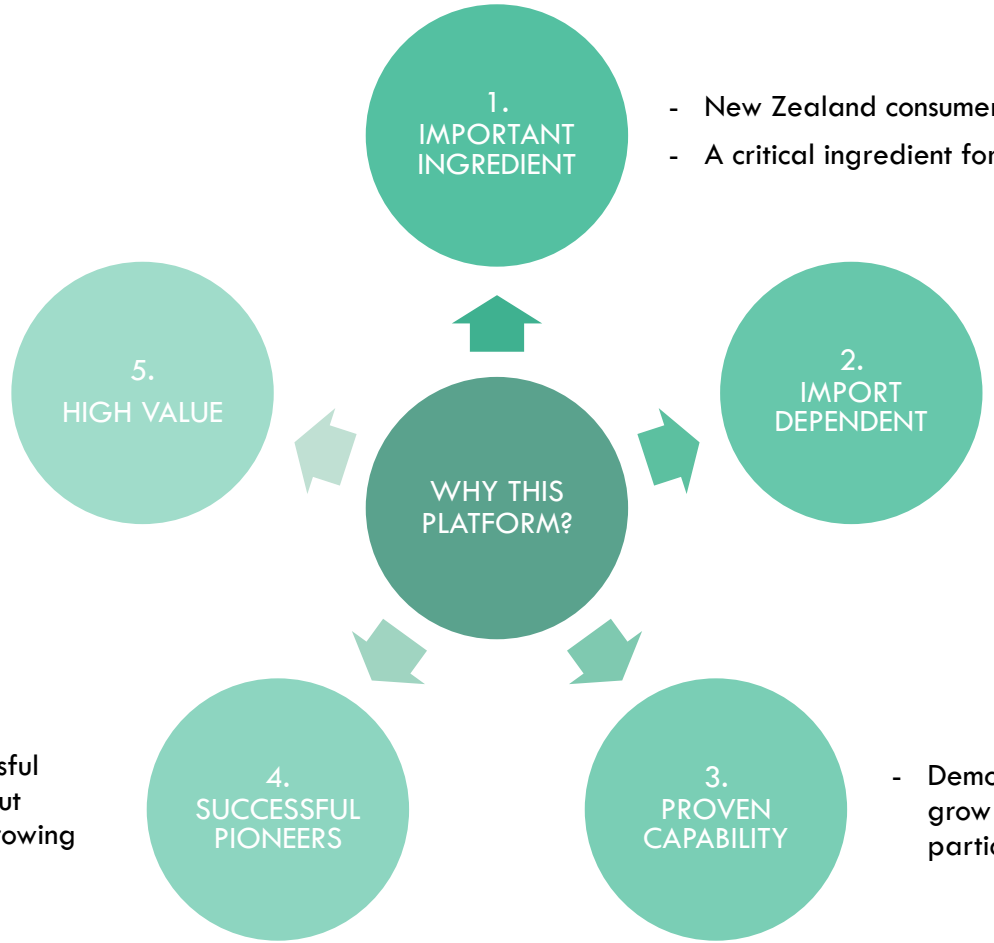
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (importation rules, species research)

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- New Zealand consumers eat a lot of bananas
- A critical ingredient for many products

- Highly dependent on imports

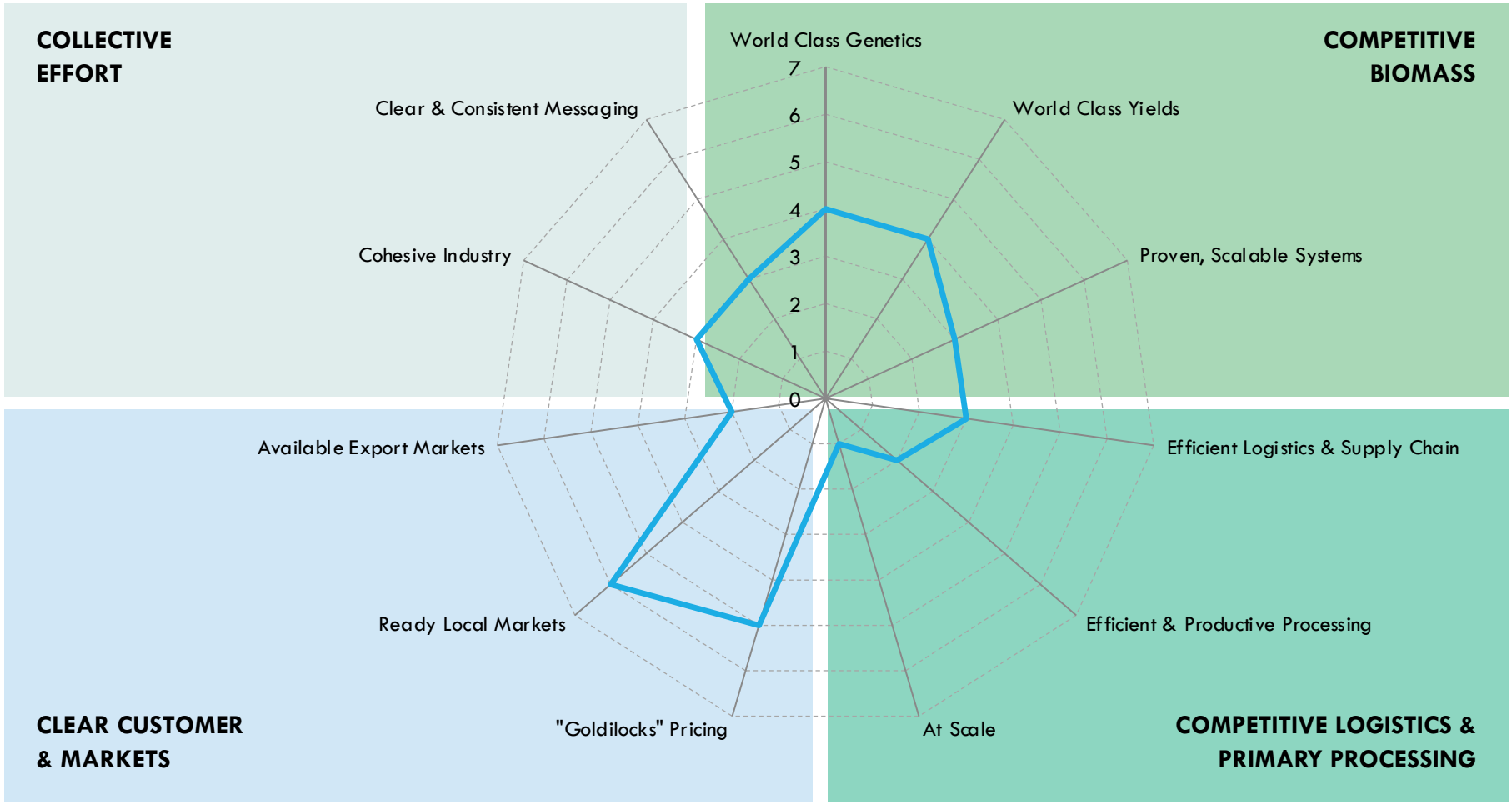
- Demonstrated early stage capability to grow bananas in New Zealand (in particular Northland)

- Emerging group of successful pioneering firms throughout Northland trialling and growing bananas

- Able to produce and grow higher value varieties (beyond the common species imported)
- Able to produce fresh blossoms

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

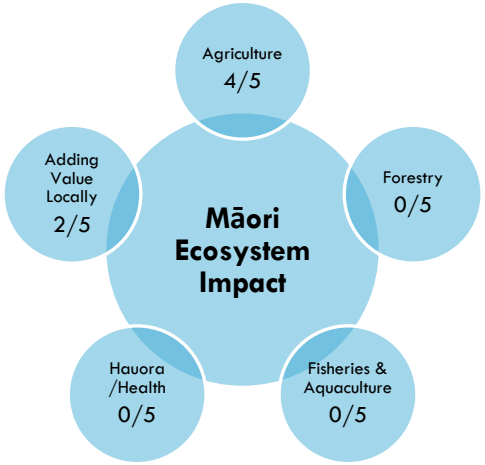
How will you enter a mature global market with firms already at scale?	Why you? Why NZ? What is your unique selling proposition?	Does the total farming business case stack up at any scale?	What lessons can the sector take to reduce issues experienced overseas?
- New Zealand cannot compete with this group without high productivity, unique species, better farming systems, very high levels of mechanisation and a premium positioning - Difficult to compete with cheap imports	- How will the bananas stand-out and succeed? - Is there commercial demand for premium bananas	- Two streams: food (bananas) and animal feed (biomass) - Strong returns must be attained to make this farming option feasible relative to other land uses	- High costs of production (in particular labour, fertiliser, chemicals) - Labour shortages - Weather events - Disease

Source: Coriolis analysis

Bananas

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Climate modelling potential with shifting regional climates particularly Northland becoming sub-tropical.
- Northland Māori interests – movement into horticulture. Could be symbiotic with other crops particularly fruits.
- Very little current importance in te Ao Māori – imported and not a taonga or protected species.
- Māori investors will want to know about market demand (particularly any highly desired varieties) and crop exposure to pests / diseases. GE might be a potential solution but political and social licence to operate will be a barrier.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**45/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

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

1 INVESTING IN SCALING-UP FARMING SYSTEMS

- More farmers over more areas
- Larger farms with lower costs per tonne
- Implementing the latest in modern systems
- Implementing the latest in regenerative farming

2 INVESTING IN INCREASING MARKETING

- Increased marketing and messaging around local and ethical production

3 INVESTING IN DEVELOPING NEW VARIETIES & PRODUCTS

- R&D into commercialising new species available in NZ
- Research into potential health claims
- NPD around product and packaging

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

INDUSTRIAL HEMP (LOW THC)

TOTAL SCORE 28/50

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	?

This platform scales up industrial hemp production as a feedstock to numerous biomass processing systems

WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- 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)	- More than 200,000 hectares grown globally; ~110,000 in China and 82,000 in Canada (conflicting data exists) - To move beyond niche, New Zealand will need to compete	- New Zealand can nurture its existing industrial hemp industry through a focus on continuous improvement of all facets of the farming system (to improve yields and international competitiveness)

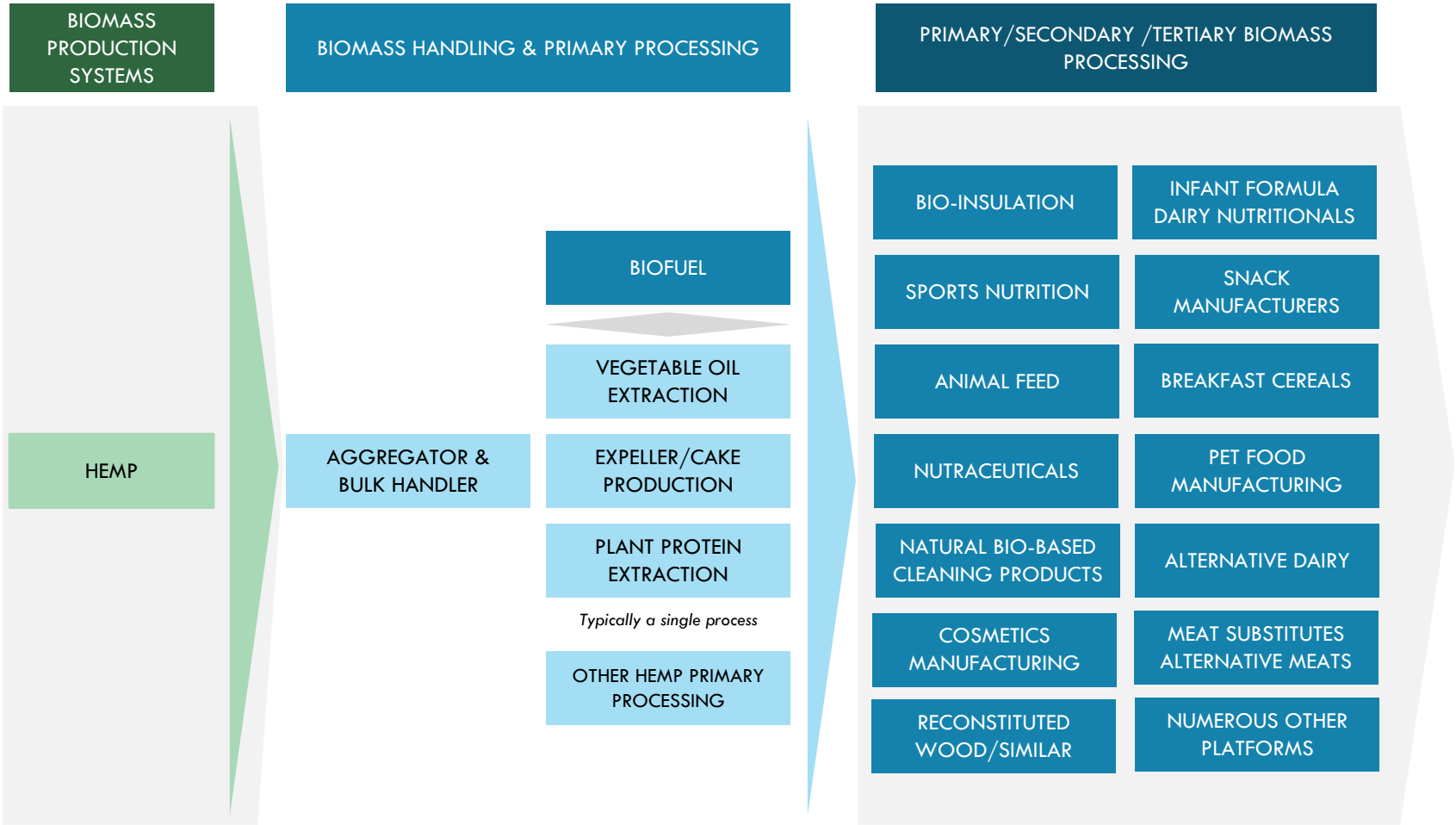
Conceptually, this platform uses hemp to provide fibres, food, beverages, oils, nutraceuticals and cosmetics

WHAT IS THE CONCEPT?

Photo credit: Wikimedia CCA 3.0; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Despite only having ~400ha planted in the country, hemp has a lot of ideas for how it could potentially connect into the wider bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Hemp is a key ingredient in a vast range of products

WHAT CAN YOU DO WITH IT?

HEALTH FOOD

BREAKFAST CEREAL

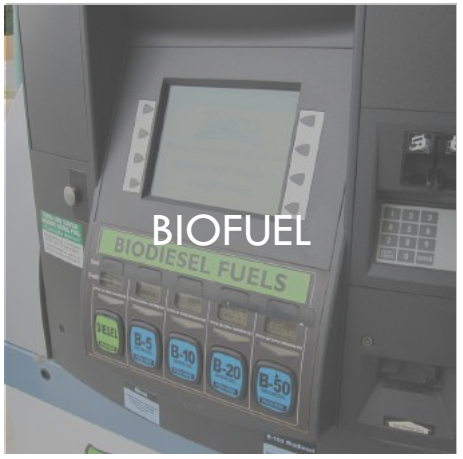
MEAT SUBSTITUTE INGREDIENT

ALTERNATIVE MILK

NUTRACEUTICAL

HAIR & SKIN PRODUCTS

CONSTRUCTION MATERIAL



BIOFUEL

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Hemp is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Utilising a New Zealand biomass - Potential feedstock crops achieve high biomass yields - Full biomass utilisation in New Zealand (e.g. oil, meal protein, animal feed, human protein, fibre)
2 **INCREASING VALUE-ADDED**	- Large range of high value outputs and products in both construction and food sectors
3 **BUILDING RESILIENCE**	- Creates employment and industry in the regions - Higher wages available, skilled labour - Mental and physical health benefits - Products support a healthy diet and overall wellness objectives
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Inherently a low emission sustainable system (can be negative carbon) - Farming system is a low emission sustainable system vs. comparable protein products - Enhances environmental capital
5 **REPLACING FOSSIL FUELS**	- Opportunity to replace fossil fuels in production - Opportunity to use as feedstock in bioenergy and bioplastics - Opportunity to replace fossil fuels on farm (soil amendments vs fertilisers)
6 **RETHINKING WASTE**	- Circular principles part of the production system or business model - Utilise fibre as solid energy feedstock - Multiple uses for co-products - New systems design creates less waste - Processing byproducts and waste streams into high value products

Hemp can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

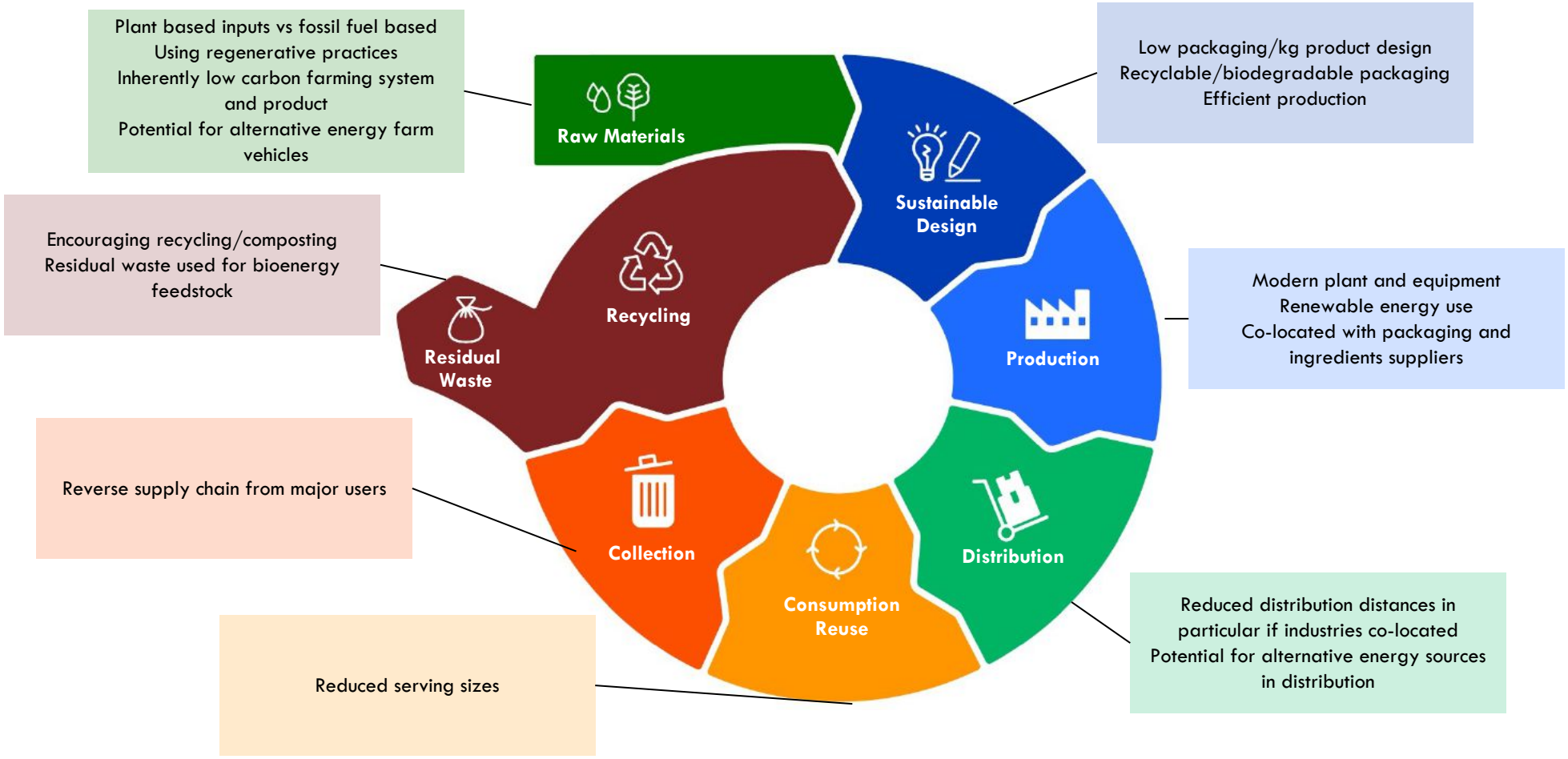


Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Hemp suppliers and firms using hemp are located across New Zealand

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- Hemp is suited to temperate climates with reasonable rainfall, this suits most of New Zealand
- Hemp is grown across New Zealand
- Food/Oil companies are located across New Zealand

NOTE: Select firms only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- Federated Farmers of New Zealand support farmers and growers

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use these products

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities are researching topics within this platform

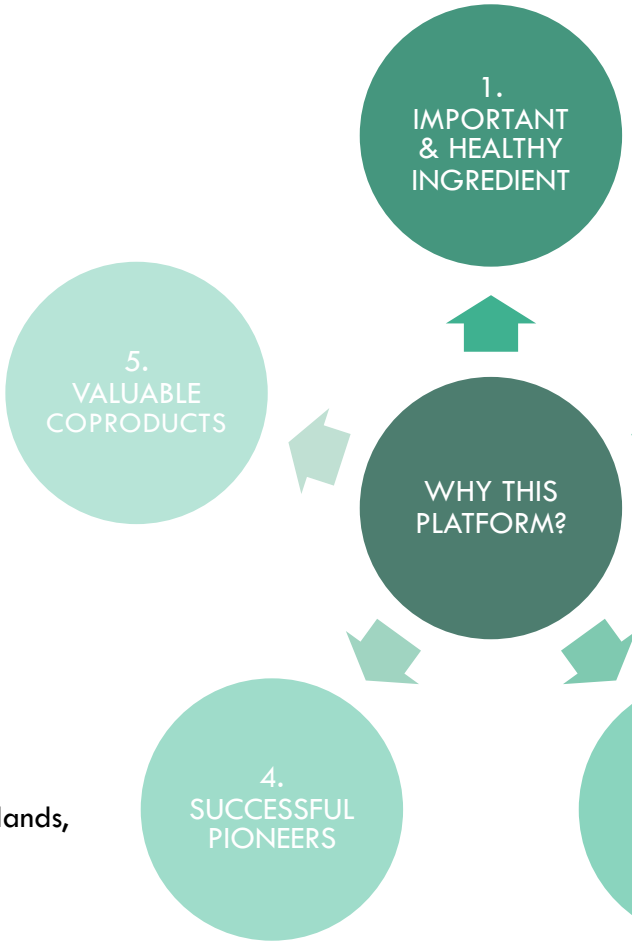
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM?



- Strong demand for healthy foods and oils (hemp seeds are 20-25% protein, 25-30% oil and 10-15% insoluble fibre
- Drive to natural health solutions
- Strong demand for sustainable construction material

- Hemp used as base of meat and dairy replacements
- Large number of plant-based protein powders/products imported

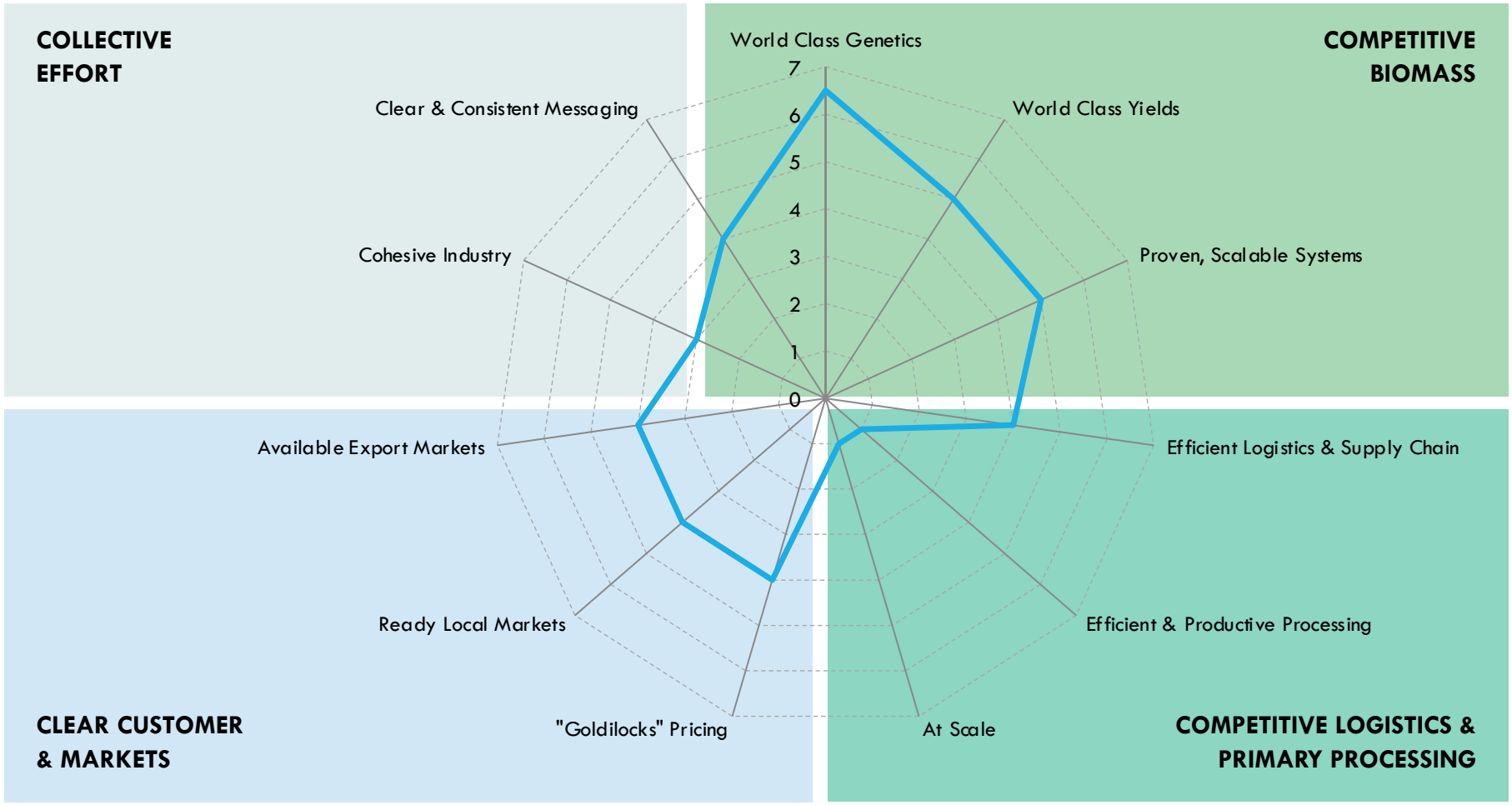
- Demonstrated capability to grow hemp in New Zealand
- Core capability in particular, in the regions

- Strong group of successful pioneering firms (e.g. Midlands, Hemp NZ)

- Large number of uses for the full biomass (key products and co-products)
- Extensible platform into many food and health products
- Hemp supports other high value categories (e.g. cosmetics and nutraceuticals)

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

How can New Zealand compete with Canada?

- Canada is the leading producer of hemp
- Is there a new technology or situation that makes this industry more viable in New Zealand?

How will you enter a mature global market with firms already at scale?

- New Zealand cannot compete with this group without high productivity, better farming systems, very high levels of mechanisation and a premium positioning
- Difficult to compete with cheap imports
- New Zealand food products (e.g. meat substitutes) compete with imports

How do New Zealand firms consistency ensure low THC levels?

- Challenge globally for many hemp producers

Is hemp a trend or a fad?

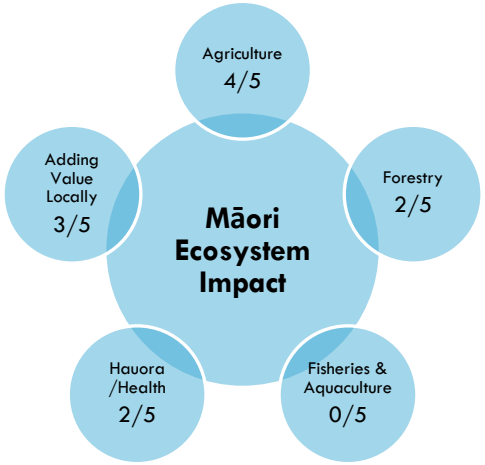
- Are the characteristics of hemp such that it survives as a key ingredient in the food industry and a biomass in general

THC = Tetrahydrocannabinol; Source: Coriolis analysis

Industrial Hemp (Low THC)

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆ ☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆ ☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- No well known traditional use of hemp (imported species).
- Not likely to be a transformative sector for Māori – there are existing players in the market, but they make up a very small percentage of the Māori economy.
- There may be potential for some Māori landowners looking for alternative use of their land.
- A relationship to the infrastructure / construction sector is potentially of interest to Māori investors. Key questions will be asked about the specific market demand and the "hero" application of this crop.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆ ☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆ ☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**50/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

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

1 INVESTING IN **SCALING-UP FARMING SYSTEMS**

- More farmers
- Larger farms with lower costs per tonne
- Implementing the latest in modern systems
- Research into genetics, agronomy and yields

2 INVESTING IN **PROCESSING CAPACITY**

- Expansion of existing operations
- New processing in new regions
- New processing equipment that optimises product quality and consistency for the specific end-use

3 INVESTING IN DEVELOPING **SPECIALISED PRODUCTS**

- R&D into potential fractionates and extracts (terpenes, phenols and phytocannabinoids)
- Research into potential health and functionality claims
- NPD around product and packaging

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

PINE NUTS

TOTAL SCORE 33/50

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

- ~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

- 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

- 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

SOURCES OF VALUE CREATION

- 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

- 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)

VALUE CHAIN LINKAGES

Sauces (e.g. pesto)	XX
Snacks	X
Baking	X
Processed foods	XX

This platform scales up production of pine trees for pine nuts with the added benefit of the pine trees being effective carbon sink

WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- Industry champion driving research and processing in the sector - Capabilities in growing pine trees in New Zealand - Climatically suited to growing pines, climate similar to its home on the Mediterranean - Pine tree forest a carbon sink*	- Modern, high productivity, mechanised production systems have yet to be developed; complicated system to remove seed from husk - Pine trees for food crop currently not included in ETS*	- New Zealand can scale up production of pine nuts and continue to develop high yielding varieties and improve processing

** Nut trees managed as food crop currently excluded from ETS, MPI*

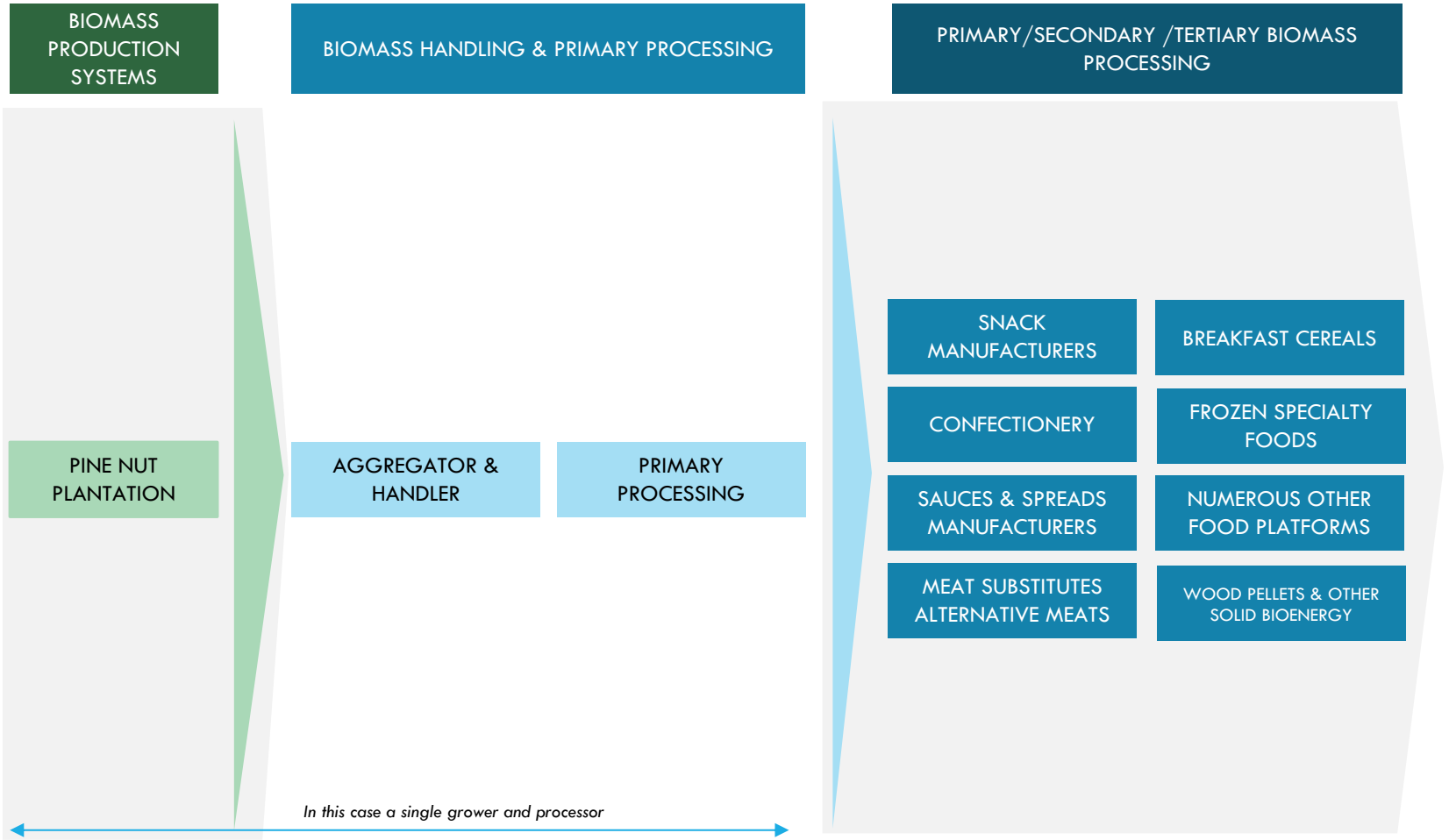
Conceptually, this opportunity uses pine nuts as a fresh nut and as an ingredient in a large range of products

WHAT IS THE CONCEPT?

Photo credit: Wikimedia CC ASA 2.0 fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Native botanicals are a small, but critical ingredient in product differentiation for a huge range of New Zealand products in the market

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Pine nuts are a hero ingredient in many dishes

WHAT CAN YOU DO WITH IT?

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Utilising pine nuts is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 INCREASING BIOMASS	- Potential to develop new farming systems - Potential to develop a co-crop - Full biomass utilisation in New Zealand
2 INCREASING VALUE-ADDED	- High value seed, adds significant value vs. pine trees for logging
3 BUILDING RESILIENCE	- Enhances cultural and social capital - Creates employment and industry in the regions - Able to substitute imports with domestic supply
4 REDUCING AGRICULTURAL GHG EMISSIONS	- Pine trees a carbon sink
5 REPLACING FOSSIL FUELS	- Opportunity to replace fossil fuels in farming system with alternative sources of energy - Potential for plastic-free packaging
6 RETHINKING WASTE	- Circular principles part of the production system or business model (e.g. pine trimmings, cones used as solid biofuel) - Multiple uses for co-products

Pine nut production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

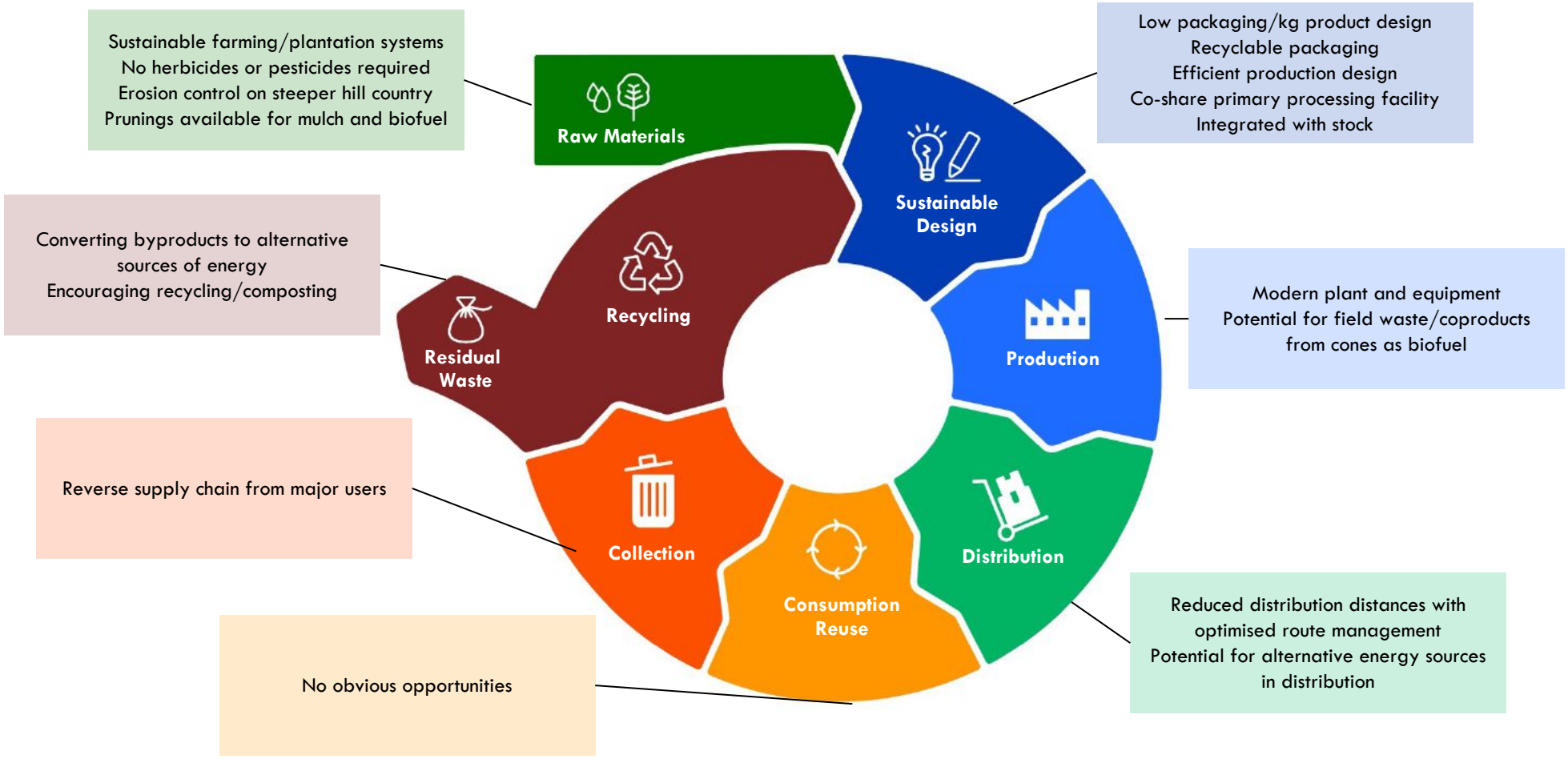


Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Pine nuts are grown successfully in Marlborough

WHERE IS THE INDUSTRY LOCATED?

SELECT FIRMS
Not a complete list

OBSERVATIONS

- There is currently one major commercial grower of pine nuts in Marlborough

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use these products

UNIVERSITIES / RESEARCH

- Founder of Pinoli pine nuts is a graduate of NZ School of Forestry at UC

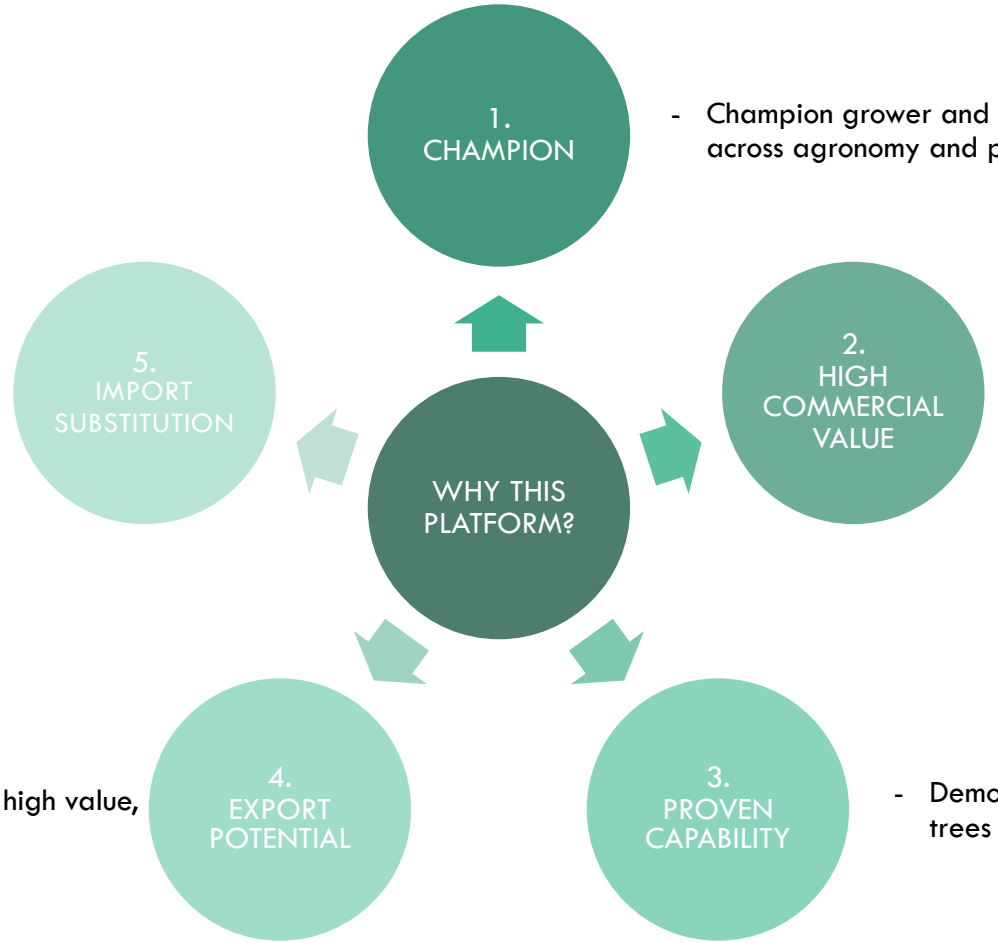
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- Champion grower and processor with genetics and skills across agronomy and primary processing

- Valuable seed, high value vs. other seeds
- Extensible platform

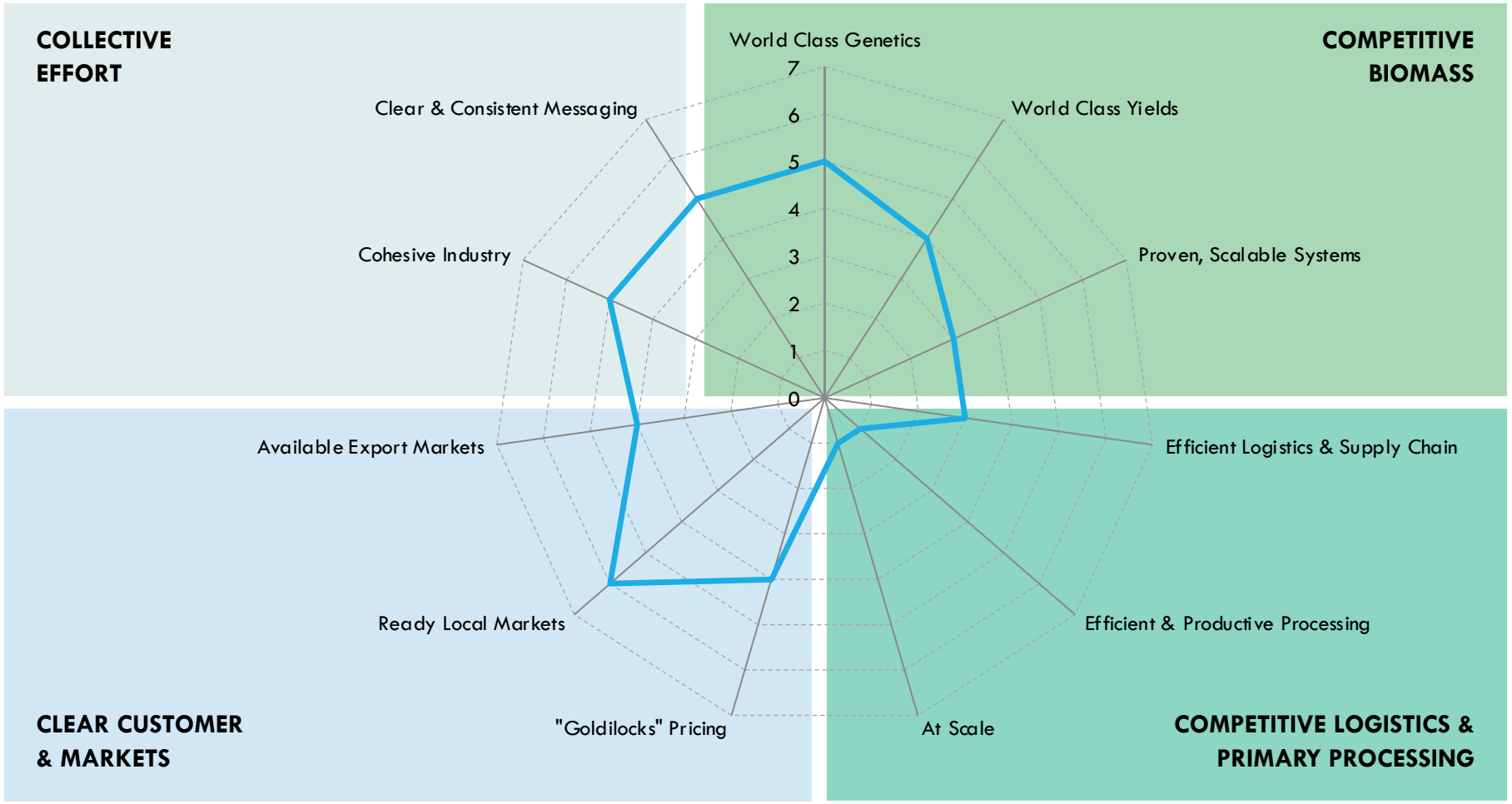
- Demonstrated capability to grow pine trees and develop food companies

- Strong consumer demand high value, fresh product

- Substitute imports with premium products made in New Zealand

Improvements are required to get the platform growth ready, most products are wild harvested

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

How difficult is it to achieve a premium?

- Difficult and complex processing system requires machinery and engineering that does not damage the seeds
- Need perfect seeds to achieve premium
- Are we able to compete with cheaper imports?

What is the timeframe to achieve a viable financial return?

- Slow growing trees requires patient capital
- High cost of production
- Start producing cones at 6-8 years and full production at 40 yrs*

Are the rootstock or cultivars available in New Zealand?

- With no new seeds able to enter New Zealand do we currently have the best stock available?
- Can we track down some of the known cultivars?
- Ideally the sector would select and trial early and heavy croppers

Is the plantation able to be a part of the Emissions Trading Scheme?

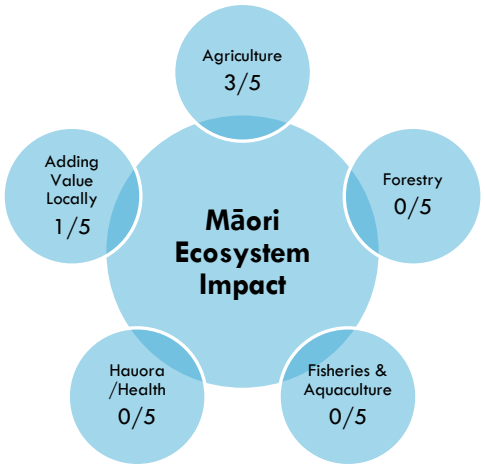
- Tree crops for food are currently outside of the ETS

*Source: * NZ Tree Crops Association; Coriolis analysis*

Pine Nuts

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆ ☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆ ☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆ ☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆ ☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Low to no engagement in this industry by Māori.
- The need to compete with cheaper imports makes it hard to see a compelling Māori industry response to this product.
- Potentially a good opportunity for individual land blocks – but not at scale.
- Māori investors would look for someone who has secured some specific market advantage.

MĀORI SECTOR SCORECARD

CONNECTIVITY? ☆

Can we build new or utilise existing international connections for expanding markets?

TREATY ASSET? ☆

Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?

JOBS? ☆ ☆

Will this platform have an employment impact, particularly for rural communities?

OUR ECONOMY? ☆

How much of an impact will this platform make on our rural economies / communities?

TAIAO? ☆ ☆

Will this improve our environment? Is there a regenerative or circular economy opportunity?

MĀTAURANGA? ☆

Can we bring insights from Mātauranga Māori to this platform to create value?

BRAND MĀORI ☆

Can we wrap this in a package? Can we bring something to this with no cultural IP issues?

LEVERAGE? ☆ ☆

Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?

OVERALL ATTRACTIVENESS	40/100

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

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

1 INVESTING IN DEVELOPING **FARMING SYSTEMS**

- Implementing the latest in modern sustainable systems
- Implementing plantation management techniques to maximise yields
- Investing in heavy cropping varieties

2 INVESTING IN PRODUCTION **PROCESSING**

- Investing in processing to ensure highest quality seeds

3 INVESTING IN **BRAND MANAGEMENT**

- Protect names and naming

** Currently not in ETS*

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

RECONSTITUTED WOOD PRODUCT MNFG.

TOTAL SCORE 36/50

INTERNATIONAL STANDARD CODES

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

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

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

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.

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

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

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

This platform suggests further growth is possible in using wood residues from mills (sawdust, bark and woodchips) to produce reconstituted wood products

WHY DO WE CARE?

SITUATION

- New Zealand has a large forestry sector and produces a lot of wood products
- A total of 36m m^2 of logs were produced in NZ
- 20-30% of a tree is left in the forest (e.g. as slash)

COMPLICATION

- New Zealand currently imports a significant amount of wood products
- The construction industry is responsible for ~15% of New Zealand's emissions. Current building construction uses steel and concrete which produce significantly higher emissions than wood products
- Residue currently not used for their highest value

RESOLUTION

- 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.

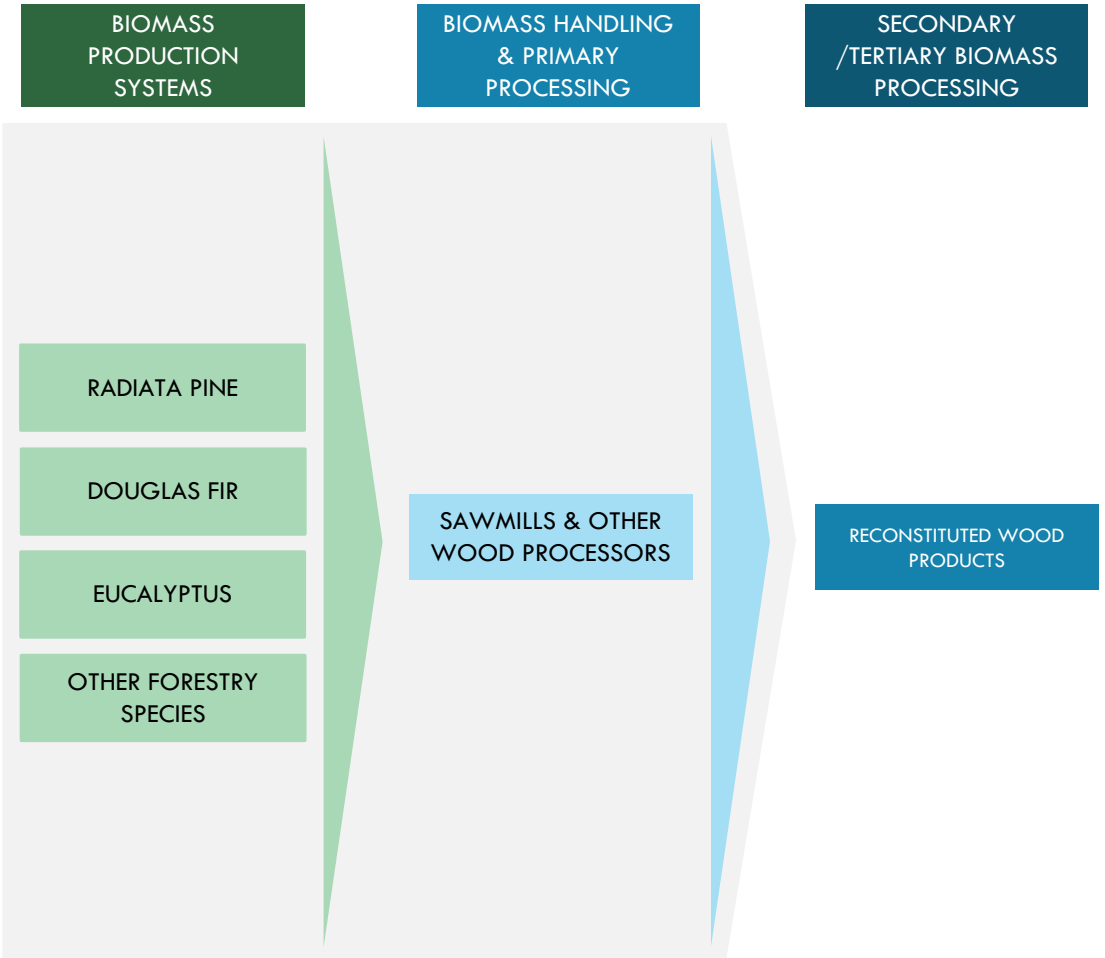
This platform uses the saw mill waste and resins to produce reconstituted wood products such as strand, chip, particle and fibre boards

WHAT IS IT?

Image credit: Wikimedia Public Domain; CC ASA 3.0, fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Reconstituted wood products manufacturers are closely linked to their key suppliers of raw materials

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



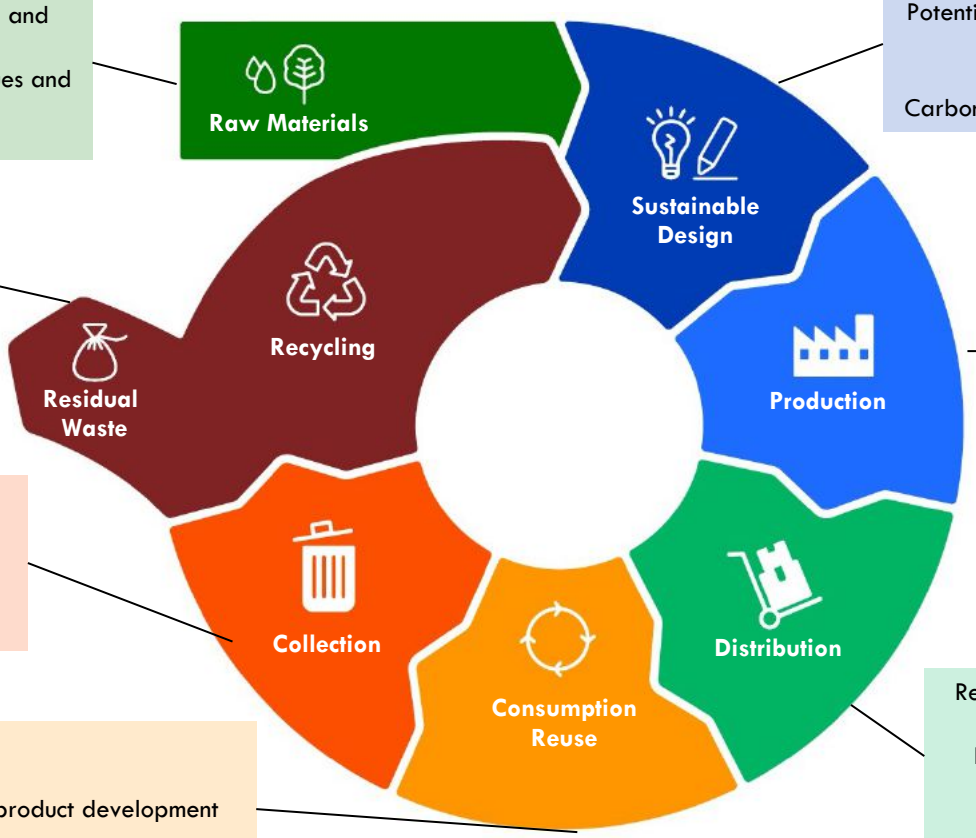
Reconstituted wood products are in line with the desired direction for the bioeconomy in particular utilising residue and reducing emissions

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Additional logs and waste required to increase residues - Full utilisation of resource if trees processed in New Zealand (vs exporting as logs)
2 **INCREASING VALUE-ADDED**	- More sawmills at scale to process industrial logs in NZ - Potential to add value to existing residue
3 **BUILDING RESILIENCE**	- Employment and industry created in the regions in growing and processing - Increases social and economic capital - Replace imports
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Localised production and co-location of facilities reduces need for long distance transport - Additional trees required for sector will offset emissions - Enhances environmental capital
5 **REPLACING FOSSIL FUELS**	- Biobased solid energy replaces fossil fuel based energy at production sites - Opportunity to develop bio-based glues and resins for panel production (e.g. using cellulose, proteins, linins and tannins)
6 **RETHINKING WASTE**	- Processing residues onsite into solid fuel energy - New systems design creates less waste

Reconstituted wood products can be part of a wider circular economy system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?



Raw material inputs sustainable and renewable
Glue sources converted to bio-glues and resins

Efficient production
Potential to design full circular economy thinking in new production
Eco-design and innovation
Carbon locked into construction material

Residues waste can be used for alternative sources of energy on-site (e.g. Laminex making bricks)
Wood can be reused (product has long lifespan)

Modern plant and equipment
Renewable energy use
Raw material and production in close proximity – co-located
Bio-based glues

No obvious opportunities

Reduced distribution distances with co-location
Potential for biofuels in distribution
Extending sustainability to logistics partners

Encouraging co-product development

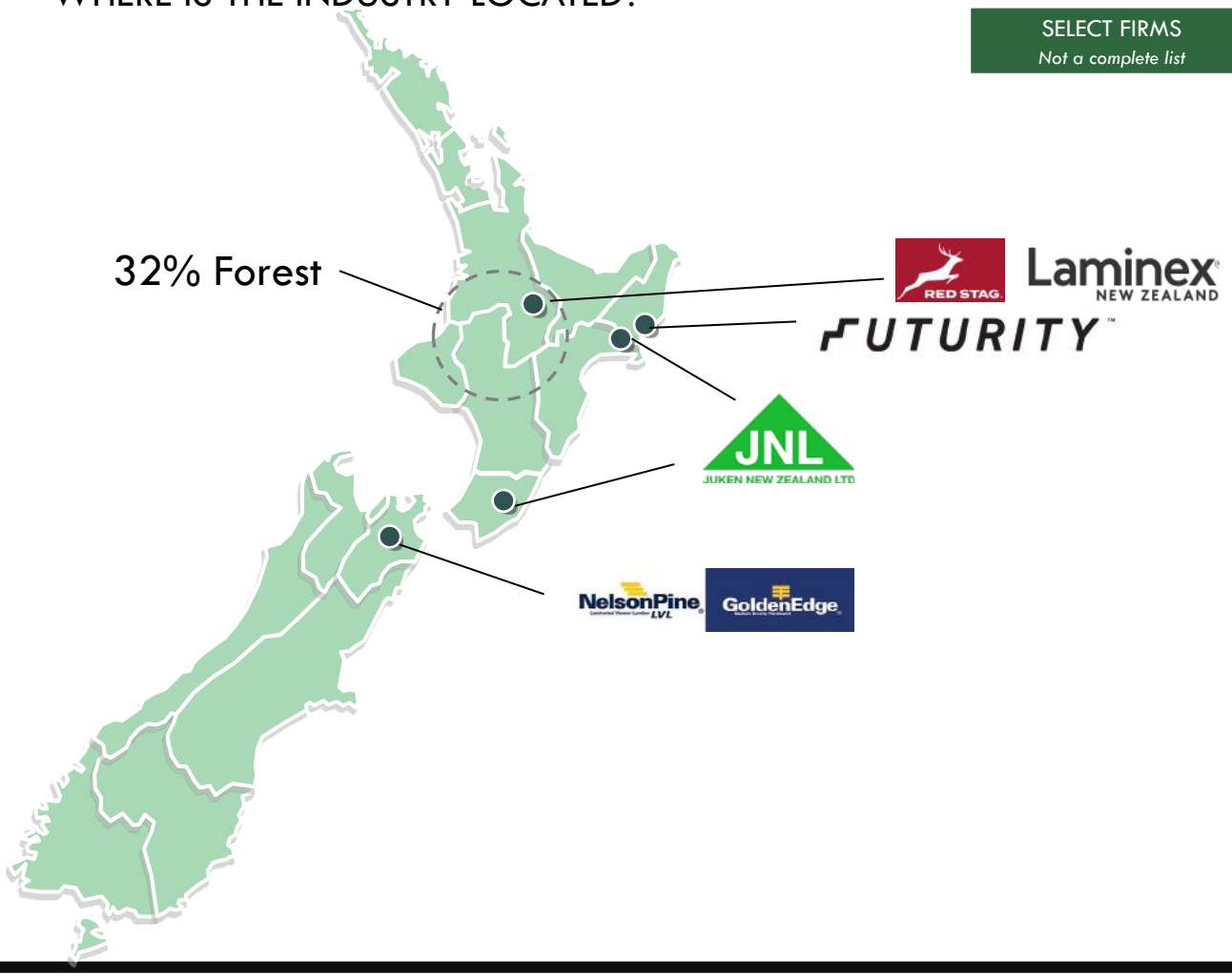
Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Forestry assets and mills and wood manufacturers are located across New Zealand

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- There are approximately 90 sawmills in NZ
- Sawmills produce sawdust, bark and chip
- There are 21 reconstituted wood product manufacturing facilities across NZ



There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

INDUSTRY ORGANISATIONS

- A range of organisations support firms growing and processing wood products

UNIVERSITIES / RESEARCH

- Canterbury University offers a forestry degree

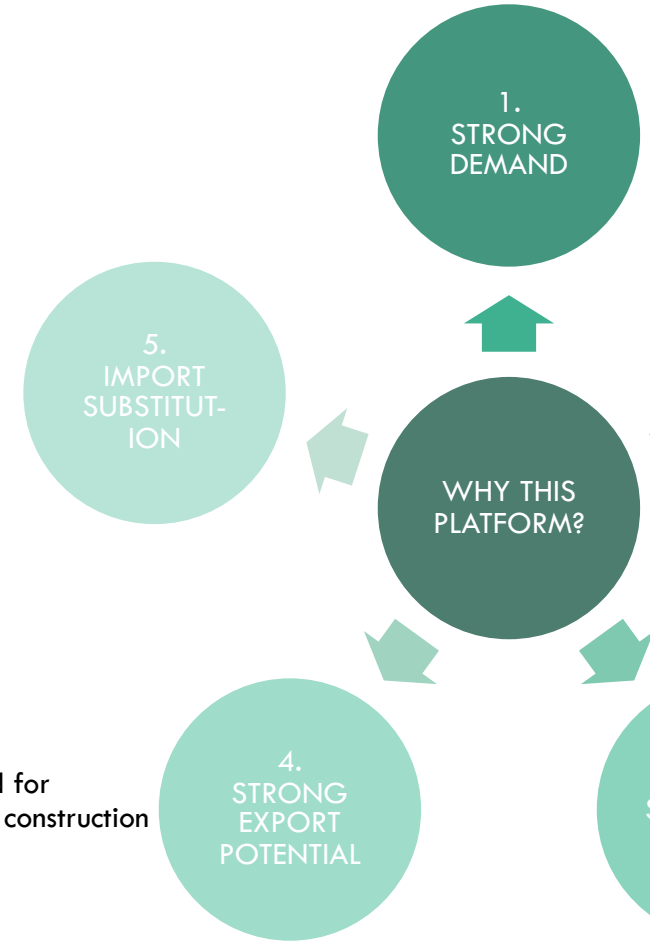
GOVERNMENT / CRI'S

- Crown Research Institutes
- Scion research around improving usability of woody residue
- EECA leads funding programmes

Source: various company and organisation websites; Coriolis analysis

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- On-going demand for locally produced construction material
- Government regulation driving reduction in construction emissions
- Solid growth in demand for houses and apartments

- Capability in developing and building wood products for construction

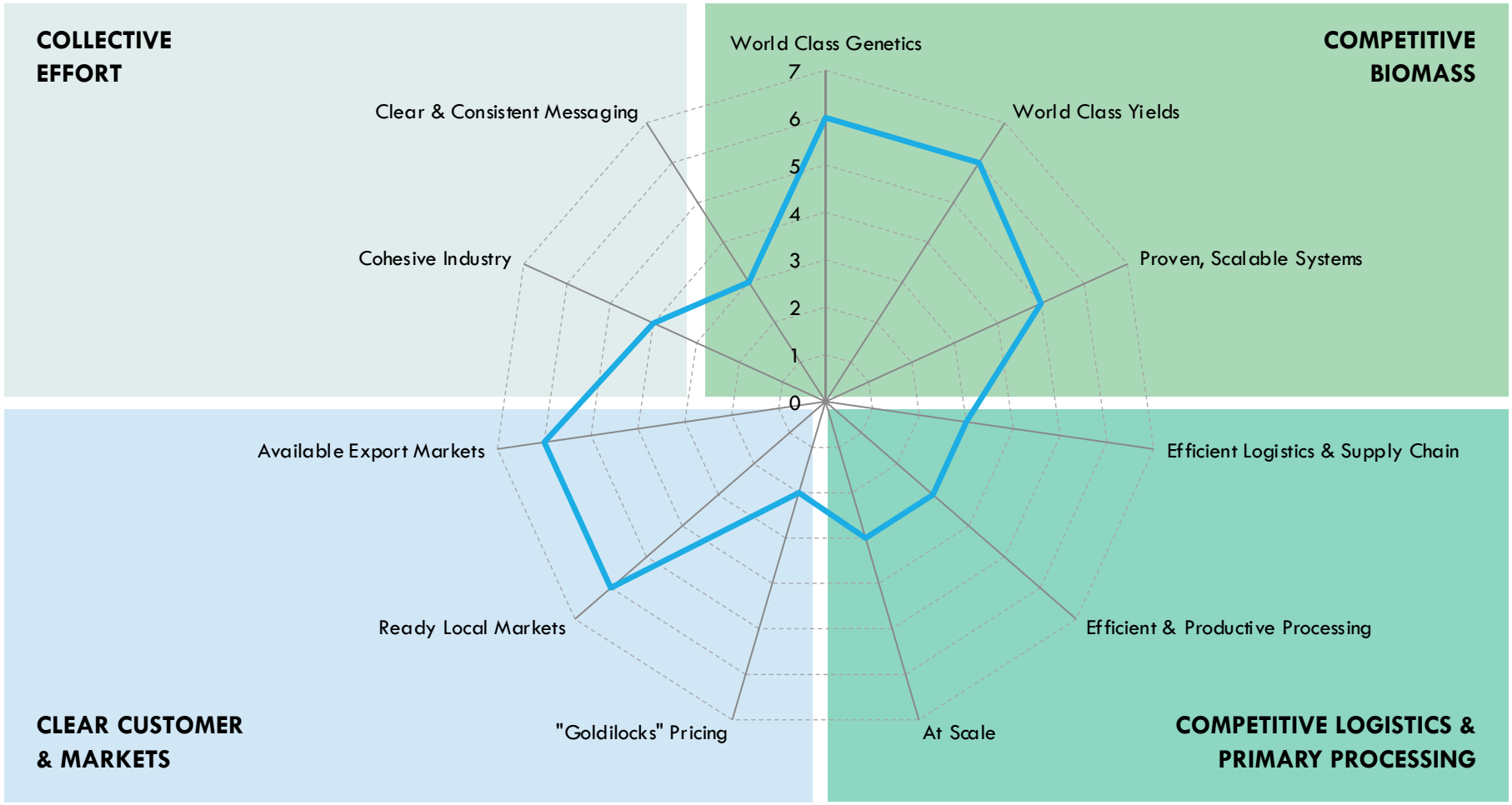
- Strong group of successful pioneering firms with the scale to grow the industry
- Futurity Bio Ventures developed a Bio-resin for wood products

- Strong consumer demand for sustainable building and construction materials

- Substitutes steel and concrete for wood products
- Large volumes of wood products imported

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

What is the sustainability of the feedstock?

- How do we guarantee access to the feedstock? Other markets will compete for the easily available and convertible feedstock (e.g paper products, hog fuel/biofuel, animal bedding)
- Increased domestic wood production will produce increased feedstock

How risky is the political environment?

- Is the political climate likely to change in the mid-term making the sector risky
- How is pricing, emissions trading scheme and subsidies likely to effect the sector
- How will overseas markets respond to supply constraints (n particular subsidised markets)

How do we keep costs under control?

- The residue from milling currently has a market, a pressure on supply will impact price
- Reconstituted wood manufacturing locations have dropped from 24 in 2000 to 21 in 2022, but employment has increased
- Wood products are heavy and have challenges with supply chains and logistics
- Cheaper imports are difficult to compete with

What do we do about the glues is there an alternative?

- Many of the glues and resins used in production of the veneered and laminated products are fossil fuel based
- Does the available supplier have a cost effective supply of bio-resins?

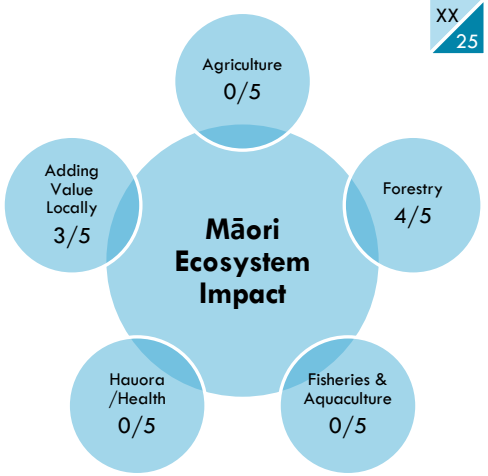
Source: Coriolis analysis

Reconstituted Wood

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?

XX/25



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

XX/20

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆ ☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆ ☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Likely to resonate with Māori landowners which are largely focused on forestry. Possibility to identify the opportunity for a new product derived from forestry activities.
- However, need to compete with imports and production costs are high. May be hard to see a compelling Māori industry response to this product.
- Regional job development, regional economy and opportunity will resonate with Māori sector. Value add returns / multiple income streams form forestry activity also potentially lifts forest rentals (significant amount of Māori economy is as landlord to forestry enterprises).
- Potential to drive industry response via existing collectives in forestry sector.
- Māori investors will be wanting to know true viability / commerciality of this sector after many decades of trying and failing to deliver value-added wood products.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆ ☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆ ☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆ ☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆ ☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**60/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

New Zealand continues to build a successful reconstituted wood sector based on renewable and sustainable feedstocks replacing existing high emissions materials and chemicals to supply domestic users

1 INVESTING IN **FEEDSTOCK FEASIBILITY STUDIES**

- Research into volumes, and locations of wood available
- Sustainability of production and supply
- What alternative species are available?
- Forestry slash recovery

2 INVESTING IN **PRODUCTION TECHNOLOGIES**

- R&D into lowering production costs
- R&D into increasing efficiency of production

3 INVESTING IN **SUPPLY CHAIN AND LOGISTICS**

- Infrastructure and logistics required for transportation, storage and handling facilities across the supply chain, including forestry slash

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

VENEER, PLYWOOD & ENGINEERED WOOD MNFG.

TOTAL SCORE 34/50

INTERNATIONAL STANDARD CODES

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

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]

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

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

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

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

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

This platform suggests further growth is possible in using industrial logs to produce engineered wood products, veneer and plywood

WHY DO WE CARE?

SITUATION

- New Zealand has a large forestry sector and produces a lot of wood products
- A total of 36m m^3 of logs were produced in NZ*
  - 22m m^3 were exported (predominantly industrial grade)
  - 14.2m m^3 of logs were processed in NZ

COMPLICATION

- New Zealand currently imports a significant amount of processed wood products
- Imports are increasing, domestic price or quality is not in line due to challenges with domestic supply
- The construction industry is responsible for ~15% of New Zealand's emissions
- Current building construction uses steel and concrete which produce significantly higher emissions than wood products (albeit steel can be recycled)

RESOLUTION

- Veneer and plywood products add value to New Zealand wood and help support the shift to a sustainable bioeconomy
- New Zealand can reduce emissions in the construction sector by displacing high emitting materials with wood products
- The Forestry Transformation Plan highlights that if 50% of the current steel and concrete construction is replaced with timber construction, the wood processing sector would require an additional 1.3m m^3 of logs to make into high-value engineered wood products

** Wood measured as cubic metre (m^3) of wood under bark in 2022*

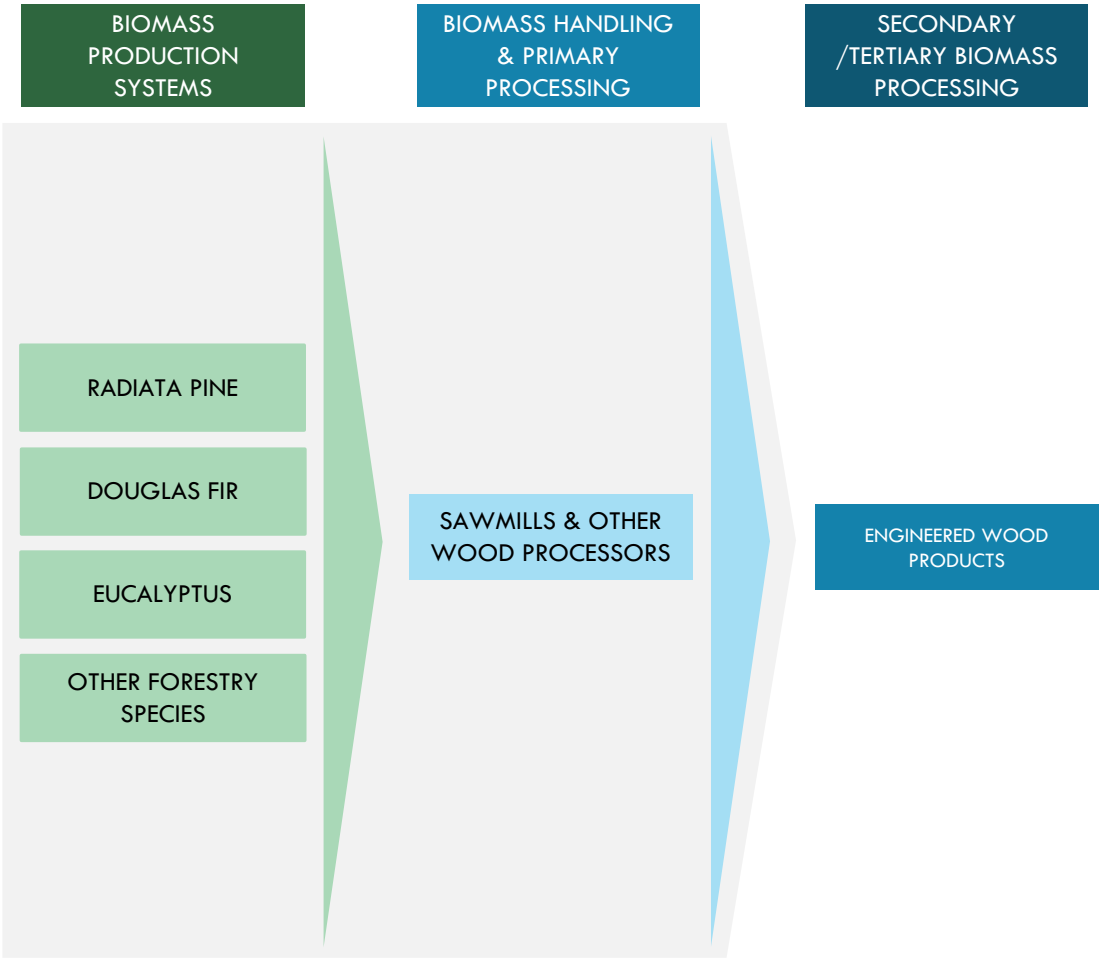
This platform uses industrial forestry logs to produce engineered wood for construction

WHAT IS IT?

Image credit: Wikimedia Public Domain; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Engineered wood products manufacturers are closely linked to their key suppliers of raw materials

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Engineered wood is in line with the desired direction for the bioeconomy in particular reducing emissions

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Additional logs required to increase supply of wood for construction material
2 **INCREASING VALUE-ADDED**	- Potential to add value to existing industrial logs (currently a significant volume exported)
3 **BUILDING RESILIENCE**	- Employment and industry created in the regions in growing and processing - Increases social and economic capital
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Localised production and co-location of facilities reduces need for long distance transport - Enhances environmental capital
5 **REPLACING FOSSIL FUELS**	- Replacing concrete and steel for wood in construction significantly reduces emissions and the use of fossil fuels - Biobased solid energy replaces fossil fuel based energy at production sites - Opportunity to develop bio-based glues and resins for laminating
6 **RETHINKING WASTE**	- Processing residues onsite into solid fuel energy - New systems design creates less waste

Veneers and engineered construction timbers production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Raw material inputs sustainable and renewable
Glue sources converted to bioglues and resins

Efficient production
Potential to design full circular economy thinking in new production
Eco-design and innovation
Carbon locked into construction material

Residues waste can be used for biofuels on-site
Wood can be reused (product has long lifespan)

Modern plant and equipment
Renewable energy use
Raw material and production in close proximity – co-located
Bio-based glues

Potential for reuse

Reduced distribution distances with co-location
Potential for alternative sources of energy in distribution

Encouraging co-product development

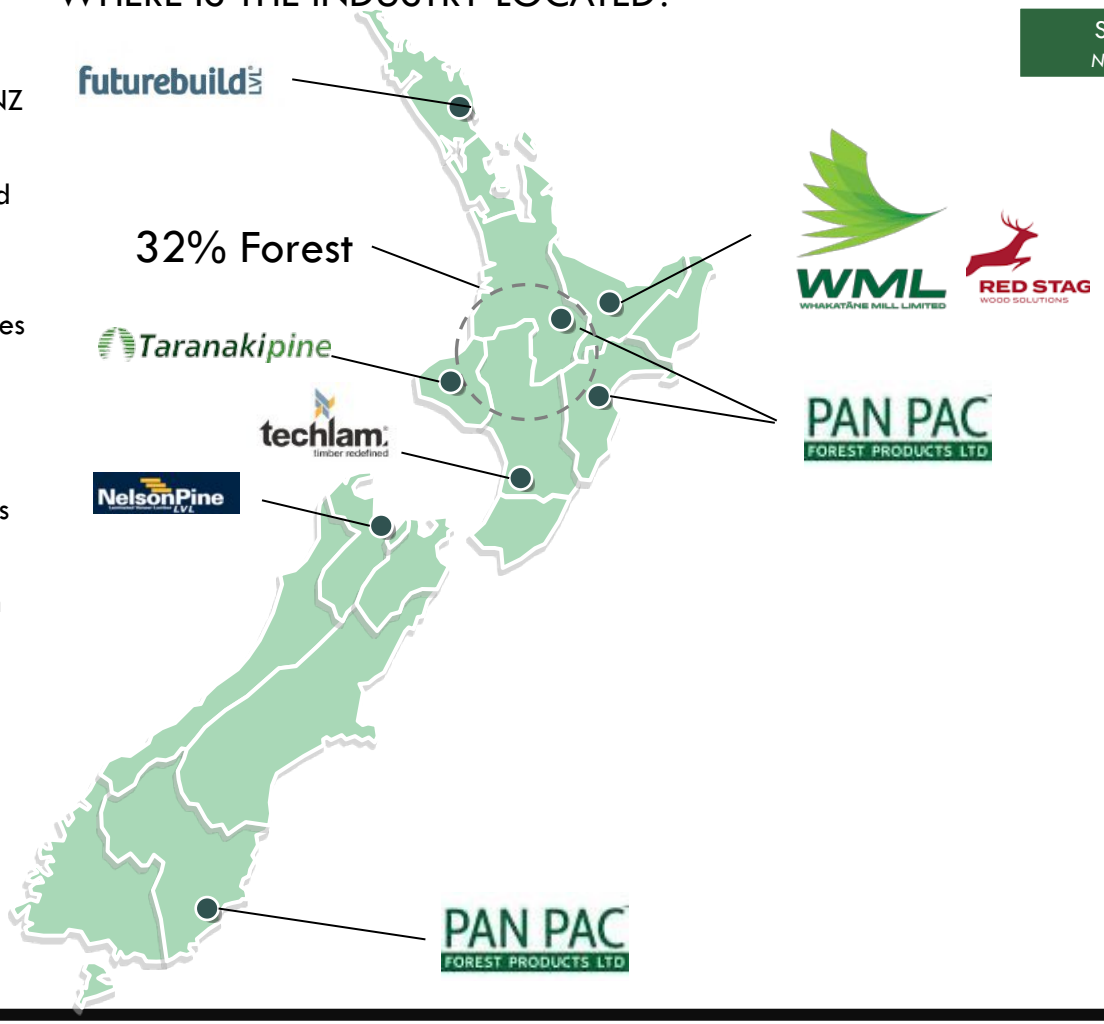
Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Forestry assets and mills and wood manufacturers are located across New Zealand

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- There are approximately 90 sawmills in NZ
- Sawmills generally supply secondary processors who then make the engineered wood (e.g. cross laminated timber, Glue Laminated Timber) and other products
- There are 15 veneer and plywood facilities across NZ
- There are 21 reconstituted wood product manufacturing facilities across NZ
- There are four major paper and pulp mills in NZ (shown)
- There are two major CLT manufacturers in NZ, Red Stag (acquired TimberLab Solutions in 2022) and Taranakipine (Woodspan)
- PanPac owned by Oji (Japan), wood capacity 530,000m3/yr
- Future Build, Juken NZ, Nelson Pine Industries, CHH, and Taranakipine all produce LVL at their mills



SELECT FIRMS
Not a complete list

NOTE: Select firms only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

INDUSTRY ORGANISATIONS

- A range of organisations support firms growing, processing and researching wood products

UNIVERSITIES / RESEARCH

- Canterbury University offers a forestry degree

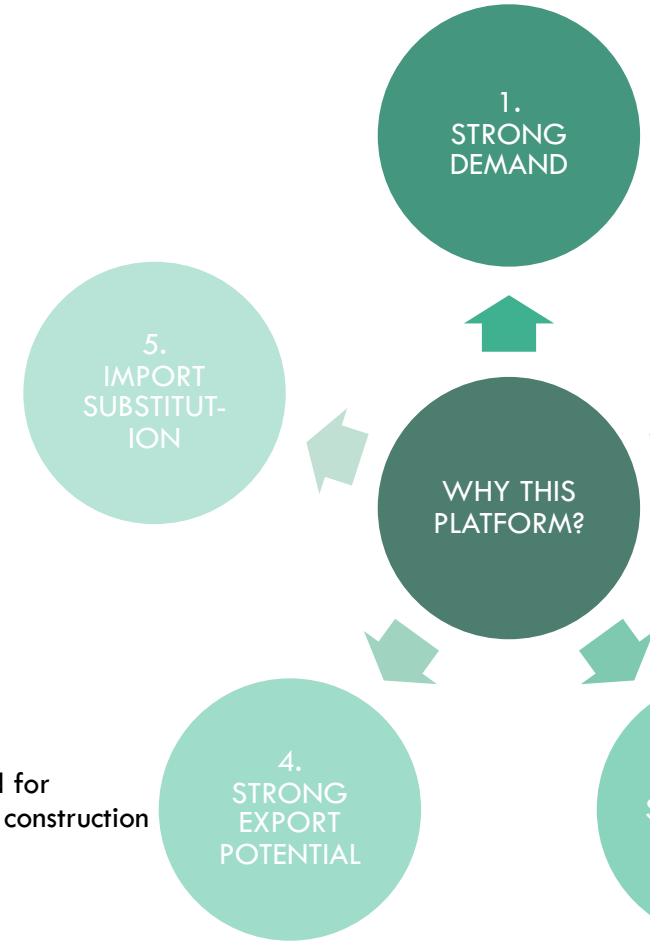
GOVERNMENT / CRI'S

- Crown Research Institutes
- Scion research around improving usability of woody residue
- EECA leads funding programmes

Source: various company and organisation websites; Coriolis analysis

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- On-going demand for locally produced construction material
- Government regulation driving reduction in construction emissions
- Solid growth in demand for houses and apartments

- Capability in developing and building with veneers and engineered wood

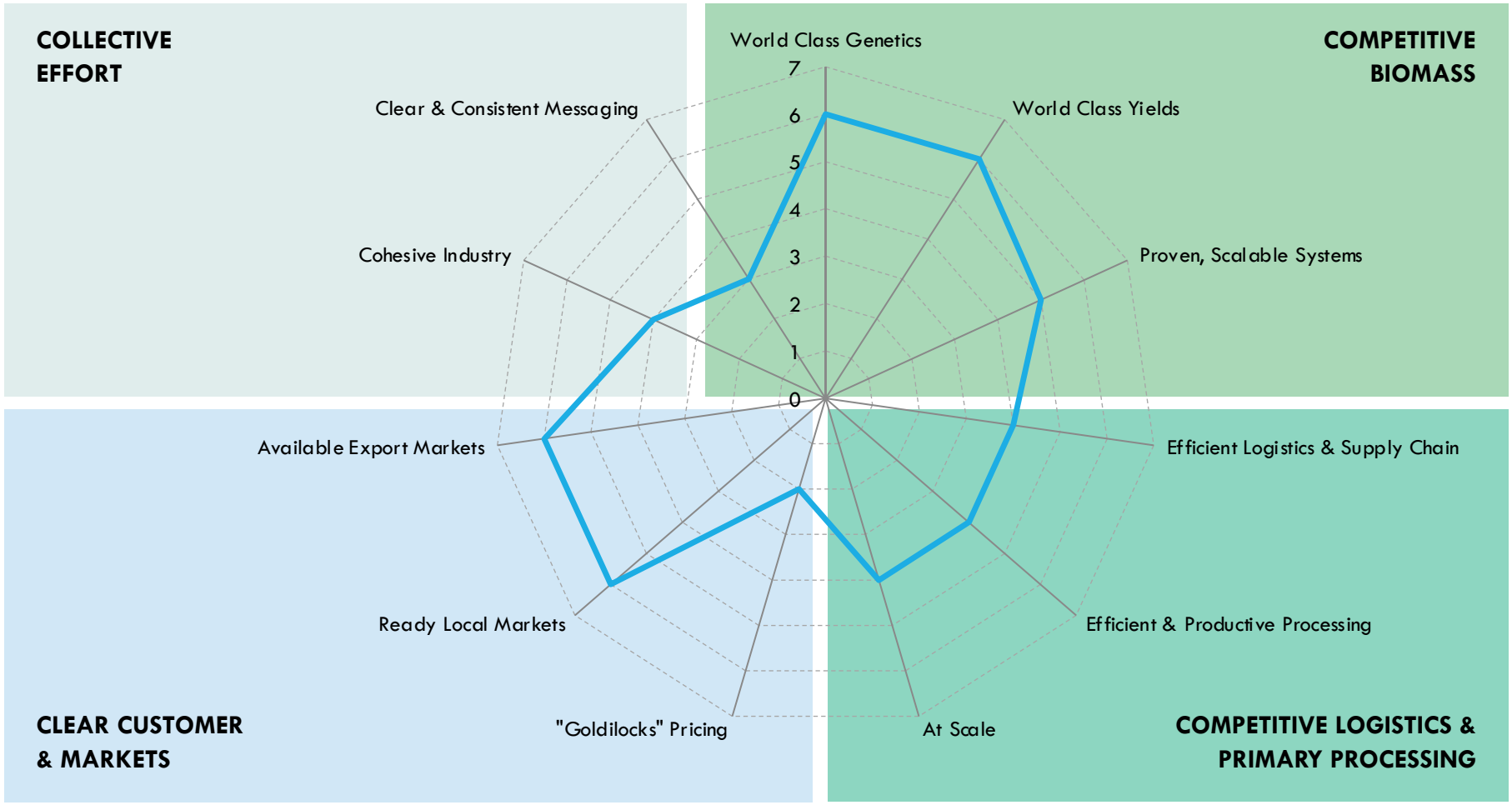
- Strong group of successful pioneering firms (e.g. Scion)

- Strong consumer demand for sustainable building and construction materials

- Substitutes steel and concrete for wood products
- Large volumes of wood products and steel imported

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

What is the sustainability of the feedstock?

- How do we guarantee access to the feedstock? Other markets will compete for the easily available and convertible feedstock (e.g exports)

How risky is the political environment?

- Is the political climate likely to change in the mid-term making the sector risky
- How is pricing, emissions trading scheme and subsidies likely to effect the sector

How do we keep costs under control?

- Plywood & veneer locations have dropped from 33 in 2000 to 15 in 2022, is there a problem?
- Wood products are heavy and have challenges with supply chains and logistics
- Cheaper imports are difficult to compete with

What do we do about the glues? Is there an alternative?

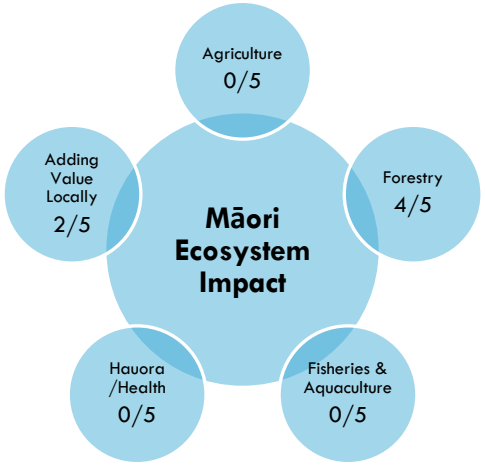
- The glues used in production of veneered and laminated products are currently fossil fuel based

Source: Coriolis analysis

Veneer / Plywood

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR MĀORI, WHAT ARE THE MAIN CONSIDERATIONS?:

- Likely to resonate with Māori landowners which are largely focused on forestry. Possibility to identify the opportunity for a new product derived from forestry activities.
- Building construction sector is of interest to Māori and a number over the years have looked at investing into manufacturing plants utilising overseas technology
- Regional job development, regional economy and opportunity will resonate with Māori sector. Value add returns / multiple income streams form forestry activity also potentially lifts forest rentals (significant amount of Māori economy is as landlord to forestry enterprises).
- Potential to drive industry response via existing collectives in forestry sector.
- Māori investors will be wanting to know true viability / commerciality of this sector after many decades of trying and failing to deliver value-added wood products.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆ ☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆ ☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**60/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

New Zealand builds a successful engineered wood sector based on renewable and sustainable feedstocks replacing existing high emissions materials to supply domestic users

1 INVESTING IN **FEEDSTOCK FEASIBILITY STUDIES**

- Research into volumes, and locations of wood available
- Sustainability of production and supply
- What alternative species are available?

2 INVESTING IN **PRODUCTION TECHNOLOGIES**

- R&D into lowering production costs
- R&D into increasing efficiency of production

3 INVESTING IN **SUPPLY CHAIN AND LOGISTICS**

- Infrastructure and logistics required for transportation, storage and handling facilities across the supply chain

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

NATURAL HOME INSULATION

TOTAL SCORE 36/50

INTERNATIONAL STANDARD CODES

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

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.

NZ INDUSTRY METRICS

Not currently formally defined by ANZSIC or measured by StatisticsNZ.

Likely spread across at least two existing classifications given above.

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.

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

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

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

This platform scales up natural insulation production using wool, hemp and potentially other domestically produced biomass

WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- New Zealand is currently exporting large but falling quantities of raw, greasy wool, primarily to China - An interesting group of firms have emerged and begun producing natural insulation products targeted at premium customers	- Existing insulation solutions work and are price competitive	- New Zealand turns its wool (and hemp) into a natural insulation product targeting high value customers at home and in key export markets willing to pay a premium

Conceptually, this platform uses hemp and wool to produce bio-insulation for the construction and building sector

WHAT IS THE CONCEPT?

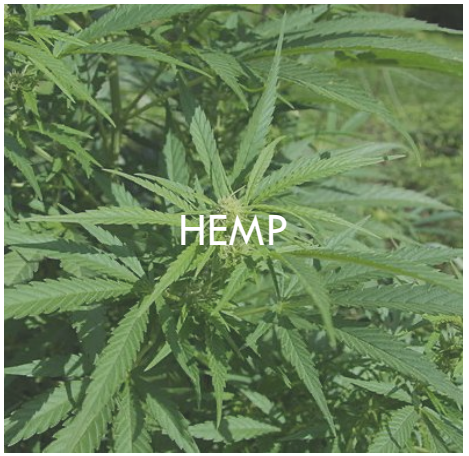
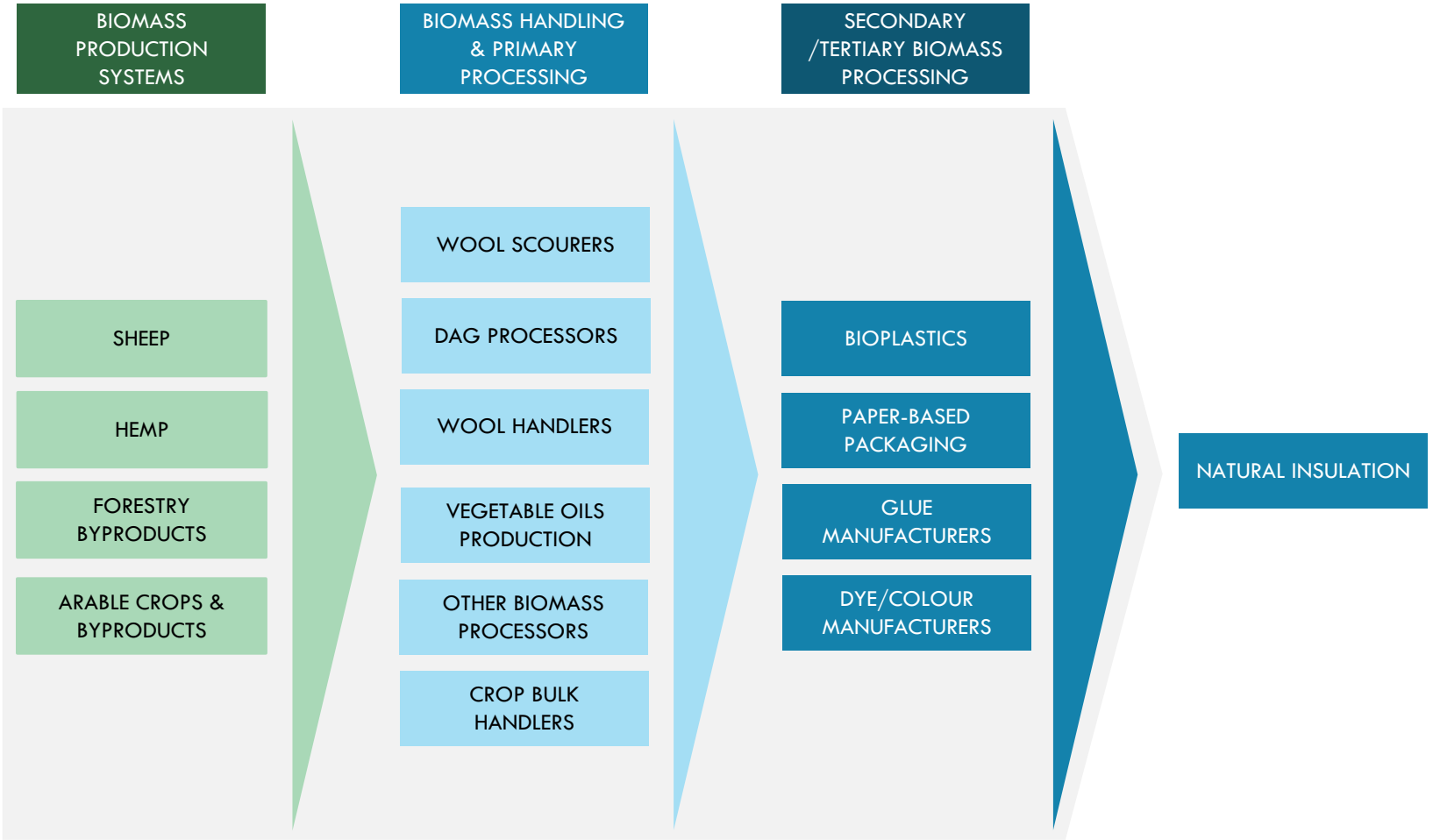


Photo credit: Wikimedia CCA 3.0; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Natural insulation products have current and potential linkages into parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Bio-insulation produces a range of products

WHAT CAN YOU DO WITH IT?

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Bio-insulation (hemp and wool) is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Utilising a New Zealand biomass - Full biomass utilisation in New Zealand
2 **INCREASING VALUE-ADDED**	- Adding value to often low value strong wool products - Adding value to "dags"
3 **BUILDING RESILIENCE**	- Creates new product currently imported - Creates employment and industry in the regions - Provides additional options for strong wool sector - Higher wages available, skilled labour
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Reduces overall emissions by providing an effective insulation against heat transfer - Lower carbon footprint than alternatives (e.g. fibreglass)
5 **REPLACING FOSSIL FUELS**	- Opportunity to replace fossil fuels in production and vehicles with low carbon alternatives - Opportunity to replace fossil fuels on farm (soil amendments vs fertilisers) as part of a organic or regenerative farm strategy
6 **RETHINKING WASTE**	- Circular principles part of the production system or business model - Wool insulation derived from 'waste' streams - Processing byproducts and waste streams into high value products and fibres

NOTE: See Industrial Hemp platform

Hemp and wool can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Plant based inputs vs fossil fuel based
Potential for alternative energy use on farm
Wool currently derived from low value streams

Low packaging/kg product design
Recyclable/biodegradable packaging
Efficient production

Encouraging recycling/composting
Coproducts used for bioenergy feedstock
Residual waste used for soil health
Can be reused and easily composted

Modern plant and equipment
Renewable energy use
Farmers co-located by processors

Reverse supply chain from major users

Reduced distribution distances
Opportunity to replace fossil fuels in production and vehicles with low carbon alternatives

Able to reuse wool and hemp products
Off cuts able to move back into system

Image credit: European Parliament; NOTE: See Industrial Hemp platform; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Bio-insulation and construction materials suppliers and firms are located across New Zealand

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- Hemp is suited to temperate climates with reasonable rainfall, this suits most of New Zealand
- Hemp is grown across New Zealand
- Sheep farms and wool facilities are also located across the country

PLANET PROTECTOR PACKAGING

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

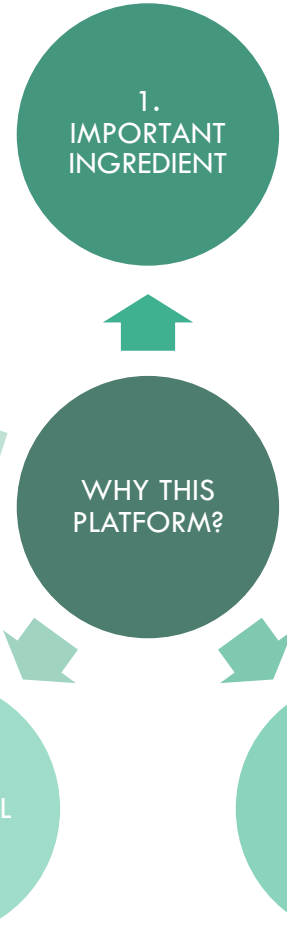
WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS	INDUSTRY ORGANISATIONS	UNIVERSITIES / RESEARCH	GOVERNMENT / CRI'S
FEDERATED FARMERS OF NEW ZEALAND (INC) WOOL IMPACT NZ	NZHIA Food. Fibre. Health. HBA NZ BIOTECH NEW ZEALAND THE NEW ZEALAND INSTITUTE OF FOOD SCIENCE & TECHNOLOGY INC	UNIVERSITY OF OTAGO VICTORIA UNIVERSITY OF WELLINGTON TE HERENGA WAKA LINCOLN UNIVERSITY MASSEY UNIVERSITY Riddet Institute FAR	Ministry for Primary Industries Manatū Ahu Matua Plant & Food Research agresearch E/S/R Science for Communities
- A range of organisations support the primary industries	- A range of organisations support firms that use these products	- A wide range of NZ Universities are researching topics within this platform	- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety) - Crown Research Institutes - Significant funding projects for the strong wool industry

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM?



- Strong demand for sustainable construction material

- Large number of building materials, including bio-insulation are imported into New Zealand

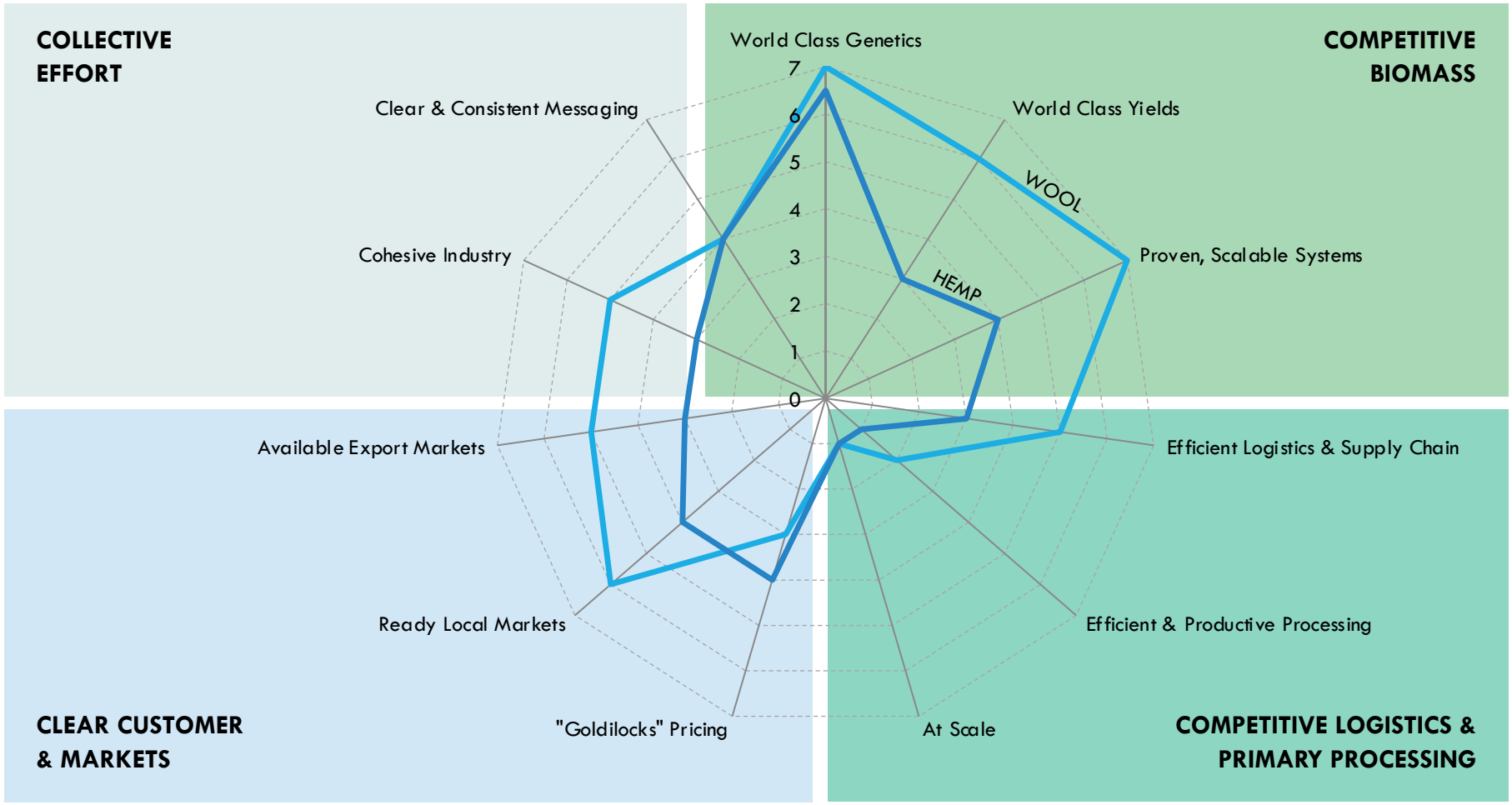
- Demonstrated capability to grow hemp in New Zealand
- Demonstrated capability in the wool sector
- Core capability in particular, in the regions

- Strong group of successful pioneering firms (e.g. HempNZ, Terra Lana)

- Large number of uses for the full biomass (key products and co-products)
- Valuable adjacent products

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

How can bio-materials compete with existing products?

- Is there a new technology or situation that makes this industry more viable in New Zealand?
- What will it take to reduce the cost of bio-insulation?

Why hasn't it worked in the past? What has changed?

- New Zealand needs to develop efficient systems and processes
- Education required for consumers, manufacturers and regulators

How will New Zealand overcome the distances to markets (heavy products)?

- How will the industry develop to ensure supply chains are as efficient and short as possible?
- Generally construction material is bulky and heavy

Are bio-insulation products from wool and hemp known by architects and builders?

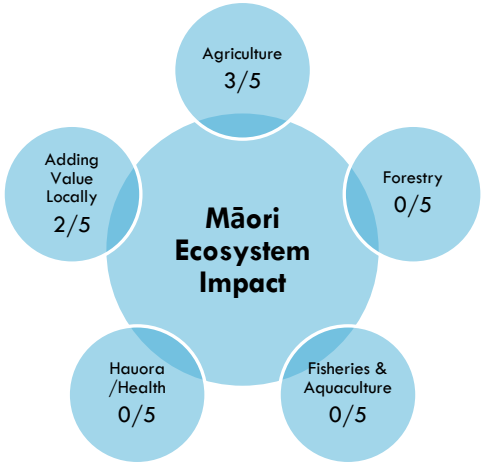
- How do you get the word out to architects and builders around the benefits of natural insulation?
- Can the positive story and benefits override the higher cost?
- Develop a lifecycle analysis to consider the environmental impact of products over time

Source: Coriolis analysis

Natural Insulation

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Very few players – unknown sector in the Māori economy.
- Māori landowners are largely focused on forestry, horticultural and farming and are the largest group of pastoral farmers in New Zealand. Sheep faming forms a significant part of that sector.
- Leverage existing assets in primary sector. Possibility to identify the opportunity for a new product derived from wool (mainly) or hemp.
- There may be potential for Māori farmers looking for alternative use of their wool.
- There have been a number of experiments in past seeking to utilise natural fibres for construction projects primarily within prototype housing models.
- Māori investors will likely not see the market as large enough for developing scalable returns.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆ ☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆ ☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**45/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

New Zealand turns its wool (and hemp) into a natural insulation product targeting high value customers at home and in key export markets willing to pay a premium

1 INVESTING IN **FARMING SYSTEMS**

- Larger hemp farms with lower costs per tonne
- Implementing the latest in modern systems for hemp
- Experimenting with hemp cultivars and crops
- Requires trials and monitoring

2 INVESTING IN **PROCESSING CAPACITY**

- Expansion of existing operations
- New processing in new regions
- New harvesting and processing equipment that optimises product quality and consistency

3 INVESTING IN DEVELOPING **SPECIALISED PRODUCTS**

- Investing in fully compliant construction materials
- Investing in resources for industry to use for design and council purposes
- Ensure products and processes follow best practice guidelines

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

COSMETICS & TOILETRIES MANUFACTURING

TOTAL SCORE 40/50

INTERNATIONAL STANDARD CODES

ANZSIC	1852
NACE (European Union)	20.42
NAICS (North America)	3256-20

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]

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].

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.

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

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

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

This platform brings together a wide range of New Zealand biomass to create unique natural or bio-cosmetics

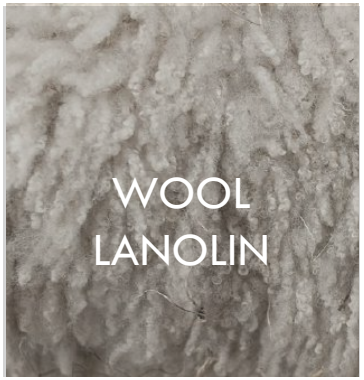
WHY DO WE CARE?

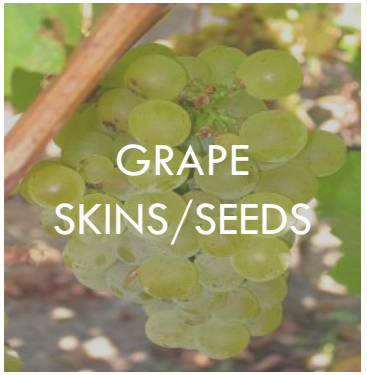
SITUATION	COMPLICATION	RESOLUTION
- Wide range of unique native plants with potential application in cosmetics - Global recognition of mānuka honey as a natural cosmetic ingredient - Largest global supplier of lanolin - Demonstrated ability to penetrate and grow sales into key Asian markets - Passionate and growing group of champions driving growth of NZ sector	- Needed capabilities for large scale export success are outside traditional New Zealander core competency*	- New Zealand has all the required ingredients to continue to build a natural cosmetics industry targeting discerning, high income consumers in major export markets

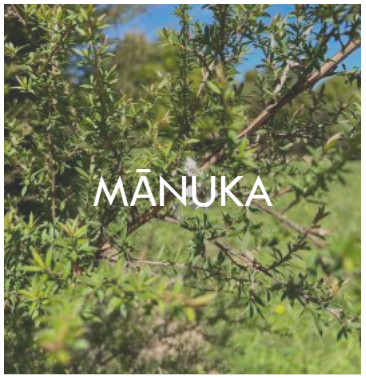
** In other words, we're not that good at high end sales and marketing to brand and image obsessed consumers*

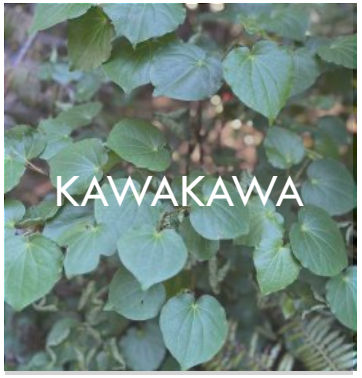
Conceptually, this opportunity uses natural products and ingredients to make cosmetics

WHAT IS THE CONCEPT?







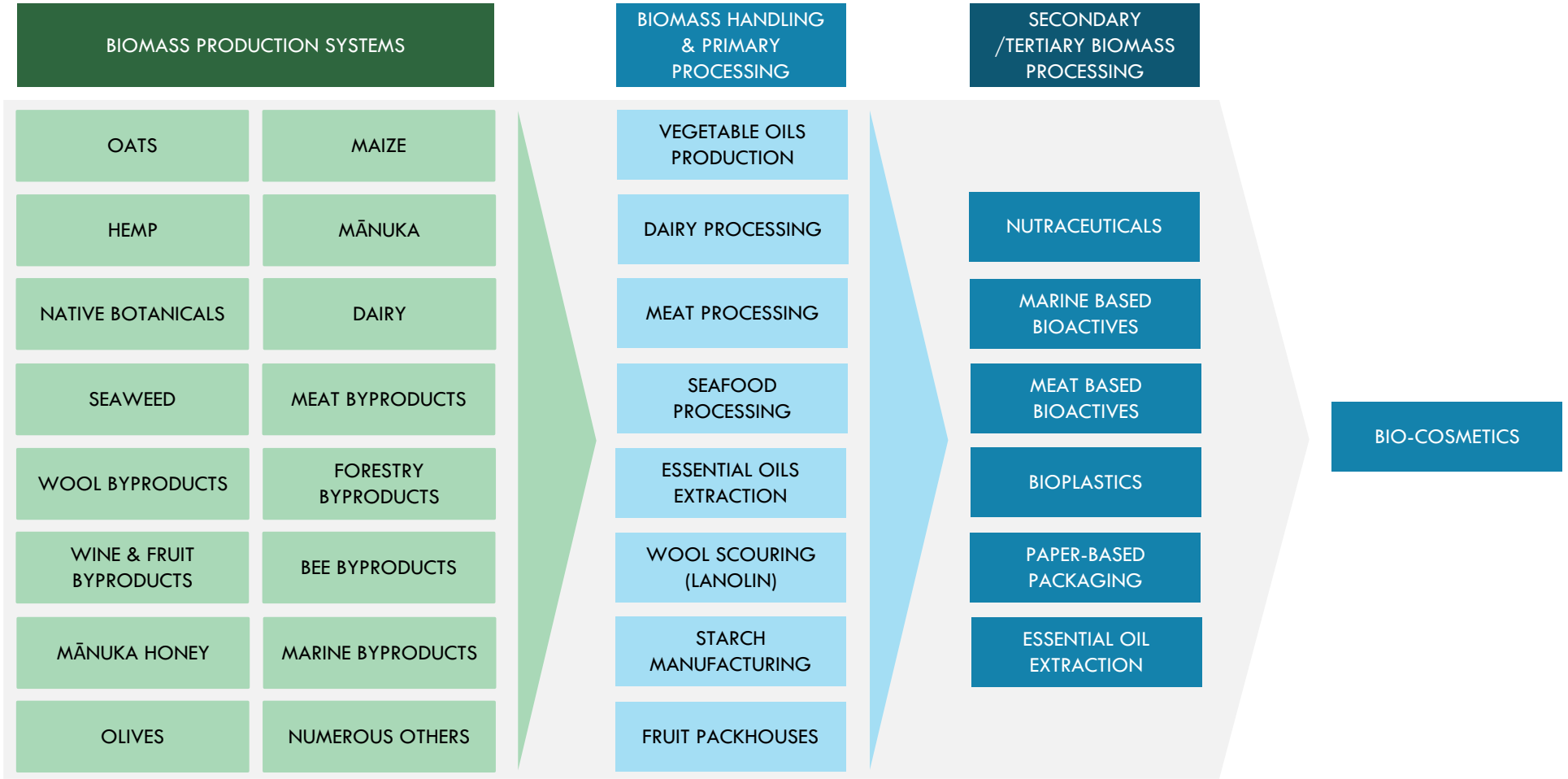


OTHER
BOTANICALS &
SEAWEEDS

Photo credit: Wikimedia CCA 4.0; Wilkinson;fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Biocosmetics has current and potential linkages into large parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



New Zealand biomaterials are a key ingredient in a range of cosmetic formats

WHAT CAN YOU DO WITH IT?

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Biocosmetics production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

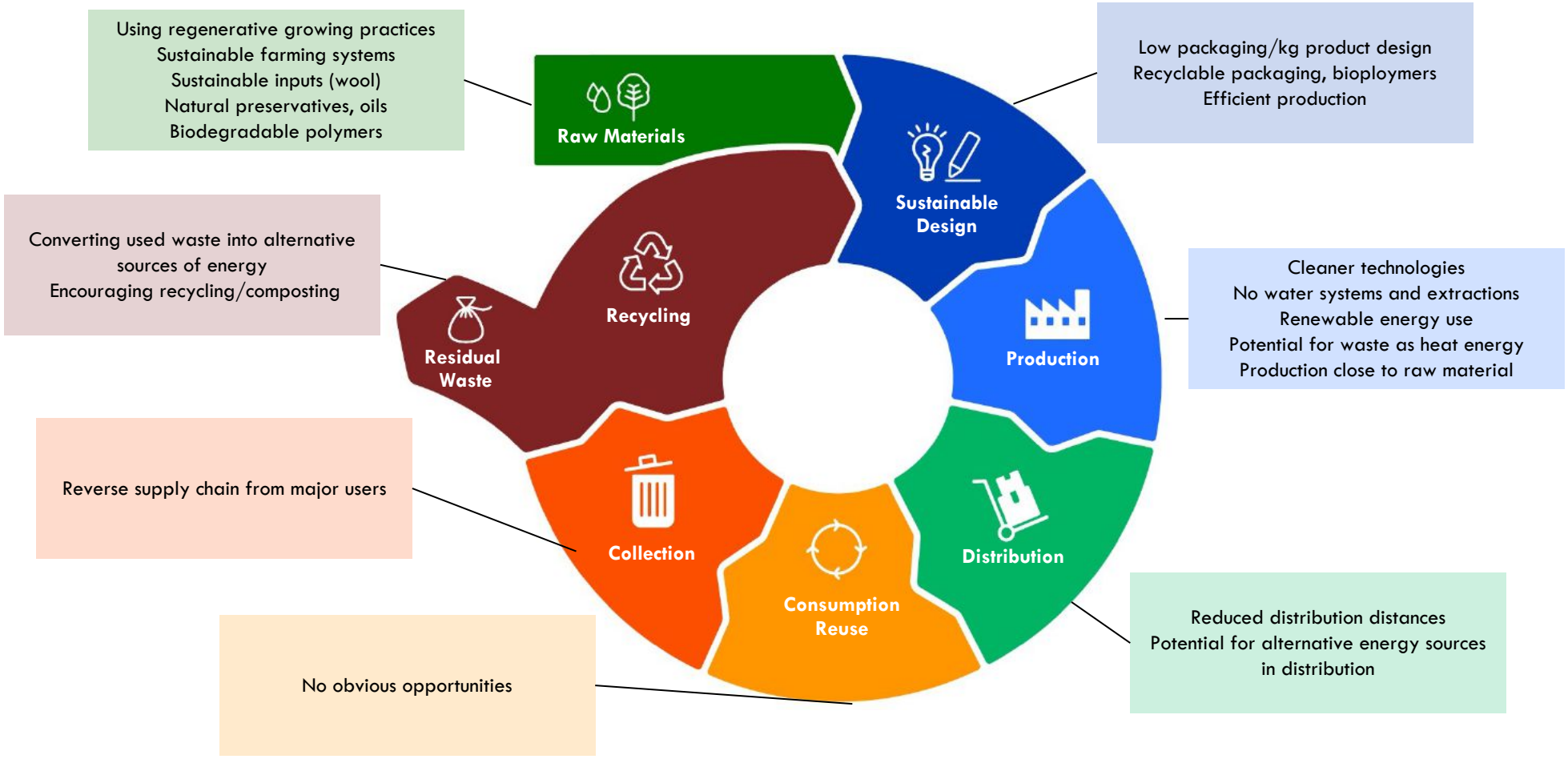


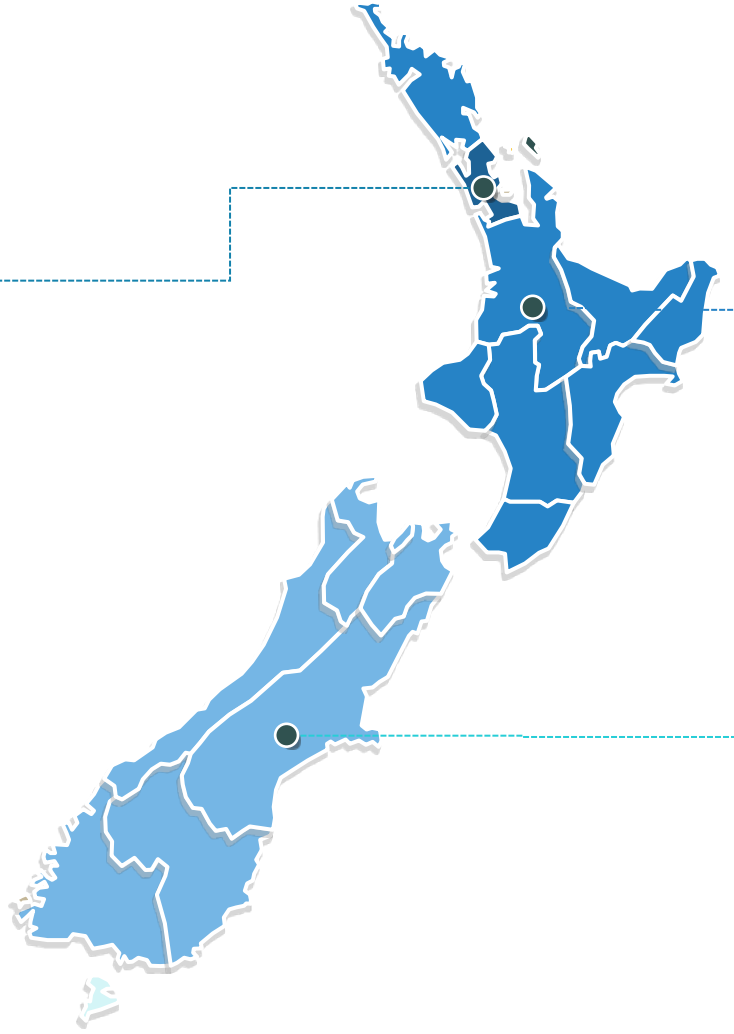
Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Biobased cosmetics are in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Potential new feedstock crops as ingredients in biobased cosmetics (e.g. seaweed)
2 **INCREASING VALUE-ADDED**	- Potential for high value outputs and products (e.g. skin care, lipstick)
3 **BUILDING RESILIENCE**	- Able to farm and produce primary inputs regionally (e.g. seaweed) - Higher wages available, skilled labour - Increased social and economic capital - Creates skills that can be transferred to other sectors
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Replacing high emission systems with low emission systems
5 **REPLACING FOSSIL FUELS**	- New biobased ingredients can replace fossil fuel based ingredients - Potential to use biodegradable/ recyclable plastics or glass - Use of biopolymers in packaging
6 **RETHINKING WASTE**	- Circular principles part of the production system or business model for new operations - Use of byproducts (e.g. forestry waste, grape seeds from wineries) - Reduces potential for harmful ingredients

Leading firms in New Zealand's cosmetics industry are spread across the country



Auckland

trilogy, Phytomed, JYP, raw nature, Pure Ingredients, parrs, Organic Bioactives, essano, āma, Frankie, Nature's Beauty, TOP HEMP, Pauling Industries, ASHLEY &CO, Only Good, beaufeous, aleph, Shieling Laboratories

Other North Island

ANTIPODES, honey lab, LIVING NATURE, NATURAL SOLUTIONS | EAST CAPE MANUKA, Manuka Bioscience, neat, EkoHub, the herb farm, Native Oils, NZnaturally, h, REAL WORLD

Canterbury

Lanocorp, Hallifax, ethique, Essential Oils of New Zealand, ZURMA, MIDLANDS, LAUREN&LOUISE

Other South Island

new zealand extracts limited, Azurlis, 3Bee, SANFORD, Topflite, NUDE KIWI

SELECT FIRMS

NOTE: Select firms only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

INDUSTRY ORGANISATIONS

- A range of organisations support firms that produce the ingredients or the end products

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities are researching topics within this platform

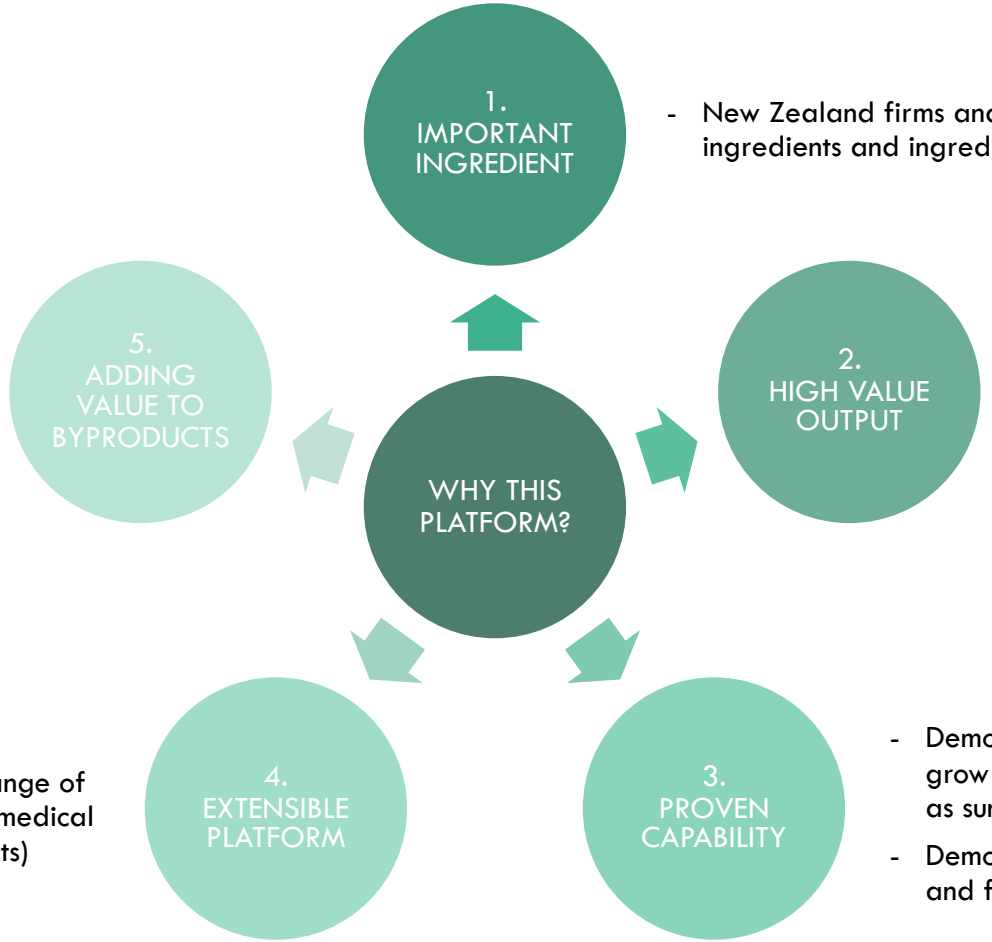
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- New Zealand firms and consumers use a lot of cosmetics ingredients and ingredients products

- Cosmetics and beauty products high $/kg
- Higher returns/ha (e.g. Māori landowners farming mānuka vs other landuse)

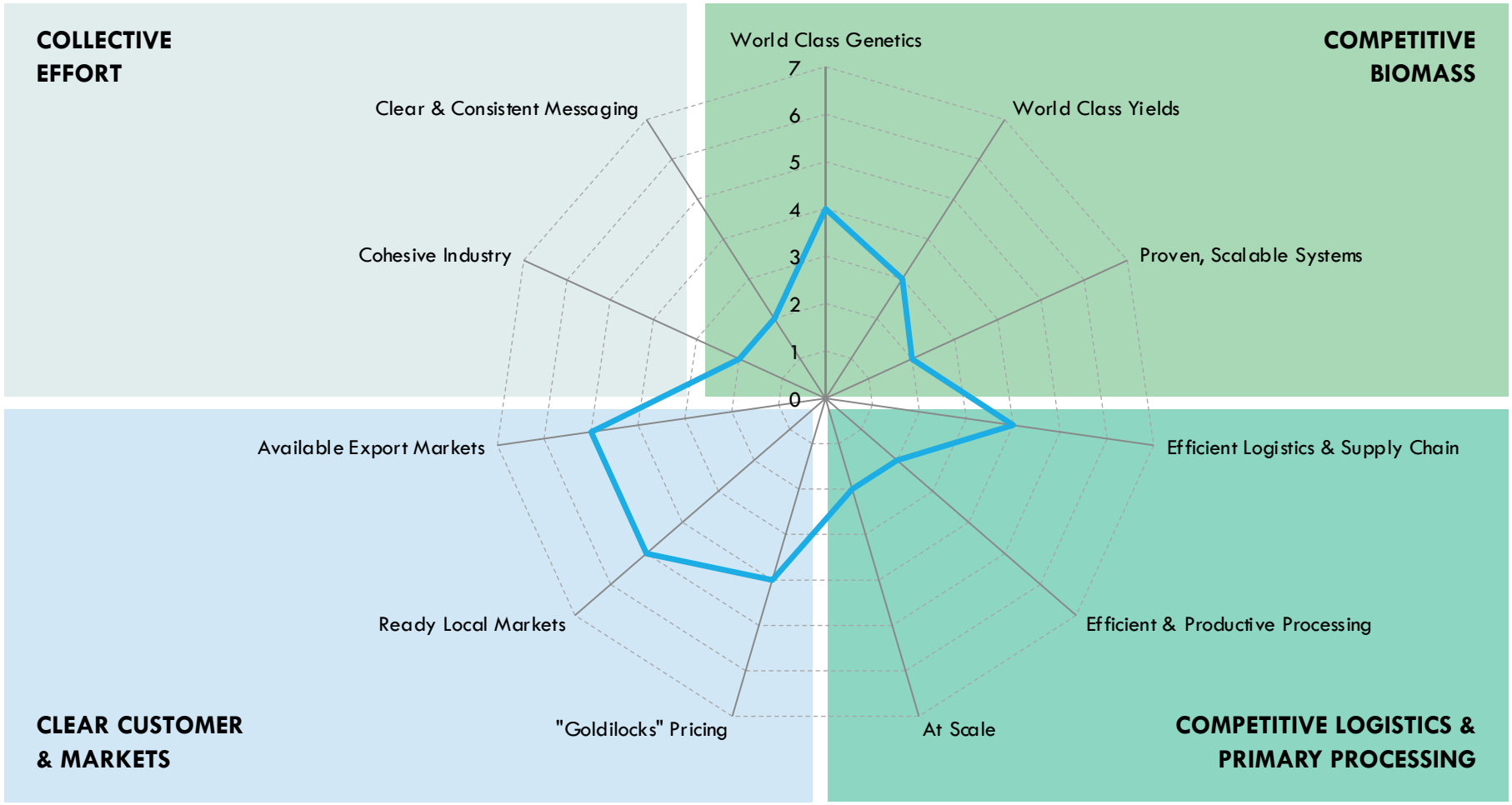
- Demonstrated capability to produce and grow inputs (including the carrier oils such as sunflower, grape) in New Zealand
- Demonstrated ability to extract, refine and formulate products

- Cosmetics have a large range of uses (from functional and medical benefits to beauty products)

- Adding value to sheep wool lanolin
- Adding value to produce processing (e.g. grapes, kiwifruit)

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

How do we ensure sustainable sourcing?

- Sustainability and ethical sourcing vital part of biocosmetics ingredients
- Do the companies understand the processing of ingredients to ensure integrity?
- What is the story behind the ingredients?

How will you enter a mature global market with firms already at scale?

- New Zealand ability to compete internationally dependent on developing efficient or unique production systems and premium positioning
- Difficult to compete with cheap imports

Why you? Why NZ? What is your unique selling proposition?

- How will the sector stand out and succeed?
- Is there commercial demand for premium ingredients and brands
- What are efficacy claims to the inputs? What is the scientific evidence, are there any clinical trials?

Can New Zealand succeed in high tech extraction and production?

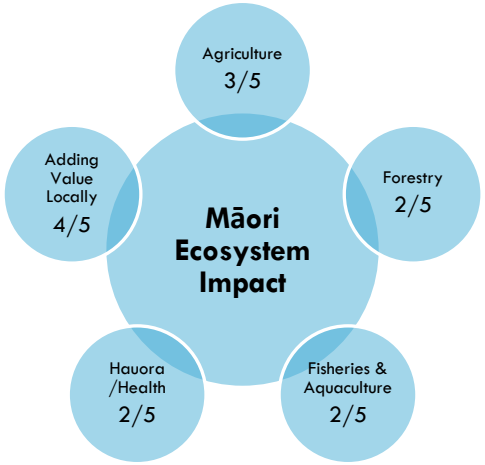
- New Zealand is reasonably new to bioextraction and production
- Can firms get up to speed and excel
- Do we know some of the key ingredients and their functionality in cosmetics, across multiple applications, that will make a material impact?

Source: Coriolis analysis

Cosmetics and Toiletries Manufacturing / Biocosmetics

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆☆☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆☆☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆☆
IS THE RISK MANAGEABLE?	☆☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Brand potential – use of native/indigenous botanicals resonates for brand Māori
- Industry resonates with te Ao Māori , Rongoa and Mātauranga – Natural balms and oils
- Leverage existing assets/distribution/retails in primary sector – easy to diversify
- Cultural narrative and traditional knowledge in cosmetics, ritual based practises – traditional relationships in botanicals and perfume
- Difficult to compete in well-established industry – over saturated market – need to differentiate
- Likely to be challenges to secure sufficient set of biomass for native botanicals
- There have been some modern attempts at Māori perfumes and cosmetics by various collectives.
- Māori investors will need to be convinced that there is sufficient leverage or other competitive advantage in this sector.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆☆☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆☆☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆☆☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**72/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted to capture the "green" biocosmetics sector

WHERE IS INVESTMENT REQUIRED?

VISION	New Zealand has all the required ingredients to continue to build a natural cosmetics industry targeting discerning, high income consumers in major export markets

1 INVESTING IN SCALING-UP PRODUCTION SYSTEMS

- Implementing the latest in modern systems for new ingredients

2 INVESTING IN CLEAN PROCESSING CAPACITY

- New processing incorporating low energy, low waste systems
- Ensuring best practice in production

3 INVESTING IN DEVELOPING SPECIALISED PRODUCTS

- R&D into potential fractionates and extracts
- Research into potential claims
- NPD around product and packaging (low/no water)
- Research into new products

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

ESSENTIAL OILS MANUFACTURING/DISTILLING

TOTAL SCORE 39/50

INTERNATIONAL STANDARD CODES

ANZSIC [CATCH-ALL CODE]	1899
NACE (European Union)	20.53
NAICS (North America)	3259-98 (part)

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]

NZ INDUSTRY METRICS

No data available.

Classified in wide ranging "other" category (1899 Other Basic Chemical Product Manufacturing Not Elsewhere Classified).

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.

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

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

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

This platform scales up essential oil production from local biomass to supply a wide range of further processors

WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- There is large and growing global demand for essential oils, particularly unique flavours and fragrances - New Zealand has a unique range of native plant species not available else where	- New Zealand currently produces very little essential oil from its biological wealth	- New Zealand growers and producers need to wake up to the incredible opportunity presented by essential oils made from unique New Zealand flora

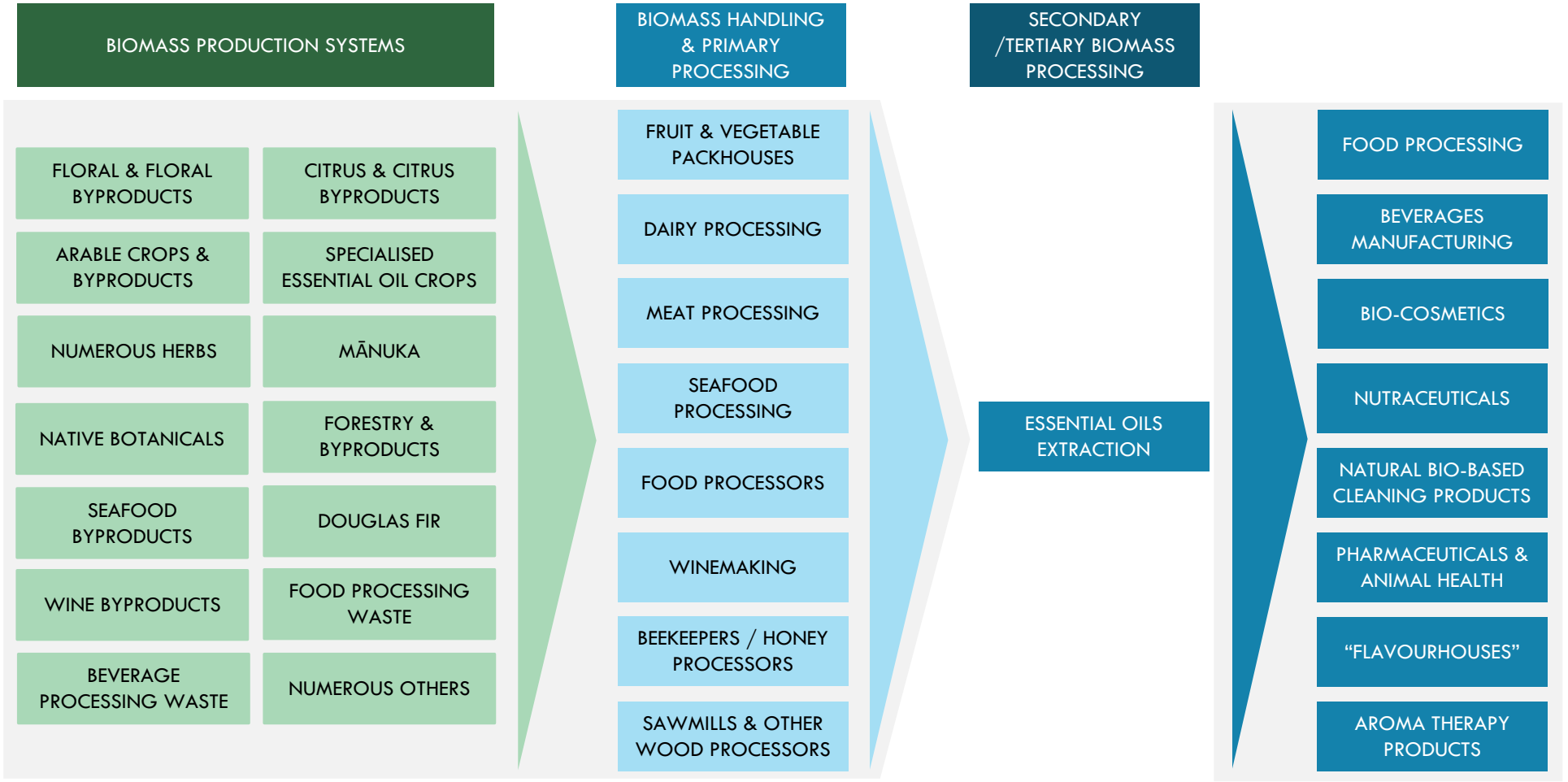
Conceptually, this opportunity extracts the oils from leaves and flowers to make essential oils for the food, household, cosmetics and health sectors

WHAT IS THE CONCEPT?

Photo credit: Wilkinson; Wikimedia CCA4.0; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Essential oils are a critical middle step to a wide range of platforms in the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



New Zealand biomaterials are a key ingredient in a range of essential oils (often blended or added to a carrier oil)

WHAT CAN YOU DO WITH IT?

AROMATHERAPY

AIR FRESHENER
AROMA THERAPY

COSMETICS

CANDLES

MEDICINAL OIL

SKIN HEALTH
(antimicrobial)

PERFUME

FOOD
INGREDIENT

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Essential oils is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 INCREASING BIOMASS	- Potential feedstock crops achieve high biomass yields - Full biomass utilisation in New Zealand (utilising forestry residue)
2 INCREASING VALUE-ADDED	- Essential oils are a high value output - Essential oils are an ingredient in high value products
3 BUILDING RESILIENCE	- Currently majority of essential oils imported - Creates employment and industry in the regions - Higher wages available, high value jobs and skilled labour
4 REDUCING AGRICULTURAL GHG EMISSIONS	- Farming system is a low emission sustainable system - Farming system low input
5 REPLACING FOSSIL FUELS	- Enhances environmental capital - Opportunity to replace fossil fuels on farm - Opportunity to replace fossil fuels in production and processing
6 RETHINKING WASTE	- Multiple uses for co-products and by-products (potential to use on-site as biofuel) - New systems design creates less waste - Processing byproducts and waste streams into high value products - Use of other sector's byproducts (e.g. forestry waste, grape seeds)

Essential oil production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

High yields
Using regenerative practices
Sustainable farming systems
Potential for alternative energy farm vehicles
Sustainable inputs (wilding pines)

Low packaging/kg product design
Recyclable packaging
Efficient production

Converting used waste into alternative sources of energy (e.g. fibre into biopellets)
Forestry waste extracted to pine oil
Encouraging recycling/composting

Modern plant and equipment
Renewable energy use
Potential for waste as heat energy
Production close to raw material

Reverse supply chain from major users

Reduced distribution distances in particular if industries co-located
Potential for alternative energy sources in distribution

No obvious opportunities

Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Essential oils firms are located across New Zealand

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- Firms range from single product specialists (i.e wilding pines, mānuka, Douglas Fir, Taramea) to a range of products imported and/or grown locally and extracted

NOTE: Select firms only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- A range of organisations support the primary sectors

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use these products

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities are researching topics within this platform

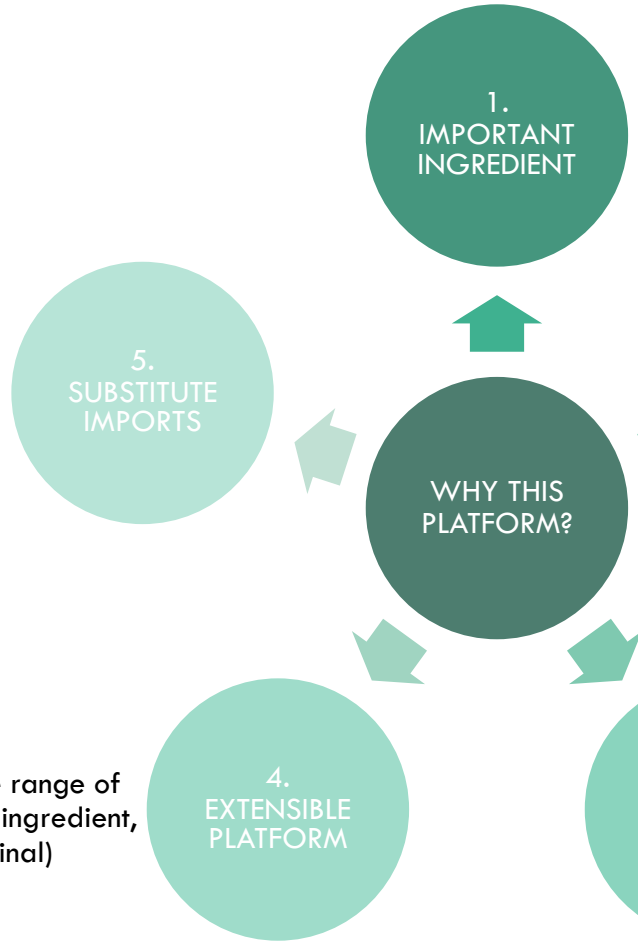
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- New Zealand firms and consumers use a lot of essential oils
- A critical ingredient in many products and exports

- High $/kg product
- Higher returns/ha (e.g. Māori landowners farming mānuka vs other landuse)

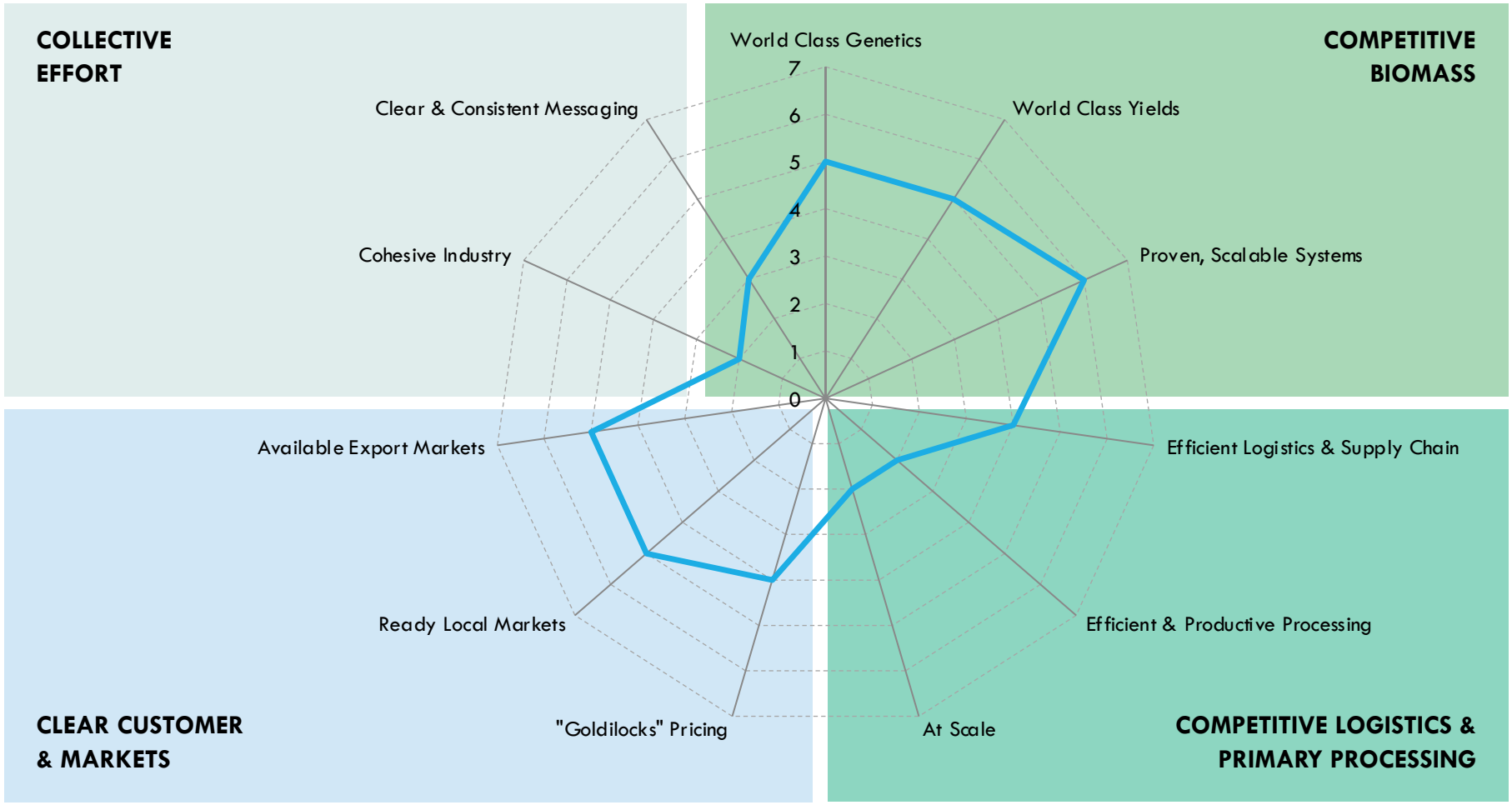
- Demonstrated capability to grow essential oil inputs (including the carriers) in New Zealand
- Demonstrated ability to extract and refine oils

- Essential oils have a large range of uses (food and beverage ingredient, perfume, cosmetics, medicinal)

- Large volumes imported

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

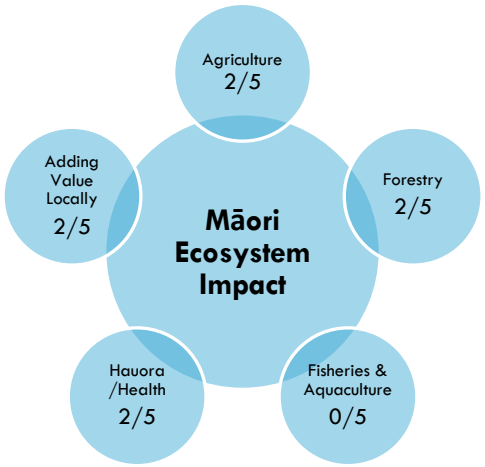
How will New Zealand mānuka compete with Australia tea tree?	How will you enter a mature global market with firms already at scale?	Why you? Why NZ? What is your unique selling proposition?	What are the therapeutic claims?
- Is there a new technology or research that makes this industry more viable or valuable?	- New Zealand cannot compete with this group without high productivity, better farming systems, very high levels of mechanisation and a premium positioning - Difficult to compete with cheap imports	- How will the sector stand out and succeed? - Is there commercial demand for premium essential oils (especially unique unknown ones)	- Can all the claims being made be validated? If not then how or why can we win?

Source: Coriolis analysis

Essential Oils Manufacturing / Distilling

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆ ☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Essential oils align with interests in mātauranga Māori and traditional medicines. There may be some theoretical Intellectual Property/Wai262 issues for individual businesses wanting to pursue this.
- Cultural narrative and traditional knowledge – traditional relationships in botanicals and oils. E.g. kānuka essential oil traditionally used by Māori for skin, respiratory and digestive ailments, or Mānuka oil.
- Brand potential – use of native/indigenous botanicals.
- Industry resonates with Brand Māori, Rongoa and Mātauranga. Leverage existing assets in primary sector – easy to diversify.
- Larger opportunities – can be used in cosmetics, perfume, food, etc.
- Difficult to compete in crowded market – need some uniqueness to new product.
- Would be difficult to get specific Māori commercial investors interested unless it was seen as an additional revenue stream to existing operations. Strongest tie-in likely with cosmetics sector.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆ ☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆ ☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆ ☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**55/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

New Zealand growers and producers will wake up to the incredible opportunity presented by essential oils made from unique New Zealand flora

1 INVESTING IN **SCALING-UP FARMING SYSTEMS**

- Larger farms with lower costs per tonne
- Implementing the latest in modern sustainable systems

2 INVESTING IN INCREASING **PROCESSING CAPACITY**

- Expansion of existing operations
- New processing in new regions
- Ensuring best practice in energy efficiency

3 INVESTING IN DEVELOPING **SPECIALISED PRODUCTS**

- R&D into potential fractionates and extracts
- Research into potential health claims
- NPD around product and packaging

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

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

This platform suggests significant further growth is possible in natural household cleaners

WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- Many global consumers are seeking natural household cleaners to ensure their family's health and safety	- Most global cleaners are based on fossil fuel derived chemicals (e.g. from coal tar)	- 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

Conceptually, this opportunity uses bio-based ingredients to replace fossil fuels in cleaning products

WHAT IS THE CONCEPT?

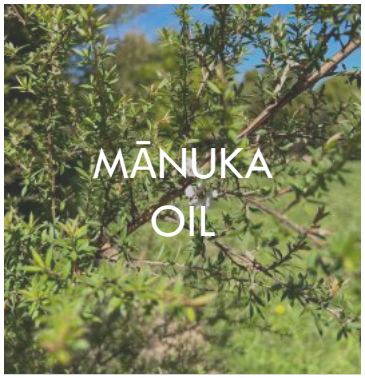
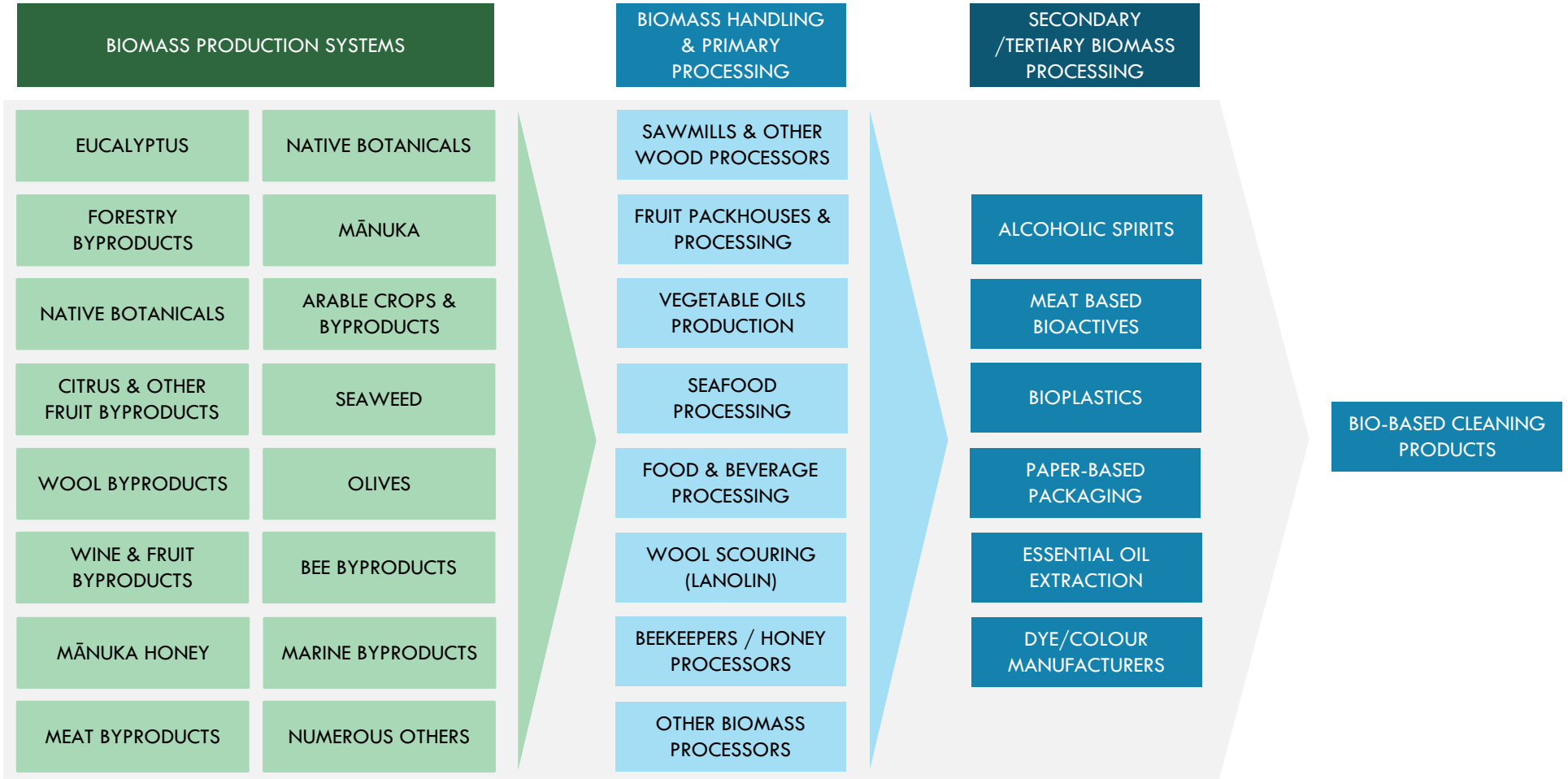


Photo credit: Wikimedia CC ASA 4.0, 3.0; DALL.E; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Natural, bio-based cleaning products have current and potential linkages into large parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Bio-based cleaning products can be applied to most cleaning situations and occasions

WHAT CAN YOU DO WITH IT?

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Bio-based cleaning products are in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Potential new feedstock crops as ingredients in biocleaners
2 **INCREASING VALUE-ADDED**	- Potential for high value outputs
3 **BUILDING RESILIENCE**	- Higher wages available, skilled labour - Increased social and economic capital
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Can support transition to plant systems
5 **REPLACING FOSSIL FUELS**	- Biocleaners can replace fossil fuel ingredients in residential houses and commercial operations - Use biodegradable/recyclable plastics
6 **RETHINKING WASTE**	- Circular principles part of the production system or business model - Reduces potential for pollution of waterways

Bio-based cleaning products can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Replaces chemical/petroleum based inputs as ingredients with plants
Using regenerative practices
Potential for biofuel

Low packaging/kg product design
Recyclable packaging
Efficient production
Refill packaging

Converting byproduct into alternative sources of energy
Encouraging recycling/composting

Modern plant and equipment
Renewable energy use and goals
Potential for field waste as heat energy
Captured CO2 in production^

Reverse supply chain from major users

Reduced packaging sizes
Encouraging container reuse, refill
Concentrates (less/serve)

Potential for alternative energy sources in distribution

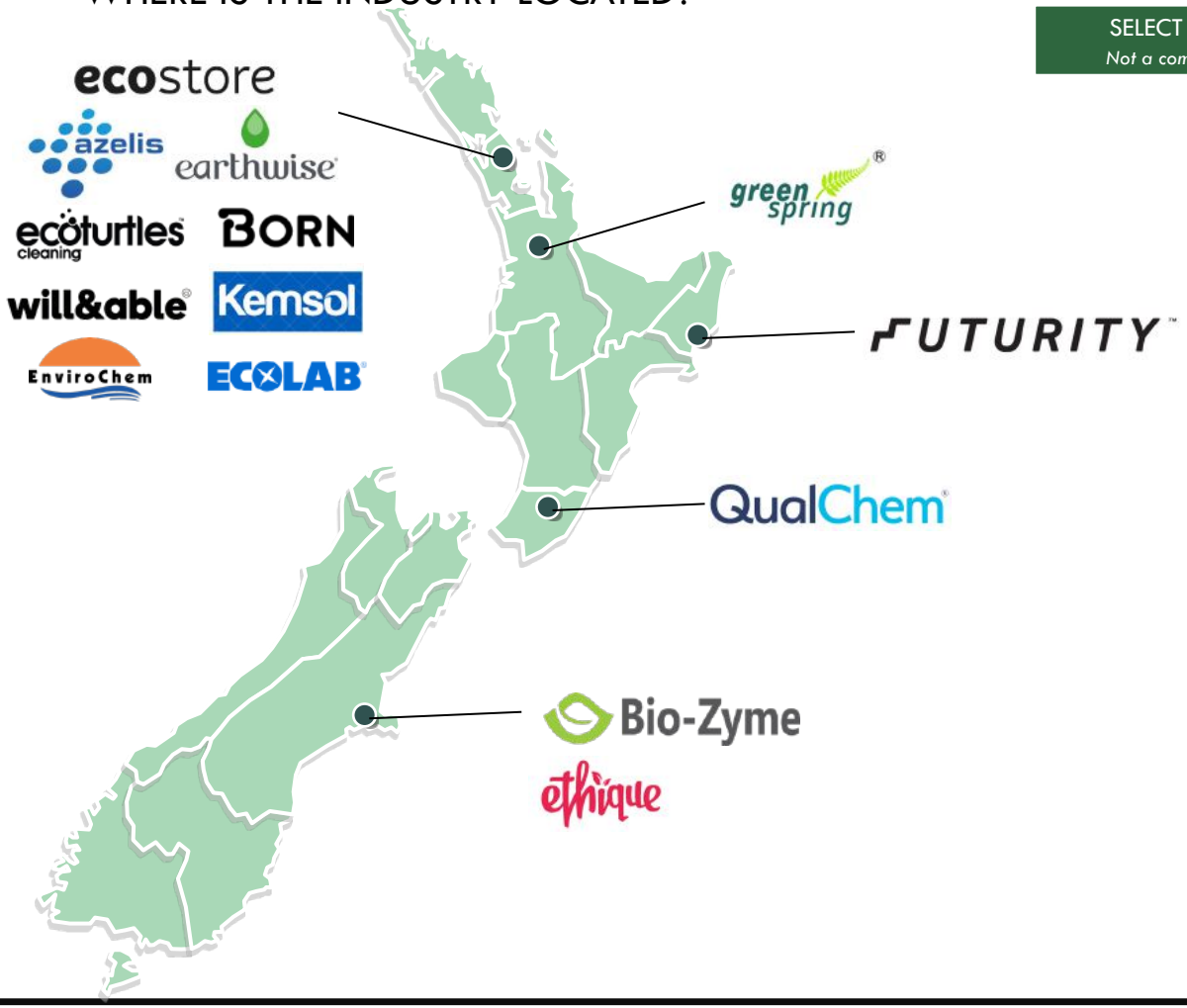
^Capturing CO2 for reuse in production system; Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Formulators and manufacturers are based primarily in Auckland

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- The majority of chemicals and ingredients are imported and used by formulators (e.g. Ecostore)
- The majority of cleaning products are imported as finished products (e.g. Unilever, Sonett, SimpleGreen)
- Azelis is a global manufacturer of ingredients with operations in NZ



NOTE: Select firms only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

INDUSTRY ORGANISATIONS

- A range of organisations support firms that manufacture these products

UNIVERSITIES / RESEARCH

- NZ Universities are researching topics within this platform (e.g. wood lignin used in detergents)

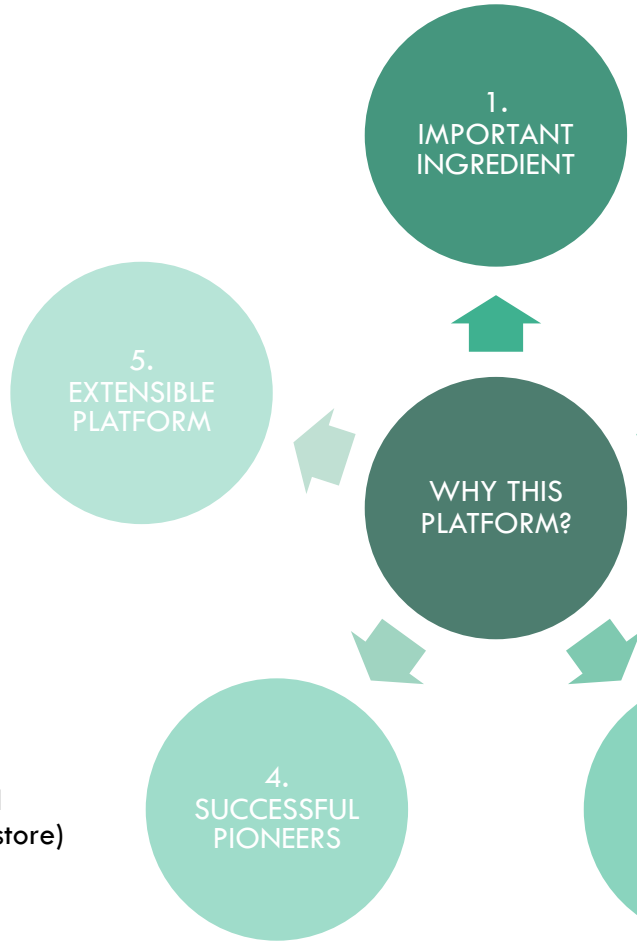
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- Firms and consumers use a lot of cleaning products
- A critical product across multiple sectors (e.g. hospitals)
- Substitute imports

- High value product

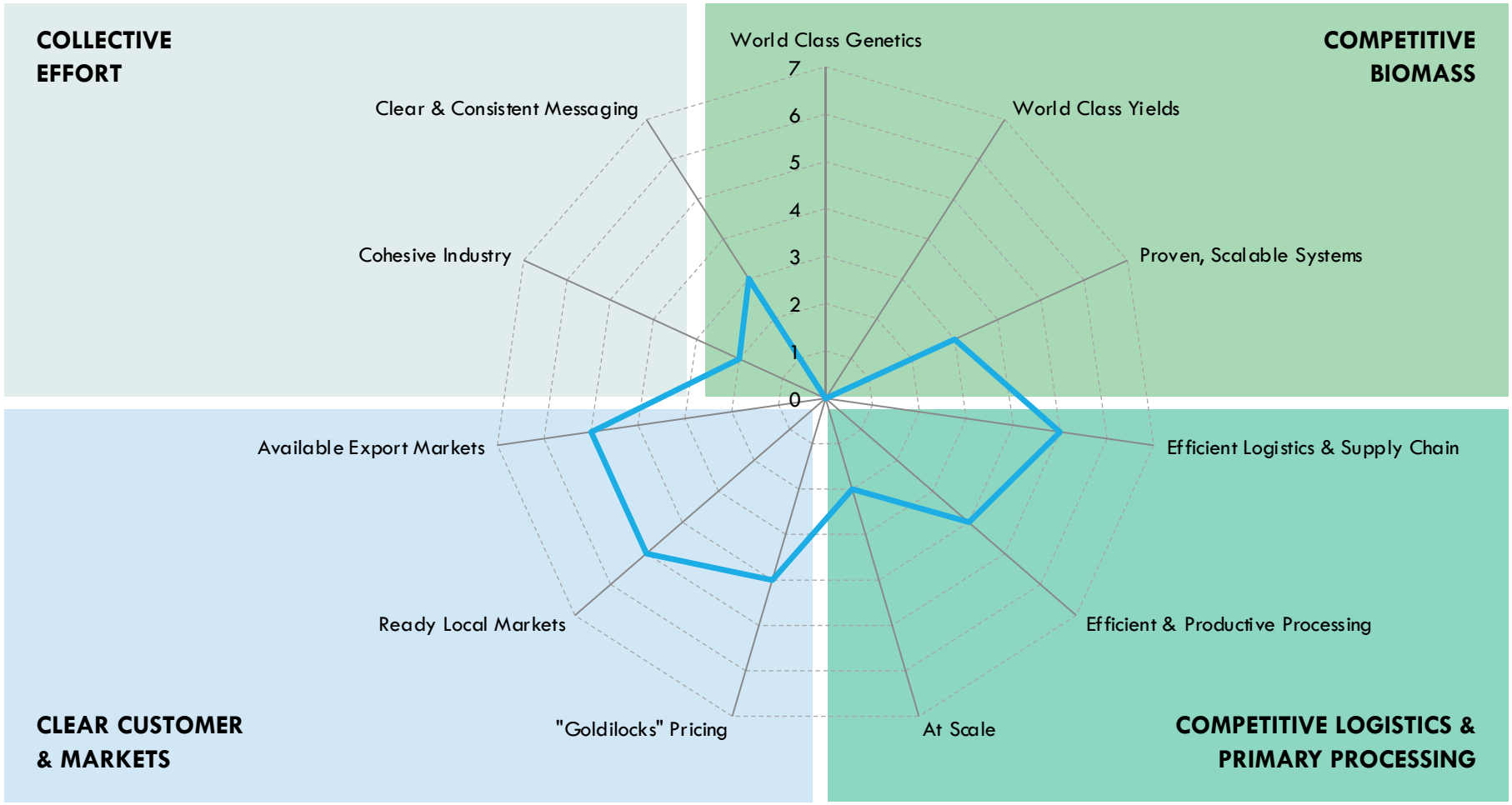
- Demonstrated capability to develop brands in New Zealand
- Demonstrated capability at manufacturing

- Strong group of successful pioneering firms (e.g. Ecostore)

- Bio-cleaning can extend into many cleaning categories and adjacent categories

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

What is the pricing strategy?

- How does the pricing strategy (discount pricing, premium pricing) compare to conventional cleaning products in terms of comparable price?
- Are the products affordable for customers?

Can NZ lead the way in bio-based cleaning products?

- Does NZ have any unique plants as ingredients for bio-based cleaning products
- Does NZ have strength or capability in enzyme production to enhance bio-cleaning products

Why you? Why NZ? What is your unique selling proposition?

- How will the sector stand out and succeed?
- Is there commercial demand for premium biocleaning products

How will NZ compete with global best practice?

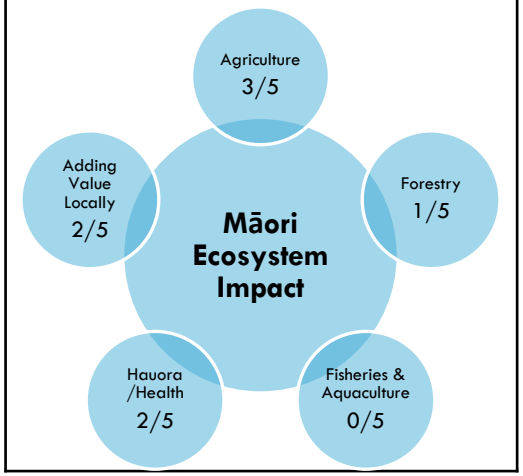
- Significant investment in this space by global leaders (e.g. Unilever €1 billion Clean Future Strategy aims to reduce100% of carbon derived fossil fuel products by 2030)
- EcoLab (US Company) invested US$190m in R&D in 2022

Source: Coriolis analysis

Bio-Based Cleaners

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆ ☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Brand potential – use of native/indigenous botanicals in finished products.
- Potential to leverage existing assets in primary sector – diversified revenue.
- Traditional relationships in botanicals that can be used in finished products. Clean green market proposition resonates with te Ao Māori
- Production costs may be too high and would have to compete with crowded market. Hard to see a compelling Māori industry response to this product.
- Māori investors would likely want to see solid supply agreements in place with revenues before committing.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆ ☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**52 /100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

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

1 INVESTING IN **INGREDIENTS**

- Investment required into low carbon chemistry, biodegradable, renewable and water-efficient formulations

2 INVESTING IN INCREASING **PROCESSING**

- Expansion of existing clean operations
- New processing facilities using new technologies and processing using CO2

3 INVESTING IN DEVELOPING **SPECIALISED PRODUCTS**

- R&D into potential unique extracts, enzymes and biotechnology research
- NPD around product and packaging

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

FATS AND OILS REFINING AND 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 mnfg.
- 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

This platform scales up vegetable oil production using locally produced biomass

WHY DO WE CARE?

SITUATION

- 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

COMPLICATION

- Vegetable oils are a highly competitive global ingredient

RESOLUTION

- Global peers support that New Zealand can have a major vegetable oil industry

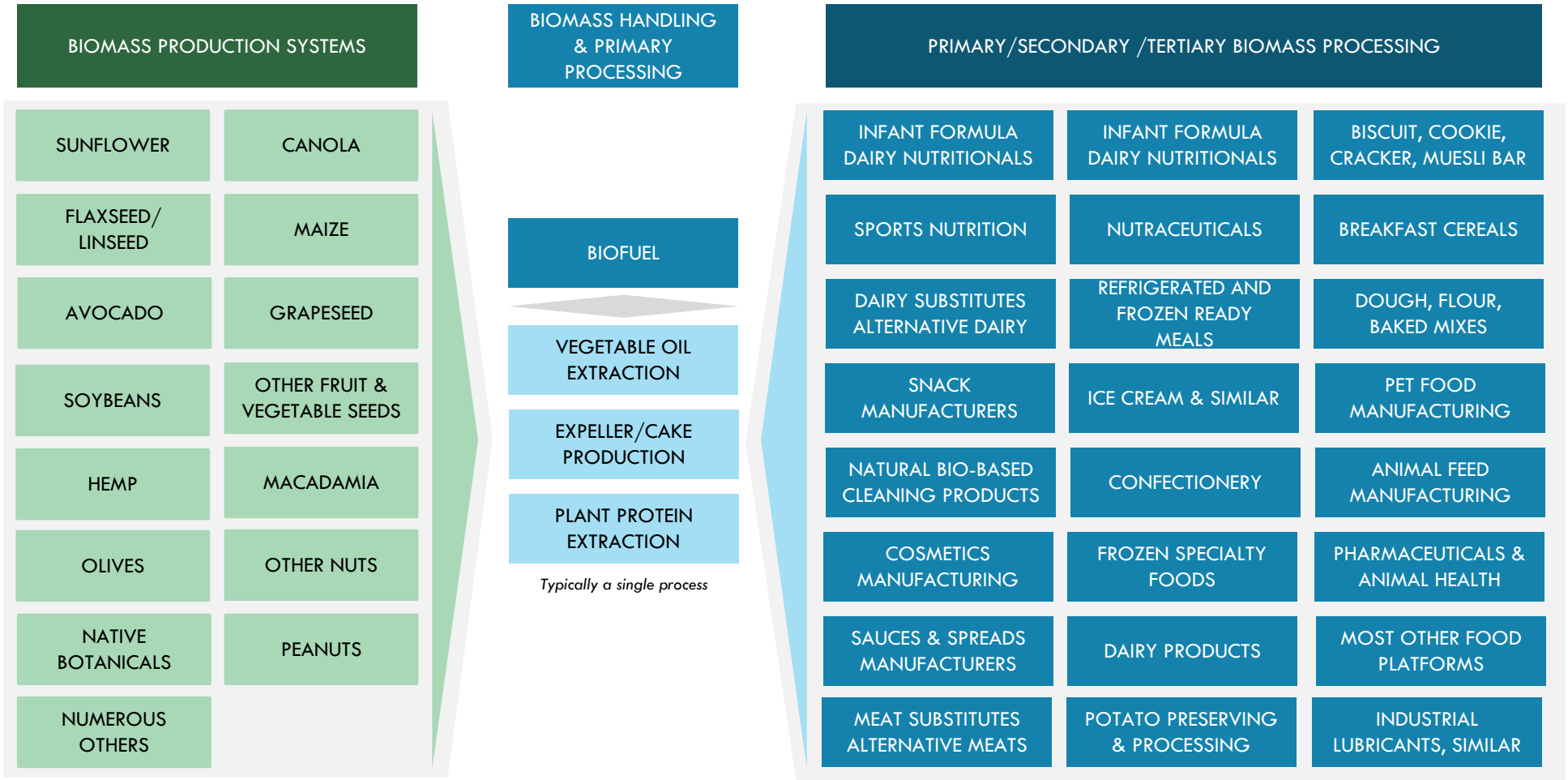
Conceptually, this opportunity extracts vegetable oils (and other useful coproducts) from a range of plants

WHAT IS THE CONCEPT?

Photo credit: Wikimedia CC ASA 4.0 Jmesser5, Rosser1954, Urjuwan Najjar, fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Vegetable oils are a critical middle step to almost every value added food and CPG/FMCG platforms in the bioeconomy (and many beyond)*

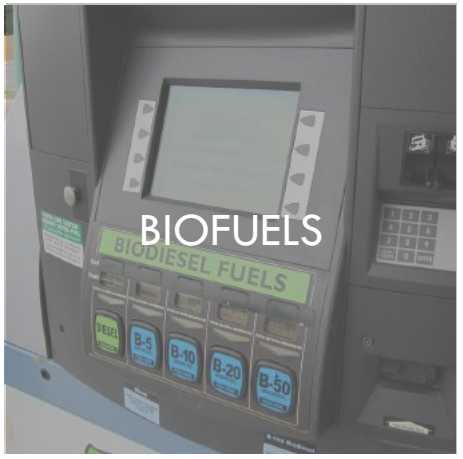
WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



CPG = Consumer Packaged Goods, Fast Moving Consumer Goods

Vegetable oils and coproducts are a key ingredient in a huge range of products

WHAT CAN YOU DO WITH IT?



Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; Biodiesel (United Soybeans; CC-BY-SA 2.0)

Vegetable oil is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Potential feedstock crops achieve high biomass yields - Full biomass utilisation in New Zealand (e.g. oil, meal protein (animal feed, human protein) and other extracts)
2 **INCREASING VALUE-ADDED**	- Potential for high value outputs
3 **BUILDING RESILIENCE**	- Currently a volatile import - Creates employment and industry in the regions (e.g. Canterbury, Otago) - Higher wages available, skilled labour
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Farming system is a low emission sustainable system vs. comparable products (fats and animal)
5 **REPLACING FOSSIL FUELS**	- Vegetable oil use as a potential feed stock for renewable energy - Opportunity to replace fossil fuels on farm (soil amendments vs fertilisers)
6 **RETHINKING WASTE**	- Circular principles part of the production system or business model - Multiple uses for co-products

Vegetable oil production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

High yields
Using regenerative practices
Sustainable farming systems
Potential for alternative energy farm vehicles

Low packaging/kg product design
Recyclable packaging
Efficient production

Converting used oil to biofuel
Encouraging recycling/composting

Modern plant and equipment
Renewable energy use
Potential for field waste as heat energy

Reverse supply chain from major users

Reduced distribution distances in particular if industries co-located
Potential for alternative energy sources in distribution

Reduced serving sizes
Encouraging filtering and reuse

Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

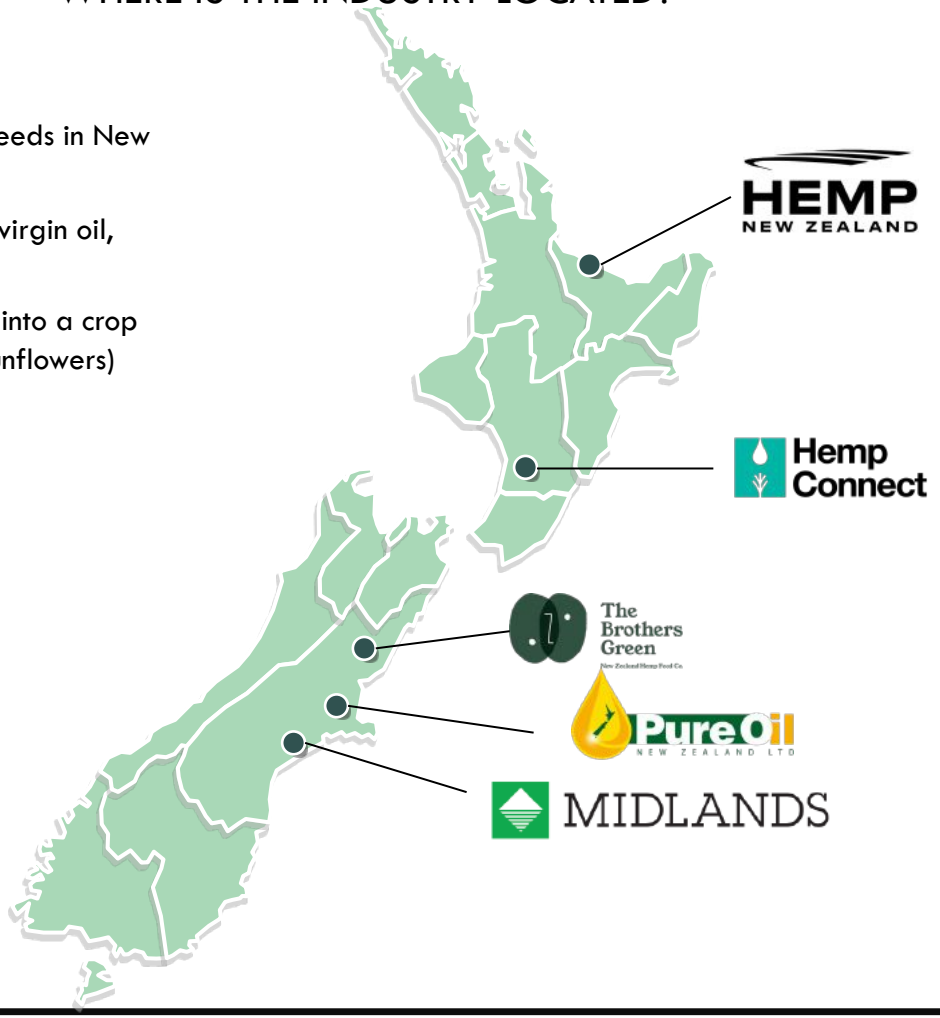
Oilseed production is currently centred in Canterbury, with hemp more spread out

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- Midlands is an early pioneer in oils and seeds in New Zealand
- New Zealand PureOil produces an extra virgin oil, soybean oil and canola oil
- Many oilseed crops integrate successfully into a crop rotation, many are low input crops (e.g. sunflowers)

SELECT FIRMS
Not a complete list



NOTE: Select firms only; Excludes olive oil

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- Federated Farmers of New Zealand support farmers and growers of oilseeds

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use oilseeds in their products

UNIVERSITIES / RESEARCH

- Foundation for Arable Research (FAR) applied research organisation supporting arable farmers
- A wide range of NZ Universities are researching topics within this platform

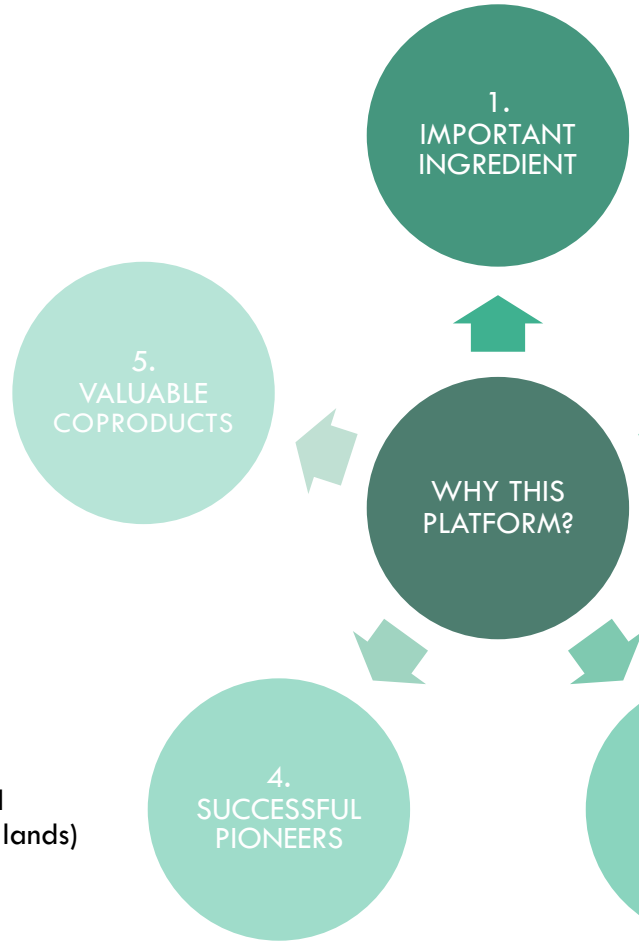
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

Source: various company and organisation websites; Coriolis analysis

There are strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- Increasing demand from New Zealand firms and consumers
- A critical ingredient in many exports (e.g. infant formula)

- Currently dependent on imports
- Market highly volatile (e.g. Ukraine War)

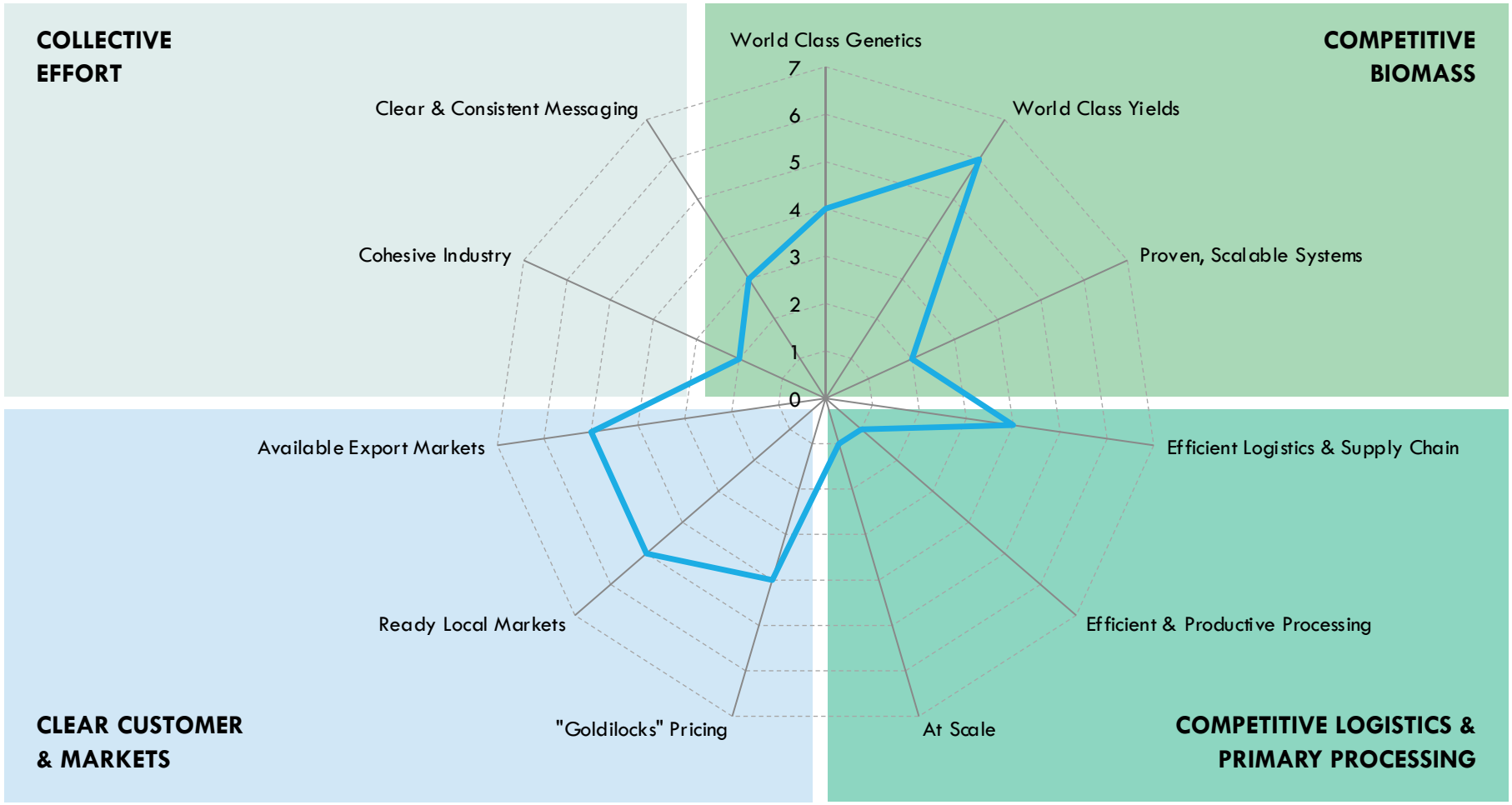
- Demonstrated capability to grow oilseeds in New Zealand

- Strong group of successful pioneering firms (e.g. Midlands)

- Coproducts are animal feed (another major import) and plant protein

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

New Zealand has had world class arable crop yields for 50 years. What has changed?

- New Zealand is world class at growing arable crops; if there was profit in it, farmers would be growing this everywhere
- Is there a new technology or situation that makes this industry more viable?
- New Zealand achieves high yields; can these be delivered consistently across multiple species

How will you enter a mature global market with firms already at scale?

- New Zealand cannot compete with this group without high productivity, better farming systems, very high levels of mechanisation and a premium positioning
- Difficult to compete with cheap imports

Why you? Why NZ? What is your unique selling proposition?

- How will the sector stand out and succeed?
- Is there commercial demand for premium oilseeds and vegetable oils

Why would anyone convert from dairy?

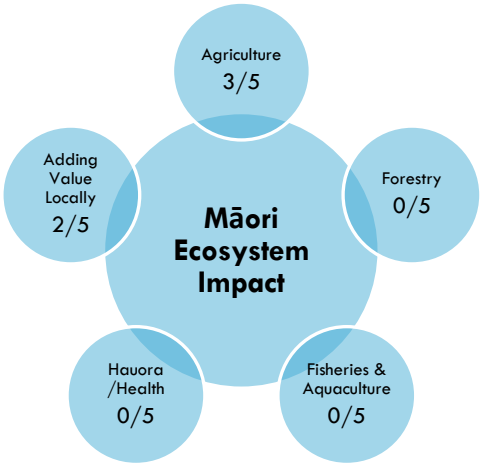
- Strong returns must be attained to make this farming option feasible

Source: Coriolis analysis

Vegetable Oils (Fats and Oils Refining and Blending)

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR MĀORI, WHAT ARE THE MAIN CONSIDERATIONS?:

- Aligns with traditional uses of native vegetable oils – mainly for food and medicinal purposes.
- Potential to leverage existing poor performing Māori land assets.
- Māori investors will be wary of the difficulty to compete in a well-established industry globally.
- Potentially a good opportunity for individual land blocks – not at scale but right-sized to provide biomass for specific opportunities.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	49/100

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION	New Zealand can have major vegetable oil industry

1 INVESTING IN **SCALING-UP FARMING SYSTEMS**

- More farmers
- Larger farms with lower costs per tonne
- Implementing the latest in modern systems

2 INVESTING IN INCREASING **PROCESSING CAPACITY**

- Expansion of existing operations
- New processing in new regions

3 INVESTING IN DEVELOPING **SPECIALISED PRODUCTS**

- R&D into potential fractionates and extracts
- Research into potential health claims
- NPD around product and packaging

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

WINE GRAPES

TOTAL SCORE 33/50

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	?

WINERIES

TOTAL SCORE 36/50

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

This platform scales up wine regions beyond Marlborough

WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- 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	- 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	- New Zealand has a track record 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.

Conceptually, this opportunity turns grapes into high value wine across multiple regions of New Zealand

WHAT IS THE CONCEPT?

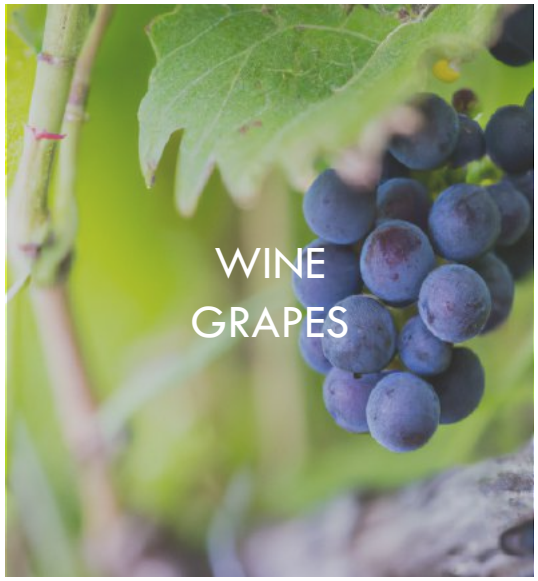
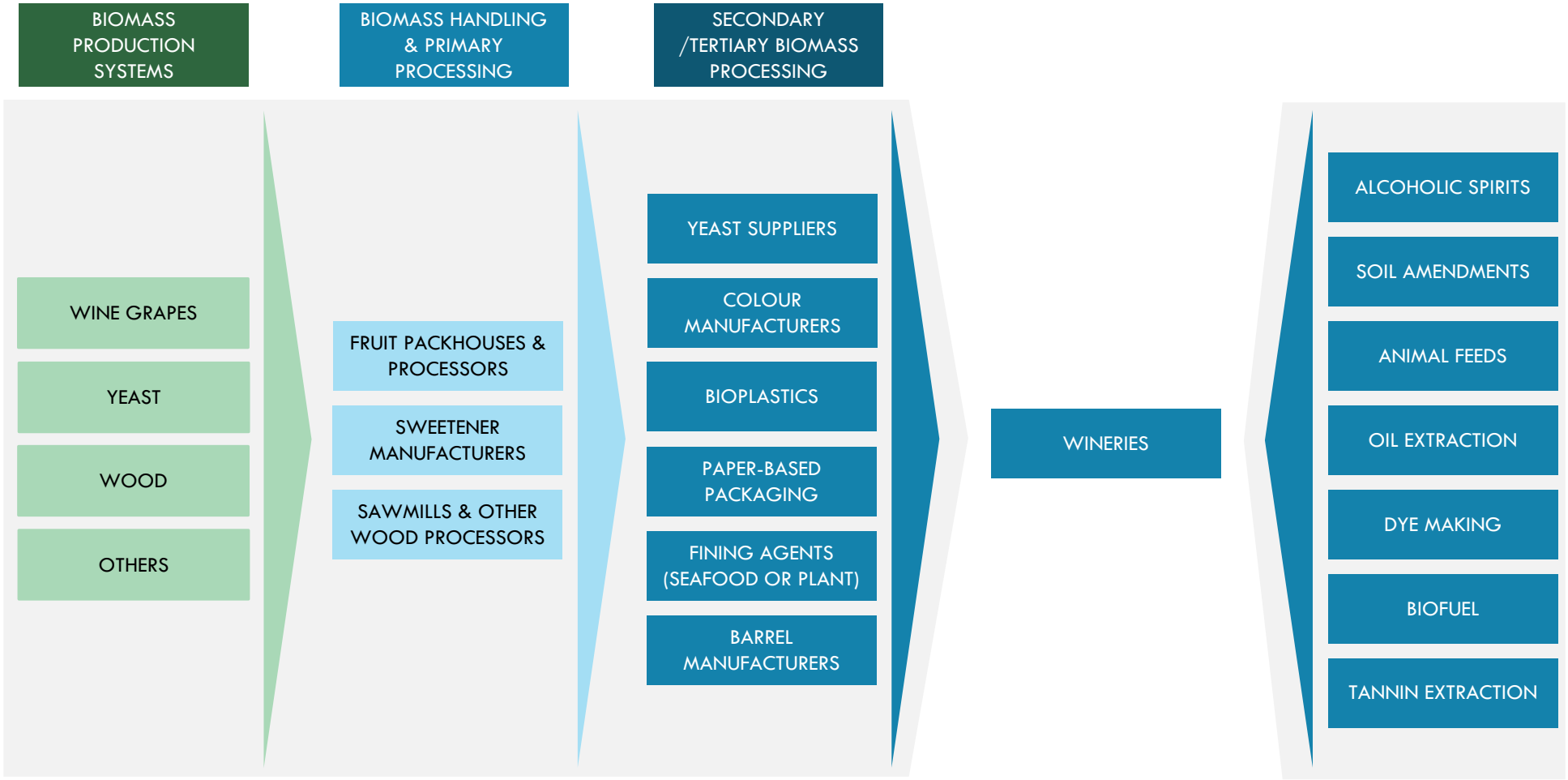


Photo credit: DALL.E; Dollar photo

Wine has current and potential linkages into significant parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Grapes and the wine industry have the opportunity to develop the industry further with new offers across new regions

WHAT CAN YOU DO WITH IT?

DISTICTIVE BOTTLE

GIFT PACKAGING

SPECIALTY REGIONAL VARIETAL

UNIQUE SPARKLING WINE

SPRITZ

WINE SELTZER

ALCOHOL FREE

GRAPPA

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Wine is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Opportunity to move into new regions
2 **INCREASING VALUE-ADDED**	- Potential for high value outputs (e.g. grappa) - Adding value to waste streams
3 **BUILDING RESILIENCE**	- Creates employment and industry in the regions (e.g. Canterbury, Otago) - Higher wages available, skilled labour
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Farming system is a low emission sustainable system vs. comparable products (fats and animal)
5 **REPLACING FOSSIL FUELS**	- Wine co-product a potential feed stock for soil amendments (e.g. biochar) - Opportunity to replace fossil fuels on farm (soil amendments vs fertilisers) - Potential for biodiesel for on-farm vehicles
6 **RETHINKING WASTE**	- New systems design creates less waste - Processing byproducts and waste streams into high value products (Bio-extracts, grape seed oil)

Wine production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Using regenerative practices (soil amendments)
Sustainable farming certifications
Potential for alternative sources of energy in vineyard machinery

Low packaging/kg product design
Recyclable packaging/cans
Efficient production

Converting ag waste into biofuel
Encouraging recycling/composting
Use of co-products for high value products

Modern plant and equipment
Renewable energy use
Potential for waste as heat energy
Separation of red wine pomace (for polyphenol refining)

Reverse supply chain from major users
Lighter packaging, recyclable

Reduced distribution distances with optimised route management
Potential for alternative energy sources in distribution
Extending sustainability to logistics partners

No obvious opportunities

Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Wine grows across New Zealand

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- New Zealand has 600 vineyards and 700 wineries across the country
- New Zealand has eleven wine regions across the country

SELECT FIRMS
Not a complete list

Source: Wine New Zealand

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

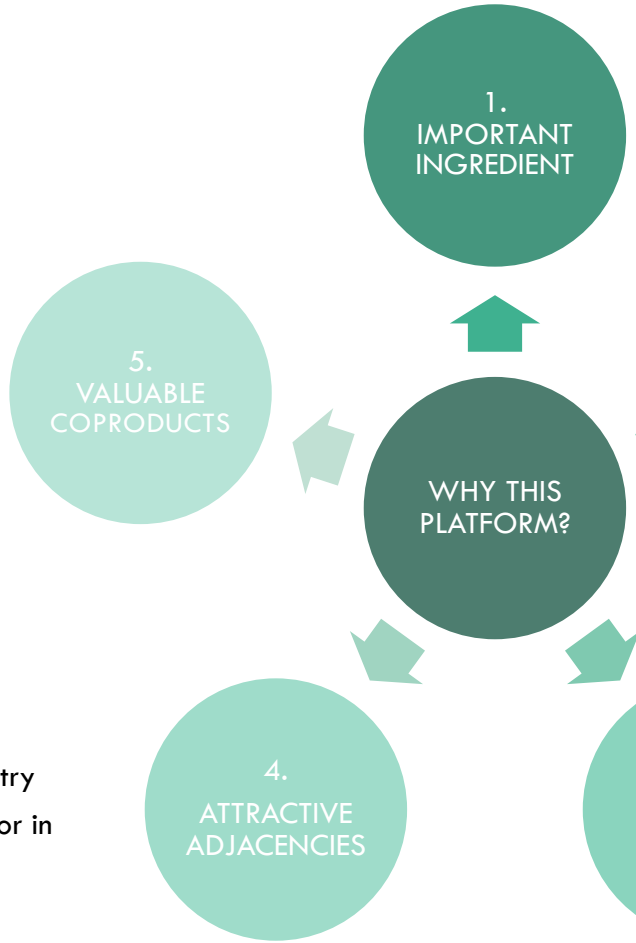
WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS	INDUSTRY ORGANISATIONS	UNIVERSITIES / RESEARCH	GOVERNMENT / CRI'S
- New Zealand Wine grower and winery association	- New Zealand Wine grower and winery association	- Multiple research streams underway that touch on parts of this opportunity including funding for the New Zealand Wine Centre based at nmit (Bragato Research Institute) - NZ Universities are researching topics within this platform (e.g. Lincoln's Centre for Viticulture & Oenology)	- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety) - P&FR research across multiple vineyard and grape topics

*Nmit = Nelson Marlborough Institute of Technology (NMIT); *CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for the wine platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



1. IMPORTANT INGREDIENT
- New Zealand and global consumers drink a lot of wine
- A critical product for many regions and provinces

2. HIGH VALUE
- Premium product for New Zealand
- Achieves a high price in premium export markets

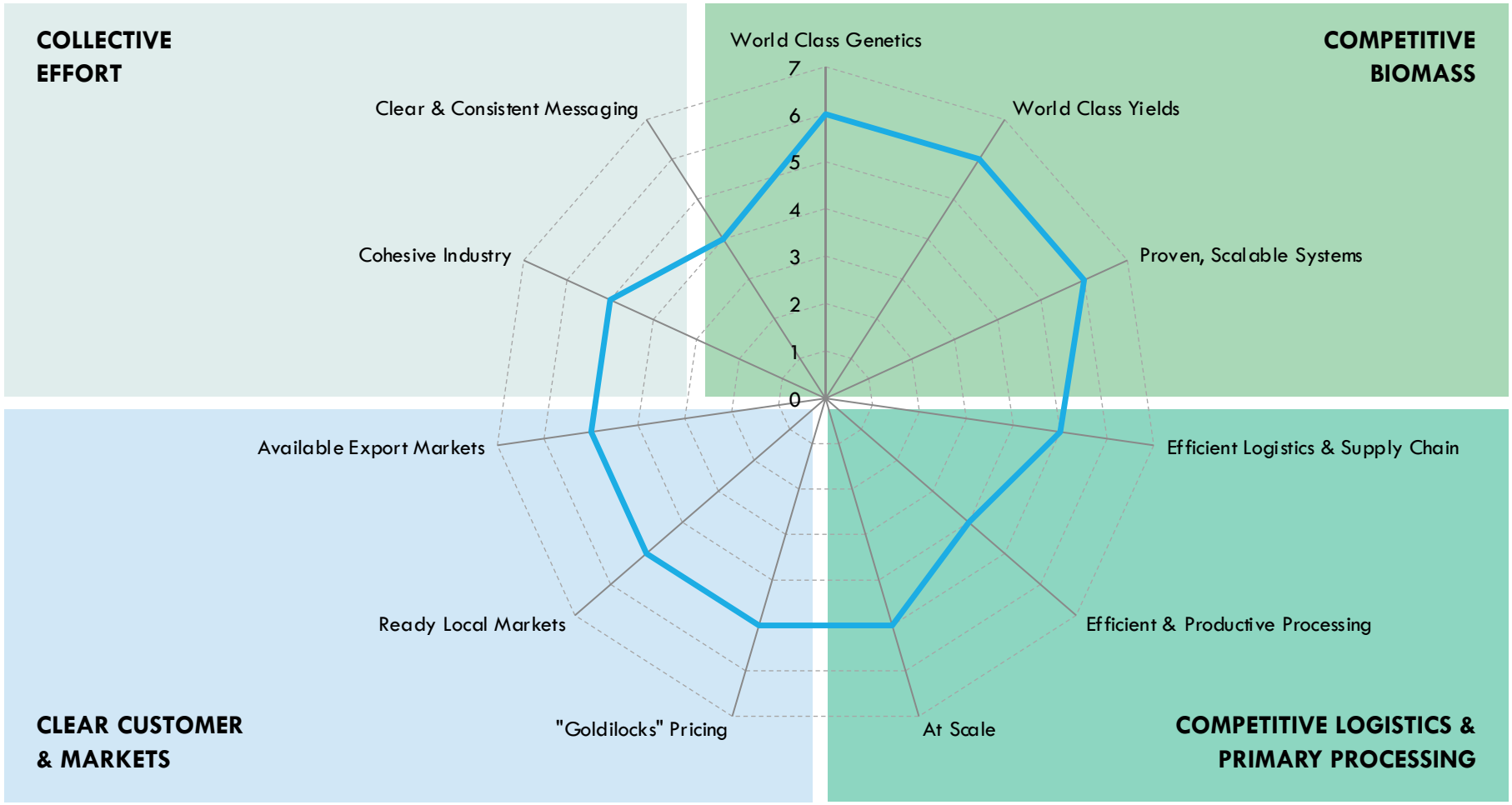
3. PROVEN CAPABILITY
- Demonstrated capability to grow grapes and produce wine in New Zealand
- This capability can move and develop successful varieties in new regions

4. ATTRACTIVE ADJACENCIES
- Supports the tourism industry
- Supports foodservice sector in regions

5. VALUABLE COPRODUCTS
- Must and lees can be used to produce high value spirits (e.g. Grappa)
- Grape marc can be used as feeding stock into biochar (soil amendments)
- Other options for grape seed oil (cosmetics industry, food)

The platform is growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

New Zealand has had success with Sauvignon Blanc and Pinot Noir, can this be extended further?

- New Zealand is world class at growing grapes and producing wine; if there were other good regions wouldn't they be there already?

What is the best opportunity for the 'waste' stream?

- Many options for waste streams:
  - Prunings (e.g. compost, biochar)
  - Grape seed skin (e.g. oils, extracts, bioactives)
  - Grape mark (e.g. high value spirits)
- Is there a new technology or situation that makes this industry more viable?

Why you? Why NZ? What is your unique selling proposition?

- How will a new product line or region stand out and succeed?
- Is there commercial demand for additional premium New Zealand wine

Are the returns available across the chain?

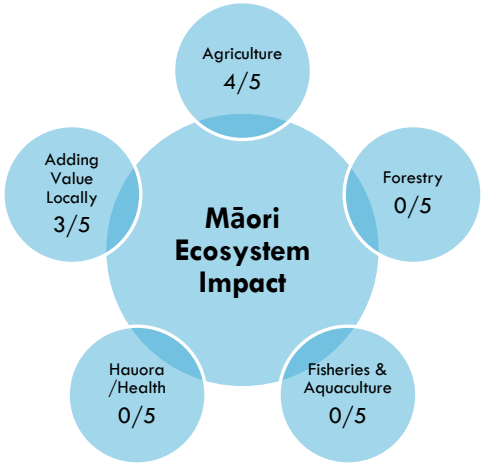
- Market power is currently with the wine processing and wineries

Source: Coriolis analysis

Wineries

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR MĀORI, WHAT ARE THE MAIN CONSIDERATIONS?:

- A few players in the Māori economy – there is a Māori winemakers collective (Tuku).
- Not a traditional activity – Māori tend to be involved in more traditional industries, such as dairy, sheep and beef or pastoral farming.
- First Māori wine business was created in 1998 (Tohu). Sector has been growing ever since.
- Branding may be a sensitive issue, i.e. using Māori names and imagery for non-Māori products.
- There may be potential for certain Māori landowners in the key winemaking regions looking for higher-returning use of their land through grapes.
- Difficult to compete in well-established industry – would need to find some uniqueness to the product.
- Some Māori investors may be constrained by their parent owners against investing in this sector.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆ ☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆ ☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	49 /100

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

New Zealand has a track record 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.

1 INVESTING IN **SCALING-UP FARMING SYSTEMS**

- More vineyards
- Larger vineyards with lower costs per tonne
- Implementing the latest in modern best practice in sustainability systems

2 INVESTING IN GREENING **PROCESSING**

- What are the best uses for the byproducts / coproducts (there are many options); in particular Marlborough
- What is the feasibility of these options?

3 INVESTING IN DEVELOPING **SPECIALISED PRODUCTS**

- Research into new products (grappa, spritz etc.)
- R&D into potential fractionates and extracts from wine skins and seeds

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

ALCOHOLIC SPIRITS

TOTAL SCORE 35/50

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)

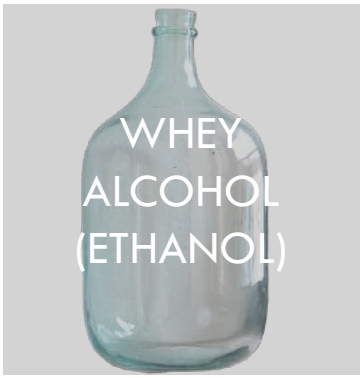
This platform suggests that there is huge opportunity to produce more alcoholic spirits from all forms of local biomass, including waste

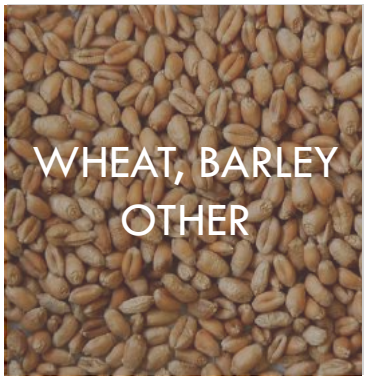
WHY DO WE CARE?

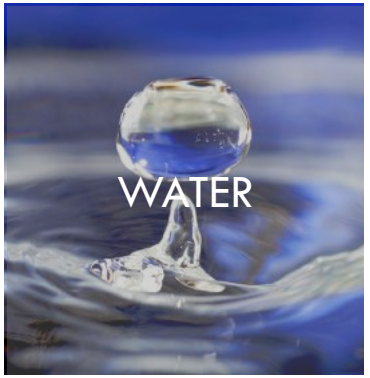
SITUATION	COMPLICATION	RESOLUTION
- New Zealand's burgeoning spirits sector has exploded over the past decade through innovative ingredients and numerous new entrants.	- Spirits imports are still relatively large and exports are relatively small. - Biomass waste streams exist that can be converted to alcohol (e.g. pomace into grappa)	- Growth can continue both by displacing imports in the domestic market and through a better focus on exports.

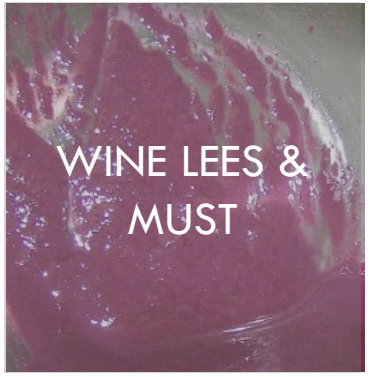
Conceptually, this opportunity is developing the alcoholic spirits sector (in particular using unique products and ingredients)

WHAT IS THE CONCEPT?









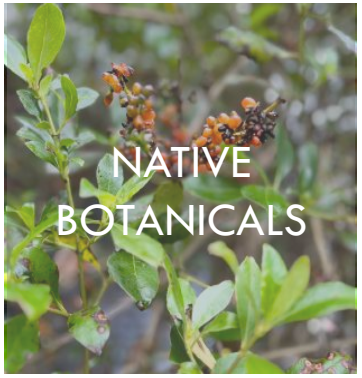
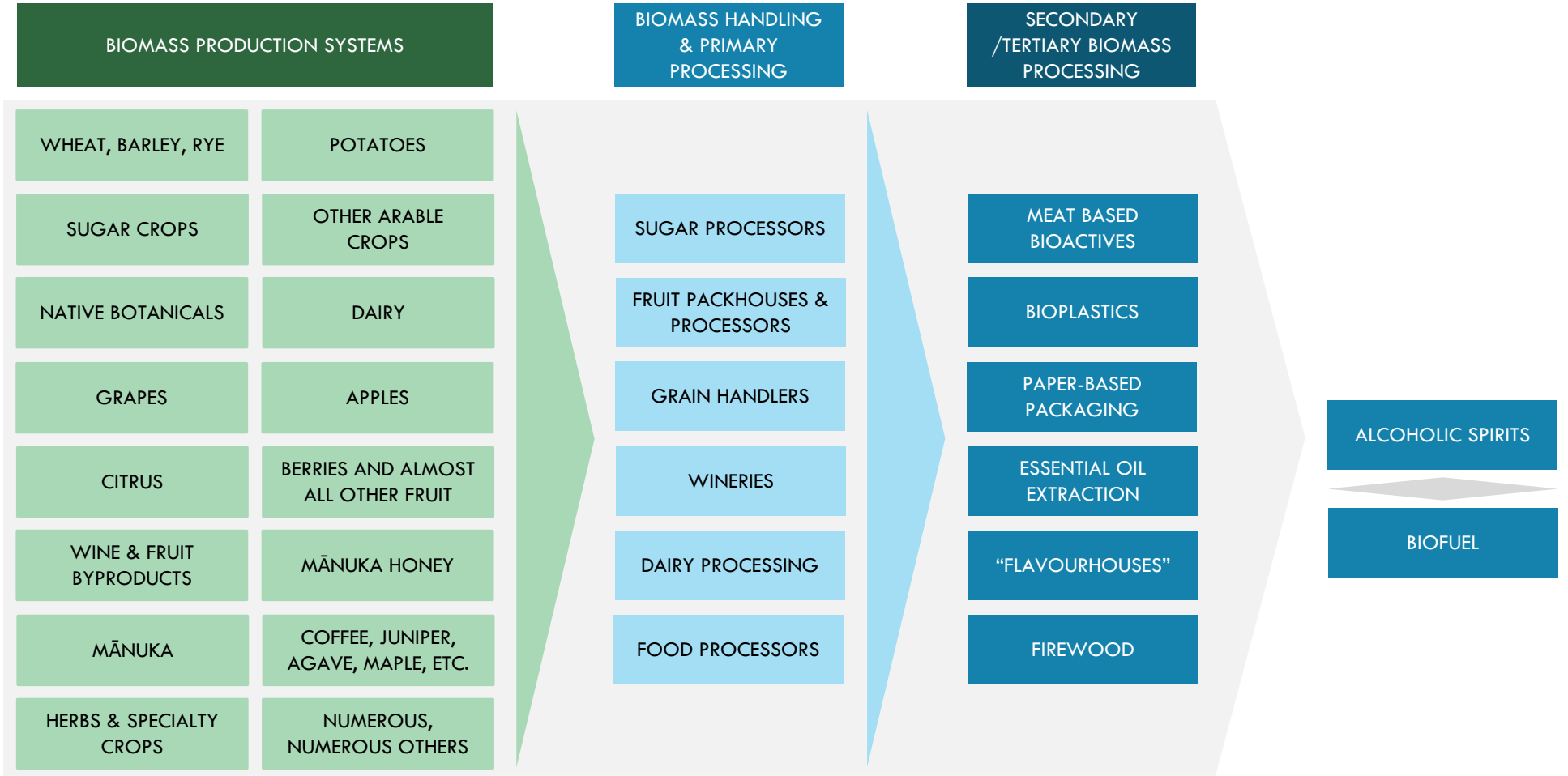


Photo credit: Wikimedia CC ASA 3.0: Denis Bastianelli; Dcrjsr; Agne27; Wilkinson; CCA 2.0: Jose Manuel Suarez; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Alcoholic spirits has current and potential linkages into large parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



A range of unique alcoholic spirits products can be produced in New Zealand

WHAT CAN YOU DO WITH IT?

**$1,000; Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes*

Alcoholic spirits is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Potential feedstock crops achieve high biomass yields (wheat, barley, corn) - Full biomass utilisation in New Zealand
2 **INCREASING VALUE-ADDED**	- Spirits are high value outputs - Utilise high value and unique inputs (e.g. native botanicals) - Adding value to whey (ethanol production)
3 **BUILDING RESILIENCE**	- Creates employment and industry throughout the country - Higher wages available, skilled labour
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Waste streams can go to animal feeds or soil amendments
5 **REPLACING FOSSIL FUELS**	- Product is basically (expensive) biofuel - Opportunity to replace fossil fuels on farm for wheat/barley production (soil amendments vs fertilisers)
6 **RETHINKING WASTE**	- Circular principles part of the production system or business model - Alcoholic spirits can utilise waste streams and co-products from other sectors

Alcoholic spirits production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

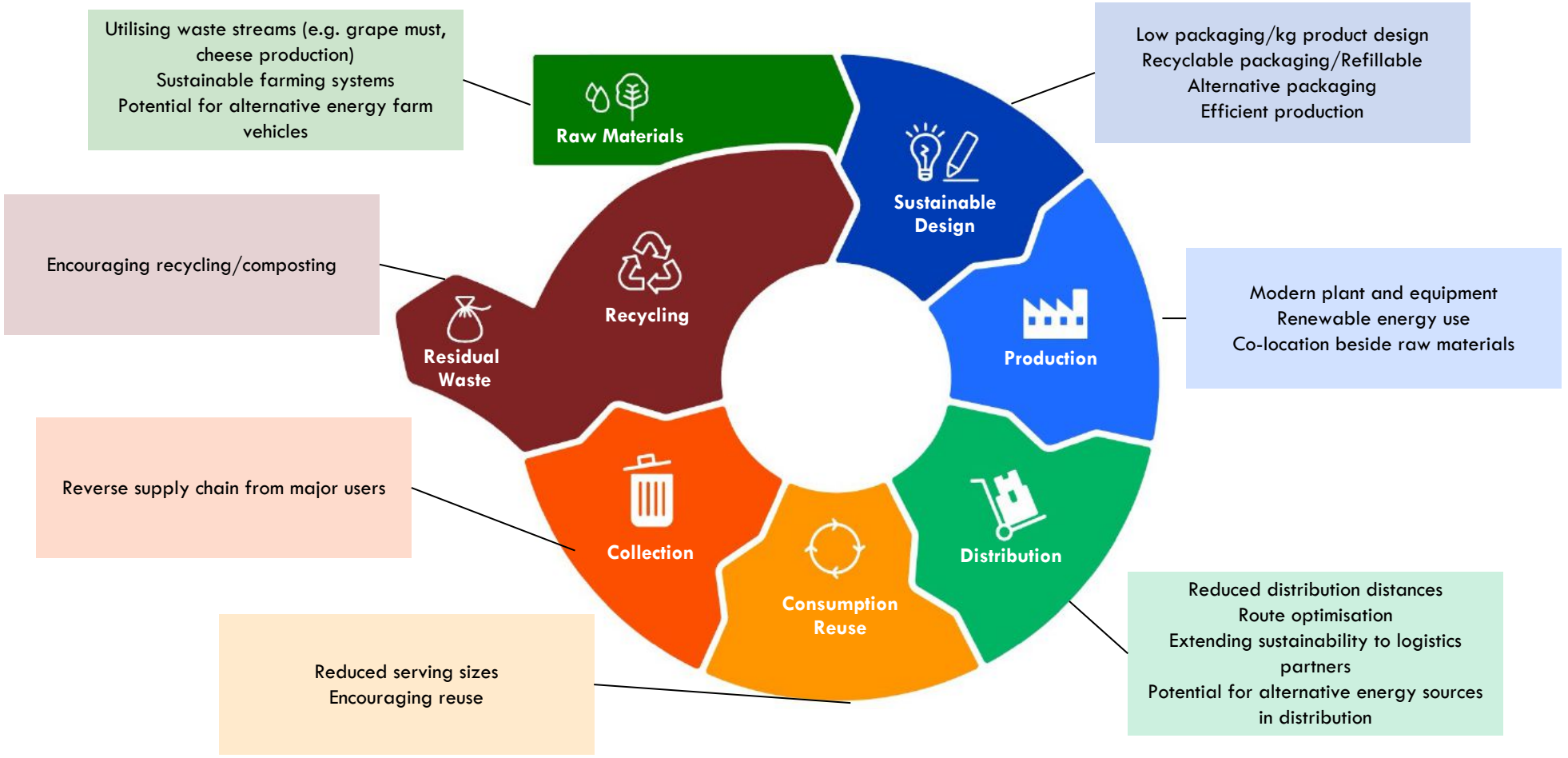


Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Alcoholic spirits firms are located across the country

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- There are 101 members in the Distilled Spirits Aotearoa industry association
- There are a significant number of importers and distributors
- There are 12 members of Spirits NZ (the major/large) spirits firms in NZ

SELECT FIRMS
Not a complete list

NOTE: Select firms only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- A range of organisations support the primary industries

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use ingredients and produce products in this platform

UNIVERSITIES / RESEARCH

- Foundation for Arable Research (FAR) applied research organisation supporting arable farmers
- A wide range of NZ Universities are researching topics within this platform

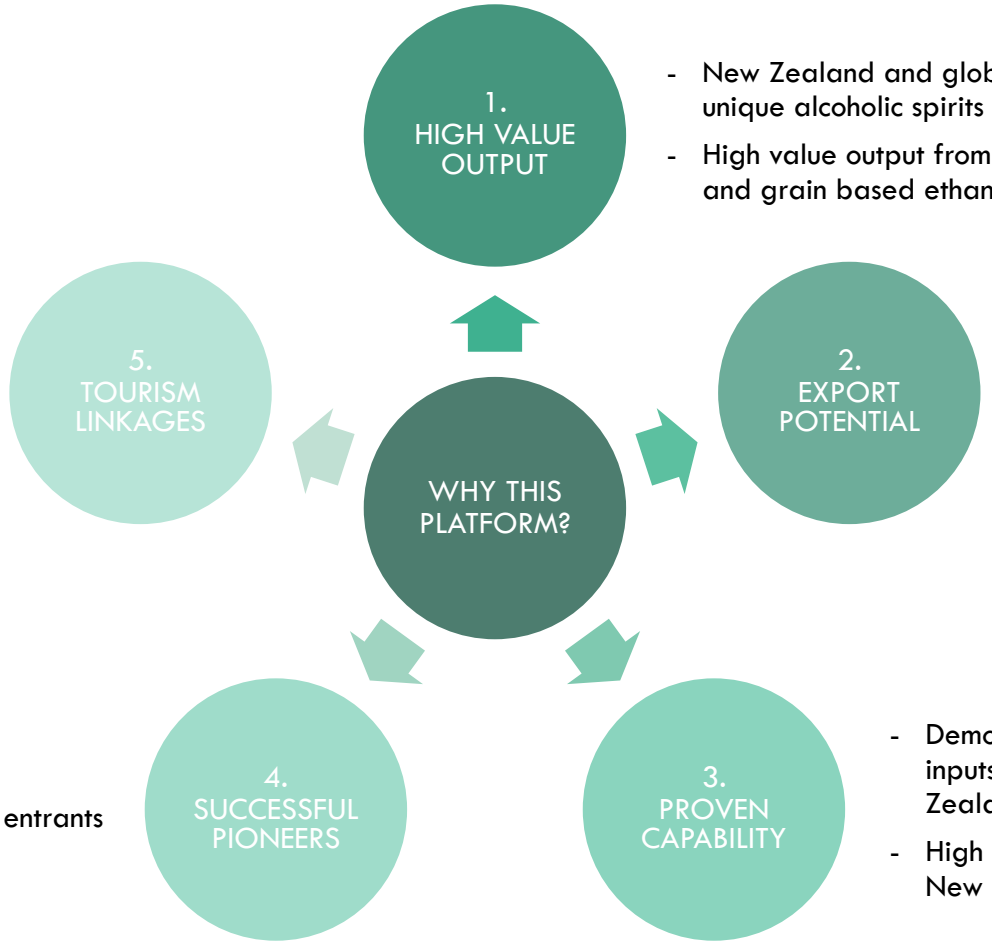
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- New Zealand and global customers consume high value unique alcoholic spirits
- High value output from dairy and grains industry (whey and grain based ethanol)

- Strong export potential

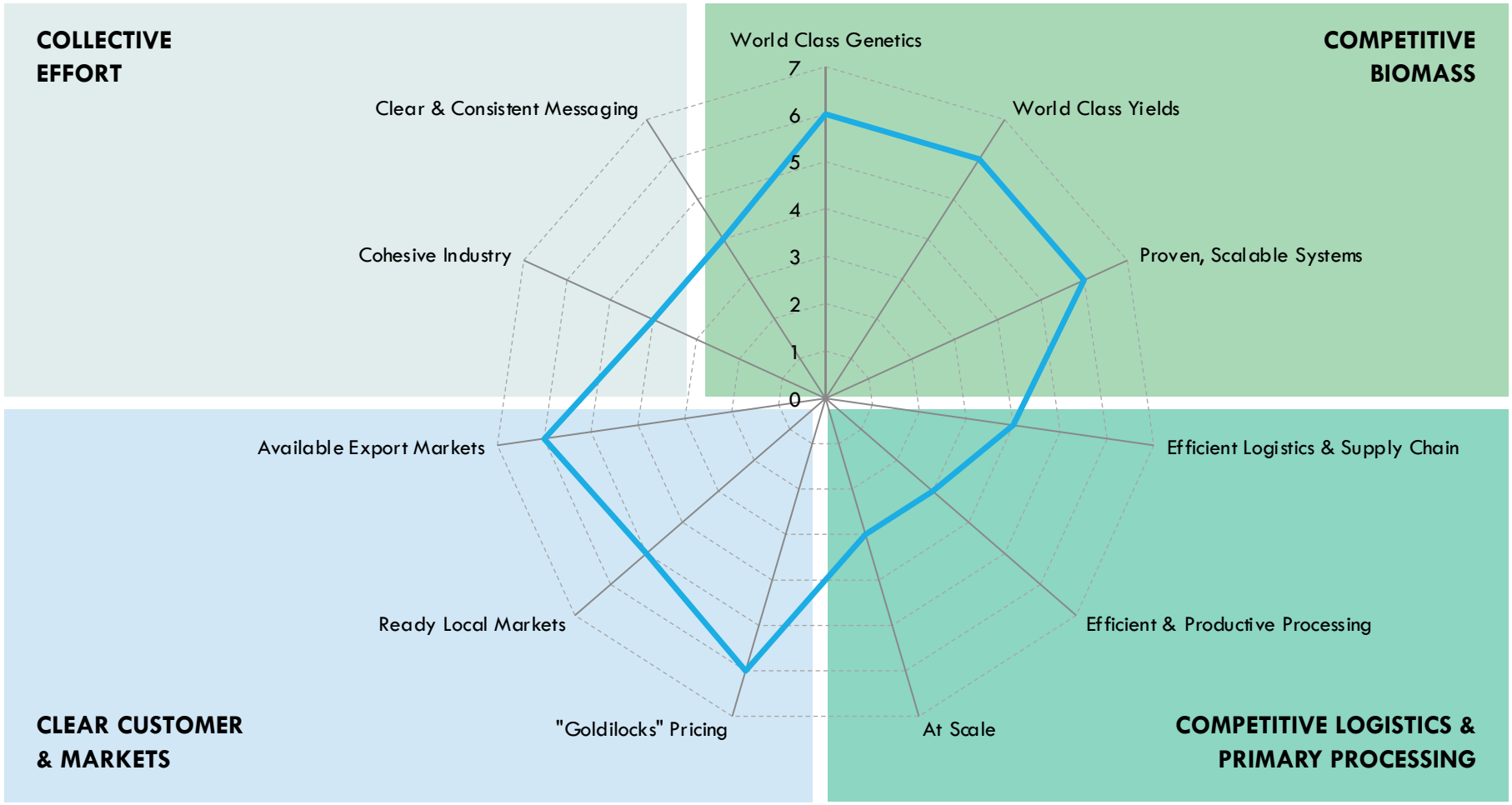
- Demonstrated capability to produce the inputs and develop the products in New Zealand
- High quality and highly awarded firms in New Zealand

- Strong group of successful pioneering firms and new entrants into the sector

- Strong linkages to the tourism sector
- Encouraging tourist spend in the regions

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Note: NZ ethanol via the dairy industry is very competitive; Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

What is the next cab off the rank for ethanol production?

- What products can New Zealand grow and distill beyond dairy ethanol (no sugar or beets in NZ)

Can NZ develop a unique spirit?

- Do we have the capabilities in new crops, production and marketing to develop a new product? (e.g. sheep milk vodka)

Why you? Why NZ? What is your unique selling proposition?

- How will the sector stand out and succeed?
- What can we utilise that is unique?

What is the market size?

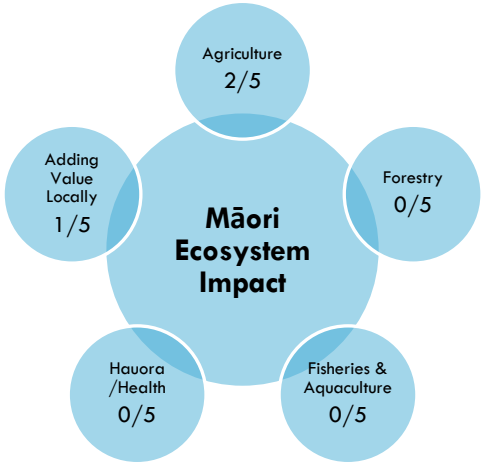
- What is the size of the market for a unique New Zealand alcoholic spirit?
- What is the growth potential of this market?
- Who are the key competitors in the same space?

Source: Coriolis analysis

Alcoholic Spirits

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- High engagement in this area – but mainly in wines brands such as Tohu, Tiki, Manu
- Little to no connection between Mātauranga Māori and the traditional use of alcohol.
- Because of large consumption and negative impacts on Māori communities, there may hesitance from investing into alcohol.
- Potential to use botanicals in this sector.
- Māori branding leverage as per the wine sector is possible but could raise some reputational / brand management issues.
- Māori investors will be likely a little reticent unless most of the commercialisation risk has been mitigated.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**54/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION	New Zealand alcoholic spirits can continue to grow both by displacing imports in the domestic market and through a better focus on exports

1 INVESTING IN **UTILISING ALL 'WASTE' STREAMS**

- Leveraging all available value from everything produced (e.g. wine must for grappa-style)

2 INVESTING IN A **COHERENT** NZ STORY AND MESSAGE

- Develop a unique product
- Protect it
- Tell a great story

3 INVESTING IN DEVELOPING **SPECIALISED PRODUCTS**

- R&D into new and unique packaging
- Focus on less waste and weight

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

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)	?

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

NZ INDUSTRY METRICS

No data available.

Classified in wide ranging "other" category (1199 Other Food Product Manufacturing Not Elsewhere Classified).

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.

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

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

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

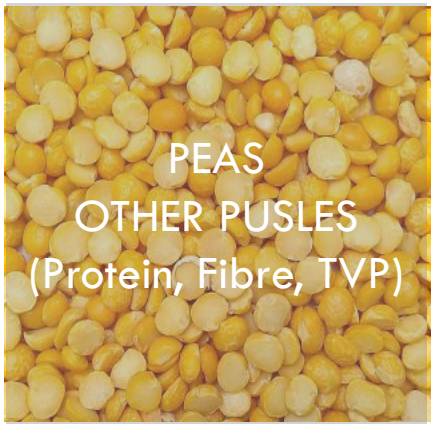
This platform embraces the growing alternative meat segment and scales up production in New Zealand from local biomass

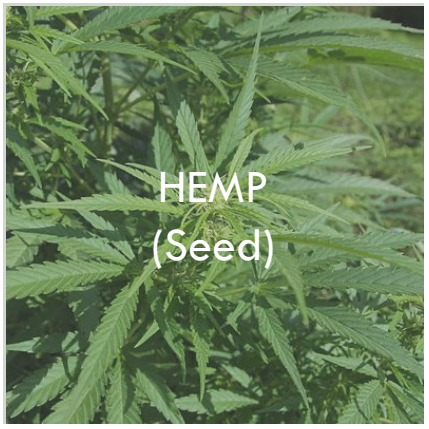
WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- 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 - New Zealand has a group of small, but growing producers of alternative meat or meat analogue/substitutes	- New Zealand is not a major producer of the key biomass used in most products	Growing interest in alternative meat in developed markets creates an opportunity for New Zealand if it can execute

Conceptually, this opportunity uses biomass and ingredients to make alternative meat ingredients and products

WHAT IS THE CONCEPT?





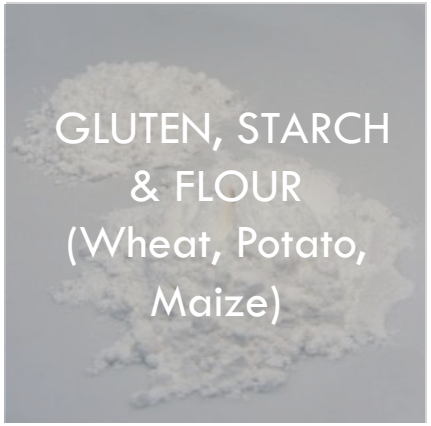
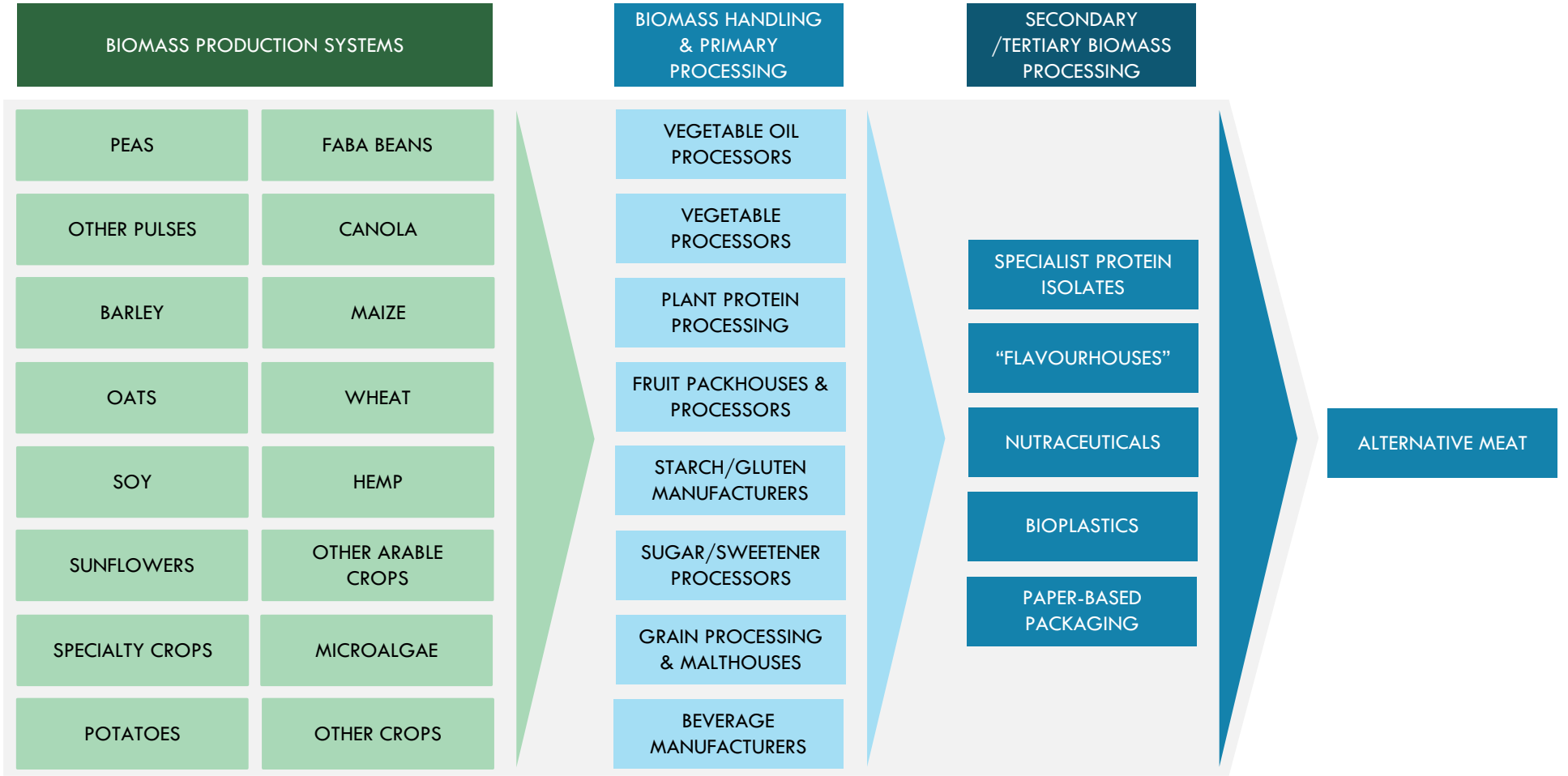


Photo credit: Wikimedia CC ASA 0, 2.0, 3.0 4.0; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research;

Alternative meats have current and potential linkages into large parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Meat substitute companies produce a diverse range of food products

WHAT CAN YOU DO WITH IT?

"MINCE"

BURGER MIX

"BACON"

DUMPLINGS


"BRATWURST"

"BURGER"

"CHICKEN" BITES

DEHYRDATED MEAL

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Meat substitute production is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Potential feedstock crops achieve high biomass yields (e.g. peas, hemp) - Full biomass utilisation in New Zealand (e.g. meal protein, starch, fibre)
2 **INCREASING VALUE-ADDED**	- Potential for high value outputs - Manufacturing and processing adding value to primary ingredients
3 **BUILDING RESILIENCE**	- Employment and industry created in the regions in crop growing and processing - Higher wages available in processing in particular - Increases social and economic capital - Creates skills that can be transferred to other sectors
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Low emission farming system vs. comparable products (e.g. milk products) - Enhances environmental capital
5 **REPLACING FOSSIL FUELS**	- Alternative sources of energy can be used in farming and potentially production systems - Opportunity to develop sustainable and renewable energy sources at production
6 **RETHINKING WASTE**	- New systems design creates less waste - Processing byproducts and coproducts into high value products and ingredients

Meat substitute primary ingredients and production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

High yields
Using regenerative practices (biofertilisers)
Sustainable farming systems
Potential for alternative energy for farm vehicles

Low packaging/kg product design
Recyclable packaging
Efficient production

Modern plant and equipment
Renewable energy use
Potential for field waste as heat energy
Raw material and production in close proximity – co-located

Reduced distribution distances by route optimisation
Potential for alternative energy sources in distribution

Encouraging co-product development and use to highest value (e.g. starch and fibre)

Reverse supply chain from major users

Encouraging recycling/composting

Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Substitute meat companies are located across the country

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- A handful of alternative meat companies are located in NZ
- Many ingredients are currently imported
- CAS Enterprises beginning pea protein concentrate production in Auckland

NOTE: Select firms only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- Federated Farmers of New Zealand supports farmers and growers
- New Zealand Oat Industry Council

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use oats in their products

UNIVERSITIES / RESEARCH

- Foundation for Arable Research (FAR) applied research organisation supporting arable farmers
- A wide range of NZ Universities are researching topics within this platform

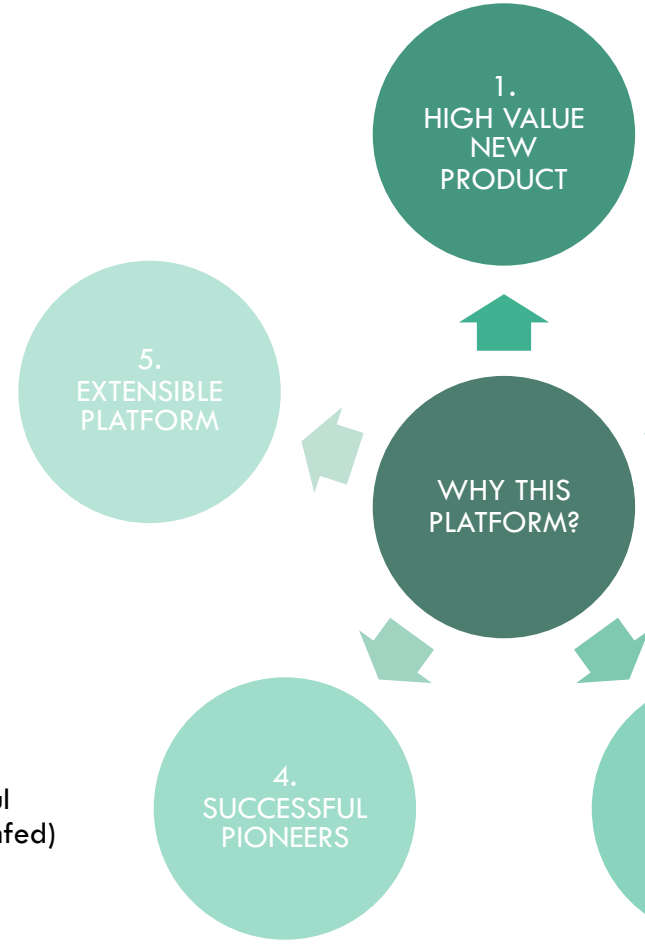
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

Source: various company and organisation websites; Coriolis analysis

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- Alternative meat products are a high value output
- Adds value to primary crops (hemp, peas, other pulses)
- Alternative meats are a new product in New Zealand

- Increased demand for alternative meat/dairy products

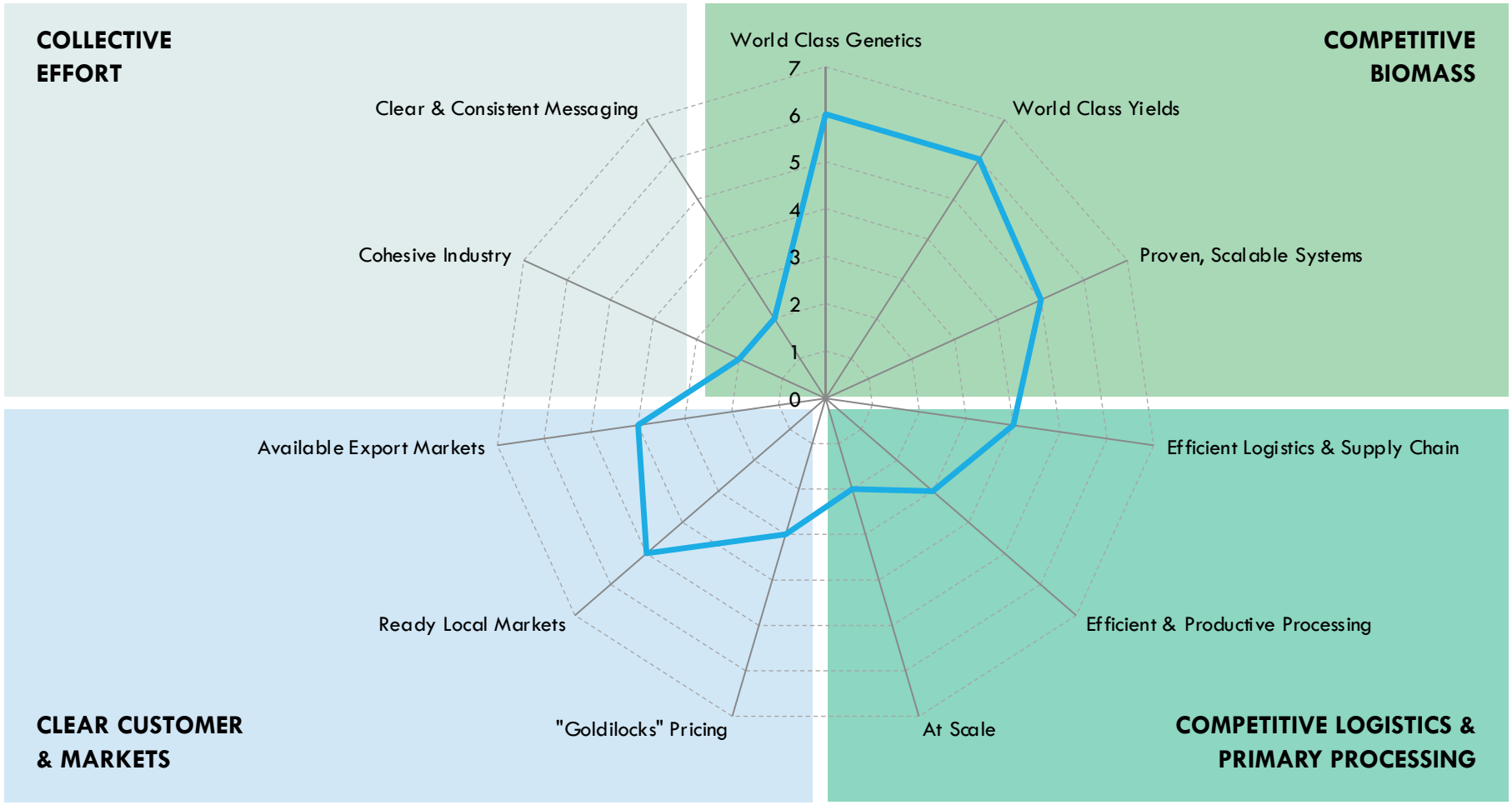
- Demonstrated capability to very successfully grow key ingredients in New Zealand (high yielding oats)
- Demonstrated ability to process key ingredients and products

- Strong group of successful pioneering firms (e.g. Sunfed)

- Ingredients can be used in many products and meal solutions

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

How will NZ compete?

- New Zealand can compete with this group with high productivity, better farming systems and very high levels of mechanisation, but can it compete with efficient processing systems and a premium positioning
- Can New Zealand compete with cheaper imports and on flavour and texture

Why you? Why NZ? What is your unique selling proposition?

- How will the sector stand out and succeed?
- Is there commercial demand for New Zealand substitute meat products?

Most ingredients are currently imported and are not able to grow competitively in NZ, is this a sustainable model?

- Soy is the base of most alternative meat products globally
- Wheat gluten protein is primarily imported
- New Zealand does not currently make TVP "crisps"
- NZ does not have a plant protein isolate plant
- High fossil fuel usage with shipping and transportation

Can New Zealand firms successfully reduce costs to achieve a larger share of stomach?

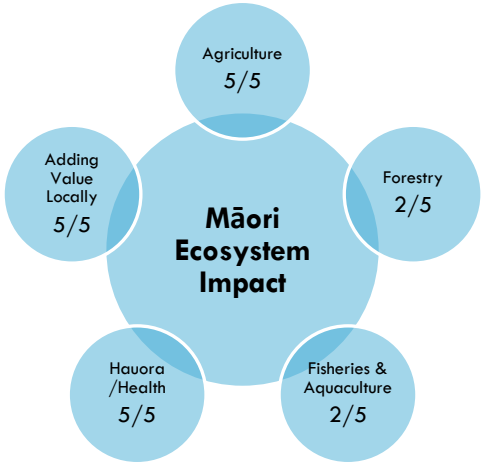
- What is required to reduce costs across the supply chain?

TVP - Textured Vegetable Protein; Source: Coriolis analysis

Alternative Meat

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- High Engagement – Many Māori are looking at plant based alternatives to meat.
- The way that Māori farm, and the way that Māori eat, doesn't reflect traditional Māori practises pre-colonisation. If Te Ao Māori shift that investment to alternative meats, there could be huge social and economic benefits. It would give Māori the opportunity to be world leaders in an emerging field.
- The way Māori traditionally harvested and cultivated kai had no serious impacts on te taiao [natural environment]. Reverting back to these ways would create a positive impact on the environment, as well as reducing the consumption of meat.
- Transformative for Māori Communities.
- Increase in employment opportunities specifically for rural communities.
- Collective leverage through the use of Māori land.
- Early crop growing experience, including for export.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆☆
Any advantage to leverage Māori assets or in utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**36/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION	New Zealand builds a prosperous substitute meat sector based on growing interest in meat substitutes in developed markets which creates an opportunity for New Zealand if it can execute

1 INVESTING IN **SCALING-UP FARMING SYSTEMS**

- Larger oat farms with lower costs per tonne
- Implementing and sharing learnings in the latest modern sustainable systems

2 INVESTING IN **PROCESSING CAPACITY**

- Expansion of existing operations
- New processing in new regions

3 INVESTING IN DEVELOPING **SPECIALISED PRODUCTS**

- R&D into sources of NZ based ingredients
- Development of natural starches
- NPD around products and packaging
- NPD around flavour and texture

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

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)	?

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. ."

NZ INDUSTRY METRICS

No data available.

Classified in wide ranging "other" category (1199 Other Food Product Manufacturing Not Elsewhere Classified).

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.

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

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

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

This platform scales up plant-based dairy substitute production using a range of domestic biomass

WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- New Zealand has a global scale dairy industry built around being a major exporter of ingredient dairy (e.g. milk powder) that is processed into actual consumer products (e.g. yoghurt) in market.	- Winning in traditional dairy does not necessarily translate immediately into success in alternative dairy for a wide range of reasons	- 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

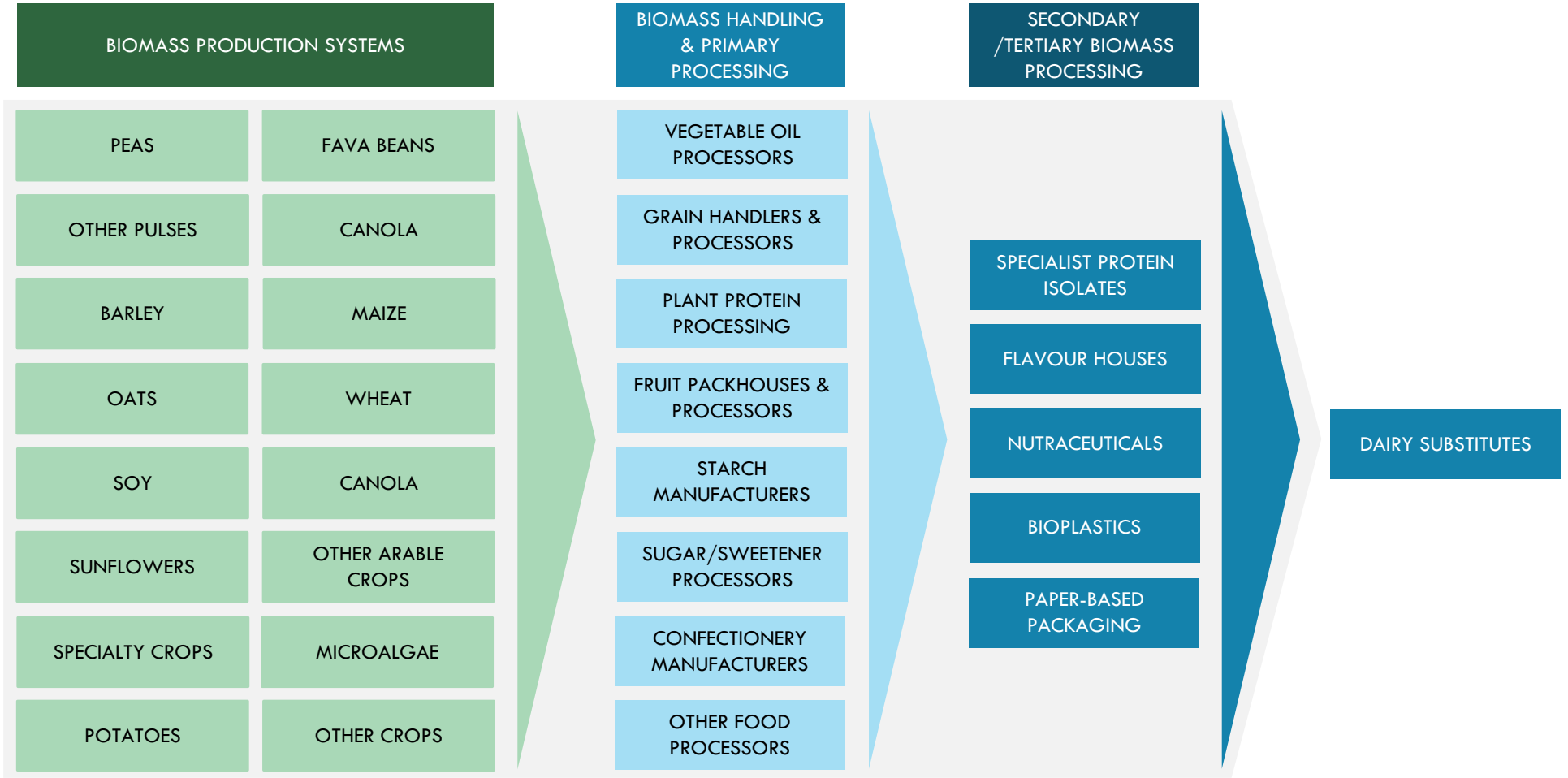
Conceptually, this opportunity is turning New Zealand grown plants and ingredients into alternative dairy food and beverage products

WHAT IS THE CONCEPT?

NOTE: Does not include plant based proteins for dairy nutritionals and sports nutrition (primarily dried), covered in another section

Dairy substitutes has current and potential linkages into large parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Dairy substitute products come in a large range of products

WHAT CAN YOU DO WITH IT?

CHEESE

BEVERAGES

"BUTTER"

COLLAGEN OAT MILK CREAMER*

CHOCOLATE

SPREAD

ICE CREAM

YOGHURT

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Dairy substitutes production is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 INCREASING BIOMASS	- Potential feedstock crops achieve high biomass yields (e.g. oats, hemp) - Full biomass utilisation in New Zealand ((e.g. meal protein (animal feed, human protein) and other extracts))
2 INCREASING VALUE-ADDED	- Potential for high value outputs (oat creamer, cosmetics, beta-glucan)
3 BUILDING RESILIENCE	- Employment and industry created in the regions (in particular Southland and Otago), in growing and processing - Increases social and economic capital - Creates skills that can be transferred to other sectors
4 REDUCING AGRICULTURAL GHG EMISSIONS	- Low emission farming system vs. comparable products (e.g. milk products) - Enhances environmental capital
5 REPLACING FOSSIL FUELS	- Biofuel can be used in farming and production systems - Opportunity to replace fossil fuels on farm (soil amendments vs fertilisers, biodiesel vs diesel)
6 RETHINKING WASTE	- New systems design creates less waste - Processing byproducts and waste streams into high value products - Product is derived from existing commodity production (e.g. oats)

Dairy substitutes growing; production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

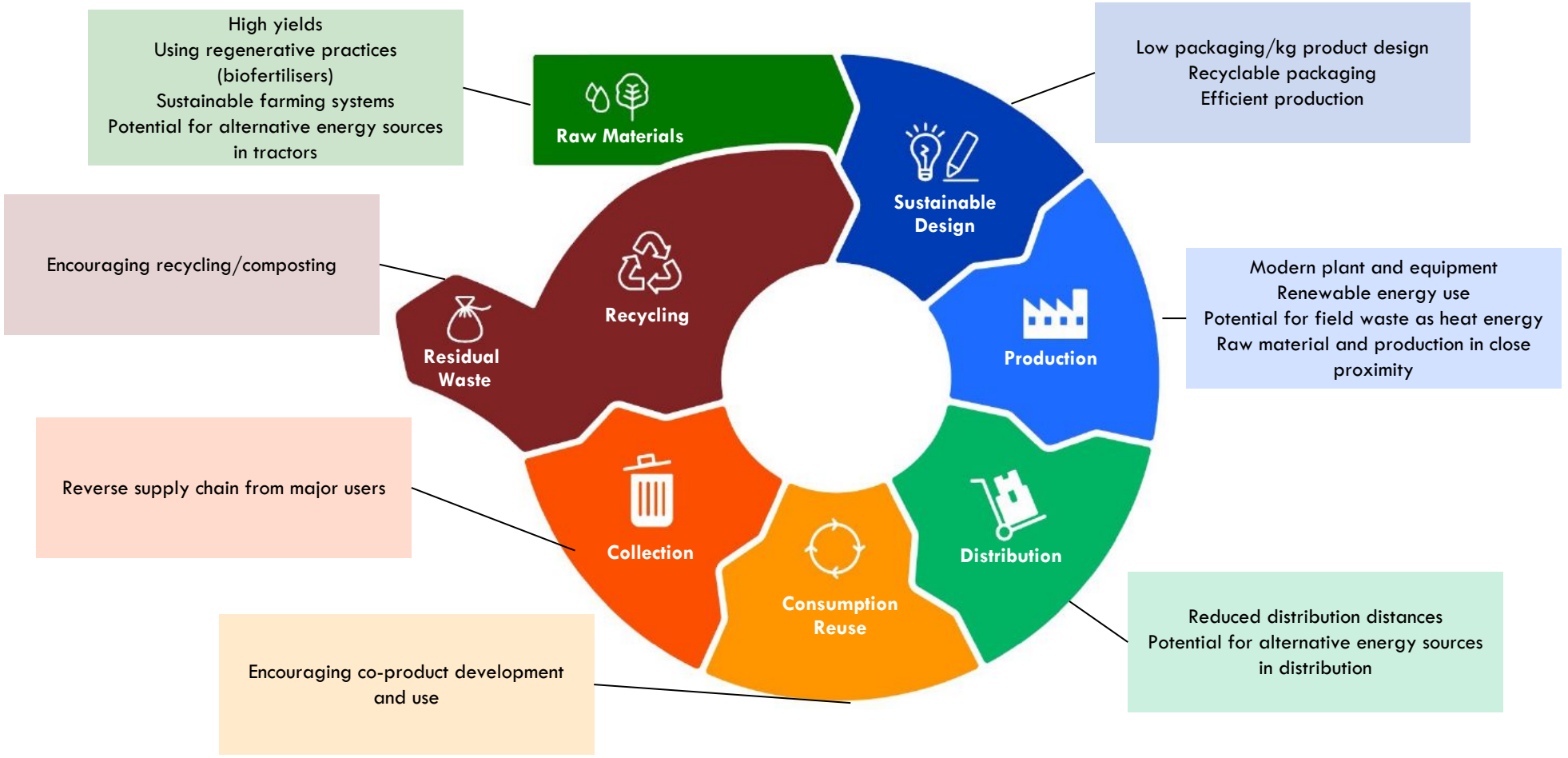


Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Dairy substitutes specialists are located across the country

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- Oats are grown primarily in Southland and Otago as part of a crop rotation
- Rise in popularity of plant based milks is seeing a rise in oat milks (now produced in NZ)

NOTE: Select firms only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- Federated Farmers of New Zealand support farmers and growers
- New Zealand Oat Industry Group

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use oats in their products

UNIVERSITIES / RESEARCH

- Foundation for Arable Research (FAR) applied research organisation supporting arable farmers
- A wide range of NZ Universities are researching topics within this platform

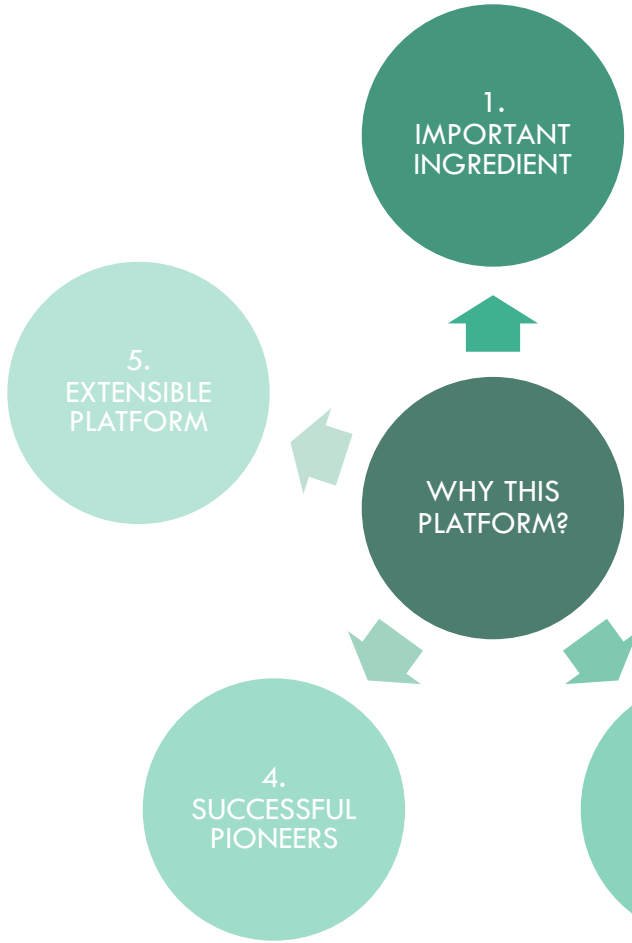
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

Source: various company and organisation websites; Coriolis analysis

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- New Zealand firms and consumers drink a lot of non-dairy milks and other ingredients

- Currently primarily dependent on imports for oat milk (NZ brands establishing themselves)
- Increased demand for alternative meat/dairy products

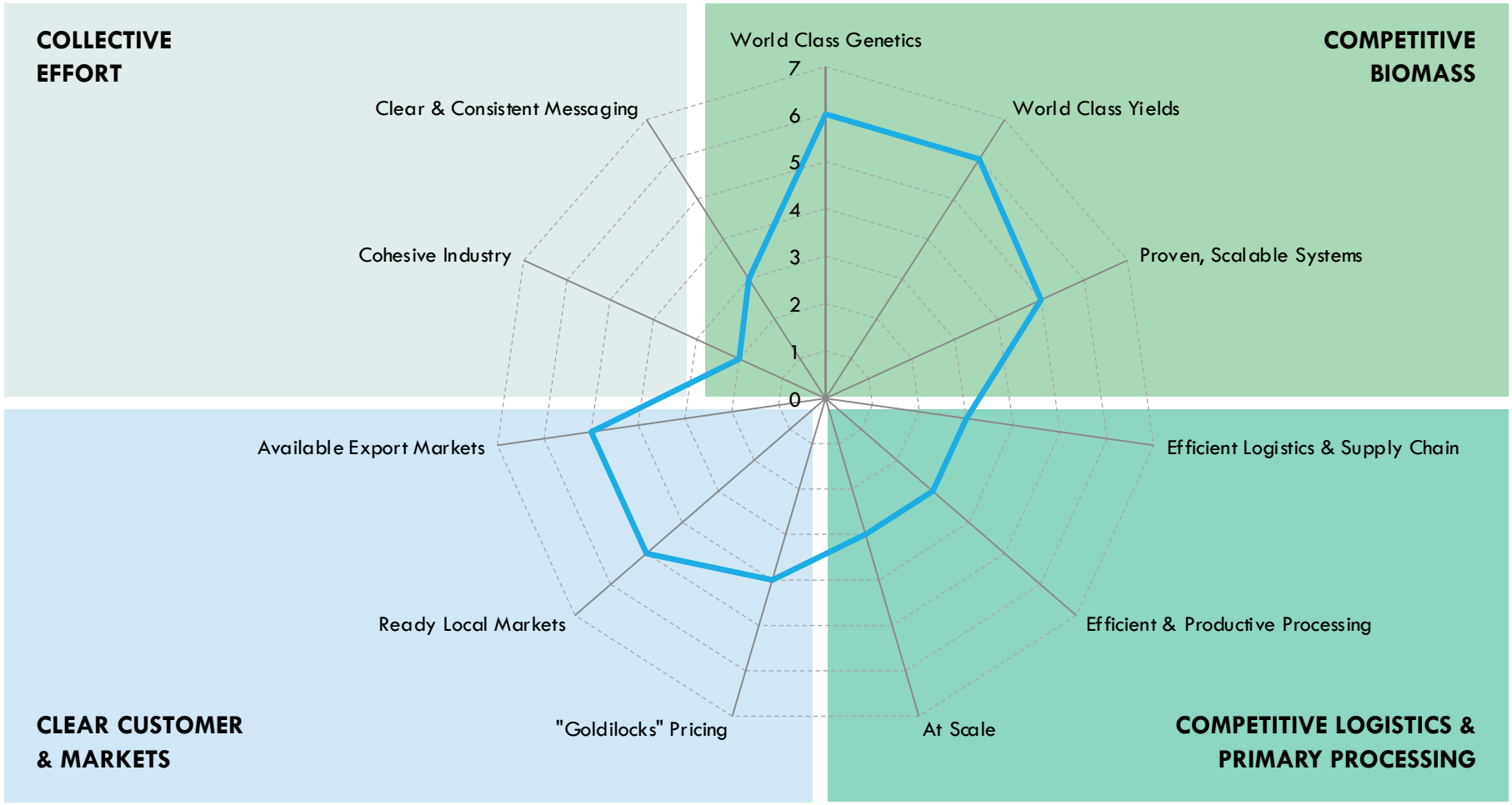
- Demonstrated capability to very successfully grow key ingredients in New Zealand (high yielding oats)
- Demonstrated ability in milk and dairy categories

- Strong group of successful pioneering firms

- Like animal dairy ingredients plant based ingredients can be used in many products

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

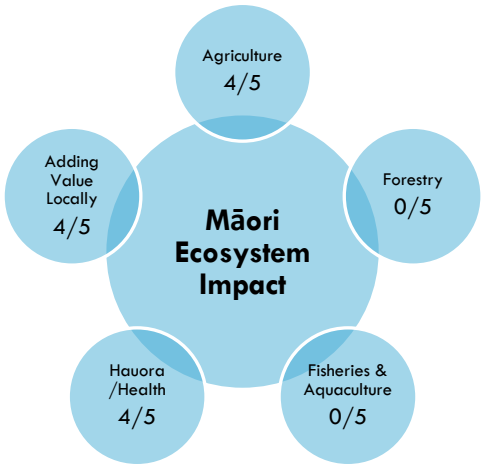
How will you enter a mature global market with firms already at scale?	Why you? Why NZ? What is your unique selling proposition?	Many/most key ingredients are currently imported; is this a sustainable model?	Are these products more natural? Are there natural options?
- New Zealand can compete with this group with high productivity, better farming systems and very high levels of mechanisation, but can it compete with efficient processing systems and a premium positioning - Can New Zealand compete with cheaper imports	- How will the sector stand out and succeed? - Is there commercial demand for New Zealand alternative dairy products?	- Soy-based milk, cheese, ice cream products imported - Almond/cashew milks imported - Coconut oil (base for cheese, butters, yoghurt and ice cream imported) - High fossil fuel usage with shipping and transportation	- Some ingredients highly processed using chemicals and high energy (e.g. hydrolyzed starch)

Source: Coriolis analysis

Dairy Substitutes / Plant-Based Dairy Analogues

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Not as 'popular' in te Ao Māori in comparison to alternative protein / meat substitutes
- Milk not traditional kai. Research finds that a lot of diseases/health issues derive from the dairy industry which could be promising for the alternative dairy market.
- The sustainability and farming processes of alternative dairy options align with Kaitiaki principles and te ao Māori values
- Alternative dairy options may also benefit te Taiao / environment.
- Collective leverage could include sustainable use of Māori land growing biomass for the alternative milk products.
- Build on existing capabilities (e.g. Miraka, Waiu Dairy)
- Hard to see it connecting or resonating with Māori brand leverage.
- Māori land investors may seek out opportunities to diversify and develop alternative revenue sources through well understood supply and marketing lines for "milk"

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆☆☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**68/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION	New Zealand can build a vibrant dairy substitute sector based on new ingredients and multiple formats and forms leading to an industry supplying New Zealand & export markets

1 INVESTING IN **SCALING-UP FARMING SYSTEMS**

- Larger oat farms with lower costs per tonne
- Implementing and sharing learnings in the latest modern sustainable systems

2 INVESTING IN **PROCESSING CAPACITY**

- Expansion of existing operations
- New processing in new regions

3 INVESTING IN DEVELOPING **SPECIALISED PRODUCTS**

- R&D into potential sources of NZ based ingredients
- Development of natural starches
- NPD around products and packaging

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

NUTRACEUTICALS

TOTAL SCORE 41/50

INTERNATIONAL STANDARD CODES

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

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]

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.

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.

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

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

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

*NPD New Product Development

This platform suggests significant further growth is possible in nutraceuticals

WHY DO WE CARE?

SITUATION

- Passionate and growing group of champions driving growth of NZ sector
- Recognised and trusted supplier of natural and healthy products
- Large and growing exports, particularly to Asia
- Many nutraceuticals come from by-products and waste streams

COMPLICATION

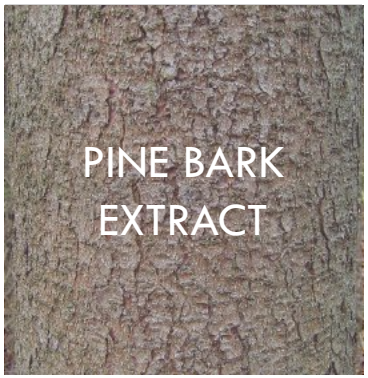
- Research on efficacy varies by product
- Domestic regulatory environment likely to continue changing going forward
- Regulatory environment in China and other high potential markets will continue changing going forward

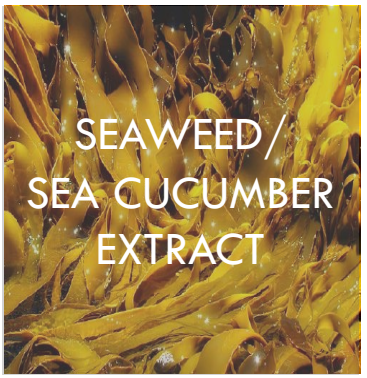
RESOLUTION

- 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

Conceptually, this opportunity uses biomaterials to produce nutraceuticals

WHAT IS THE CONCEPT?





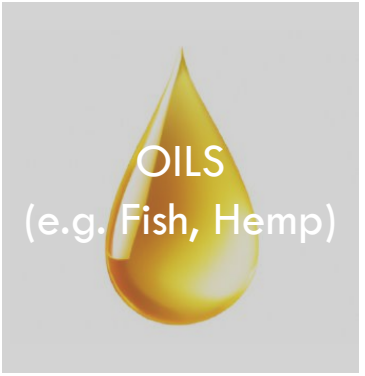
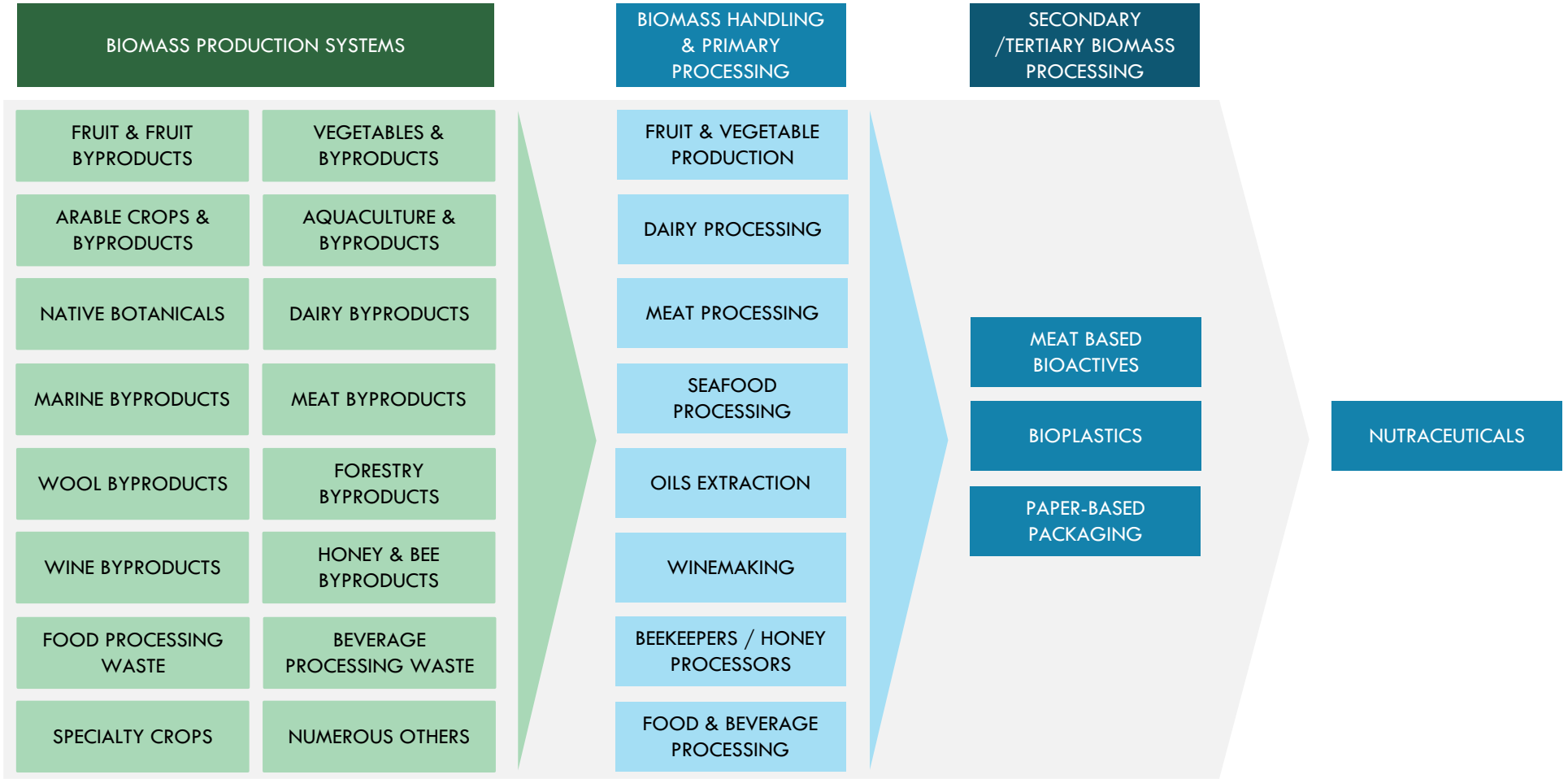


Photo credit: Wikimedia CCA 3.0; DALL.E; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Nutraceuticals has current and potential linkages into large parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



A range of unique New Zealand bioresources are transformed into functional and high value nutraceuticals

WHAT CAN YOU DO WITH IT?

DEER VELVET FOR VITALITY

BLACKCURRANT AND PINEBARK EXTRACT FOR MENTAL CLARITY

SPIRULINA FOR ENERGY

COLLAGEN FOR HAIR, SKIN AND NAIL STRENGTH

ALGAL, HOKI OMEGA AND DHA OILS

PROBOTIC & LACTOFERRIN FOR KIDS GROWTH

ANTIOZIDANT FOR CELL VITALITY

CBD OIL FOR PAIN

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Nutraceuticals are in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 INCREASING BIOMASS	- Potential feedstock crops achieve high biomass yields - Full biomass utilisation in New Zealand
2 INCREASING VALUE-ADDED	- Nutraceuticals are a high value product - Utilises science
3 BUILDING RESILIENCE	- Creates employment and industry in the regions - Higher wages available, skilled labour required in manufacturing, NPD etc. - Increased social and economic capital - Creates skills that can be transferred to other sectors
4 REDUCING AGRICULTURAL GHG EMISSIONS	- Replacing high emission systems with low emission systems - More value added post farm gate creates scope to reduce emissions on-farm through lower stock rates (more for less)
5 REPLACING FOSSIL FUELS	- Opportunity to replace fossil fuels on farm and in production - Replacing fossil fuel based ingredients - Replacing fossil fuel based packaging
6 RETHINKING WASTE	- Adopt circular principles as part of the production system or business model - Use of byproducts or waste streams (e.g. forestry waste, grape seeds and skins)

Nutraceuticals can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

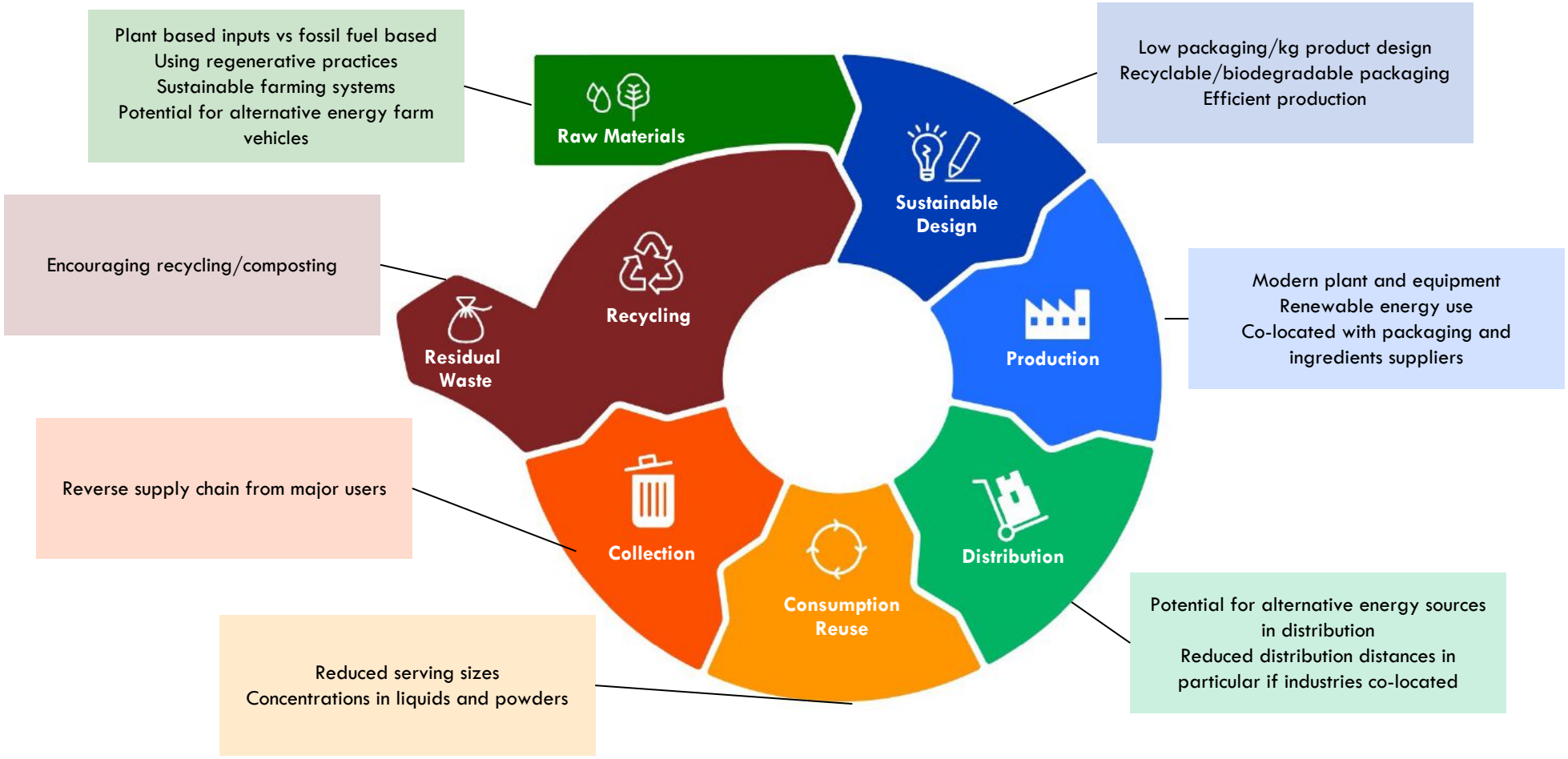


Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Nutraceuticals ingredients suppliers and firms are located across the country but clustered around Auckland

SELECT FIRMS
Not a complete list

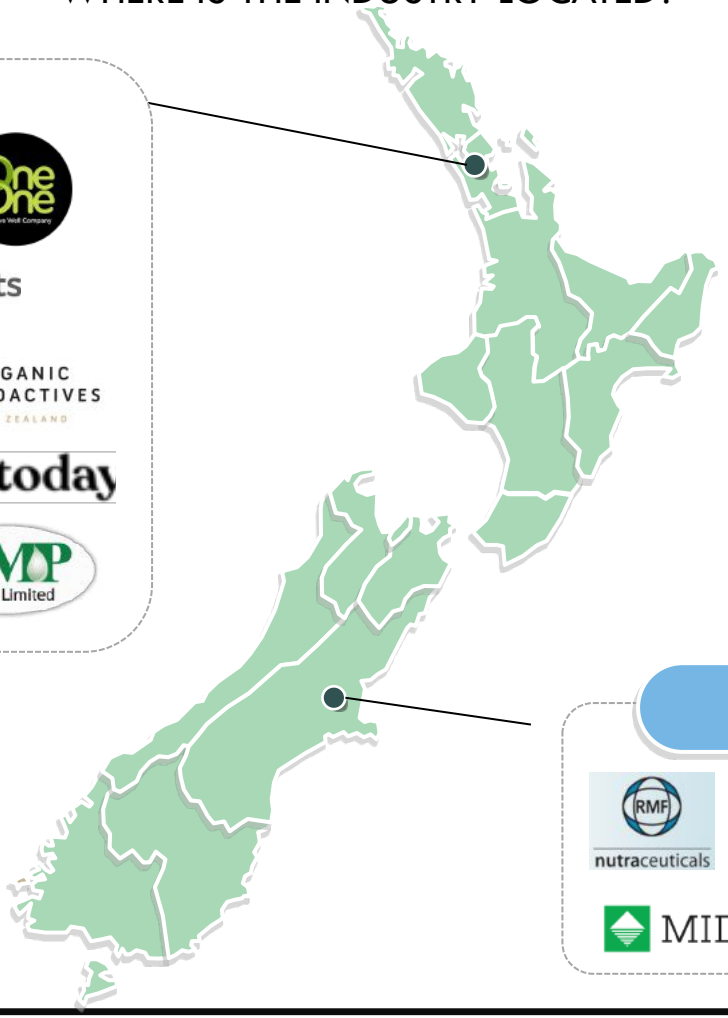
WHERE IS THE INDUSTRY LOCATED?

Auckland

douglas
vitaco
One One
Bio Vit
Pure Ingredients
Cosmetics • Personal care • Natural health
goodhealth
Anagenix
ORGANIC BIOACTIVES
Arepa
Lifestream
me | today
MitoQ
THE HEALTH LAB
GMP Dairy Limited

Other North Island

nutri NZ
ENZO NUTRACEUTICALS
ENZOGENOL
Quantec
PharmaNZ
BePURE



Other South Island

BioBalance New Zealand
PURE VITALITY

Canterbury

RMF nutraceuticals
bio-mer
WAITAKI BIOSCIENCES
MIDLANDS
EvergreenDeer

NOTE: Select firms and contract manufacturers only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- A range of organisations support the primary industries

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use these products

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities are researching topics within this platform

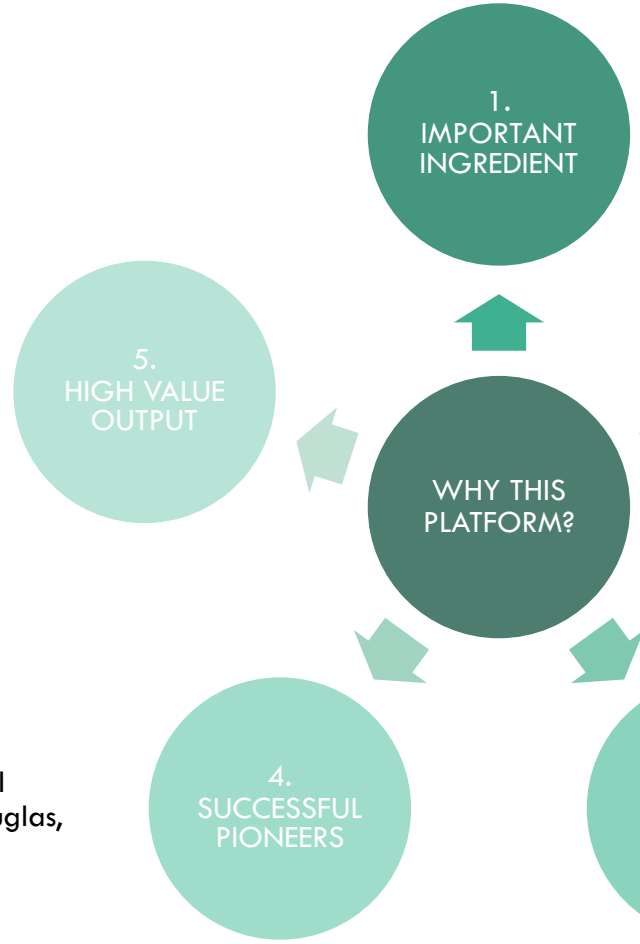
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- New Zealand firms and consumers use a lot of nutraceuticals
- A critical ingredient in many exports

- High value export
- New Zealand strong reputation for quality and trusted ingredients

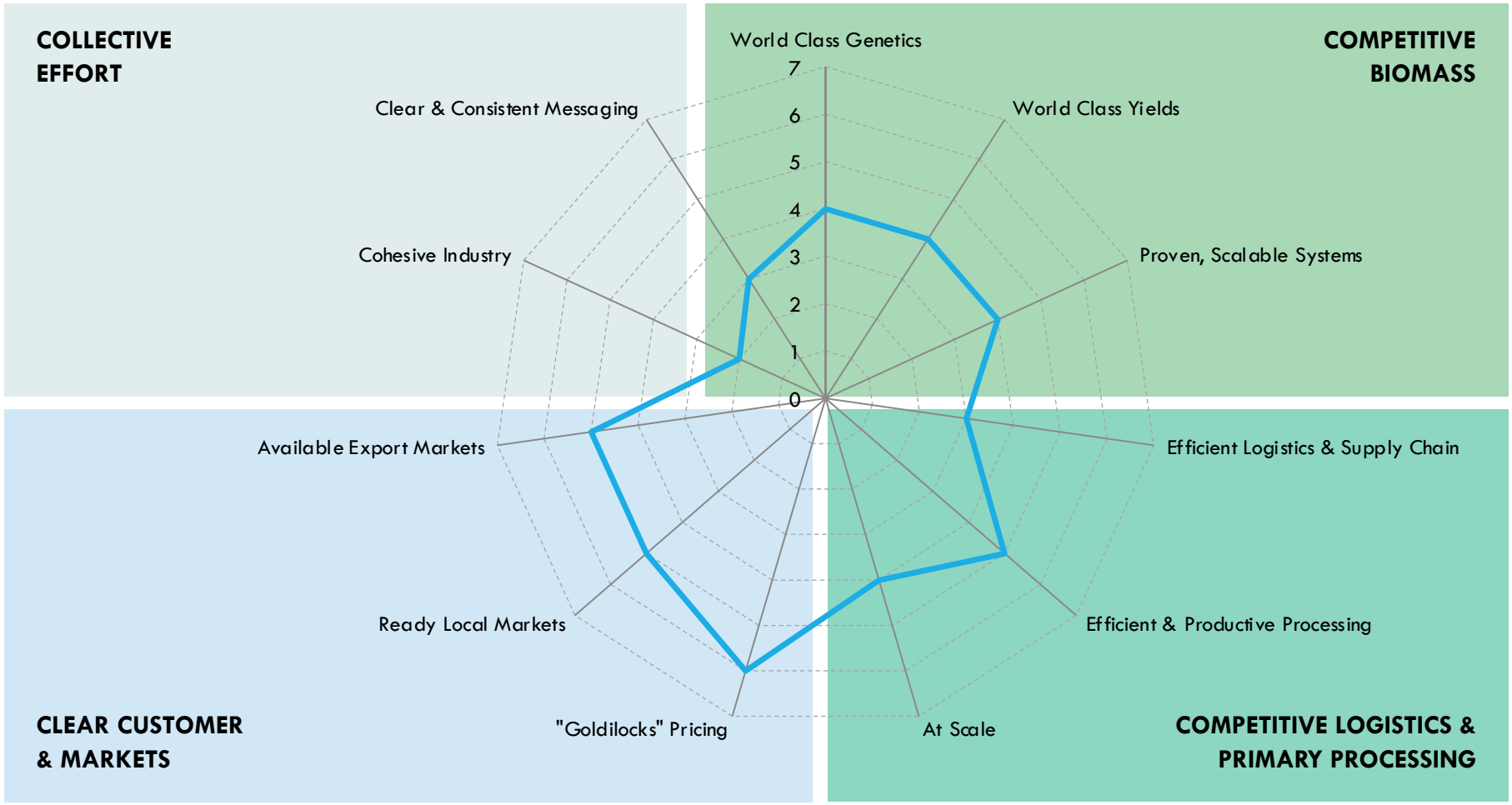
- Demonstrated capability to produce nutraceuticals in New Zealand
- Capability throughout the supply chain including contract manufacturers
- Scientific research into efficacy and functional benefits

- Strong group of successful pioneering firms (e.g. Douglas, Lifestream)

- High value products produced as pill, capsule or powdered (high $/kg)
- Used as ingredient in functional foods, nutritional F&B products

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

Can we continue to make it work?

- Is there a new technology or situation that makes this industry more viable?
- New Zealand achieves high yields in many crops; can these be delivered consistently across multiple species
- Can we successful develop the farming systems required for success in new areas (e.g. native botanicals, seaweed)

Why you? Why NZ? What is your unique selling proposition?

- How will the sector and individual products stand out and succeed?
- Is there commercial demand for premium nutraceuticals

Is the science keeping up with consumer requirements?

- Where are the key demand areas (e.g. children's health, immunity boosting etc.)
- How will the science keep ahead of the global competition?

How do we best reach our target markets?

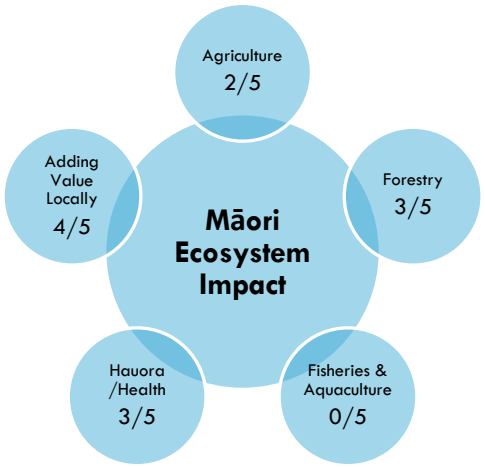
- Many nutraceuticals are sold on-line. How do we successfully target our customers?

Source: Coriolis analysis

Nutraceuticals

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆☆☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆☆☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆☆☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- High engagement – traditionally called 'Rongoa Māori'. The combination of natural resources for nutritional or medicinal purposes.
- Traditional knowledge and practices of kawakawa, harakeke, horopito, mānuka, kānuka, kumarahau etc. There are many traditional and modern practices.
- Treaty asset: protection of cultural knowledge, cultural appropriation of commercialised rongoa māori. Potential WAI 262 issues.
- Māori investors will wonder if too tricky an issue given the "noise" around traditional IP. Alternatively, Māori investors might see an opportunity to leverage Māori brand / mātauranga Māori to take a stake in larger scale supplier in this market
- Linkages into essential oils

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆☆☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆☆☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆☆☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**65/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION	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

1 INVESTING IN **EFFICACY RESEARCH**

- Ongoing research into efficacy in particular vs. the key competition (e.g. greenshell mussels extracts)

2 INVESTING IN INCREASING **PROCESSING CAPACITY**

- Expansion of existing operations using circular principles
- New processing in regions close to raw materials

3 INVESTING IN DEVELOPING **SPECIALISED PRODUCTS**

- R&D into potential targeted fractionates and extracts (e.g. polyphenols, terpenes), in particular from waste streams
- Research into potential health claims
- NPD around product and packaging

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

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)

PLATFORM DEFINITION

In the current NZ standard industry classification, infant formula is captured under the catch-all "Cheese and Other Dairy Product Mnfg." [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]

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.

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.

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

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

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

LCPUFAs: long chain polyunsaturated fatty acids

This platform extends everyday infant formula into specialised medical products and similar products targeted at other age groups

WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- Over the past twenty years, New Zealand has built a billion dollar infant formula platform on the back of existing dairy capabilities	- Child numbers are declining, particularly in China - At the same time, competition is growing	Further growth will require (1) a shift from everyday to specialised products (e.g. medical formulas targeting specific conditions) including markets beyond children and (2) improved in-market sales and marketing, particularly to doctors

Conceptually, this opportunity uses dairy biomass to produce high value dairy ingredients and nutritionals for infant, adult and medical products

WHAT IS THE CONCEPT?

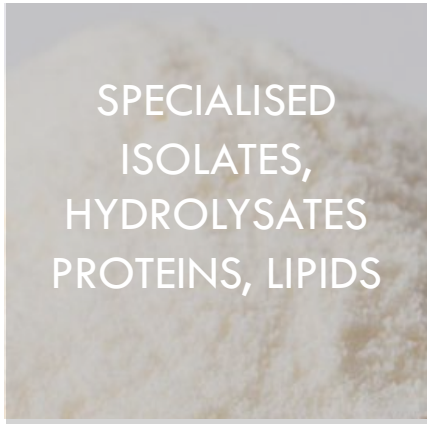
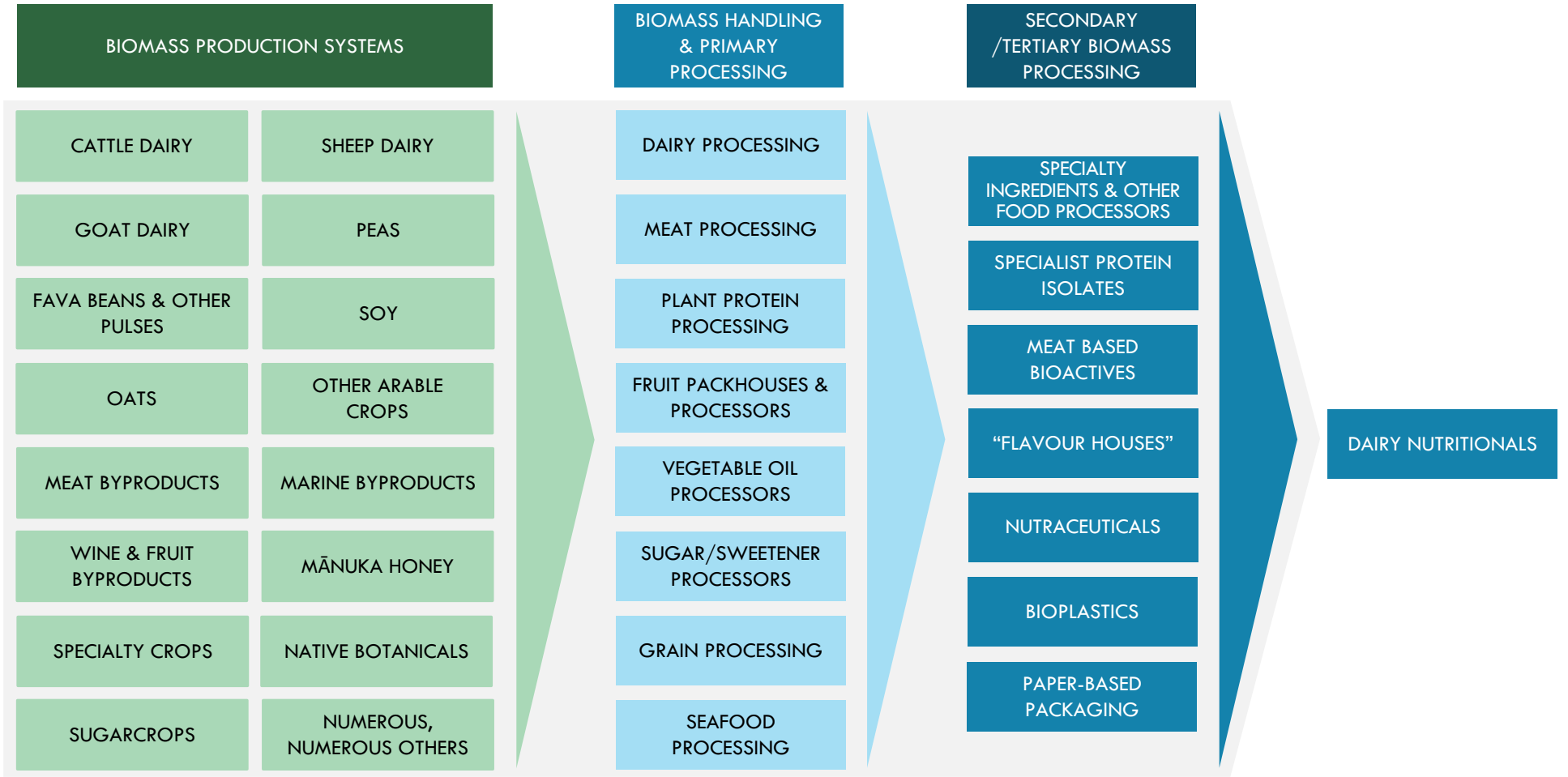


Photo credit: NZ Story; Wikimedia CC ASA 3.0; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Dairy nutritional products sits at the peak of a wide network of current and potential linkages into large parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Dairy nutritionals is a concept that encompasses a wide variety of high value products

WHAT CAN YOU DO WITH IT?

INFANT FORMULA

HEALTHY AGING FORMULA

SPECIALISED/ TARGETED MEDICAL

SPECIALISED MEDICAL BEVERAGE

LOW GI GOAT POWDER BEVERAGE

COLOSTRUM

IMMUNITY POWDER (Lactoferrin)

LACTOFERRIN BEVERAGE

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Dairy nutritional products are in line with the desired direction for the bioeconomy, they add significant value to the dairy sector

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Utilises existing biomass for higher value
2 **INCREASING VALUE-ADDED**	- High value output of dairy nutritional powders, beverages - High value and unique specialty dairy ingredients
3 **BUILDING RESILIENCE**	- Creates employment and industry in the regions - Higher wages available, skilled labour - Products support a healthy diet and overall wellness objectives
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- More value added post farm gate creates scope to reduce emissions on-farm through lower stock rates
5 **REPLACING FOSSIL FUELS**	- Opportunity to replace fossil fuels in processing (e.g. biodiesel, solid fuel) - Opportunity to replace fossil fuels on-farm (e.g. soil amendments, biodiesel) - Opportunity to use recyclable and sustainable packaging
6 **RETHINKING WASTE**	- Circular principles incorporated into the production system or business model - New systems design creates less waste - Product is derived from existing commodity production - High tech extraction systems able to extract more from less

Dairy nutritionals production is part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

High yields (dairy and pulse crops)
Able to use sustainable, regenerative farming systems
Potential for alternative energy farm vehicles

Low packaging/kg product design
Recyclable/biodegradable packaging
Efficient production

Encouraging recycling/composting
Potential for additional extraction of waste streams

Modern plant and equipment
Renewable energy use where possible
Production located close to raw material inputs
Maximise coproducts

Reverse supply chain from major users
Recycling and reusing major packaging (e.g. aluminium cans)

Reduced distribution distances
Potential for alternative energy sources in distribution
Extending sustainability to logistics partners

No obvious opportunities

Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Nutritional dairy firms and specialised dairy ingredients firms are spread across the country

SELECT FIRMS
Not a complete list

WHERE IS THE INDUSTRY LOCATED?

Auckland

Fonterra, nzmp, NIG NUTRITIONALS, NewMilk, GMP Dairy Limited, DNL, vitaco, NEW ZEALAND PURE DAIRY, WINSTON NUTRITIONAL, DANONE NUTRICIA Early Life Nutrition, SNL Synergy Nutrition Limited, Vitalabs NEW ZEALAND, One One, Lifestream, PROFILE PRODUCTS

Other North Island

nzmp, Quantec, TATUA, PĀMU, BODCO Home for Dairy, Dairy Goat Co-operative, Happy Valley Nutrition Limited, Hansells Masterton

Other South Island

Alaron, SEPEREX NUTRITIONALS LEADING BIOACTIVE HEALTH INGREDIENTS

Canterbury

Wimex Ltd, proseria

NOTE: Select branded firms and contract manufacturers only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- Federated Farmers of New Zealand support farmers

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use protein powders in their products

UNIVERSITIES / RESEARCH

- Foundation for Arable Research (FAR) applied research organisation supporting arable farmers
- A wide range of NZ Universities are researching topics within this platform

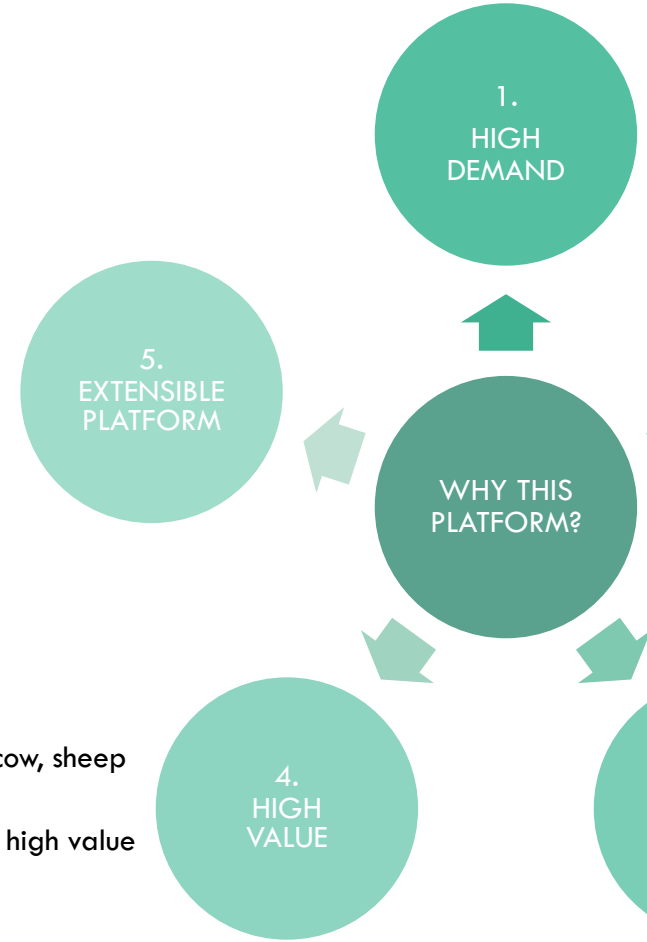
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

Source: various company and organisation websites; Coriolis analysis

There are a range of strong arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- Specialised dairy nutritionals are a high growth market in New Zealand and globally
- As the population ages the demand will increase for specialised aged care dairy nutritionals

- New Zealand has strong current exports of dairy products
- Potential to increase export value from existing production

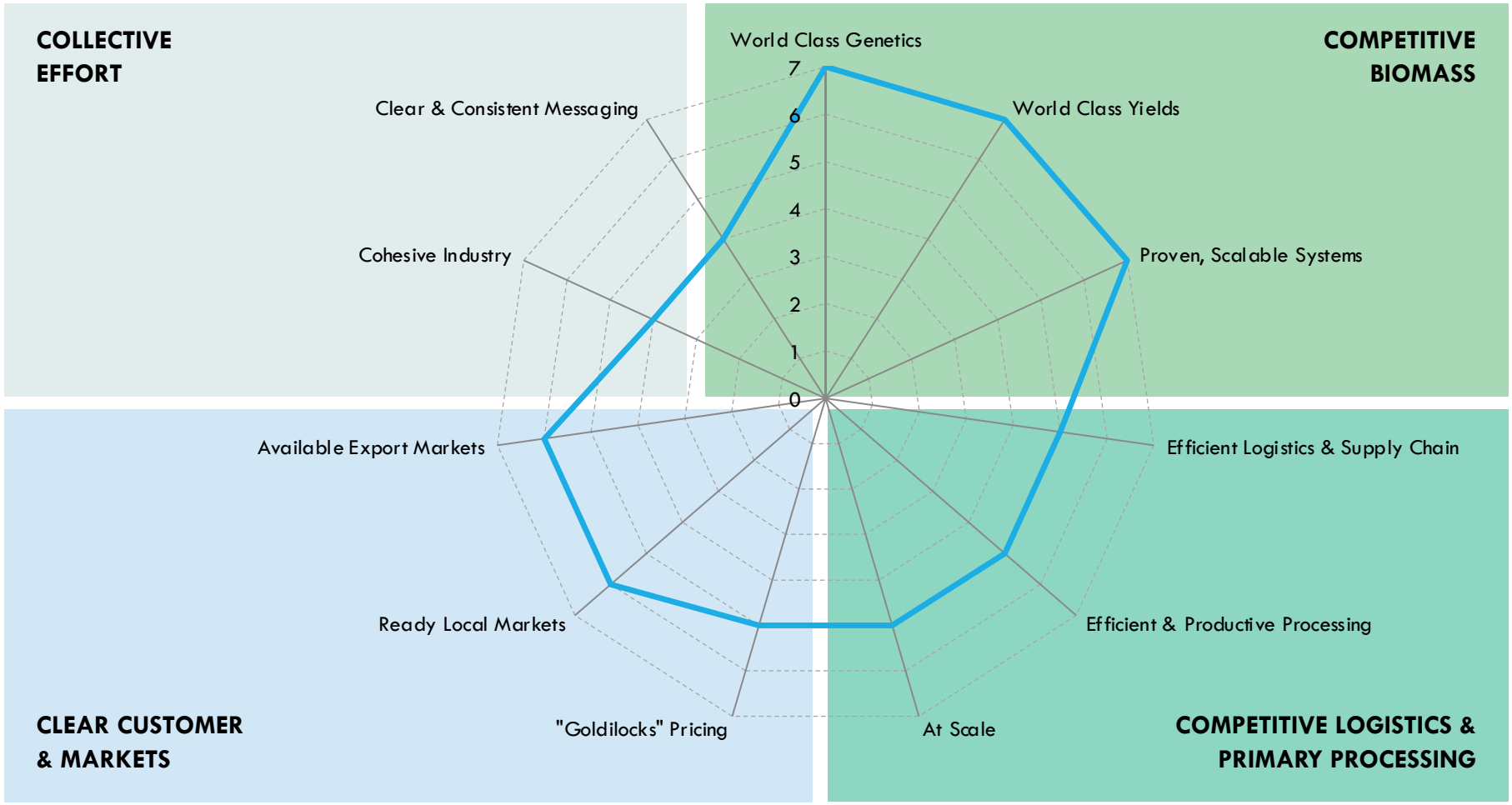
- Demonstrated capability to produce and market dairy products, ingredients and nutritionals

- High value outputs from cow, sheep and goat ingredients
- Combines well with other high value ingredients

- Dairy Nutritionals are an extensible platform (powder, liquids, supplements, snacks, bars)

The platform performs well in general, however improvements can be made to access new markets and produce new products

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



NOTE: WPI is at scale and efficient, gaps are currently with the plant-based proteins; Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

Why is most dairy exported as ingredients?

- There is further opportunity to add value to dairy products by producing the ingredients and end-user products focusing on specialised dairy nutritionals
- Why haven't efforts worked to date? (i.e. majority of exports still milk powders)

Is it risky to focus so much on Asia (especially China)?

- What are the most attractive markets for dairy nutritionals?
- Who is willing to pay the most for dairy nutritionals and why?

Why you? Why NZ? What is your unique selling proposition?

- How will the sector stand out and succeed? Free range, pasture fed?
- Is there commercial demand?
- Which markets are the most attractive?
- Can the success in cow dairy extend to other proteins, such as sheep, goat and plant-based?

Why can we import dairy whey protein cheaper from the EU than NZ?

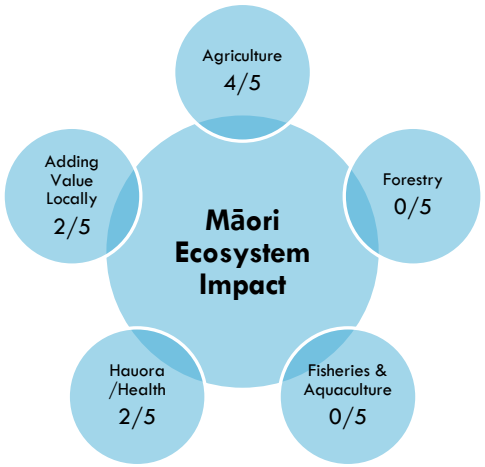
- Great question. Volume, volume, volume

Source: Coriolis analysis

Infant Formula / Wider Dairy Nutritionals

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Low engagement – lack of perceived connection between this opportunity and Māori.
- Strong global competitors – would need to see a strong point of difference.
- Little alignment with Māori values/brands/principles and no traditional or natural connection.
- Ongoing potential environmental harm issues to be mitigated from herd management: cattle, goats etc.
- Likely some interest from existing Māori land investors seeking to extract greater returns from existing dairy or sheep operations.
- Some attraction in working with industry organisations and universities / research institutes to secure patentable IP.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**68/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

New Zealand builds a resilient dairy nutritionals sector based on (1) a shift from everyday to specialised products (e.g. medical formulas targeting specific conditions) including markets beyond children and (2) improved in-market sales and marketing, particularly to doctors

1 INVESTING IN INCREASING **PROCESSING CAPACITY**

- Implementing the latest in modern systems

2 INVESTING IN DEVELOPING **SPECIALISED PRODUCTS**

- Expansion of existing operations
- Research into potential health claims
- R&D into targeted formulations

3 INVESTING IN **PACKAGING**

- NPD around product and packaging

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

SPORTS NUTRITION / WEIGHT CONTROL

TOTAL SCORE 38/50

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)

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

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	?

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

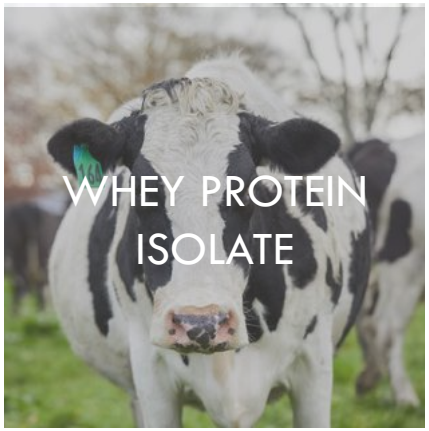
This platform scales up sports nutrition through continued innovation around local biomass ingredients

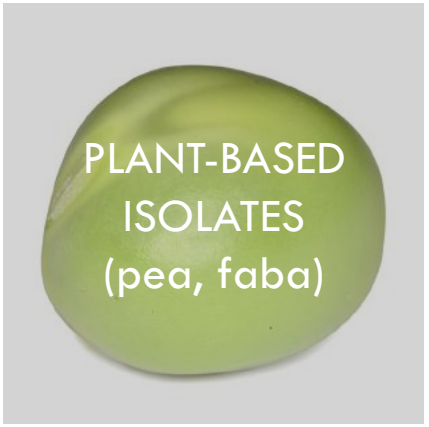
WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- New Zealand is building a sports nutrition platform on the back of existing dairy capabilities	- New Zealand currently imports many major non-dairy ingredients (e.g pea protein isolate)	- With growing global demand, particularly as Chinese consumers enter the category, New Zealand is well positioned for further growth based on exports

Conceptually, this opportunity uses whey and plant-based proteins and other ingredients to produce high value sports nutrition products

WHAT IS THE CONCEPT?





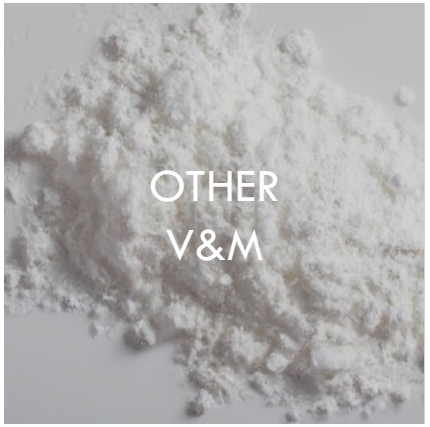
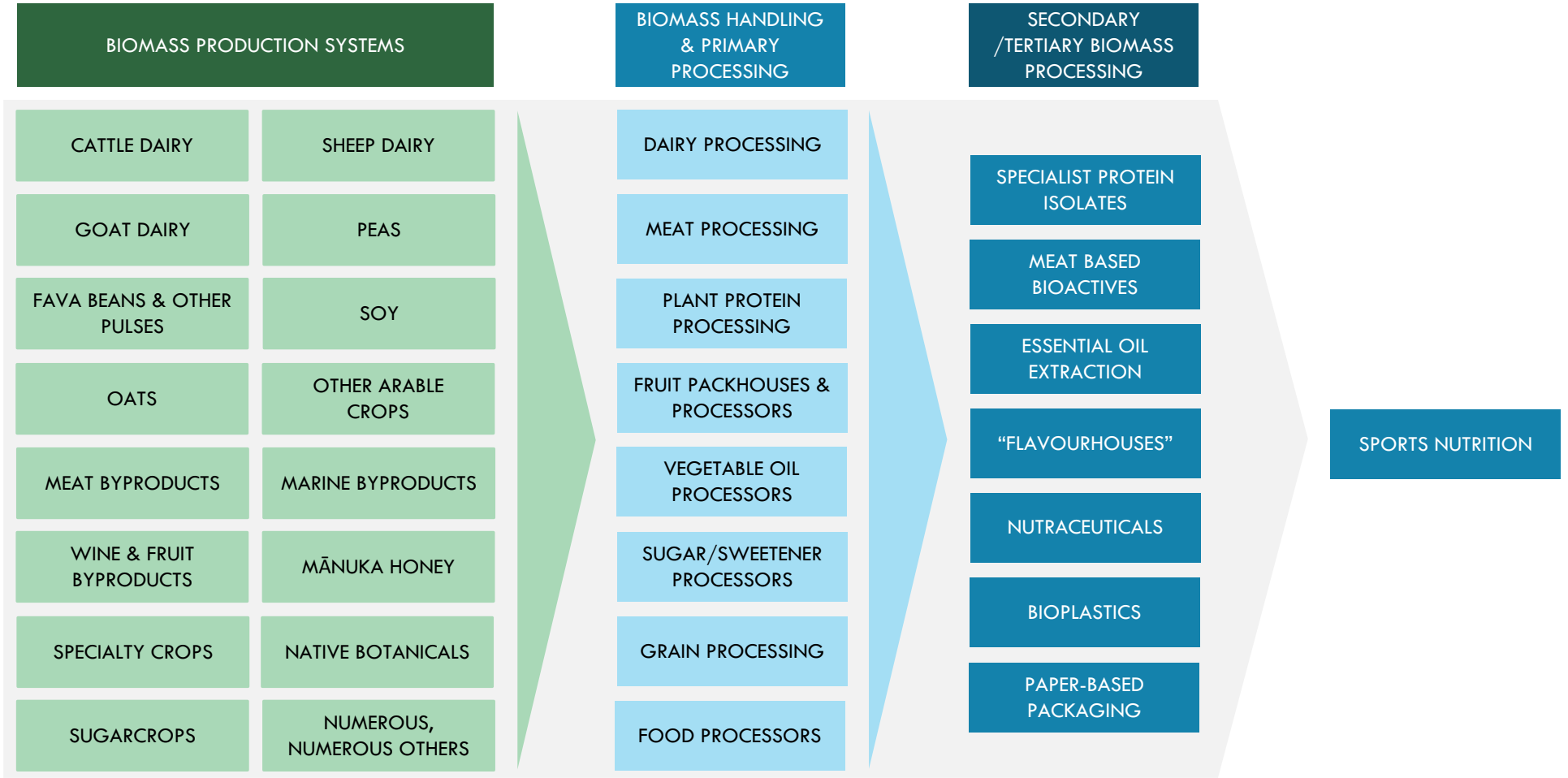


Photo credit: NZ Story; Wikimedia CC ASA 4.0; DALL.E; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

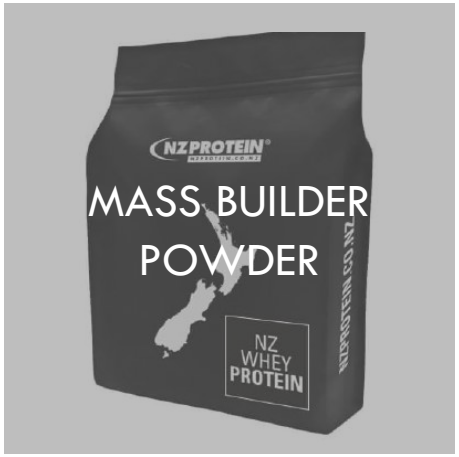
Sports nutrition has current and potential linkages into large parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Sports nutrition and weight management products come in many forms

WHAT CAN YOU DO WITH IT?



MASS BUILDER POWDER

SLIMMING POWDER

VEGAN POWDER OPTION - PEA

HEMP POWDER

READY TO DRINK BEVERAGE

PROTEIN BARS

SMOOTHIE

SNACKS

Source: various company websites; Coriolis analysis. Photo credit: fair use/fair dealing; low resolution; complete product/brand for illustrative purposes

Sports nutrition products are in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 INCREASING BIOMASS	- Full utilisation of dairy biomass in New Zealand - Potential to grow peas and/or other pulses for use as key ingredient for plant-based biomass
2 INCREASING VALUE-ADDED	- High value output of dairy protein powders - High value of plant based powders - High value coproducts
3 BUILDING RESILIENCE	- Creates employment and industry in the regions - Higher wages available, skilled labour - Products support a healthy diet and overall wellness objectives - Currently all plant-based protein isolates imported
4 REDUCING AGRICULTURAL GHG EMISSIONS	- Plant-based system is inherently a low emission system - More value added post farm gate creates scope to reduce emissions on-farm through lower stock rates
5 REPLACING FOSSIL FUELS	- Opportunity to replace fossil fuels in processing (e.g. solid fuel) - Opportunity to use recyclable and sustainable packaging
6 RETHINKING WASTE	- Circular principles part of the production system or business model - New systems design creates less waste - Product is derived from existing commodity production - High tech extraction systems able to extract more from less

Sports nutrition and weight management protein production is part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

High yields (dairy and pulse crops)
Using regenerative practices
Sustainable farming systems
Potential for alternative energy farm vehicles

Low packaging/kg product design
Recyclable/biodegradable packaging
Efficient production

Encouraging recycling/composting

Modern plant and equipment
Renewable energy use
Located close to raw material inputs
Maximise coproducts (e.g. starch, fibre)

Reverse supply chain from major users

Potential for alternative energy sources in distribution
Reduced distribution distances in particular if industries co-located
Extending sustainability to logistics partners

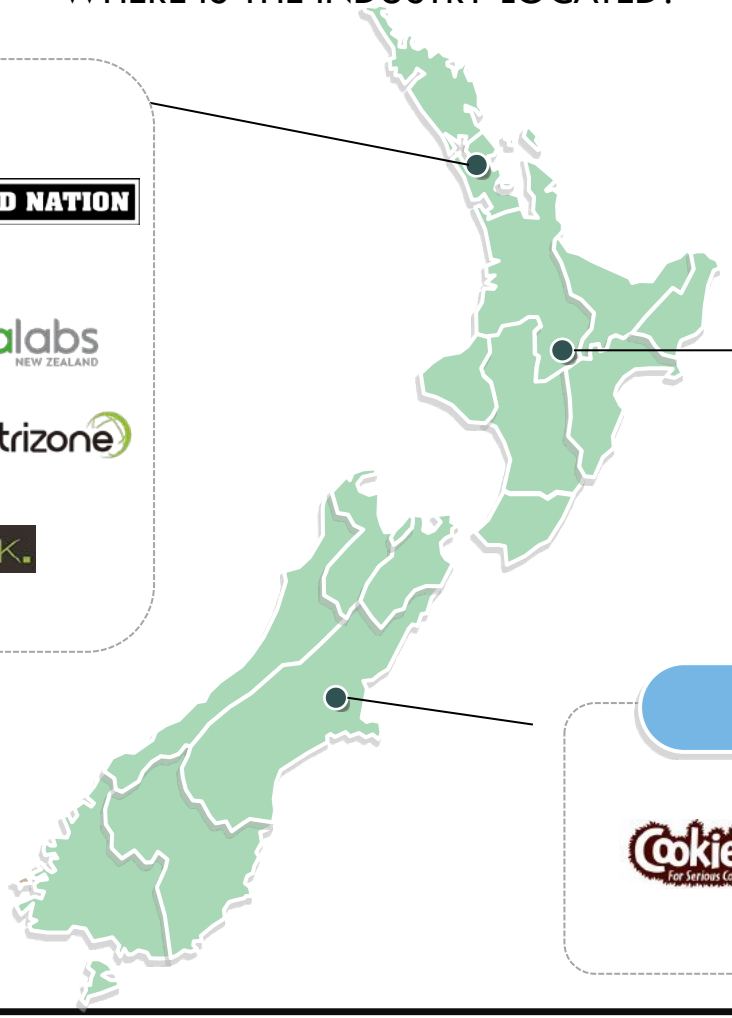
Reduced serving sizes
Encouraging filtering waste and reuse

Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

The manufacturers of sport nutrition/weight management products are spread across the country

SELECT FIRMS
Not a complete list

WHERE IS THE INDUSTRY LOCATED?



Auckland

vitaco
nuzest
BRAND NATION
Natural Farm Group
Vitalabs NEW ZEALAND
PROFILE PRODUCTS
NZPROTEIN NZPROTEIN.CO.NZ
Nutrizone
NOODE.
HEALTHPAK.

Other North Island

Hansells Masterton
nzmp
nutratech better your body
radix nutrition
NOTHING NAUGHTY.
Justines
zealea
clean NUTRITION

Other South Island

Alaron
inline
aglow
PHARMALINK Extracts Limited
Nutraceutical innovation and manufacture

Canterbury

CookieTime For Serious Cookie Munchers
proooma
Wimpex ltd

NOTE: Select branded firms and contract manufacturers only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- Federated Farmers of New Zealand support farmers

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use protein powders in their products

UNIVERSITIES / RESEARCH

- Foundation for Arable Research (FAR) applied research organisation supporting arable farmers
- A wide range of NZ Universities are researching topics within this platform

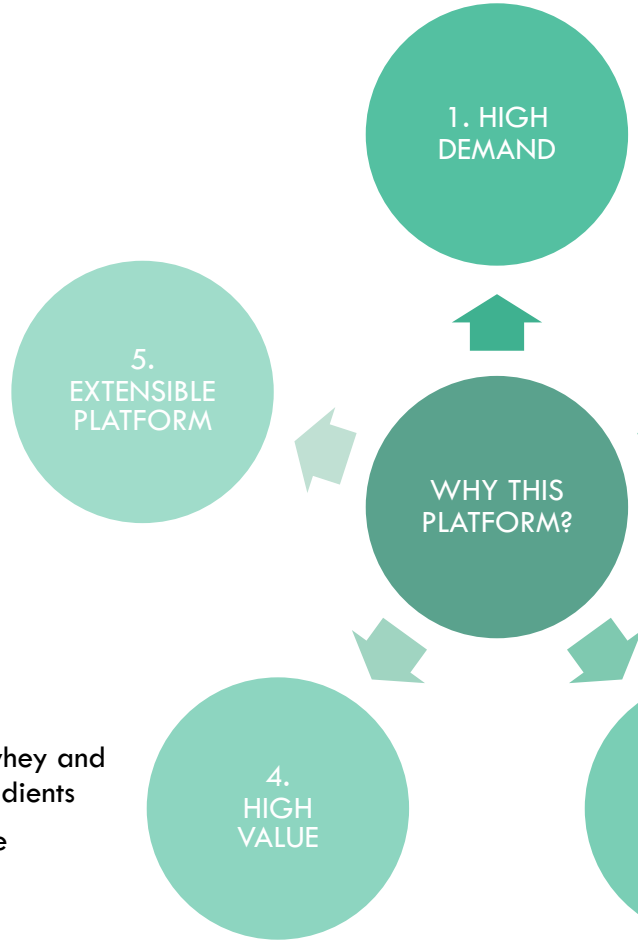
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

Source: various company and organisation websites; Coriolis analysis

There are a range of strong arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- Sports nutrition and weight management is a high growth market in New Zealand and globally

- Dependent on imports for plant-based proteins isolates
- Market highly volatile (e.g. supply challenges, price volatility)

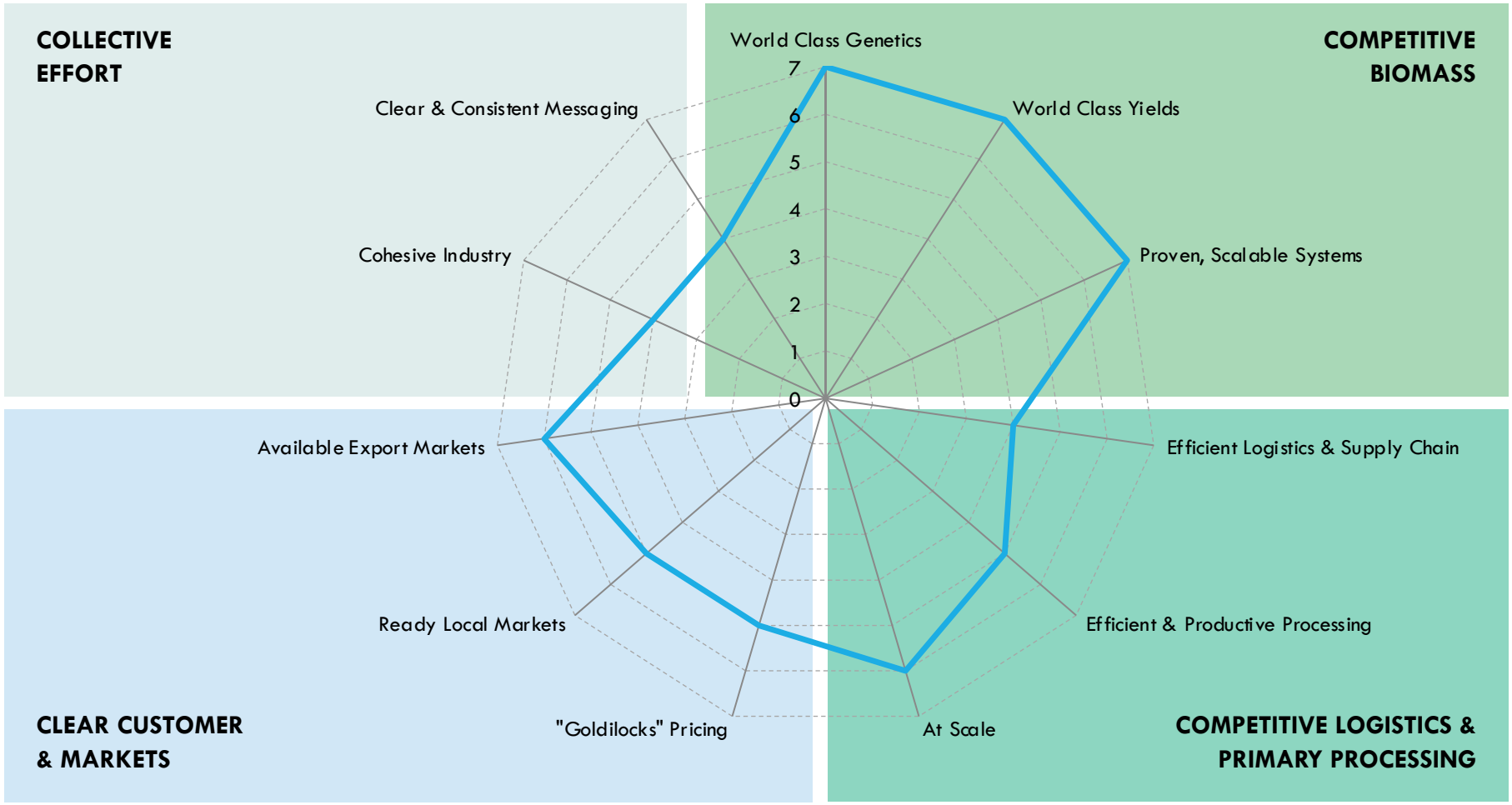
- Demonstrated capability to produce and market whey proteins (this could extend to plant based proteins)

- High value outputs from whey and plant-based protein ingredients
- Combines other high value ingredients

- Sport nutrition and weight management is an extensible platform (powder, snacks, bars, beverages)

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



NOTE: WPI is at scale and efficient, gaps are currently with the plant-based proteins; Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

Why is most dairy exported as ingredients?

- Is there further opportunity to add value to dairy via sports nutrition or nutritional weight management powders?

What is the feasibility of developing a plant-based isolate plant in New Zealand?

- There is currently a gap in the market with no plant-based isolate plant
- New Zealand achieves high arable crop yields; can these be delivered consistently across multiple species
- Is there a new technology or situation that makes a plant-based industry more viable – in particular plant-based?
- How will NZ compete with quality international options?

Why you? Why NZ? What is your unique selling proposition (USP)?

- How will the sector stand out and succeed? Free range, pasture fed?
- Is there commercial demand for premium sports nutrition
- Which markets are the most attractive?
- Can the success in cow dairy extend to other proteins?

Why can we import NZ dairy whey protein cheaper from the EU than NZ?

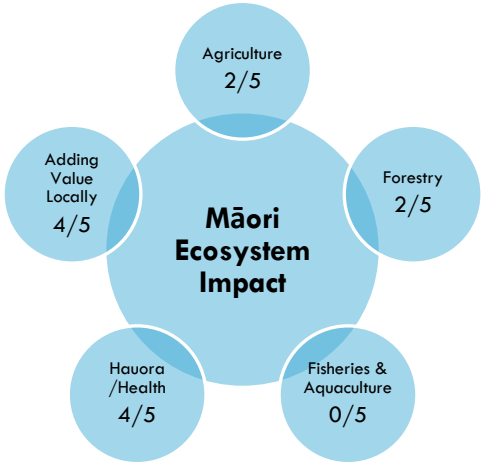
- Great question. Volume, volume, volume.
- Is there an opportunity for smaller firms to form a buying group

Source: Coriolis analysis

Sports Nutrition / Weight Management

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆ ☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆ ☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆ ☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆ ☆
IS THE RISK MANAGEABLE?	☆ ☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- No traditional connection but a modern connectivity to hauora / wellness
- There would be some clear resonating to Māori around health issues e.g. addressing obesity
- Difficult to compete in well-established industry – would need to be a clear differentiator
- Brand potential – use of native/indigenous botanicals, sports industry
- High profile of Māori sports personalities
- Health and sports resonates with brand Māori and Mātauranga
- Leverage existing assets/distribution/retails in primary sector – opportunity to diversify
- Māori investors would be looking at some connectivity to accessing the large margins in this sector

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆ ☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆ ☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆ ☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆ ☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆ ☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**70/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

With growing global demand, particularly as Chinese consumers enter the category, New Zealand is well positioned for further growth based on exports

1 INVESTING IN INCREASING **PROCESSING CAPACITY**

- Implementing the latest in modern systems
- Investing in plant-based processing

2 INVESTING IN DEVELOPING **SPECIALISED PRODUCTS**

- Expansion of existing operations

3 INVESTING IN **RESEARCH & DEVELOPMENT**

- R&D into potential new NZ unique ingredients
- Research into potential health claims
- NPD around product and packaging

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

MEAT BIOACTIVES/BYPRODUCT PROCESSING

TOTAL SCORE 37/50

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://nara.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

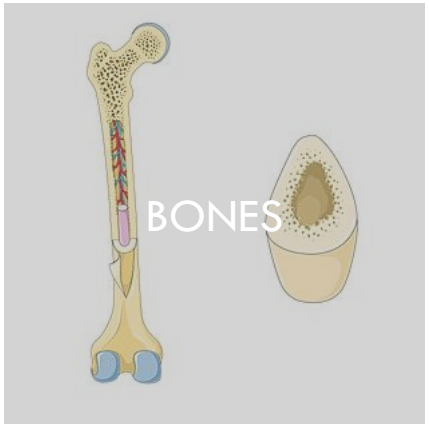
Conceptually this platform proposes using meat byproducts and coproducts to produce high value bioactives

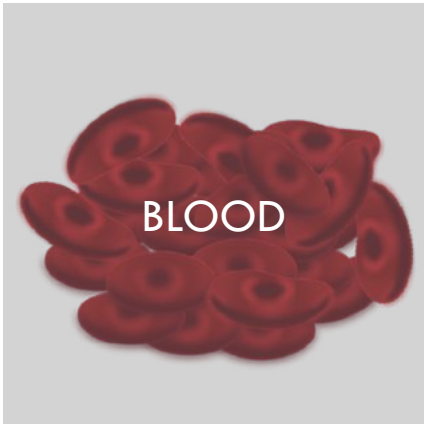
WHY DO WE CARE?

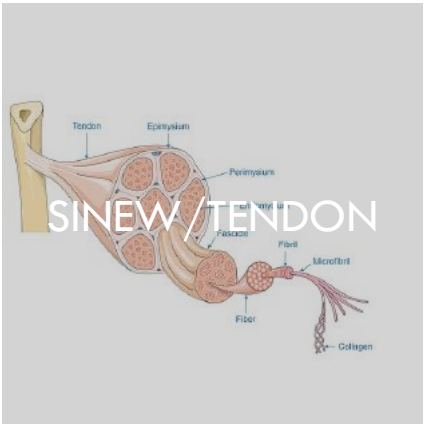
SITUATION	COMPLICATION	RESOLUTION
- New Zealand has a successful meat processing industry that produces a large amount of byproducts and 'waste'. - New Zealand has a large traditional rendering sector and an emerging meat bioactives sector	- Most meat processing byproducts and waste still goes to low value uses	- New Zealand firms can do more to create value from secondary meat byproduct streams.

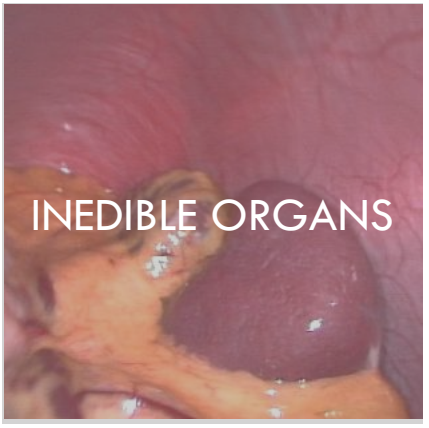
Conceptually, this opportunity adds value to byproducts and coproducts from animals (post-abattoir)

WHAT IS THE CONCEPT?









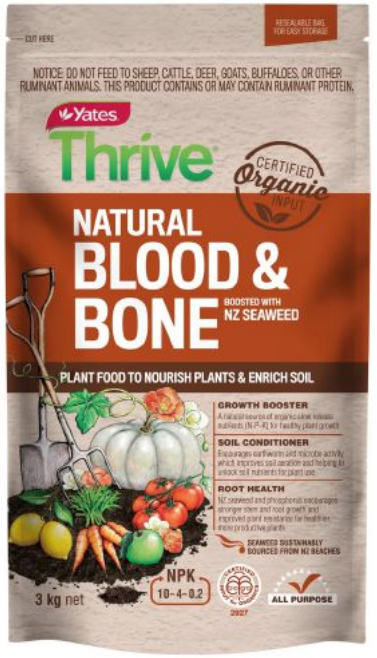
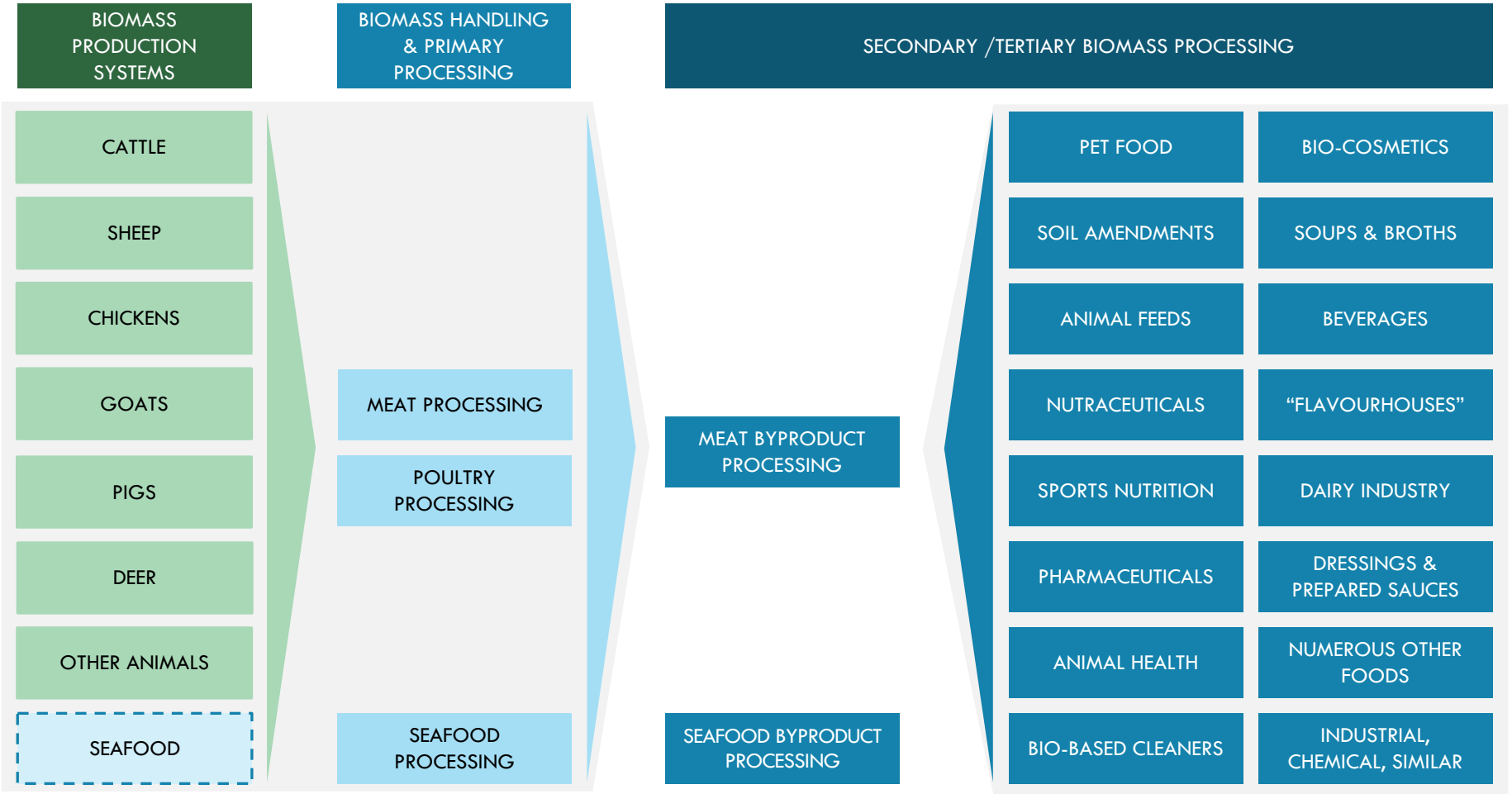


Photo credit: Wikimedia CC ASA 3.0 4.0; DALL.E; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

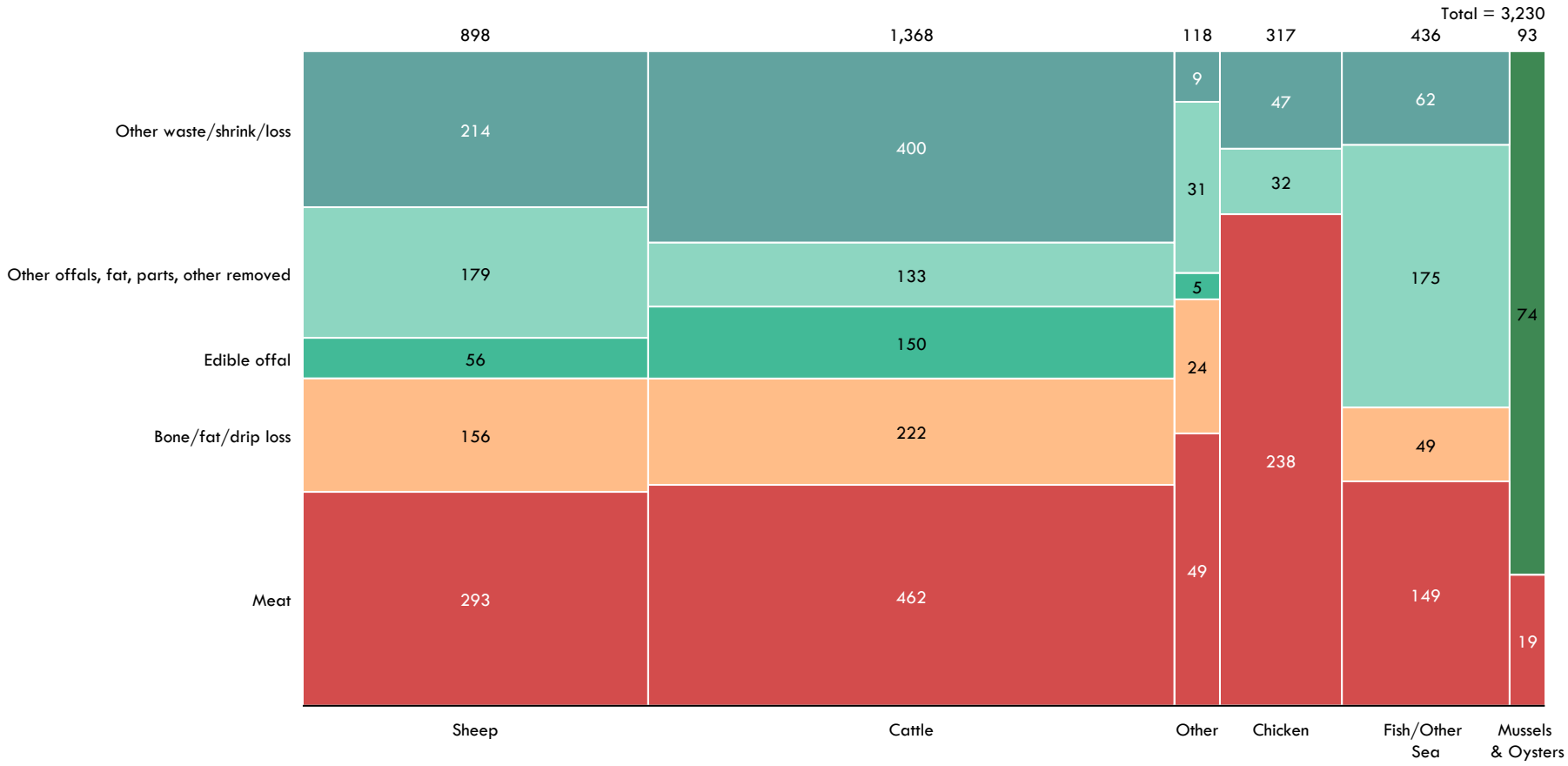
Meat byproduct processing has numerous current and potential linkages into significant parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



New Zealand animals provide a wide variety and large volume of raw materials beyond meat and edible offal

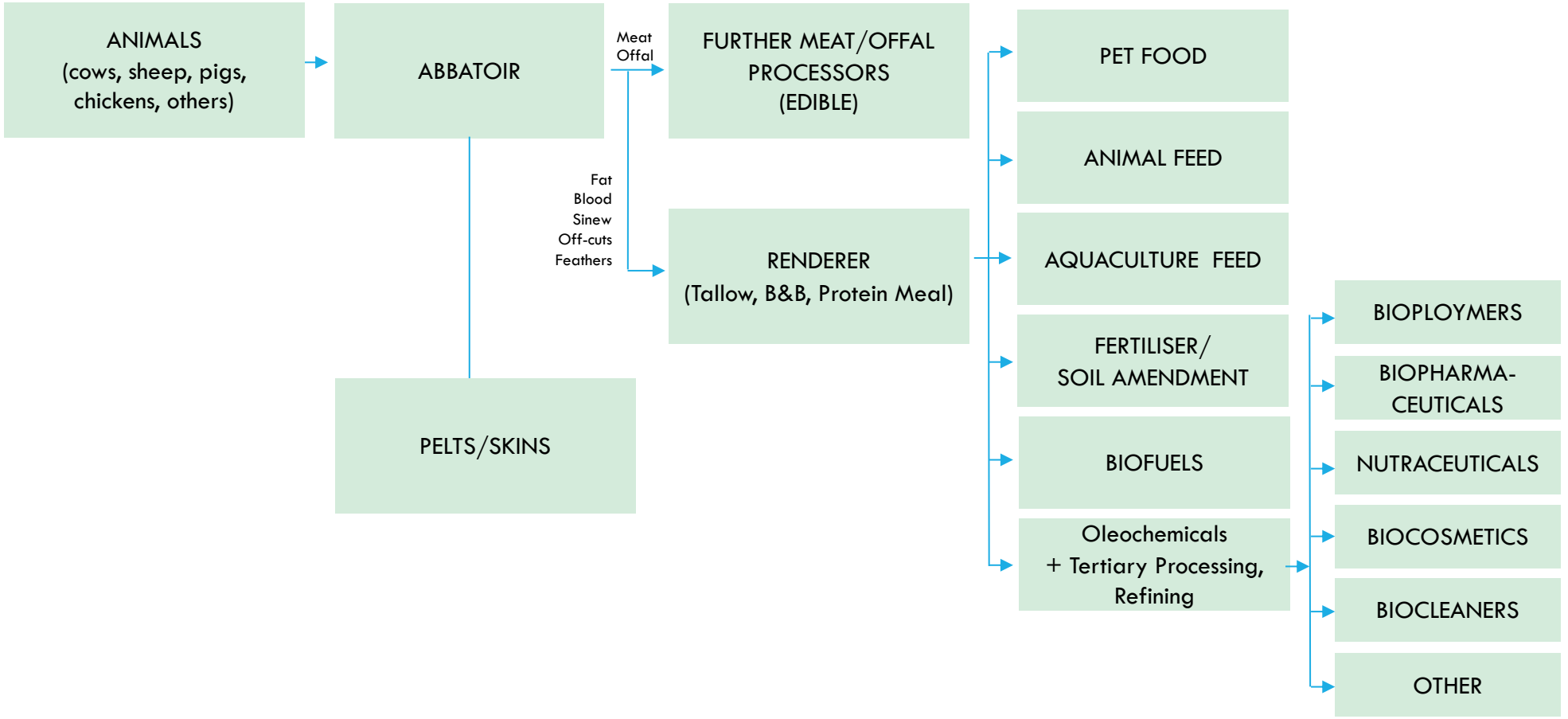
ANIMAL BASED RAW MATERIAL BY TYPE/DISPOSITION (TONNES, 2019)



Note: seafood excludes bycatch and waste fish currently dumped at sea; excluding skin, gut contents & blood; data is potential, not actual; actual will be lower based on what is sold (export carcase vs. exports bone-in vs. domestic boneless): Source: UN FAO AgStat; UN FIshStat; AHDB; MPI; various published articles; various textbooks; industry interviews; Coriolis analysis and estimates

Animal co-products and by-products have a wide range of uses beyond feeding people

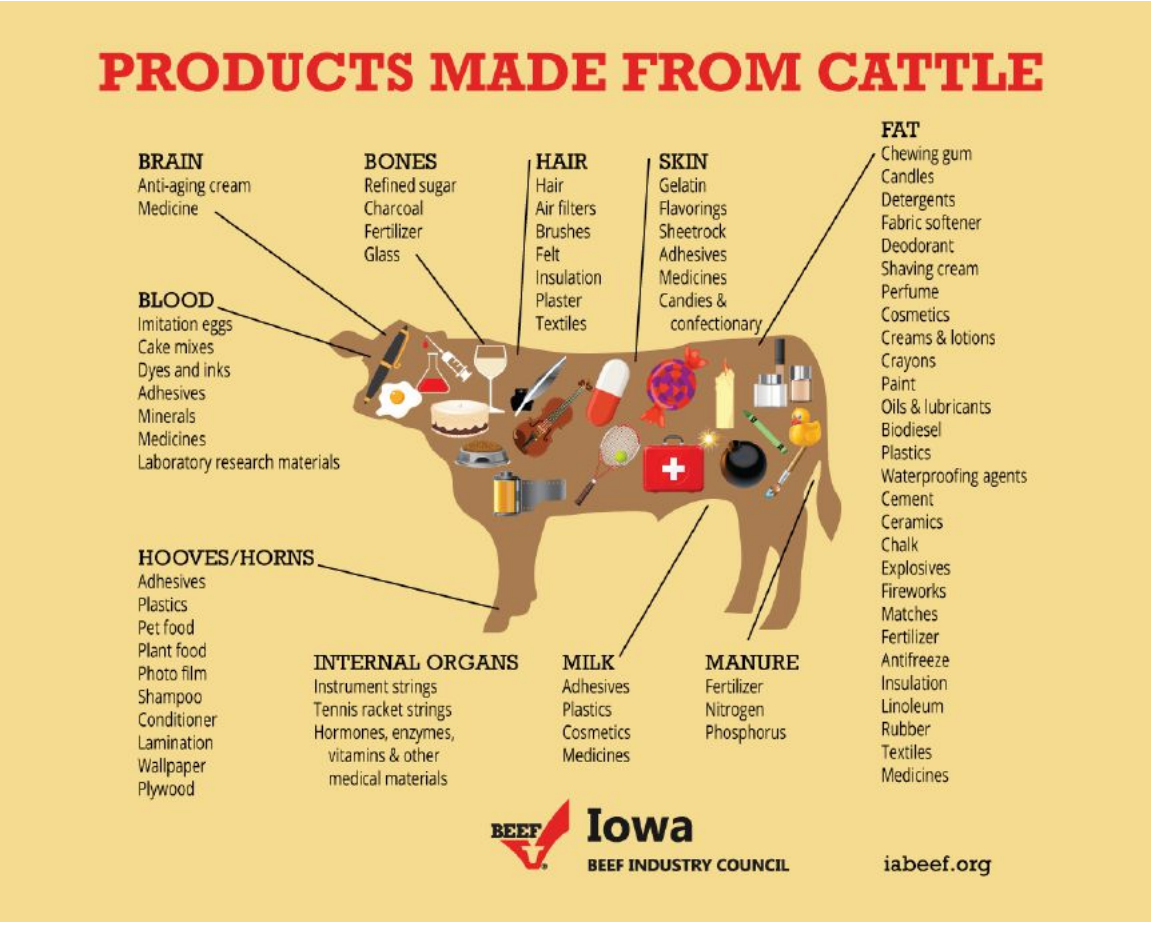
BASIC ANIMAL PROCESSING CHAIN



Source: Iowa Beef Industry Council

Animal co-products and by-products have a wide range of uses beyond feeding people

PRODUCTS MADE FROM COWS



Source: Iowa Beef Industry Council

High value meat byproduct processing is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 INCREASING BIOMASS	- Utilising a unique New Zealand biomass - Full biomass utilisation in New Zealand (e.g. tallow, bones, off-cuts)
2 INCREASING VALUE-ADDED	- High value products are available from co-products
3 BUILDING RESILIENCE	- Creates employment and industry in the regions - Higher wages available, skilled labour in R&D and science space
4 REDUCING AGRICULTURAL GHG EMISSIONS	- System is inherently a low emission sustainable system (abattoirs and renderers moving to sustainable fuel sources) - Produces products for bioeconomy (soil amendments, animal feed, biodiesel) - Enhances environmental capital
5 REPLACING FOSSIL FUELS	- Opportunity to replace fossil fuels in production and vehicles with low carbon alternatives - Opportunity to produce products that replace fossil fuel based chemicals
6 RETHINKING WASTE	- Circular principles part of the production system or business model - New systems design creates less waste - Processing byproducts and waste streams into high value products - High tech extraction systems able to extract more from less

Meat byproduct processing can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

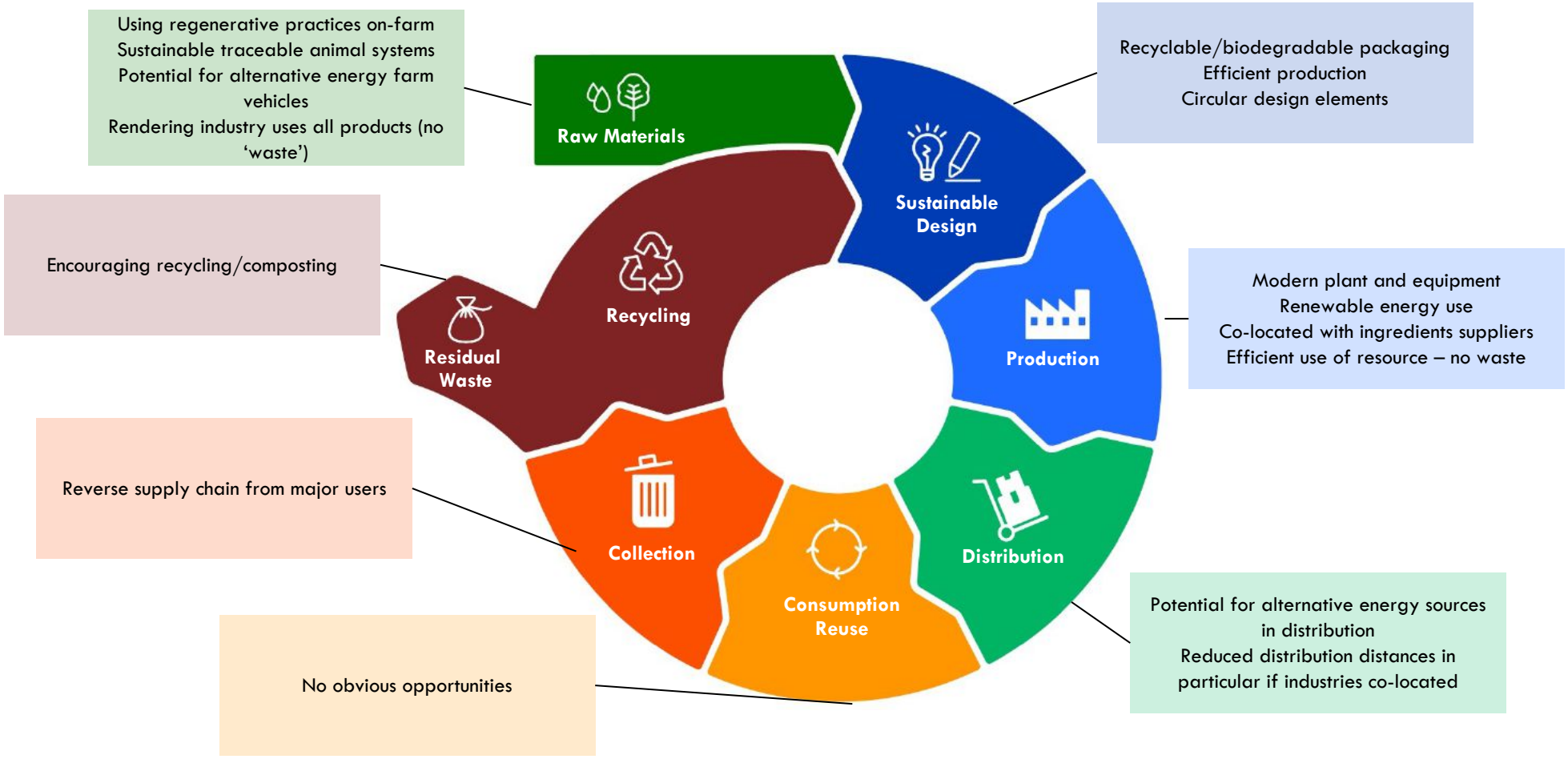


Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Renderers are located across New Zealand, specialist suppliers are primarily in the North Island

SELECT FIRMS
Not a complete list

WHERE IS THE INDUSTRY LOCATED?

Upper North Island

^Tūākau Proteins Limited

x4 **Waitao Natural Proteins***

Taranaki Bio Extracts
The New Zealand Difference

(^Taranaki By-Products))

Lower North Island

Fielding Proteins*

TAYLOR PRESTON LIMITED

(^Hawkes Bay Protein)

Other South Island

WALLACE GROUP x2

ALLIANCE FARMERS' PRODUCE x2

BlueSkyMeats
New Zealand farmed, Southern fresh

PRIME RANGE MEATS LTD

SPM

Value Proteins

Canterbury

South Canterbury By-Products

ANZCO FOODS

ALLIANCE FARMERS' PRODUCE

*NOTE: Select firms only ; *Wallace NI facilities acquired in 2020 by Greenlea, Wilson Hellaby and Glenninburg Holdings (Smiths 70% and Dahlenburg (30%)) ^ SBT owns Taranaki By Products Ltd , Hawkes Bay Protein Ltd, Tuakau Proteins Ltd (50%, with Lowe Corp 50%), and Taranaki Bio Extracts Ltd (50% with ANZCO (Itoham Foods)).*

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use these products

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities are researching topics within this platform

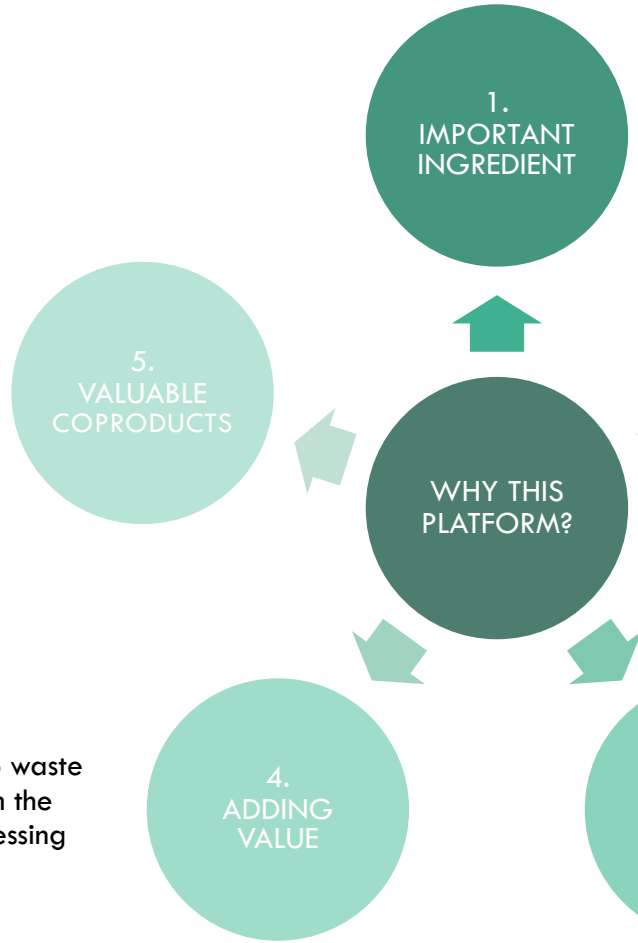
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM?



- Co-products are made into hundreds of products (e.g. Alliance sell 450 specialty items valued at 10% of the total carcass)
- Tallow, blood, bile etc are critical ingredient in many products and exports (animal feed, fertiliser, biopharmaceuticals etc.)

- On-going demand for biological solutions vs fossil fuel chemicals
- Tallow very high demand - bio fuels pushing up the price of tallow (e.g. Singapore focus on biodiesel production have high demands)

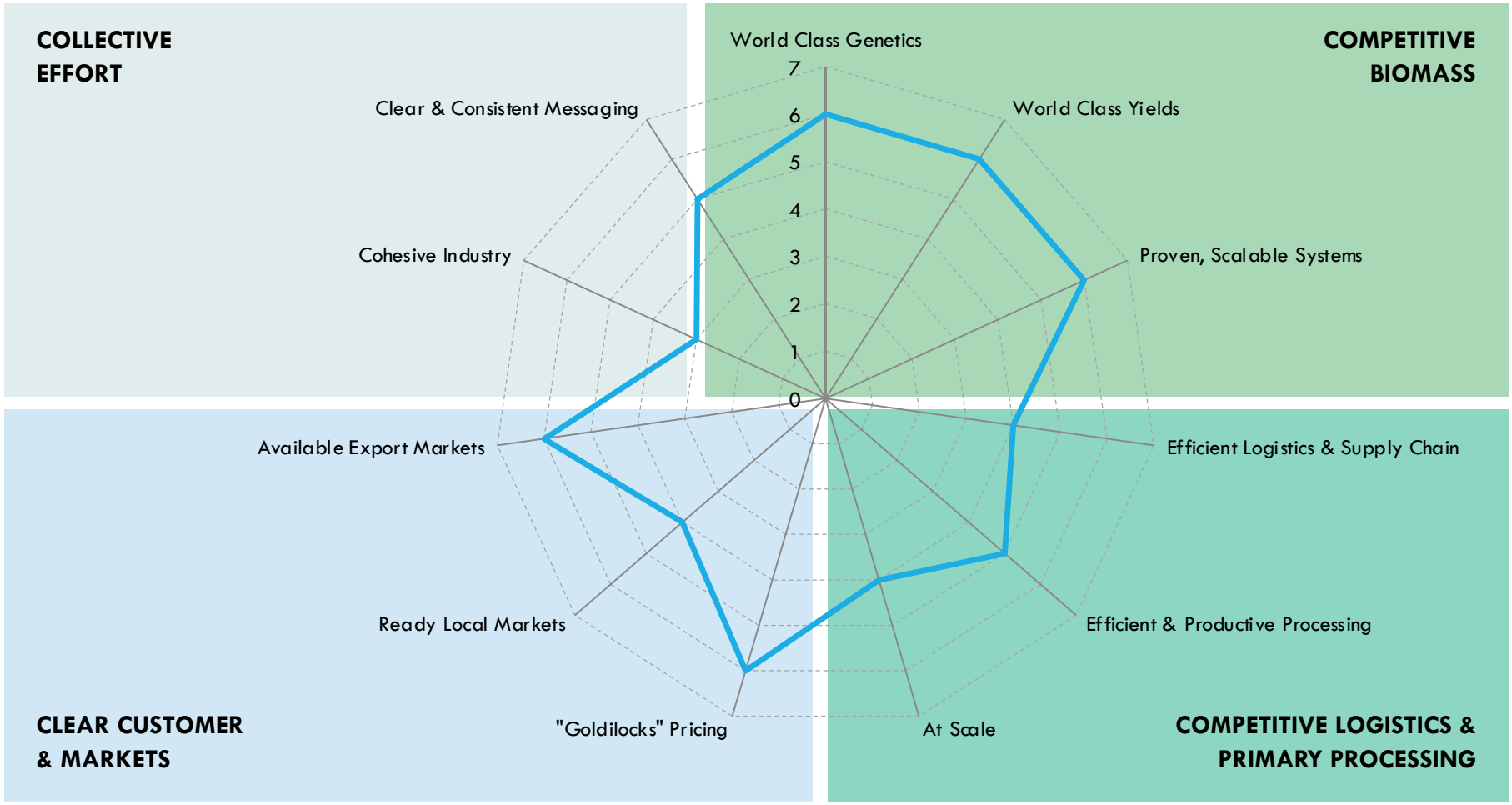
- Demonstrated capability to process and utilise meat 5th quarters (offal) in New Zealand
- Well established firms using blood serum, bile, placenta etc.

- Firms are adding value to waste streams and residues from the renderers and meat processing sectors

- Coproducts can be further processed into multiple high value products (e.g. blood serum vs blood and bone fertiliser)

Improvements are required to get the platform growth ready, the abattoirs and renders are at scale, as opposed to the specialists

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

What is the sustainability of the feedstock?

- How do we guarantee access to the feedstock? Other sectors will compete for the easily available and convertible feedstock (e.g tallow exported, biofuel or soil amendments)

How risky is the political environment?

- Is the political climate likely to change in the mid-term making the sector risky
- How will pricing be impacted by strong demand for biological feedstock and "waste"

Why you? Why NZ? What is your unique selling proposition?

- How will the sector stand out and succeed?
- Is there commercial demand for New Zealand product

Are we willing to pay the price needed to separate the product at the source?

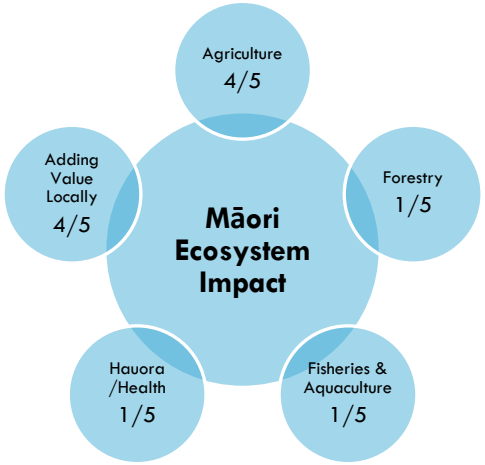
- Most waste in the abattoir goes down the petfood or renderers shoot, additional staff are required to separate key items and products
- Scale is required to make separation worth while

Source: Coriolis analysis

Meat Byproduct Processing

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- High long-term engagement/connectivity between Māori sheep and beef operators and this sector.
- Traditionally, Māori utilised parts of animals for different purposes e.g. bones were used as weapons, taonga, animal skins for clothing and accessories. This sector resonates with that approach.
- The practice aligns with Te Ao Māori values, principles and traditions and long term farming operations (large scale Māori farming operations in beef are some of the most productive in the country).
- Strong sector connectivity and interest in working with industry organisations and universities / research institutes to secure patentable IP
- Some Māori land investors might be attracted to this sector as adjacent to existing operations.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆☆☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**68/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

Building on growing recent success, New Zealand firms can do more to create value from secondary meat byproduct streams

1 INVESTING IN **DEVELOPING R&D**

- R&D around new products that add-value to co-products
- R&D into potential new compounds
- Research into additional utilisation options

2 INVESTING IN INCREASING **PROCESSING CAPACITY**

- Expansion of existing operations
- New processing in new regions

3 INVESTING IN DEVELOPING **FEASIBILITY STUDIES**

- Where is the largest gap and opportunity in the market for highly developed co-products
- Where can we win?

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

MARINE BIOACTIVES

TOTAL SCORE 38/50

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

SOURCES OF VALUE CREATION

- Focused science to identify activity in specific large waste streams
- New product development targeting new waste steams
- Industry consolidation to increase scale
- Improvements in robotics to increase productivity
- Further separation and fractionation of byproducts and waste streams

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

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*

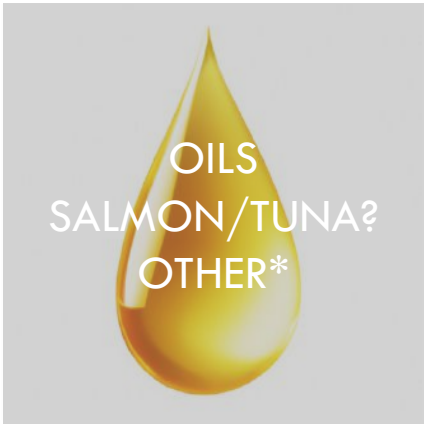
Conceptually this platform proposes using marine products, byproducts and coproducts to produce high value bioactives

WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- New Zealand has a very large and successful seafood industry - That sector produces a large amount of byproducts and 'waste'. - New Zealand has an emerging marine bioactives sector	- Most seafood processing byproducts and waste still goes to low value uses (e.g. aquaculture feed meal)	- New Zealand firms can do more to create value from secondary marine byproduct streams.

Bioactives are extracted from the full product, byproducts or coproducts from marine animals and seaweed

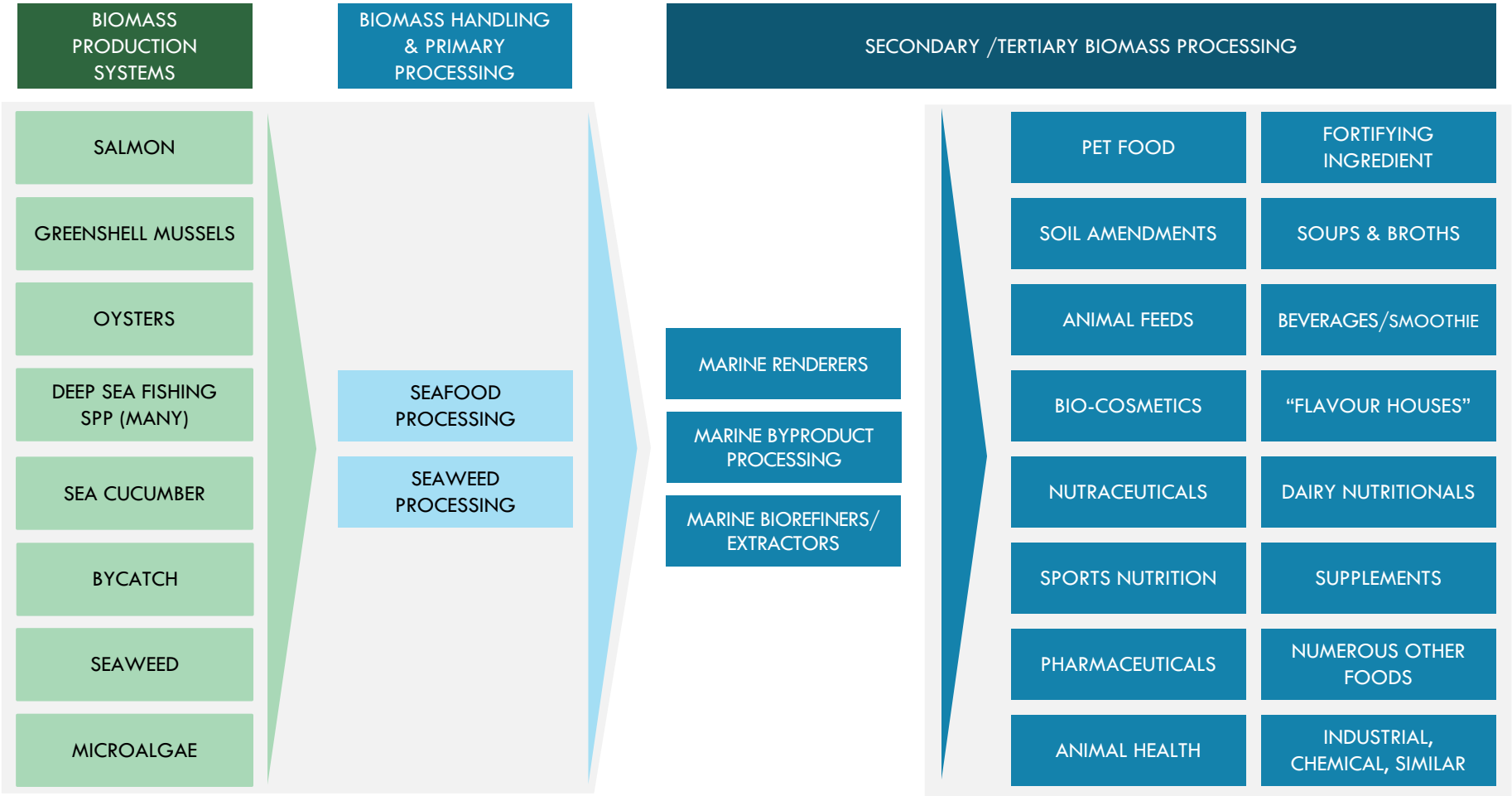
WHAT IS THE CONCEPT?



** Research into sea stars, sea cucumbe, kina etc. Photo credit: Wikimedia CC ASA; 3.0; DALL:E; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research*

Marine bioactive processing has numerous current and potential linkages into significant parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Marine bioactive processing is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Utilising a unique New Zealand biomass - Full biomass utilisation (e.g. fish flesh, carcass, bone, skin, cartilage and offal)
2 **INCREASING VALUE-ADDED**	- High value products are available from co-products, by-catch (e.g. shark liver oil and squalene) - Value of marine extracts is higher than raw product in many cases
3 **BUILDING RESILIENCE**	- Creates employment and industry in the regions - Higher wages available, skilled labour in R&D and science space
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Seaweed is a carbon sink and can reduce emissions from wider seafood system - Greenshell mussels and Oysters small carbon footprint* vs other animal products studied - Enhances environmental capital
5 **REPLACING FOSSIL FUELS**	- Opportunity to replace fossil fuels in production and vehicles with low carbon alternatives - Opportunity to replace ocean plastic products (e.g. plastic floats and buoys)
6 **RETHINKING WASTE**	- Adopt circular principles as part of the production system or business model - New systems design creates less waste - Processing bycatch and waste streams into high value products - High tech extraction systems able to extract more from less

** Source: Thinkstep-anz, LCA of New Zealand mussels and oysters, 2021*

The marine bioactive sector can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

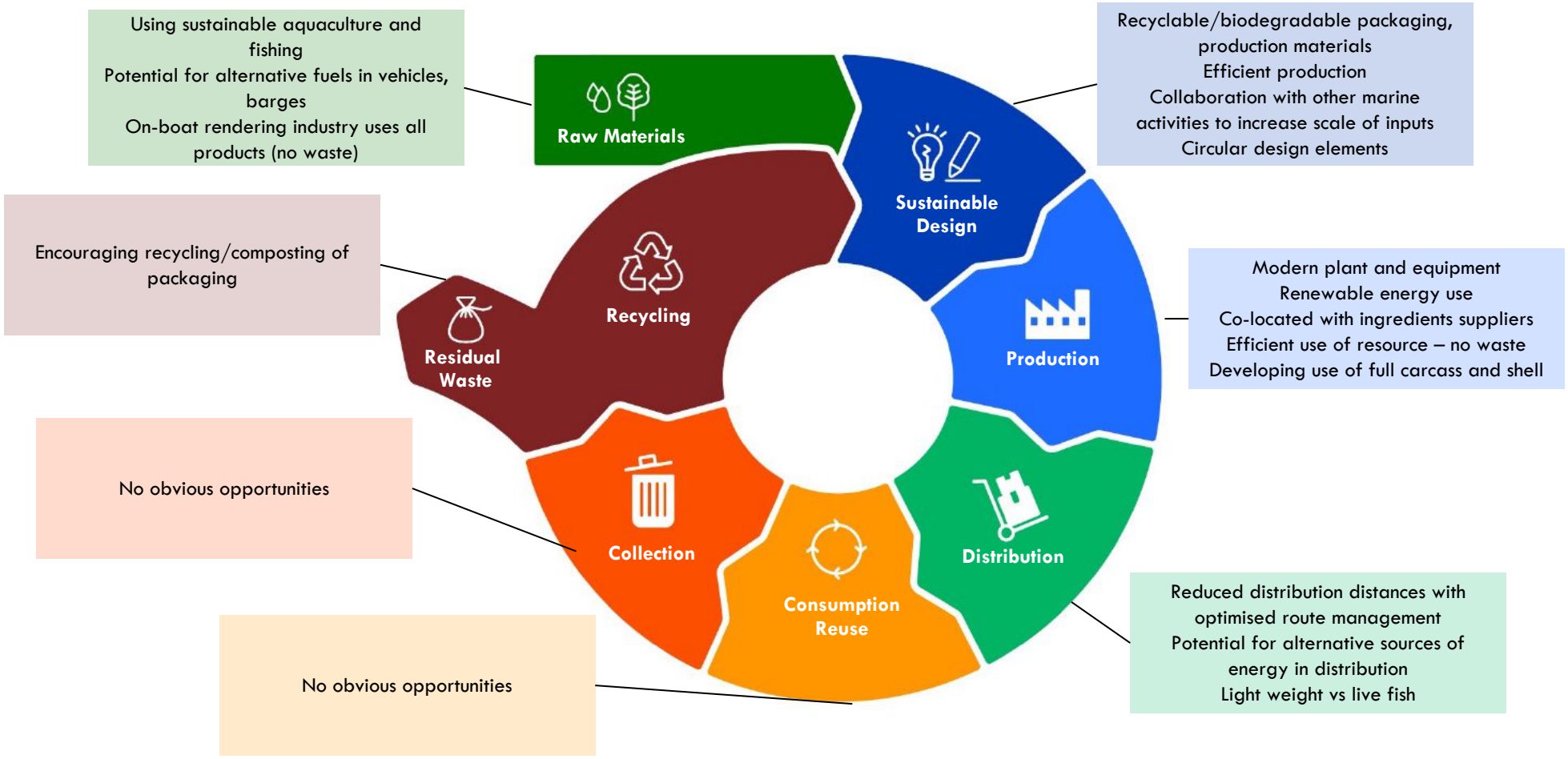
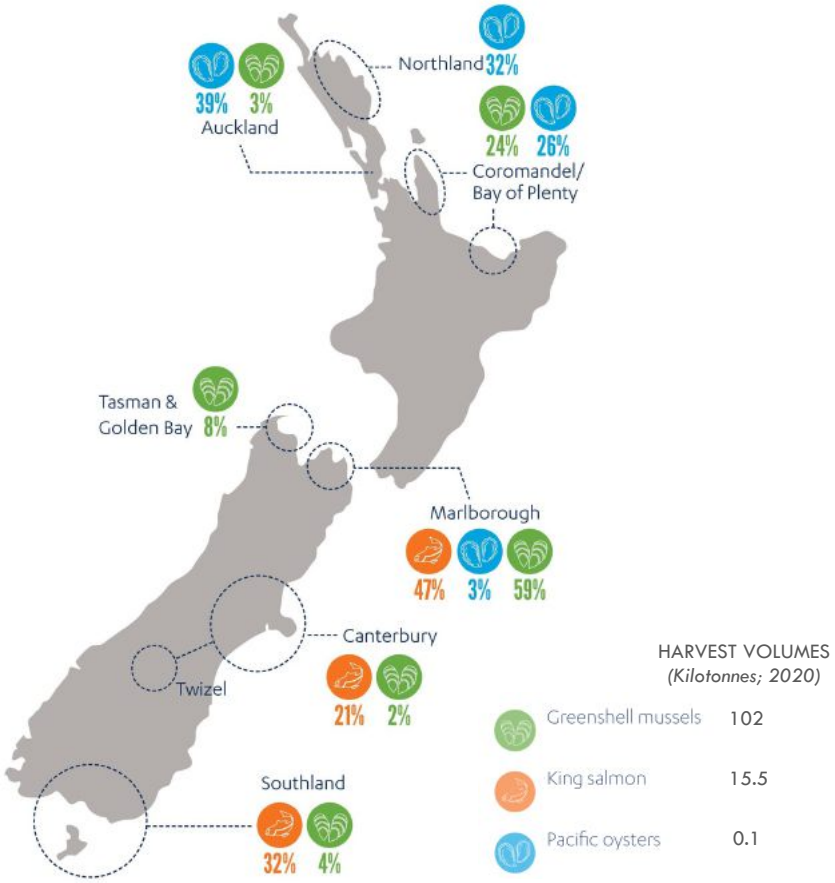


Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Mussels are clustered in Marlborough and salmon are located in three locations in the South Island

AQUACULTURE KEY LOCATIONS

(% of volume)



Source: Aquaculture NZ

Fishing companies and aquaculture operations are located across New Zealand, specialist extractors are clustered in Nelson and Christchurch

WHERE IS THE INDUSTRY LOCATED?

FISHING/PROCESSING

SANFORD
Talley's
UNITED
SEALORD
NGĀI TAHU SEAFOOD
Te Ohu Kaimoana
MOANA NEW ZEALAND
Solander OCEAN TO PLATE
VELA FISHING LTD
Independent
Takitimu SEAFOODS
CLOUDY BAY CLAMS
pauaco
Ngati Porou Seafoods Group
PelcoNZ
LEE FISH
WESTFLEET SEAFOODS EST 1979
FIORDLAND LOBSTER COMPANY

AQUACULTURE

New Zealand King Salmon
Mt COOK alpine salmon
KONO
MOANA NEW ZEALAND
Talley's
OPC
North Island Mussels Ltd
Te Ohu Kaimoana
AKAROA SALMON
UNITED
SANFORD
CANTERBURY COAST OYSTERS
HIGH COUNTRY SALMON

SELECT FIRMS
Not a complete list

NOTE: Select Firms only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- The marine sector is supported by aquaculture, seafood and seaweed associations

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use and produce these products

UNIVERSITIES / RESEARCH

- Cawthron is a leader in this space
- A wide range of NZ Universities are researching topics within this platform

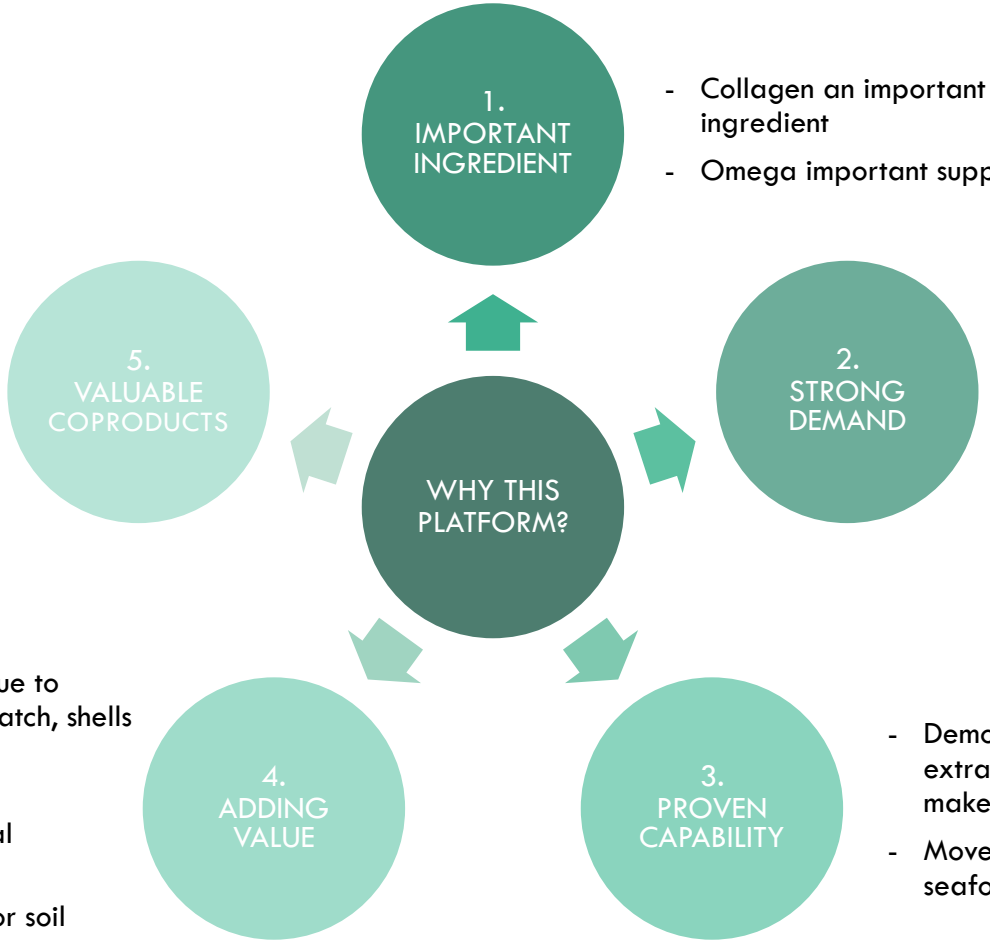
GOVERNMENT / CRI'S*

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM?



- Collagen an important supplement and cosmetic ingredient
- Omega important supplement

- Strong demand for natural solutions to health supplements, nutraceuticals and cosmetics
- New Zealand in strong position to supply ingredients with strong sustainability credentials

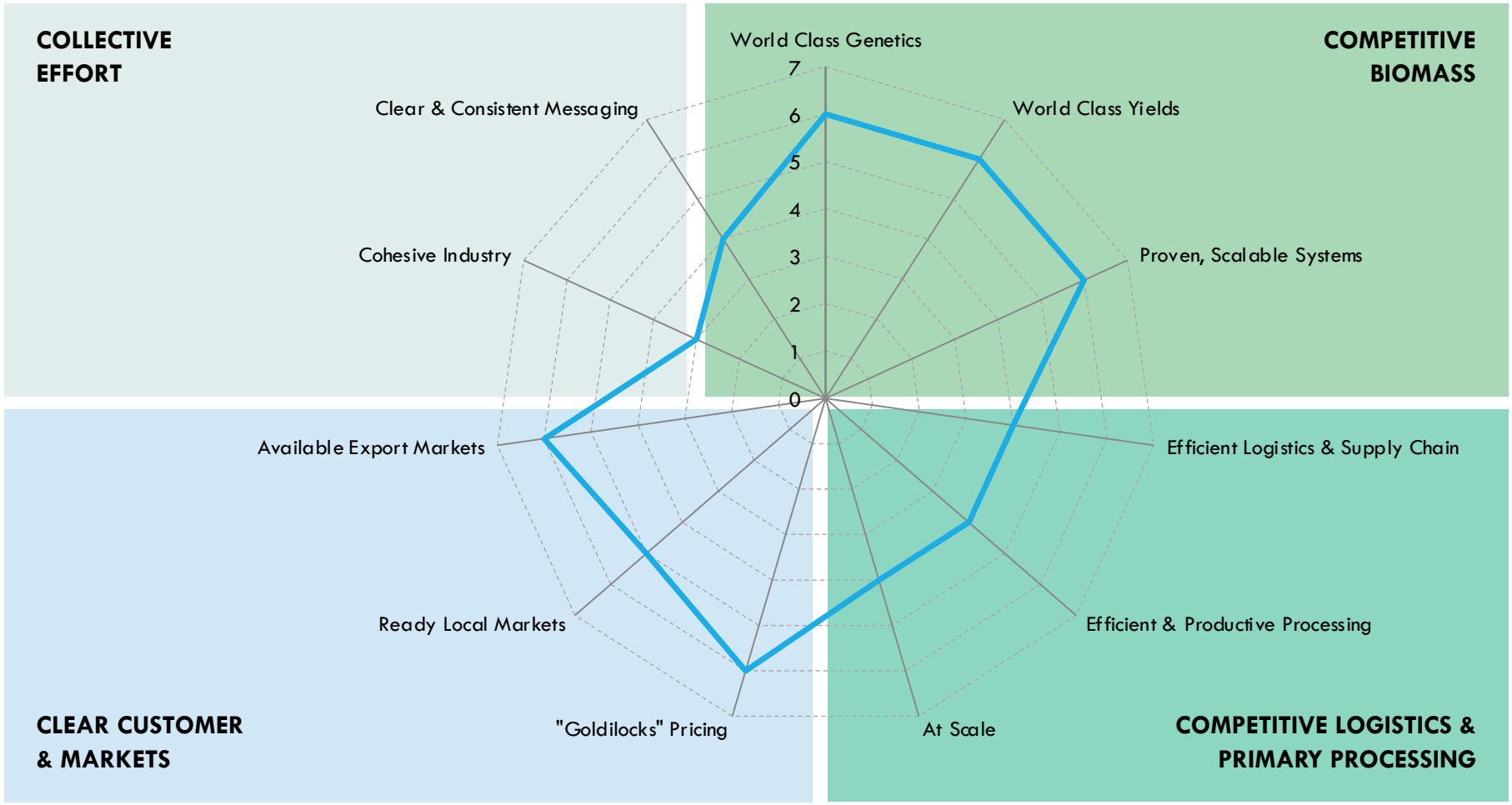
- Demonstrated capability to process extract value from greenshell mussels to make oils and powders
- Movements into extracting collagen from seafood

- Firms are able to add value to waste streams such as bycatch, shells (e.g. high in minerals and compounds)
- Able to supplement natural limestone
- Shells/by products used for soil conditioning

- Products can be further processed and fractionated into multiple high value products (e.g. cosmetics, marine pharmaceutical ingredients)

Improvements are required to get the platform more efficient in processing at scale

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

What is our next cab off the rank?

- What is the economic potential of our various marine species?
- What volumes do we have to work with?
- How do we extract the most value from by-catch?
- Is product development constrained by supply or cost of raw material?

Is the science there in discovery or should we adopt and adapt?

- Does New Zealand have the current capabilities beyond greenshell mussels compounds and a range of oils and powders?
- Who are the leaders with global best practice in extractions? We should adopt and adapt.

Why you? Why NZ? What is your unique selling proposition?

- How will the sector stand out and succeed?
- Is there commercial demand for New Zealand ingredients or products
- How unique is our product offering? Is it easily copied?

Are we willing to pay the price needed to separate the product on boat?

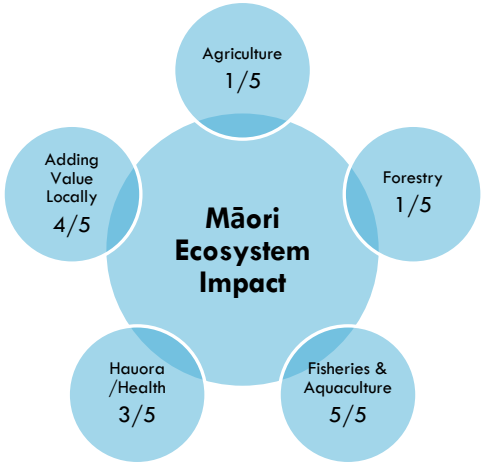
- Most 'waste' on deep sea vessels is rendered. Is there room and additional staff available to separate key items and products.
- Scale is required to make separation worth while; the larger fisheries such as hoki are at scale

Source: Coriolis analysis

Marine Bioactive

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆☆☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆☆☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆☆
IS THE RISK MANAGEABLE?	☆☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- High engagement within the Māori community.
- Intellectual property rights and the protection of traditional knowledge related to marine resources and the potential uses of marine bioactives.
- Sustainable economic opportunities need to be considered upon the commercialisation and economic development of marine bioactives.
- The use of marine life in certain areas can directly impact Māori communities and Treaty partnerships.
- Marine life play a huge role in Te Ao Māori through mātauranga māori, tikanga, pūrakau, taonga, and other cultural practices are all connected.
- Ability to leverage off significant Māori interests in commercial fishing and marine aquaculture. Ability to influence two of the largest players in the sector (Moana and Sealord) as well as connections to Sandford and other industry processing participants (MacLab etc.)
- Resonates directly in Māori sector with declining returns from commercial fishing as well as utilising more from the bycatch and other waste byproduct.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆☆☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆☆☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆☆☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**80/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted, all are required for ongoing success in the industry

WHERE IS INVESTMENT REQUIRED?

VISION	New Zealand has a successful seafood production and processing industry that produces a large amount of byproducts and 'waste'. Firms can successfully create value from these secondary streams, particularly bycatch.

1 INVESTING IN DEVELOPING R&D

- R&D around new products that add-value to co-products
- R&D into potential new compounds/fractionates
- Research into additional utilisation options

2 INVESTING IN INCREASING PROCESSING CAPACITY

- Expansion of existing operations
- New processing in new regions
- Significant capex required to scale up to commercial operations

3 INVESTING IN DEVELOPING FEASIBILITY STUDIES

- Where is the largest gap and opportunity in the market for highly developed bioextracts
- Where else can we win?
- Who or what is the existing competition?

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

FEED MILLING: "ANIMAL FEED" FOR FARM ANIMALS

TOTAL SCORE 43/50

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

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.)

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	?

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 Straight)

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

This platform proposes rethinking animal feeds to make emissions reducing products using locally produced biomass (including those from waste streams)

WHY DO WE CARE?

SITUATION	COMPLICATION	RESOLUTION
- 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	- Ruminant systems, including cattle and sheep, are major contributors to global GHG emissions - Supplementary and modified feeds can reduce emissions	- Animal feed millers can be part of the solution and support New Zealand's emissions reduction targets

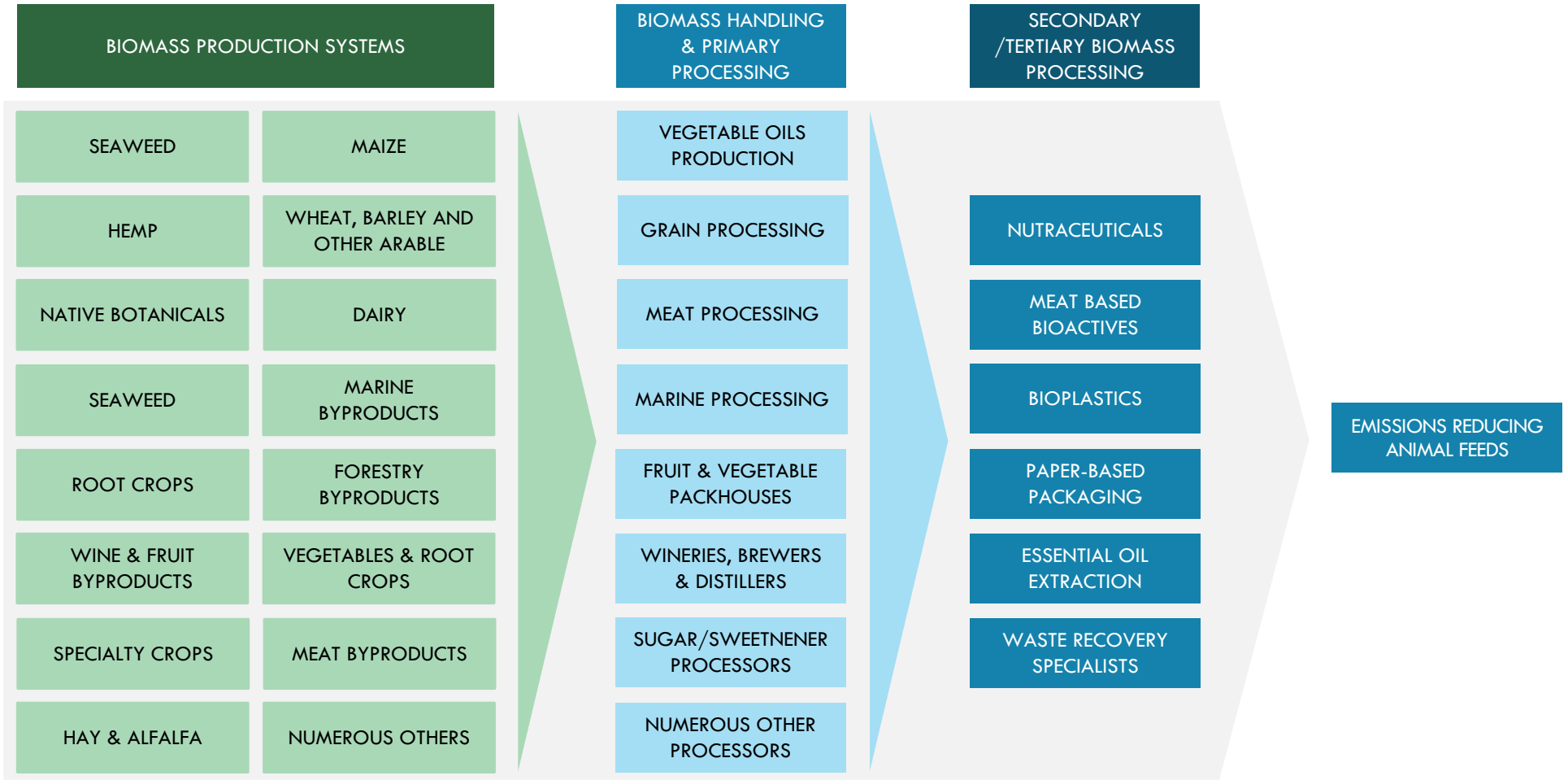
This opportunity uses biomass, biomass from co-products and supplements to reduce animal emissions in cows and sheep

WHAT IS THE CONCEPT?

Image credit: Wikimedia CC ASA 4.0; NZ Story; CCA 2.0; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Emissions reducing animal feeds have current and potential linkages into large parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



A range of options for reducing animals on-farm emissions are either being researched or now available

OPTIONS FOR REDUCING ANIMALS ON-FARM EMISSIONS

MITIGATION MEASURE	BRIEF DESCRIPTION	FORM	STATUS
LOW EMISSION FEEDS/FODDER	Forage Rape Plantain GM Ryegrass	Pasture/ Feed	- On-going research into forage crops and impact on emissions - GM no approval for testing in New Zealand
METHANE INHIBITOR SUPPLEMENT FEEDS	Seaweed Biochar	Feed Supplement	- Research into seaweed as animal supplementary feed - Global and domestic research into role of biochar - Ongoing research required
METHANE INHIBITORS	Chemical compound blocks ability to produce methane	Pill	- Available through DSM (requires pharmaceutical approval) - CALM Programme progressing in New Zealand
METHANE VACCINE	Vaccine to induce antibodies to suppress methanogens	Injection	- Development phase
BREEDING LOW EMISSION ANIMALS	Selective breeding of low emission stock (sheep and cattle)	Breeding	- Currently breeding low CH_4 sheep - Proof of concept in sheep - No low emission cattle in New Zealand at present

**DCD = dicyandiamide; Source: BERG; various articles; Coriolis research and analysis*

Emissions reducing animal products are in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 INCREASING BIOMASS	- Full biomass utilisation in New Zealand - Potential use of additional seaweed products
2 INCREASING VALUE-ADDED	- Potentially high value outputs
3 BUILDING RESILIENCE	- Reducing emissions in cattle and sheep will aid the resilience of the agricultural sector - Reduces potential for emissions tax on farms/agricultural businesses - Sector positively contributing to reducing emissions
4 REDUCING AGRICULTURAL GHG EMISSIONS	- Feed and products able to target GHG emissions - Targets New Zealand's largest emitters methane (enteric fermentation) and nitrous oxide from cattle and sheep - Enhances environmental capital
5 REPLACING FOSSIL FUELS	- Opportunity to replace fossil fuels in production - Opportunity to replace fossil fuels on farm (soil amendments vs fertilisers)
6 RETHINKING WASTE	- Strong linkages with other systems - Processing byproducts and waste streams into high value products (kiwifruit, grape 'waste') - High tech extraction systems able to extract more from less

Emissions reducing solutions for animals are part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Potential for less fertilisers
Inputs from waste (e.g. forestry slash for biochar)
Using regenerative practices
Potential for alternative energy farm vehicles

Efficient production and design of any new systems
Solution part of wider farm practices

Encouraging recycling/composting

Renewable energy use
Seaweed products and Biochar co-located

Reverse supply chain from major users

Reduced distribution distances
Potential for alternative energy sources in distribution
Co-location of activities to reduce transport costs
Extending sustainability to logistics partners

Concentrations in liquids and powders

Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Farm animal feed operations and emissions reducing animal products firms are located across New Zealand

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- Fonterra is researching seaweeds role in reducing methane emissions (primarily in Australia)
- A number of research projects are underway across the country (e.g. Methane Mitigation Ventures)
- Both Ravensdown and Ballance (Cooperative fertiliser companies) supply N-reducing fertilisers
- Many other large firms operate feed operations in NZ: Viterra, MainFeeds, Farmlands. Golden Grain, AgriFeeds, J.Swap, Sharpes, Advanced feed etc.
- The national feed operators have multiple hubs across the country

SELECT FIRMS
Not a complete list

NOTE: Select firms only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- A range of organisations support farmers and growers in primary production

INDUSTRY ORGANISATIONS

- A range of organisations support firms to reduce emissions

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities are researching topics within this platform

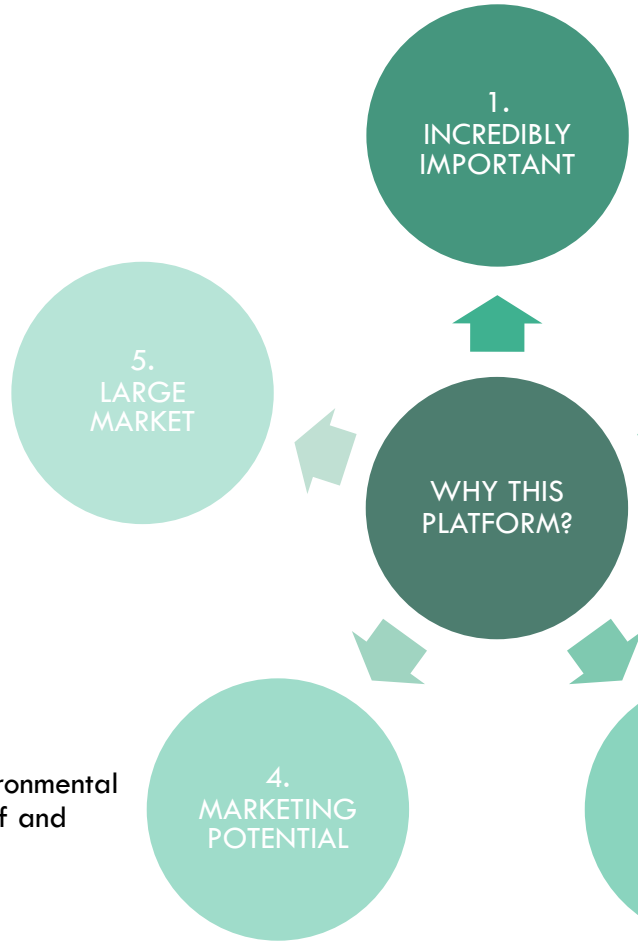
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM?



- New Zealand's GHG emissions are dominated by agricultural emissions
- Critical to find economically viable solutions for cattle and sheep farmers

- Strong demand for solutions that reduce emissions from other pastoral system firms and countries

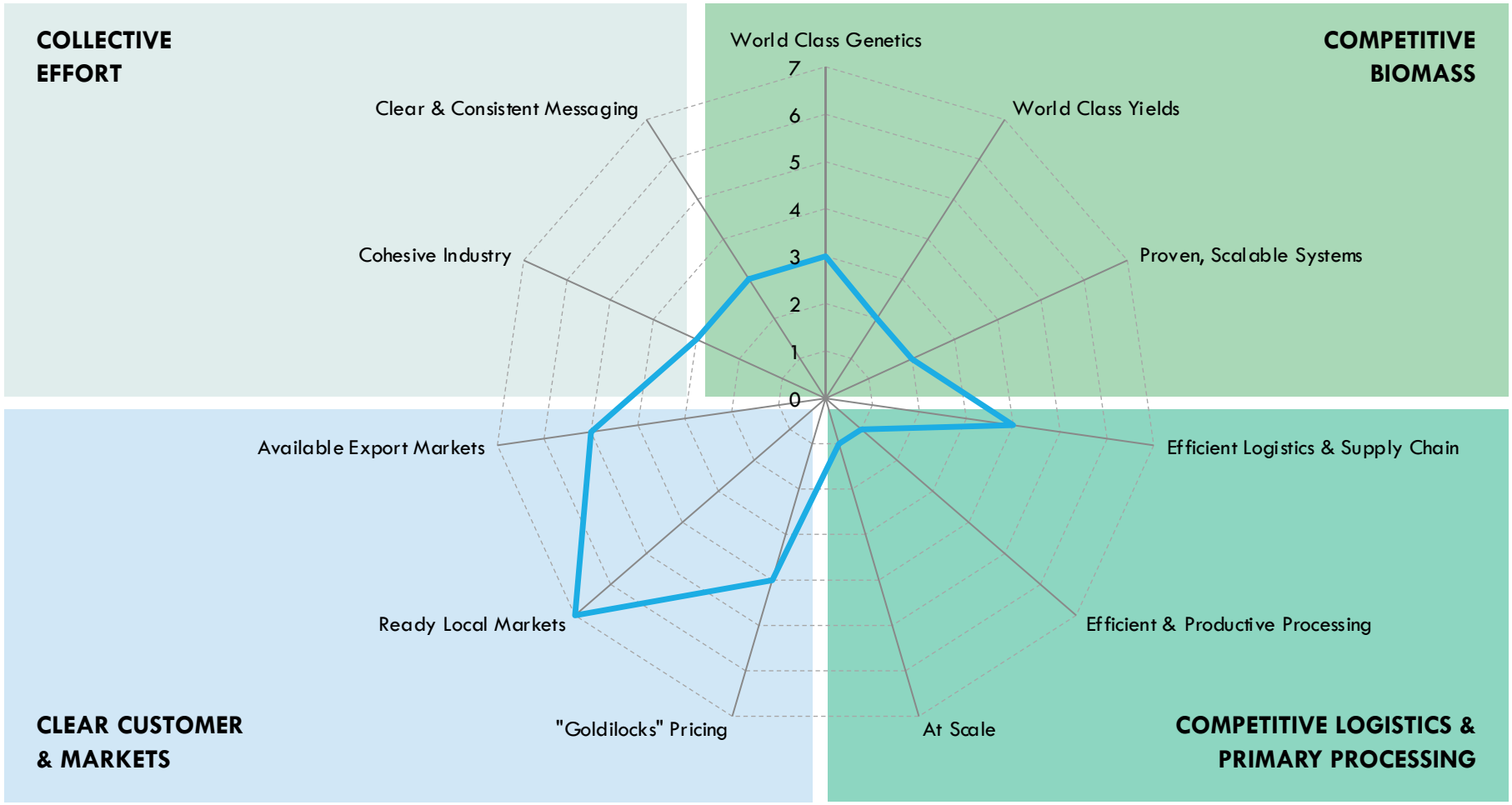
- Demonstrated capability in researching multiple dairy and sheep problems
- Multiple universities and institutions dedicated to finding solutions

- Ability to market the environmental benefits of NZ dairy, beef and sheep products

- Successful and cost effective solutions will access a large domestic and international market

Improvements are required to get the sector growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

Will these strategies be enough to reduce on-farm emissions?

- New Zealand has world-class research around pasture-fed animals, can this transfer to this problem?
- What is timeframe for success? Which new technology or situation will make this industry more viable?

How flexible is the regulatory environment with regards to novel solutions?

- GM (Genetic Modification) is still a dirty phrase in New Zealand
- What is the government's position on GM?
- What is the market's position on GM?

Isn't the easiest solution reducing farm animal numbers?

- How does reducing farm animals numbers impact profitability of the sector?

Does the solution expand to non-pasture-fed farming systems?

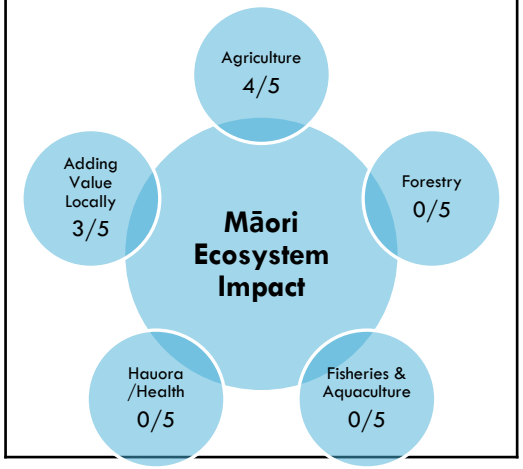
- New Zealand's farming systems are unique to a limited number of markets
- How big is the market to the given solutions? Does this apply to multiple farming systems (i.e. providing a larger overall market)

Source: Coriolis analysis

Animal Feed Alternatives

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆ ☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆ ☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Some attraction to multiple uses/revenue streams for underutilised land. The ability to build upon existing agricultural industry infrastructure will be attractive.
- Adjacent to existing land use operations leveraging industry connections / knowhow / distribution etc. will also be attractive.
- Key element is the ability to reduce emissions through feed to ruminant stock. If Māori investors get comfortable with this then might be significant interest to assist intensification of farming with reduced carbon footprint.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆ ☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆ ☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**60 /100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION	Animal feed millers can be part of the solution and support New Zealand's emissions reduction targets

1 INVESTING IN RESEARCH & DEVELOPMENT

- On-going research into the most viable options
- Research into monitoring

2 INVESTING IN INCREASING EXISTING SYSTEMS

- Expansion of existing operations with proven results (e.g. seaweed)

3 INVESTING IN KNOWLEDGE SHARING

- Invest in dissemination of knowledge from scientific research to farm management practices
- Develop user friendly resources for farmers

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

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

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

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].

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.

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

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)

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

This platform scales up production of biomass to produce biofertilisers and soil amendments to replace synthetic-based fertilisers

WHY DO WE CARE?

SITUATION

- Chemical fertilisers are contributing to NZ GHG emissions and causing problems in groundwater and waterways
- There are two major suppliers of fertiliser in New Zealand, Ravensdown and Ballance - both farmer-owned Cooperatives
- NZ farming systems, in particular dairy, rely on synthetic fertilisers to increase production and productivity
- New Zealand imported 1.4m tonnes of nitrogenous, potassic, phosphatic and blends in 2021
- In 2019 606.9k tonnes of urea was applied to NZ farms*
- The dairy sector used 63% of nitrogen-based fertilisers in 2017

COMPLICATION

- Half the food on earth exists as a result of synthetic fertilisers
- The NZ government set an annual cap of 190kgN/ha on synthetic nitrogen fertiliser
- Nitrogen fertiliser causes nitrous oxide emissions a major contributor to New Zealand's GHG emissions
- Production process uses hydrocarbon gas to produce nitrogen fertilisers
- Runoff from excessive fertiliser use contributes to nitrogen leaching from pastures resulting in nitrate contamination in groundwater and surface waters
- A lot of natural solutions have been put forward by avid proponents

RESOLUTION

- Numerous new solutions that are less/not reliant on synthetic fertilisers exist at trial scales
- Biofertiliser options are possible across animal pasture-based systems, arable cropping and horticulture systems
- Potential to source new biomass and waste streams to use as biofertilizer and soil amendment
- A solution needs to be found that stacks up for the environment and the farmer

* *Source: Statistics NZ*

This opportunity focuses on replacing synthetic fertilisers with biomaterials

WHAT IS IN AND OUT OF SCOPE

AGTECH

- On-going measuring and monitoring soil conditions
- Precision agriculture systems that measure the exact amounts of fertiliser required across the property and apply accordingly
- Understanding of crops and pastures and their seasonal requirements

SKILLS & MANAGEMENT

- Reducing N-based fertilisers
- Using nitrogen-fixing crops and management techniques
- Using Organic and/or Regenerative Farming Practices
- Using fertilisers containing urease inhibitors (chemical compounds slow down microbial conversion of Nitrogen to nitrate and nitrous oxide).
- Using fertigation

NEW/ EMERGING BIOFERTILISERS

- Potential to source new biomass to use as fertiliser (e.g. seaweed)
- Potential to source biomass from waste streams in forestry, horticulture, food processing, animals systems to produce fertiliser (biochar, blood and bone, compost and mulch)
- Potential to use inoculants of fungi and bacteria to enhance plant growth and improve nutrient uptake

Presume that changes in these areas are in progress
Solutions that are out of scope

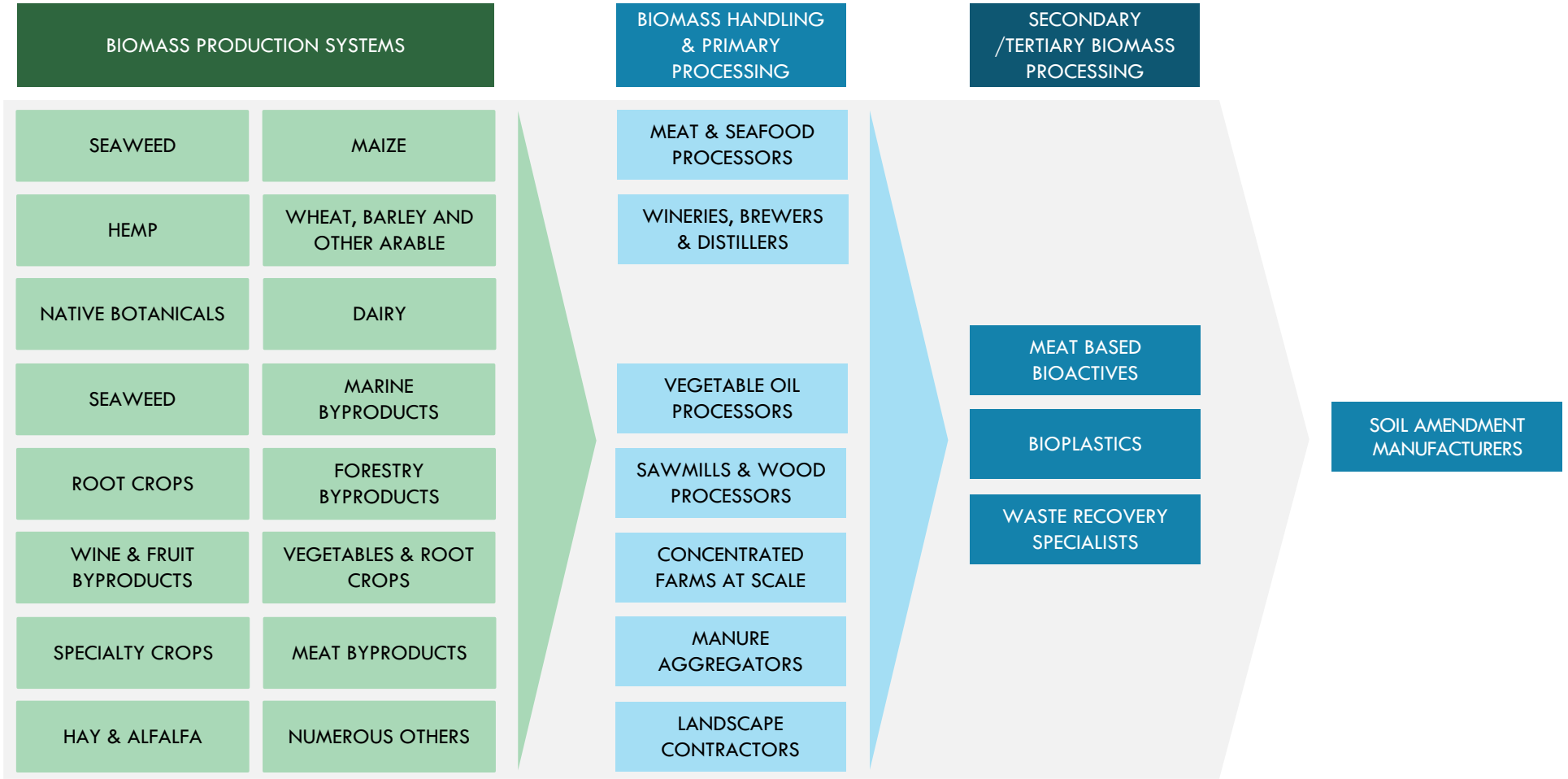
This opportunity uses new biomass or biomass from 'waste' as a soil amendment or biofertiliser

WHAT IS THE PRODUCT?

Image credit: Wikimedia CC ASA 2.0, 3.0, 4.0; Wilkinson; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Soil amendments have current and potential linkages into large parts of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Biofertilisers/soil amendments are in line with the desired outcomes of the bioeconomy; in particular by reducing GHG emissions and water pollution

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Full biomass utilisation (e.g. waste streams to resources) - Potential use of seaweed products
2 **INCREASING VALUE-ADDED**	- Potentially high value outputs
3 **BUILDING RESILIENCE**	- Reducing emissions in farming systems will aid the resilience of the agricultural sector - Reducing water pollution increases health of environment - Sector positively contributing to reducing emissions
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Reducing/replacing synthetic fertilisers reduces overall agricultural GHG emissions - Enhances environmental capital - Biochar sequesters carbon in the soil
5 **REPLACING FOSSIL FUELS**	- Opportunity to replace fossil fuels in production - Synthetic fertilisers have high energy and high emission production systems
6 **RETHINKING WASTE**	- Strong linkages with other systems - Processing by-products and waste streams into soil amendments (waste from: forestry, kiwifruit, apple, grape 'waste', food waste) - High tech extraction systems able to extract more from less

Bio-based soil amendments are part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

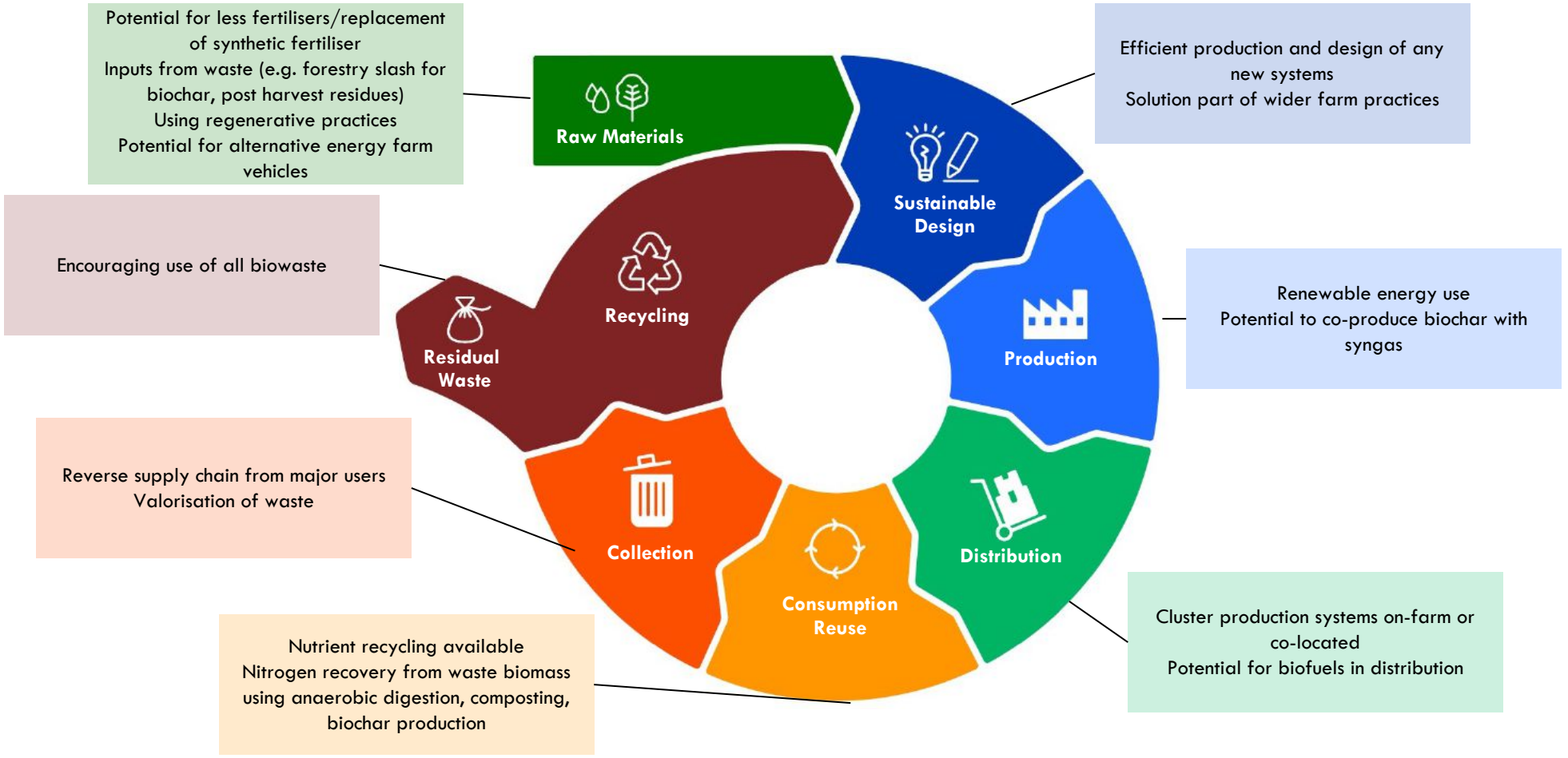


Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

Soil amendments and biofertiliser companies are located across New Zealand

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- Both Ravensdown and Ballance (Cooperative fertiliser companies) supply N-reducing fertilisers (urease inhibitors)

SELECT FIRMS
Not a complete list

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

PRIMARY ORGANISATIONS

- Range of organisations support New Zealand primary production

INDUSTRY ORGANISATIONS

- A range of organisations support firms that use these products

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities and research institutes are researching topics within this platform

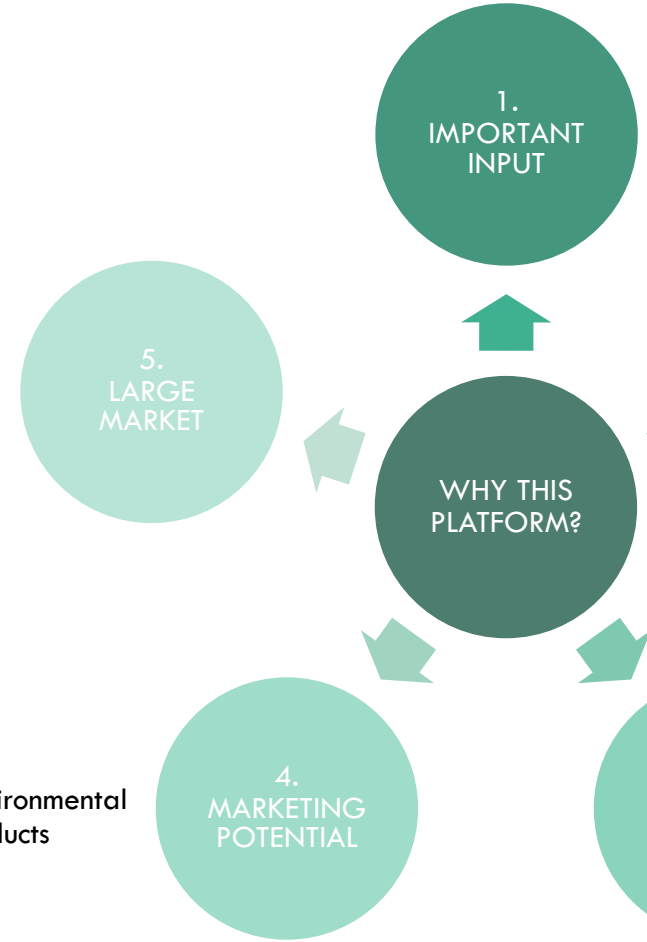
GOVERNMENT / CRI'S

- A wide range of state agencies touch on this opportunity (e.g. importation rules, food safety)
- Crown Research Institutes

**CRI = Crown Research Institutes; Source: various company and organisation websites; Coriolis analysis*

There are a range of strong economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM?



- New Zealand's GHG emissions are dominated by agricultural emissions
- Critical to find economically viable solutions for farming systems (in particular dairy)

- Dependent on imports (majority of fertilisers are imported)
- Volatile countries and product (e.g. rock phosphate from Western Sahara)

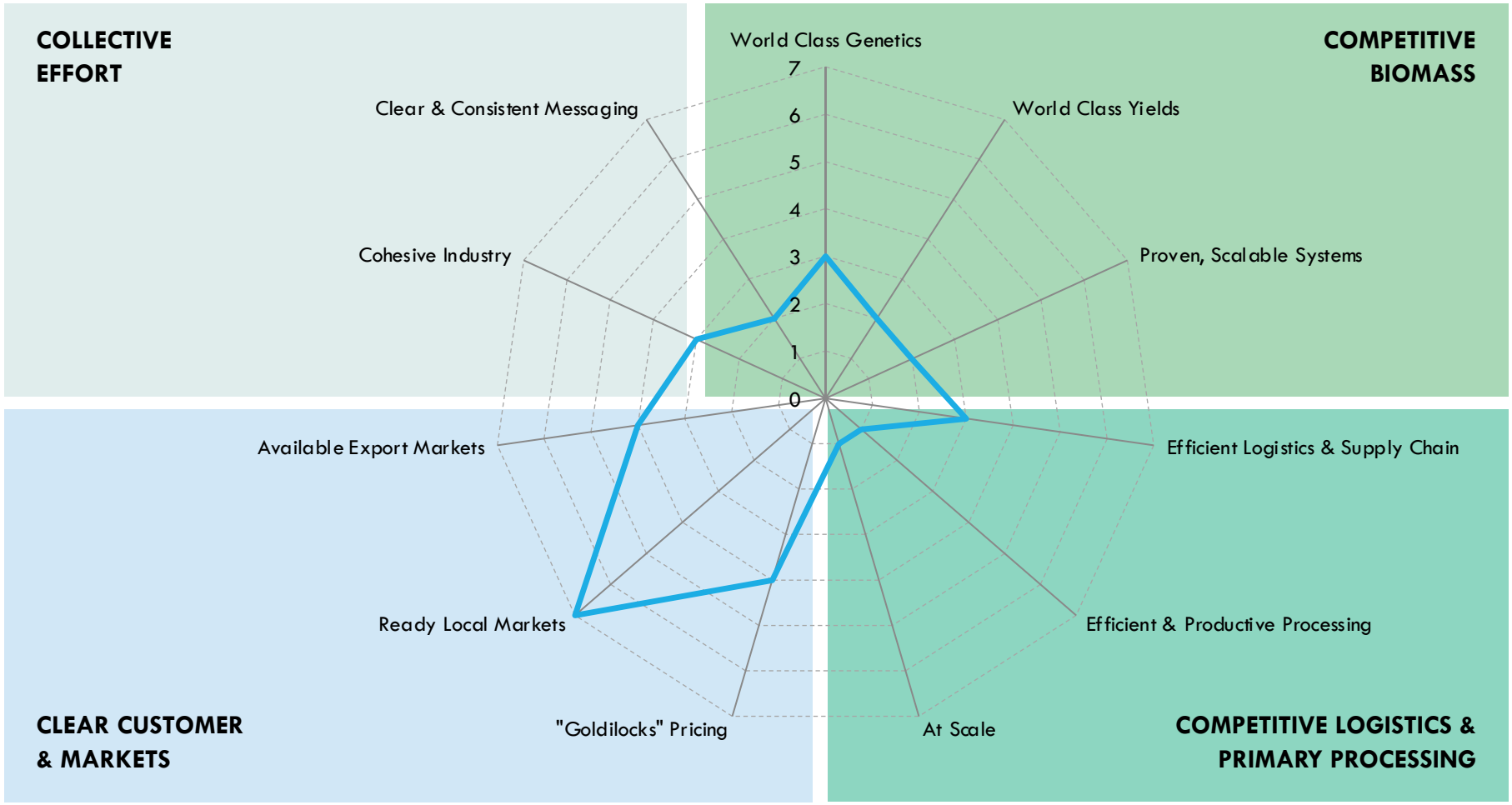
- Demonstrated capability in researching crops and pasture systems
- Multiple universities and institutions dedicated to finding solutions

- Ability to market the environmental benefits of NZ food products

- Successful and cost effective solutions will access a large domestic market

Improvements are required to get the sector growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

Will farms get the same performance from biofertilisers?

- What is the performance of biofertilisers by farm type?
- Can I expect the same pasture/crop growth?
- How much do we currently know about the role and performance of fungi and bacteria in soil science?

What is the cost of biofertilisers vs. synthetic fertilisers?

- Can the biofertilisers and soil amendments be made at a cost comparable (ideally cheaper) than the existing products?

Isn't the easiest solution just applying less fertiliser?

- How does reducing synthetic fertiliser impact emissions and productivity?
- How can the synthetic and bio-based fertilisers be used in unison?

Are we able to achieve scale with the various applications?

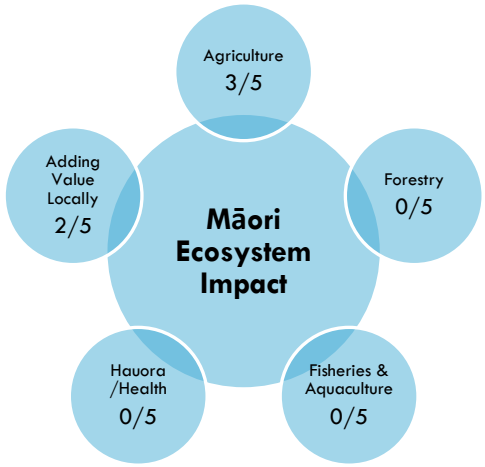
- Can we achieve scale and a cost effective farming system with seaweed?
- Can we produce biochar at scale?

Source: Coriolis analysis

Fertiliser: Soil Amendments / Compost Manufacturing

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- The ability to build upon or supply into existing agricultural industry infrastructure sector will be attractive.
- Adjacent to existing land use operations leveraging industry connections / knowhow / distribution etc will also be attractive.
- Brand Māori – alignment with cultural interest in te Taiao / environment improvement.
- Māori investors will be cautious on unproven technologies. One Iwi has lost millions in respect of a biochar play and these stories circulate quickly.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**38/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

A solution needs to be found to replace artificial fertilisers with GHG neutral soil amendments that stacks up for the environment and the farmer

1 INVESTING IN RESEARCH & DEVELOPMENT

- On-going research into most viable options for bio fertilisers across different farming systems (e.g. dairy, beef, horticulture, crops)

2 INVESTING IN INCREASING EXISTING SYSTEMS

- Expansion of existing operations with proven results (e.g. biochar)

3 INVESTING IN KNOWLEDGE SHARING

- Invest in dissemination of knowledge from scientific research to farm management practices
- Develop user friendly resources for farmers

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 415

BIOGAS 432

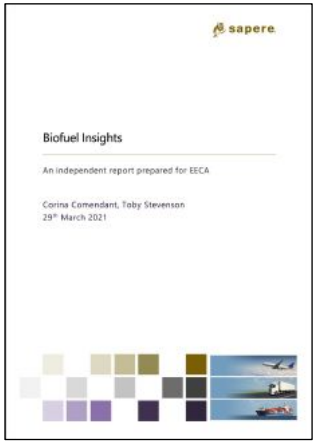
BIOPLASTICS 449

FORESTRY BIOCHEMICALS 465

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

This is not a stand-alone section; please review the large body of work available on the opportunities and challenges in the New Zealand biofuel and alternative energy sector prior to reading this section

SELECT REPORTS ON THIS SECTOR

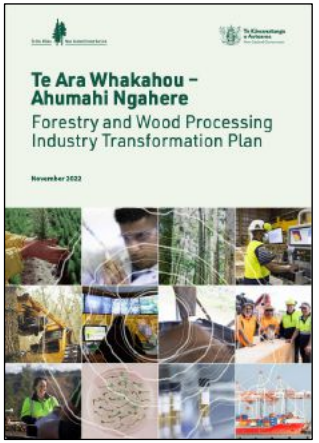


https://www.eeca.govt.nz/assets/EECA-Resources/Research-papers-guides/Liquid-Biofuel-Research-Report-March-2021.pdf

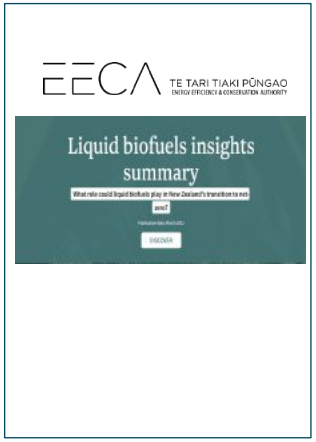
https://www.mbie.govt.nz/dmsdocument/4292-process-heat-in-new-zealand-opportunities-and-barriers-to-lowering-emissions

https://www.eeca.govt.nz/assets/EECA-Resources/Research-papers-guides/Off-road-liquid-fuel-insights.pdf

https://www.mpi.govt.nz/dmsdocument/51007-NZ-Wood-Fibre-Futures-Project-Stage-Two-Final-Main-Report



https://www.mpi.govt.nz/dmsdocument/54472-Te-Ara-Whakahou-Ahumahi-Ngahere-Forestry-and-Wood-Processing-Industry-Transformation-Plan



https://www.eeca.govt.nz/insights/eeca-insights/liquid-biofuels-insights-summary/

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

Conceptually this platform uses wood pellets, hog fuel, woodchips etc. for solid fuel to replace coal domestically and commercially

WHY DO WE CARE?

SITUATION

- 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^
- Coal is extensively used in boilers across New Zealand (e.g. to heat schools, in dairy factories to dry milk)
- The dairy industry is built on removing liquid from milk, and coal is currently a significant part of this process
- Government plans on phasing out coal boilers for low to medium heat by 2037

COMPLICATION

- While the wood processing sector has moved in places to use wood waste, other sectors of the bioeconomy still use significant coal for heat energy. With new thinking and new equipment, this situation can change.
- The government has developed a decarbonisation policy and fund
- Proposing to phase out existing coal boilers by 2037
- All remaining coal boilers in New Zealand schools will be replaced with renewable woody biomass or electric heating sources by 2025
- Coal production and use in processing has high GHG emissions
- New Zealand policies and plans in place to reduce GHG emissions

RESOLUTION

- NZ requires a cost effective process for producing solid bioenergy

- Total GIDI* funding of $79.5m has co-funded 66 projects to support energy efficiency, and the switch from fossil fuels to cleaner renewable energy sources
- The GIDI projects breakdown (presented in table right) is based on the technology. Refer to the table for further detail
- The projects relating to biomass are primarily Biogas Boiler (2), Biomass Boiler (21), and Wood Furnace (1)
- GIDI funding increased to $600m
- Government provided $22m in co-funding to 14 firms to convert to new sustainable technologies (part of wider scheme, see those reports for details)
- Government Biomass Supply Chain Investment Fund to support forestry residue conversion to boiler-ready fuel (open as at April 2023)
- State Sector Decarbonisation Fund (SSDF) and Carbon Neutral Government Programme support

GIDI PROJECT BREAKDOWN

Primary Technology	No. of Projects
Biogas Boiler	2
Biomass Boiler	21
Electric Furnace	1
Electrode Boiler	6
Energy Efficiency	9
Foam Generator	1
Geothermal Steam	1
Heat Pump	21
Infrared Dryer	2
Mechanical Vapour Recompression	1
Pulse Electric Field	1
Spray Condenser	1
Thermal Screen	1
Wood Furnace	1

** GIDI = Government Investment in Decarbonising Industry Fund ^ Source: MBIE Coal Statistics; https://www.eeca.govt.nz/co-funding/public-sector-decarbonisation/state-sector-decarbonisation-fund/; https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/carbon-neutral-government-programme/about-carbon-neutral-government-programme/#:~:text=The%20Carbon%20Neutral%20Government%20Programme%20(CNGP)%20has%20been%20set%20up,to%20a%20low%2Demissions%20economy.*

This opportunity focuses on replacing fossil fuel based solid energy with solid biofuels such as wood pellets

WHAT IS IN AND OUT OF SCOPE

TECHNOLOGY

- Equipment (boilers)
- Imports (pellets)

MANAGEMENT

- Internal decision–making

NOTE: "It is much more efficient to convert biomass directly to heat (e.g. in a biomass boiler) than from heat to mechanical work to run a turbine (see exergy definition / second law of thermodynamics - "not all heat energy can be converted into work in a cyclic process")"*

AVAILABLE BIOMASS

- What biomass is available in New Zealand as feedstock
  - Wood/Forestry waste
  - Agricultural residues (hemp, maize, sunflower husks, corn cobs etc.)
  - Dedicated fast growing woody crops (e.g. eucalyptus, willow, poplar, pinus radiata)
  - Energy Crops (e.g. Switchgrass, miscanthus, reeds)
  - Animal manure (poultry litter, cow manure, pig waste)
  - Algae (pellets and bricks)

Solutions that are out of scope for this section

We acknowledge that solid bioenergy can also replace LPG and diesel for process heat.

We also acknowledge the significant advances in boiler technology resulting in greater energy recovery

* *pers comm, EECA*

This platform uses biomass or biomaterials to produce solid biofuel

WHAT IS THE FEEDSTOCK?

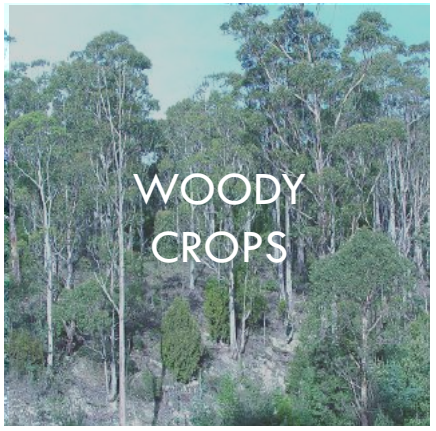
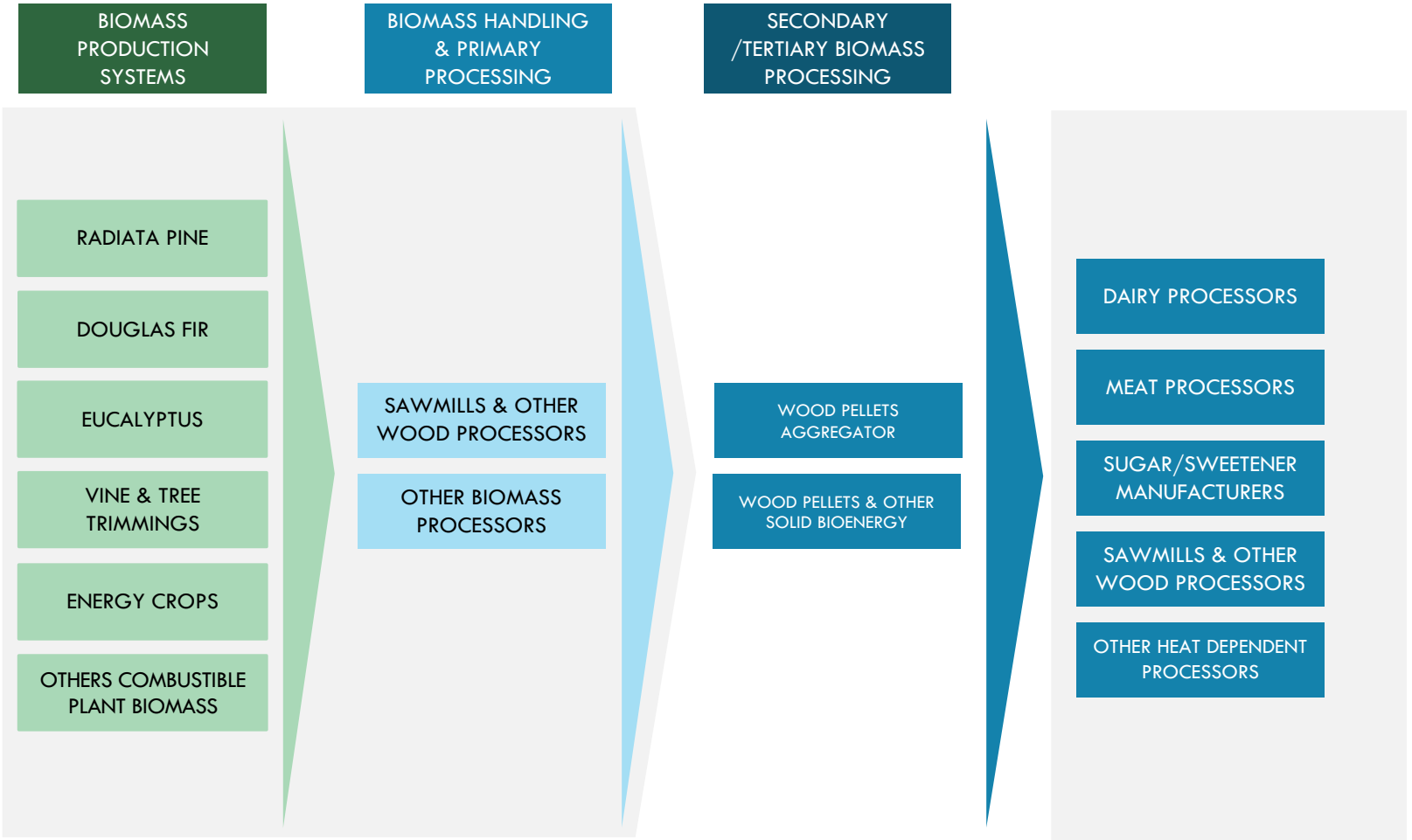


Image credit: Public Domain; Wikimedia CC ASA 3.0, 2.5, 4.0; Wilkinson; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Wood pellets and other solid bioenergy has current and potential linkages primarily into the parts of the bioeconomy that are heat dependent

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



New Zealand has a number of feedstock options for solid biofuel

POTENTIAL FEEDSTOCK ADVANTAGES AND DISADVANTAGES

FEEDSTOCK	BRIEF DESCRIPTION	ADVANTAGE	DISADVANTAGE
FORESTRY PRODUCTS RESIDUES	- Utilising forestry waste from processing (sawdust, chips) to produce solid biofuel – burnt directly on site in the case of wood processors - Converted into white wood pellets and black pellets (the latter not currently made in NZ*)	- Well known process - Large volumes available across many regions - Less carbon footprint during processing - Promotes circular economy	- May compete with other uses for wood fibre (e.g. pulp making, fibre board) - Collection challenges (distance, cost, logistics) - Quality and consistency of biomass
AGRICULTURAL RESIDUES	- Utilising waste from agricultural waste (e.g. pea straw, sunflower husks, hemp stalks, maize husks) - Most efficient if grown adjacent to production – use for processing	- Available in concentrated areas- local sourcing (e.g. sunflowers in Canterbury) - Does not compete with food production - Promotes circular economy and waste minimisation	- Large volumes of waste and residue required - Quality and consistency of biomass volumes - Competition for biomass, waste unavailable to other systems (e.g. animal feed, animal bedding) - Collection and storage can be expensive - Lower energy vs alternatives
WOODY CROPS	- Use fast growing plants such as eucalyptus, poplar, willow, mānuka – short rotation woody crops - In particular, located on marginal land - Most efficient if grown adjacent to production	- Well known process - Can be developed in conjunction with production system	- Space required for growing if adjacent to manufacturing or processing - Quality and consistency of biomass
ENERGY CROPS	- Crops grown specifically for bioenergy such as switch grasses, miscanthus, giant reed (raupo) - Used for its high energy content, fast growing	- Grows well across NZ - Grown as dedicated crop ensuring consistent supply - Can be grown on marginal land	- Dedicated land required potentially competing with food supply - Selective breeding to improve yields - Quality and consistency of biomass
ALGAE	- Macro algae AKA seaweed able to be used to make biofuel - Can be grown in adjacent aquatic environments - Produced in bricks or pellets	- Renewable fast growing resource - Sustainable, does not require arable land - Absorbs CO2, developed as part of waste reduction plant - Can be grown in range of environments including wastewater	- Scalability; currently no viable farming system - Many global attempts failed - Specialised technology required, which can be energy intensive - May required additional processing – adding to cost - Collection, storage and processing can be expensive
ANIMAL MANURE	- Very traditional use of animal manure - Using chicken litter, cow dung, pig waste as the feedstock	- Renewable and sustainable resource - Reduced carbon footprint - Incorporate into circular economy, on-going production	- Collection, storage and processing can be expensive - Moisture content needs managing - Issues with odour - Removal from farm system (fertiliser required to replace) - High production of ash and particulate matter

**NOTE: White wood pellets mature market of compressed wooden pellets, Black pellets are torrefied (thermally treated) with resulting reduced moisture, higher density and energy and easier to store vs white wood pellets; Source: various articles and reports; Coriolis research and analysis*

Solid bioenergy production is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Potential feedstock crops achieve high biomass yields (e.g. woody tree crops)
2 **INCREASING VALUE-ADDED**	- Potential to add value to existing agricultural waste streams, forestry waste streams or residues
3 **BUILDING RESILIENCE**	- Employment and industry created in the regions in growing and processing - Higher wages available in processing in particular - Increases social and economic capital
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Solid biofuels able to be used in heating and electricity generation (e.g. heating greenhouses) - Localised production reduces need for long distance transport - Enhances environmental capital
5 **REPLACING FOSSIL FUELS**	- Biobased solid energy replaces fossil fuel based energy such as coal - Opportunity to develop sustainable and renewable energy sources at all locations - It is much more efficient to convert biomass directly to heat (e.g. in a biomass boiler) than from heat to mechanical work to run a turbine*
6 **RETHINKING WASTE**	- Waste streams seen as a resource - Processing agricultural byproducts and forestry waste streams and coproducts into solid fuel energy - New systems design creates less waste

** EECA pers comm; ^ Modelled, not quantified*

Solid biofuel production can be part of a wider circular system

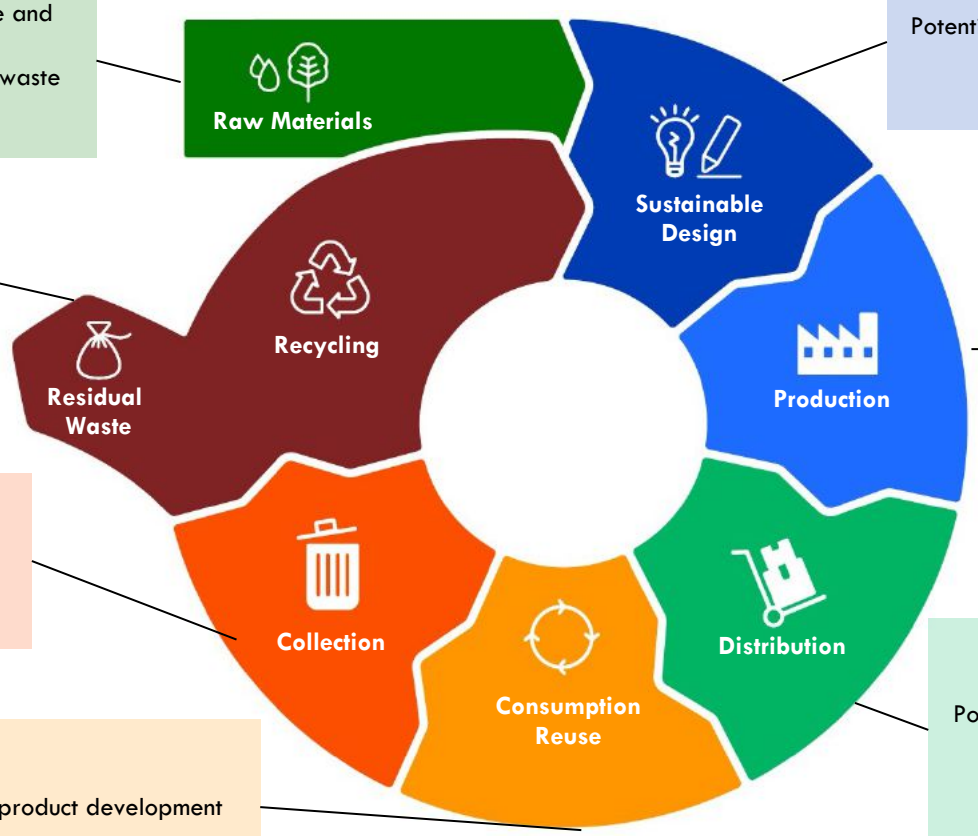
WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Raw material inputs sustainable and renewable
Many potential inputs currently waste streams and residues

Residual waste across multiple systems can be used for biofuels

Opportunity for backhaul loads

Encouraging co-product development



Efficient production
Potential to design full circular economy thinking in new production
Eco-design and innovation

Modern plant and equipment
Renewable energy use
Raw material and production in close proximity – co-location feasibility?

Reduced distribution distances in particular if industries co-located
Potential for alternative energy sources in distribution
Extending sustainability to logistics partners

Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

There are a number of solid biofuel firms located across New Zealand, primarily using wood biomass

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- Solid biofuel suppliers are well established in NZ (e.g. Azwood supply a full range of wood energy products across New Zealand (bulk to bags))
- Alternative solid biofuels are less common (e.g. miscanthus)
- Fonterra converted two factories to wood pellets – wood trial estimated 77,000ha of low-grade logs and slash required to replace all coal, by the end of 2023 only 6 of 29 sites using coal*
- Genesis and NZ Bioforestry to explore potential for biofuels as alternative for Huntly Power station

SELECT FIRMS
Not a complete list

SELECT FEEDSTOCK FIRMS

PORT BLAKELY

Rayonier

* *Source: Fonterra via article, 2023 NOTE: Select firms only*

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

INDUSTRY ORGANISATIONS

- A range of organisations support firms producing and researching Biofuels and bioenergy

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities are researching topics within this platform

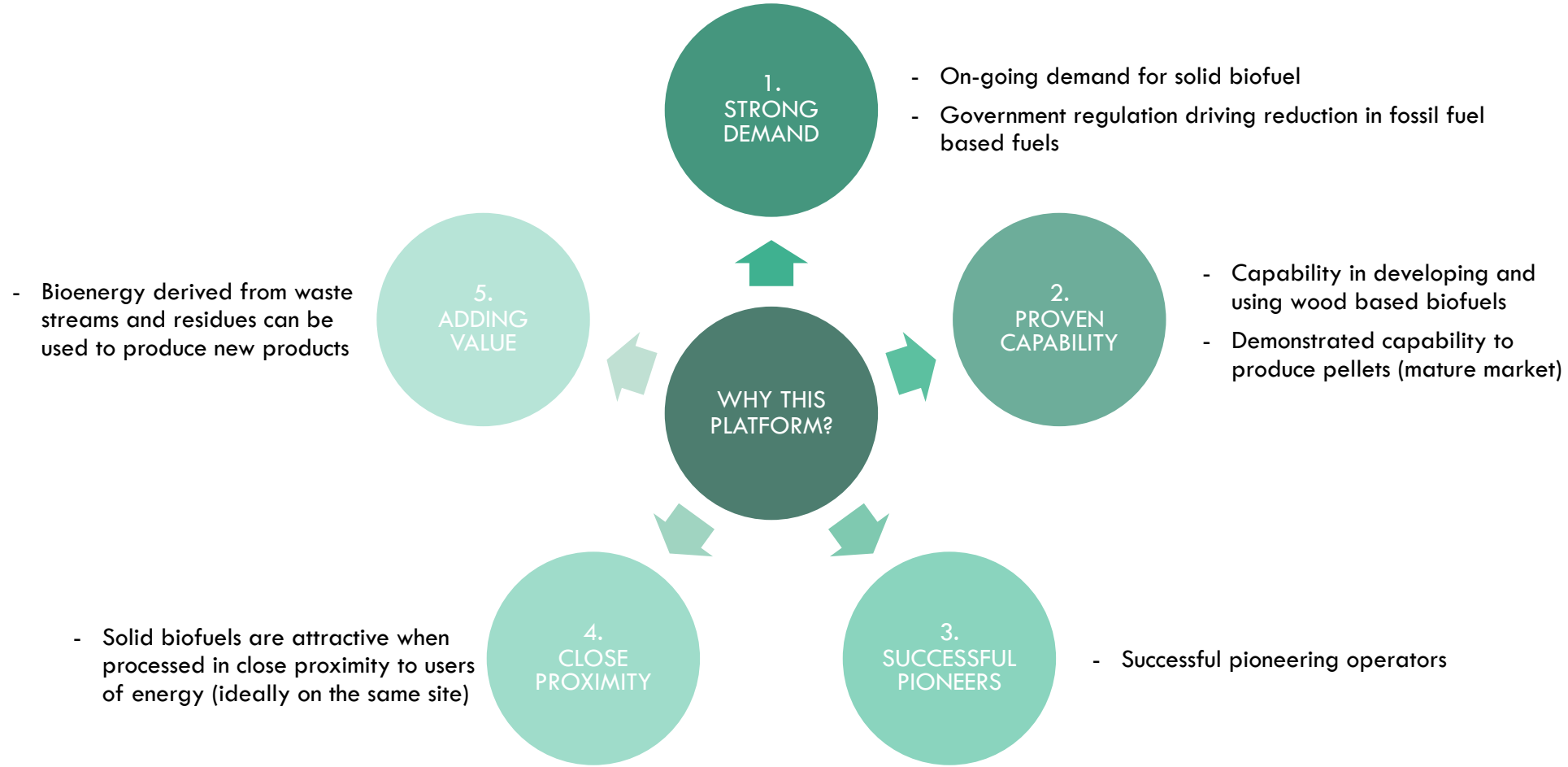
GOVERNMENT / CRI'S

- Crown Research Institutes
- Scion research around improving usability of woody residue
- EECA leads funding programmes

Source: various company and organisation websites; Coriolis analysis

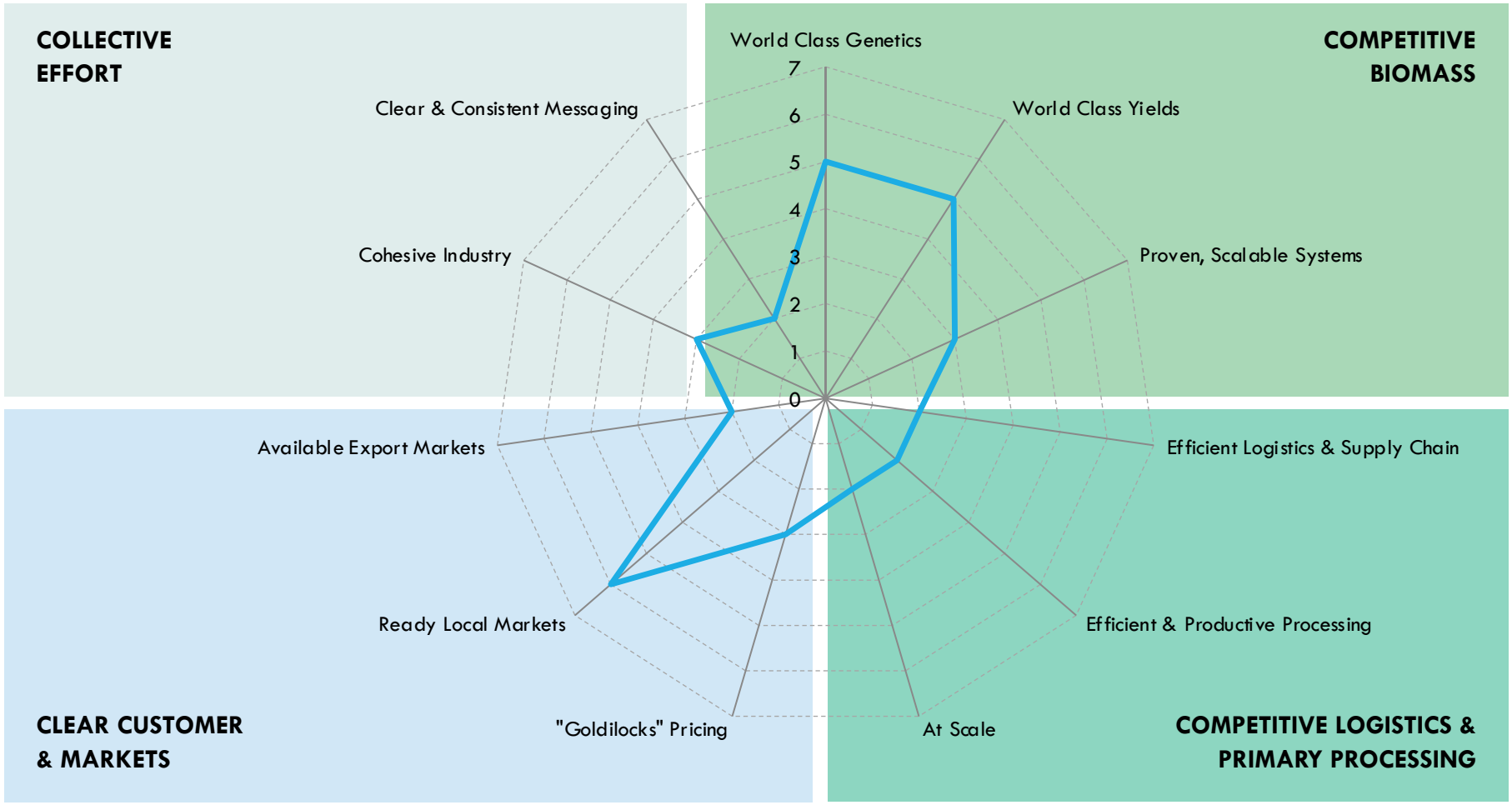
There are a range of strong arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

What is the sustainability of the feedstock?

- How do we secure access to the feedstock? Other sectors will compete for the easily available and convertible feedstock (e.g exports, for biofuel or soil amendments)

How risky is the political environment?

- Is the political climate likely to change in the mid-term making the sector risky
- How is pricing, emissions trading scheme and subsidies likely to affect the sector
- What Sustainability credentials and market access is available?

Do we have enough waste feedstock in the right places to support the sector?

- Beyond forestry, are the other potential feedstocks available in large enough quantities to be meaningful and commercially viable?
- Is the feedstock in the right place in the right volumes? Is there a backup feedstock?
- For example, Huntly would require 22,500ha to create 250,000t of black pellets*

Is the feedstock economically viable at scale?

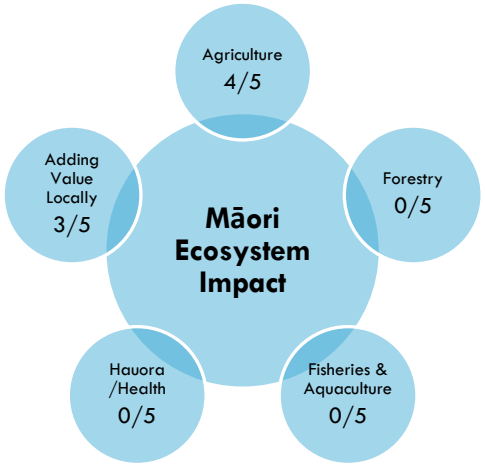
- What are the production costs, pricing and competition with other energy sources?
- Limited experience in NZ with torrefied wood production
- What is the economics of transporting wood pellets

** Genesis estimations, article: https://www.farmersweekly.co.nz/technology/huntly-wood-trial-hailed-as-leap-ahead-for-biofuel/; Source: Coriolis analysis*

Solid Bioenergy

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆ ☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆ ☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Māori land groups could be interested in this – due to the fact that much of the Māori economy is focused on the agricultural sector along with the climate change narrative.
- Clear alignment with cultural values of environmentalism, kaitiakitanga
- Attractive alternate use / revenue of underperforming Māori land and forestry assets.
- Lack of clarity around selecting best biomass approach for alternate fuel feeder might prevent involvement or investment by Māori.
- Utilisation of forestry slash as a fuel will resonate with East Coast and Northern Māori groups.
- Māori investors will be wary of the reality of location and transport costs vs the story being sold.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆ ☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆ ☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**51/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

New Zealand requires a cost effective process and system for producing solid bioenergy

1 INVESTING IN **FEEDSTOCK FEASIBILITY STUDIES**

- Research into volumes, locations and types of feedstocks available*
- Including opportunity cost of competing uses of feedstock
- Sustainability of production and supply

2 INVESTING IN **PRODUCTION TECHNOLOGIES**

- R&D into production processes, pelletising, briquetting, combustion systems – using new feedstock, more efficient processing and torrefaction
- R&D into increasing efficiency of production

3 INVESTING IN **SUPPLY CHAIN AND LOGISTICS**

- Infrastructure and logistics required for transportation, storage and handling facilities across the supply chain

**Underway by EECA in the Regional Energy Transition Accelerator (RETA) programme*

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

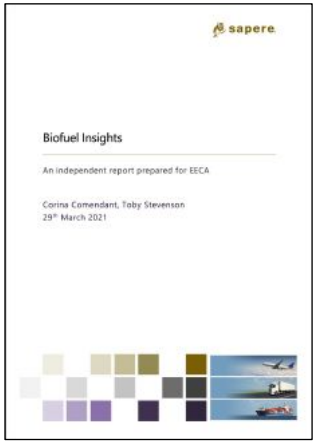
BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

This is not a stand-alone section; please review the large body of work available on the opportunities and challenges in the New Zealand biofuel and alternative energy sector prior to reading this section

SELECT REPORTS ON THIS SECTOR

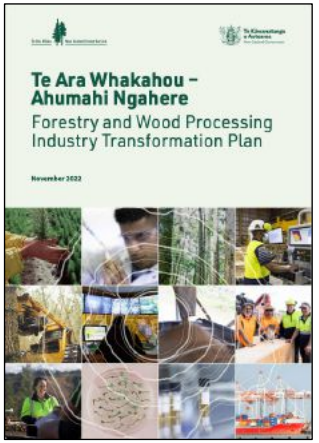


https://www.eeca.govt.nz/assets/EECA-Resources/Research-papers-guides/Liquid-Biofuel-Research-Report-March-2021.pdf

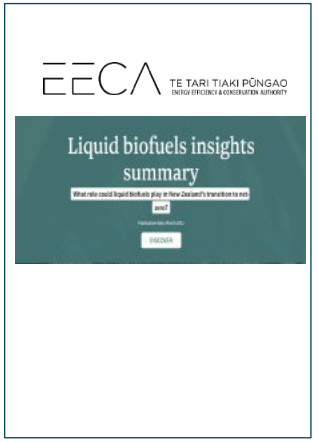
https://www.mbie.govt.nz/dmsdocument/4292-process-heat-in-new-zealand-opportunities-and-barriers-to-lowering-emissions

https://www.eeca.govt.nz/assets/EECA-Resources/Research-papers-guides/Off-road-liquid-fuel-insights.pdf

https://www.mpi.govt.nz/dmsdocument/51007-NZ-Wood-Fibre-Futures-Project-Stage-Two-Final-Main-Report



https://www.mpi.govt.nz/dmsdocument/54472-Te-Ara-Whakahou-Ahumahi-Ngahere-Forestry-and-Wood-Processing-Industry-Transformation-Plan



https://www.eeca.govt.nz/insights/eeca-insights/liquid-biofuels-insights-summary/

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

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"

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

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.

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

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*

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 vegetable oils and similar waste streams
- Other opportunities exist

** 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; Compare EROI for conventional oil varies by location and source from between ~10 to ~40*

This platform scales up domestic production of liquid biofuel from local biomass to replace fossil fuel based petrol and diesel

WHY DO WE CARE?

SITUATION

- New Zealand imports large quantities of petrol and diesel
- In Dec 2022 New Zealand had 2.89m cars, 702,000 trucks, 80,000 other vehicles including tractors[1]
- In YE March 21 New Zealand used 2.86b litres of petrol and the same amount in diesel (2.86b litres)
- Farm tractors and equipment are large users of diesel. 26% of diesel is used for off-road applications. Off-road uses of fossil fuels are 6.6% of NZ Total Consumer Energy (2019) and 9% of energy sectors GHG emissions (2018)).[2]

COMPLICATION

- Transport fuel is New Zealand's largest energy supply problem (third largest emitter of GHGs)
- Fuel emissions also result in health conditions (air pollution)
- Fuel is a major cause of New Zealand's trade deficit
- Some fuel originates from politically unstable and volatile countries
- New Zealand's Emissions Reduction Plan aims to reduce our reliance on fossil fuels
- New Zealand has policies and plans in place to reduce GHG emissions
- Woody biomass is expensive

RESOLUTION

- New Zealand must move towards lowering emissions and providing solutions to transition to cleaner energy sources including biofuels where this makes economic sense
- Biofuels (bioethanol and biodiesel) are renewable fuels made from organic materials. Biofuels reduce greenhouse gas emissions (in many but not all cases*), as they are produced from renewable resources.
- Despite a number of high profile challenges, this sector could replace liquid fossil fuels in the longer term, in selected transport applications (e.g. on-farm vehicles).
- Biocrude is a versatile base as an input to biofuels (among other things)

** See EECA Liquide Biofuel report for more complete details and explanation; 1. Statistics NZ; 2. Martin Jenkins, Off-road liquid fuel insights for EECA 2021*

This opportunity focuses on replacing fossil fuel based fuel with liquid biofuels

WHAT IS IN AND OUT OF SCOPE

TECHNOLOGY

- Batteries
- EV's
- EV subsidies
- 41,203 EVs in New Zealand in 2022* (making up less than 1% of all vehicle registrations)

ALTERNATIVE TRANSPORT

- Ships
- Trains
- Public Transport
- Bicycles

IMPORTS OF BIOFUELS

BIOMASS

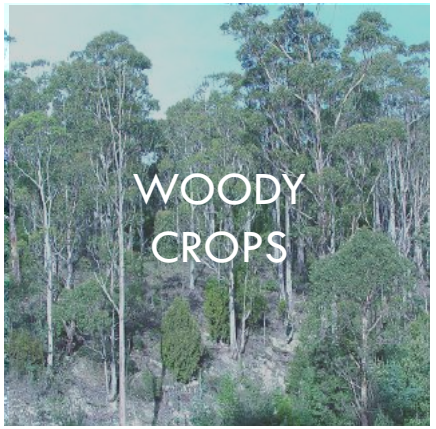
- What biomass is available in New Zealand as feedstock
  - Forestry waste
  - Agricultural residues
  - By products (used cooking oil, tallow)
  - Oli crops (canola)
  - Starch /sugar crops (maize)
  - Seaweed
  - Microalgae
  - Energy crops (raupo)

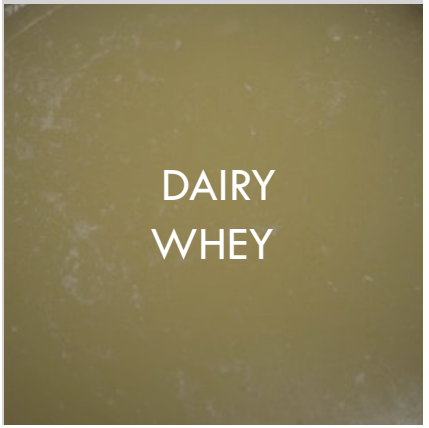
Solutions that are out of scope for this section

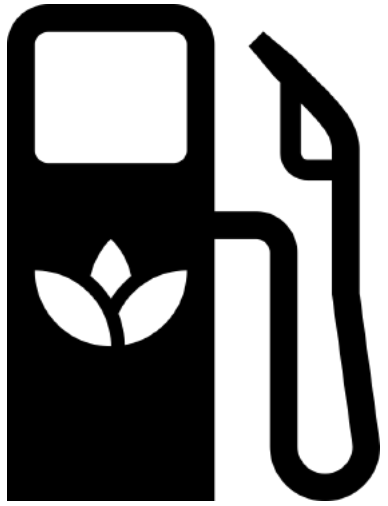
Source: Coriolis from various sources

This platform uses biomass and byproducts from biomaterials to produce liquid biofuels

WHAT IS THE FEEDSTOCK?





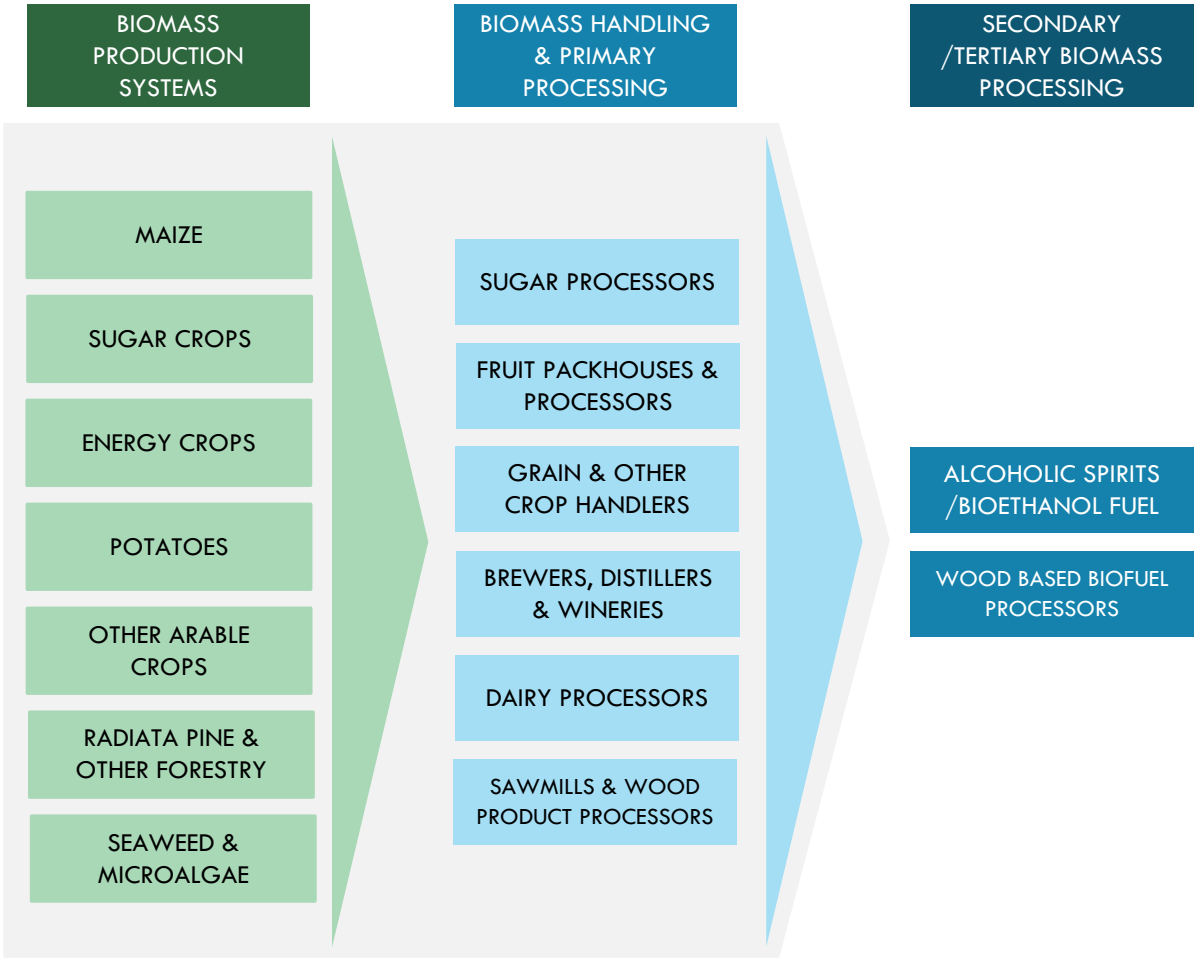


SEE EECA Liquid Biofuels insights for more detailed assessment

Image credit: Public Domain; Wikimedia CC ASA 3.0, 4.0, 1.0; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research

Bioethanol (aka. pure alcoholic spirits) has current and potential linkages into large parts of the bioeconomy*

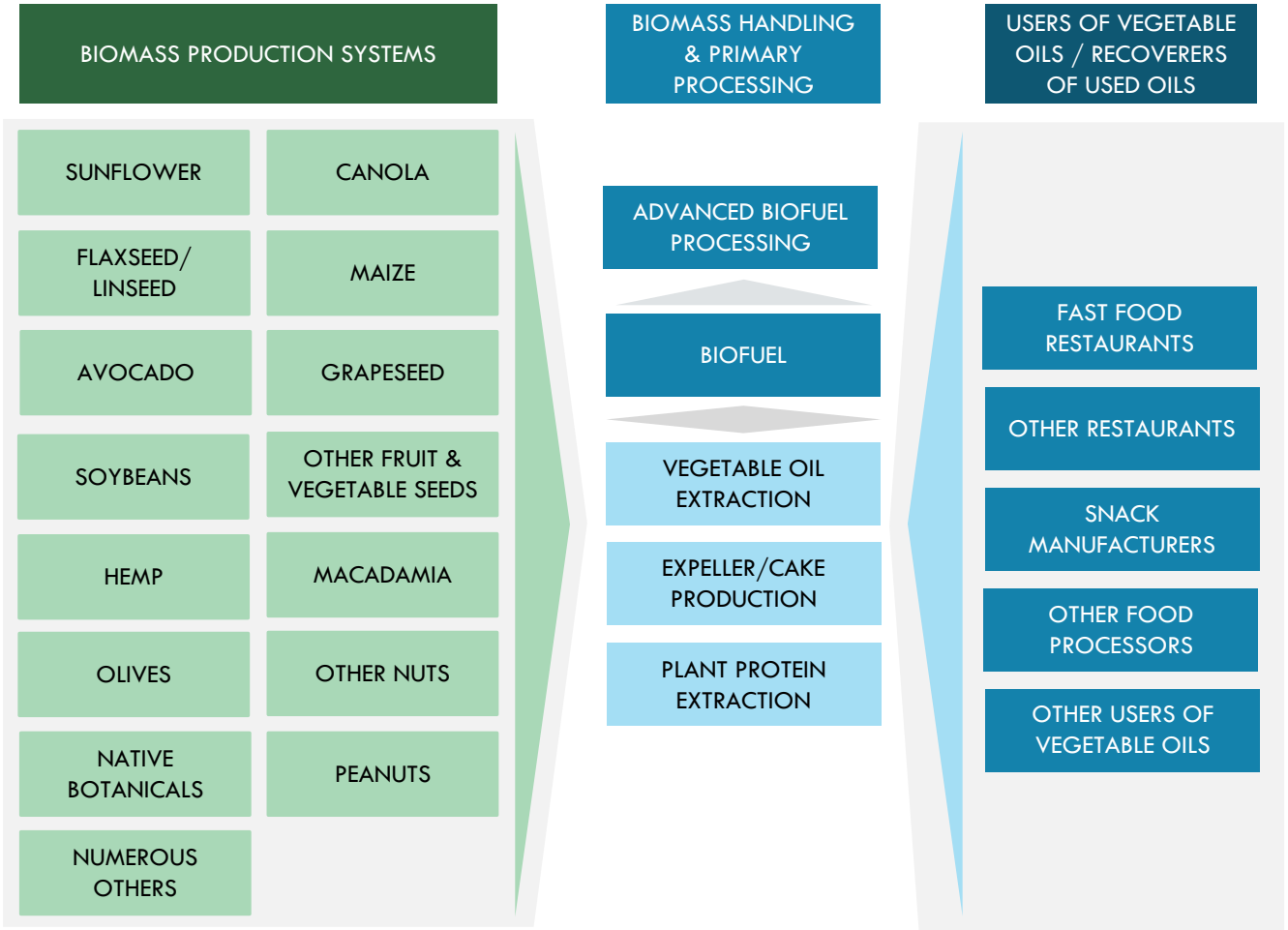
WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



** NOTE: "For an energy source 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." EECA Liquid Biofuels Report*

Biodiesel (aka. further processed vegetable oil) can be made from virgin oilcrops or recovered from waste vegetable oils

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



Liquid bioenergy production is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 INCREASING BIOMASS	- Potential feedstock crops achieve high biomass yields (e.g. woody tree crops, high energy plants) - Feedstock from forestry waste streams
2 INCREASING VALUE-ADDED	- Potential to add value to existing agricultural waste streams or residues
3 BUILDING RESILIENCE	- Domestic production of liquid biofuels builds resilience (de-risks reliance on imports) - Increases social and economic capital
4 REDUCING AGRICULTURAL GHG EMISSIONS	- Liquid biodiesel able to be used in farm vehicles (conventional biofuels have limited impact vs advanced biofuels due to low blending potential)
5 REPLACING FOSSIL FUELS	- Biofuel replaces fossil fuel or can be blended with existing fuels - Opportunity to develop sustainable and renewable energy sources - Compared to these conventional biofuels, advanced biofuels from biomass have much lower emissions related to land-use change*
6 RETHINKING WASTE	- Agricultural/forestry waste streams can be converted into fuels - New advanced systems design creates less waste

** EECA Liquid Biofuels report*

Liquid biofuel production is a key input into the circular economy system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Raw material inputs sustainable and renewable (in particular forestry waste)
Many potential inputs currently waste streams and residues

Efficient production
Potential to design full circular economy thinking in new production

Residual waste across multiple systems can be used for biofuels

Modern plant and equipment
Biofuel and production used to power processing

Reverse supply chain from major users (e.g. waste stream from processing)

Encouraging co-product development

Reduced distribution distances with co-location or route optimisation
Potential for alternative energy sources in distribution
Extending sustainability to logistics partners

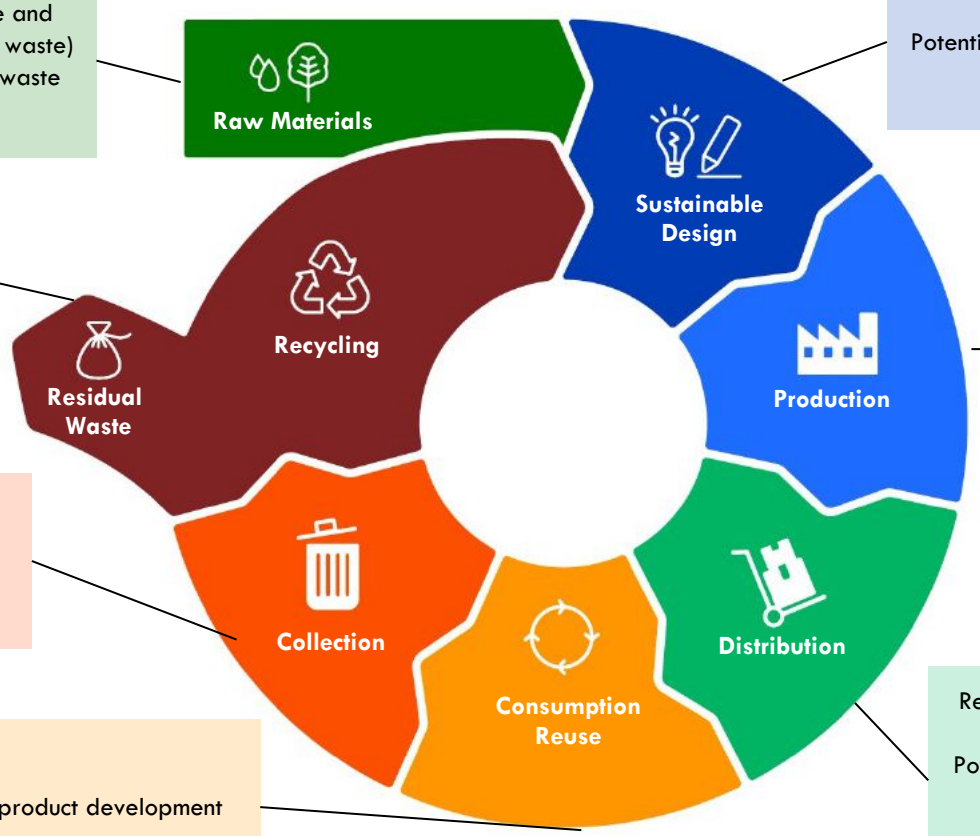


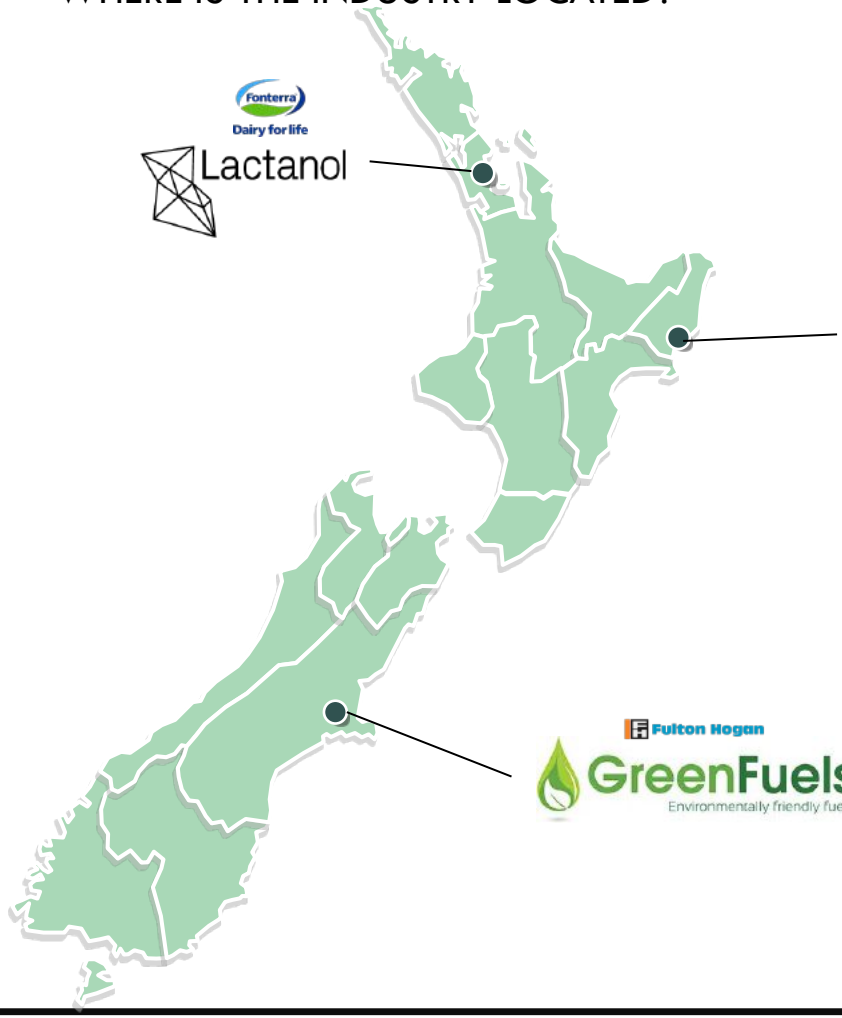
Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

There are several liquid biofuel firms located across New Zealand

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- Lactanol (Division of Fonterra) uses dairy whey to produce ethanol (co-located with 5 Fonterra factories), supplies Gull - Converted Tirau site to lactose production 2022.
- Numerous other plants failed e.g. Z Energys Te Lira Hao plant
- On-going interest in biofuel from startups, and fuel companies (Z Energy, Challenge, BP), aviation companies (Air NZ), etc.
- No advanced biofuel refineries



Only pilot activity at this stage (pre commercial)

Greenfuels uses 100% recycled vegetable oils and produces blends (5%, 20%, 100%)

900k litres; supply constrained

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

INDUSTRY ORGANISATIONS

- A range of organisations support firms producing and researching Biofuels and bioenergy

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities are researching topics within this platform
- Auckland University and NIWA researching algae

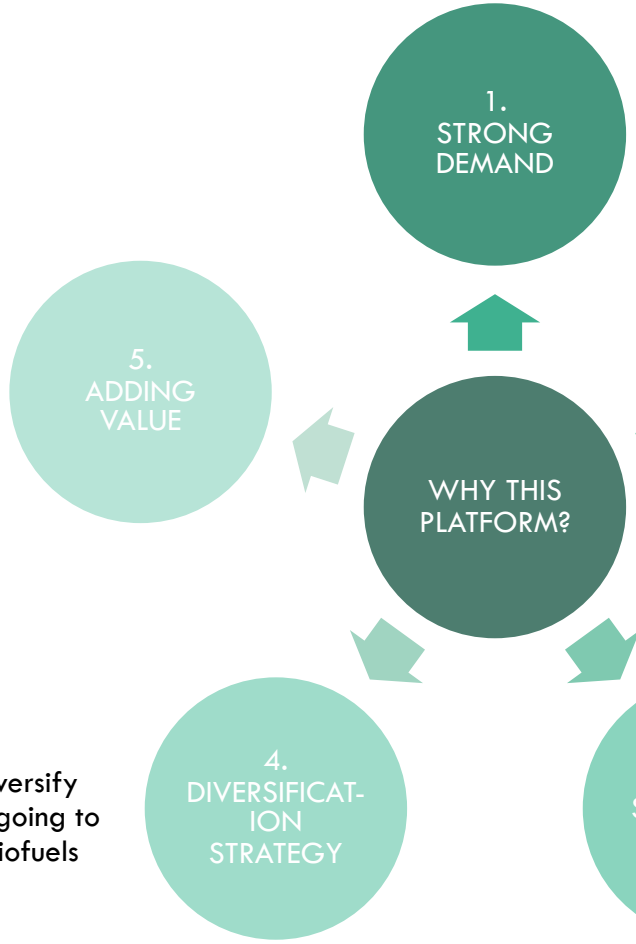
GOVERNMENT / CRI'S

- Crown Research Institutes
- Scion research around forestry biomass and development tools
- NIWA researching algae potential
- EECA leads funding programmes

Source: various company and organisation websites; Coriolis analysis

There are a range of arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- On-going demand for biofuel
- Government regulation driving reduction in fossil fuels

- Capability in developing and using conventional biofuels
- Scion researching advanced biofuels

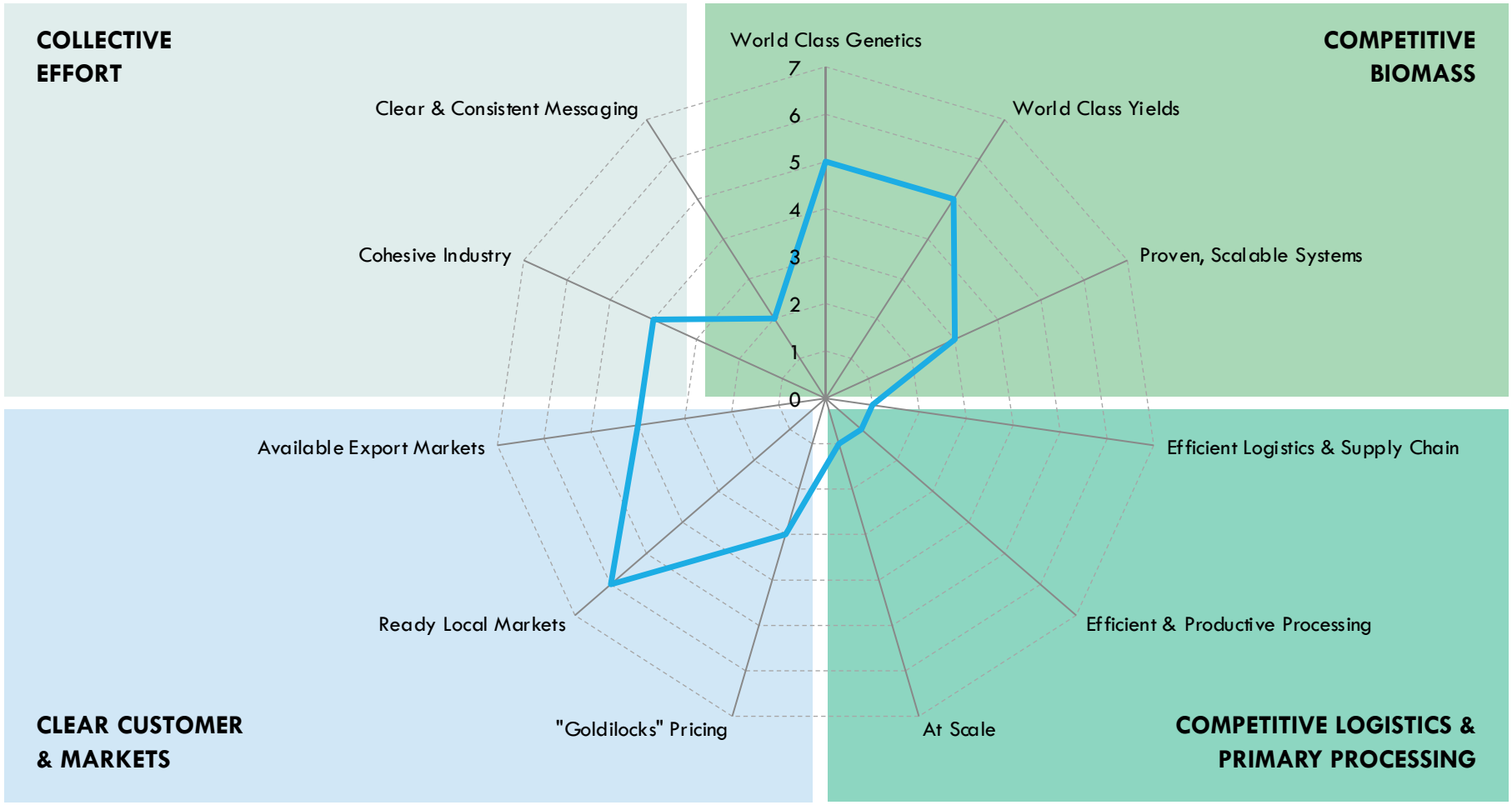
- Emerging group of pioneering firms

- New Zealand needs to diversify energy sources if it is not going to be reliant on imports of biofuels

- Potential for bioenergy derived from waste streams and residues to be used to produce new innovative products

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

What are you proposing to use as feedstock?

- NZ does not grow sugar crops, which are the only feedstocks that stack up unsubsidised (albeit in Brazil and Indonesia)
- Maize primarily grown for animal feed; there is no social licence to grow higher yielding GM varieties
- Returns per hectare are low (vs. dairy)
- Trees contain lignocellulosic biomass, which is complex and resistant to degradation*

Attempts at biofuel production in NZ have not succeeded and lost money. Will anything change?

- There have been what? Five or six high profile failures in New Zealand doing this. What has changed?
- Economically viable production is likely to require large scale plants and access to huge amounts of (imported) feedstock. Why won't we just end up importing biofuel from Singapore rather than fossil fuel?
- Note closure of NZ's oil refinery
- How will we compete with highly subsidised producers elsewhere?

The technology still costs significantly more than fossil fuels. Can this ever be fixed?

- All other things being equal, does NZ have the knowledge and technical capability to adopt and adapt latest off-the-shelf imported technology?
- Beyond forestry, are the other potential feedstocks available in large enough quantities to be meaningful and commercially viable?
- Models estimate a large advanced liquid biofuel plant costs $1b where 1m tonnes of woody biomass converts to ~120m L of drop-in liquid biofuel^; ~4% of NZ's total diesel consumption in 2021

How much free money is the government going to splash around on this?

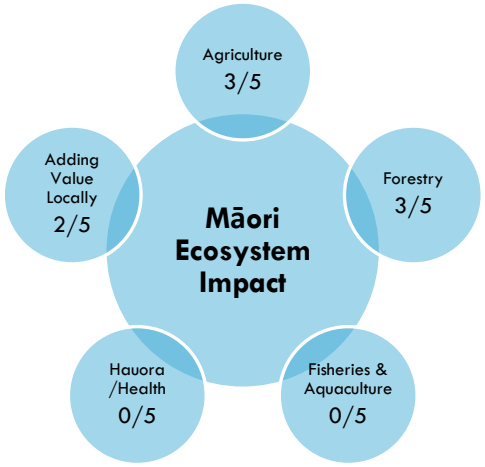
- Is the Government likely to significantly support biofuels production long term?
- The economics don't stack up without significant ongoing subsidies and mandates (e.g. ethanol in the US). Aren't there better options for decarbonisation? For example, with a surfeit of renewable electricity potential, isn't NZ better off electrifying everything?
- What is the long term future? If ICE# vehicles are phased out, where will this fuel be used?

** Visualise a large dead tree in the forest. It sits there for a long time before nature recycles it. If there was a quick solution to turning trees into energy, evolution would have identified it a long time ago. ^MPI: Wood, Fibres Future and Coriolis analysis (assumes a biodiesel density of 0.88 kg/L). # ICE = Internal Combustion Engine; NOTE: See EECA's Liquid Biofuels for additional assumptions and models*

Bioethanol / Biodiesel

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆ ☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆ ☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆ ☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR MĀORI, WHAT ARE THE MAIN CONSIDERATIONS?:

- Māori land groups potential interest – due to the fact that much of the Māori economy is focused on the agricultural sector along with the climate change narrative.
- Clear alignment with cultural values of environmentalism, kaitiakitanga.
- Potentially attractive alternate use / revenue of underperforming Māori land and forestry assets.
- Utilisation of waste product / forestry slash etc as a fuel will resonate with Māori groups. But hard to see how it can be done at significant enough scale to warrant industry transformation.
- Māori investors will be hard to convince given wide range of issues including risk of price competitiveness, likelihood of stable regulatory approach over multiple governments and possibility of technology disruption.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆ ☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	41/100

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

Despite a long string of failures, New Zealand still requires a cost effective process and system for producing liquid biofuel

1 REDUCING NET **FEEDSTOCK COSTS**

- Improving supply chains to remove cost
- Including opportunity cost of competing uses of feedstock
- Sustainability of production and supply

2 INVESTING IN **PRODUCTION TECHNOLOGIES**

- R&D into producing and refining (in particular advanced biofuels (to reduce blending limits))
- R&D into increasing efficiency of production

3 INVESTING IN **SUPPLY CHAIN AND LOGISTICS**

- Infrastructure and logistics required for transportation, storage and handling facilities across the supply chain

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

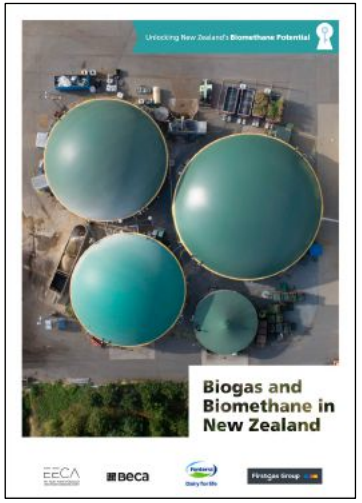
FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

This is not a stand-alone section; please review the large body of work available on the opportunities and challenges in the New Zealand biofuel and alternative energy sector prior to reading this section

SELECT REPORTS ON THIS SECTOR

https://www.mbie.govt.nz/dmsdocument/4292-process-heat-in-new-zealand-opportunities-and-barriers-to-lowering-emissions



https://gasischanging.co.nz/assets/uploads/Biogas-and-Biomethane-in-NZ-Unlocking-New-Zealands-Renewable-Natural-Gas-Potential.pdf

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

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)"

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)

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.

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

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

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

This platform scales up use of organic material to produce biogas replacing fossil-based gas

WHY DO WE CARE?

SITUATION

- The modern economy creates a lot of waste
- Large agrifood and bioeconomy producing meat, seafood and dairy products create a lot of waste in the form of organic material
- Municipal landfills and wastewater treatment plants concentrate waste; landfills and plants are spread across the country

COMPLICATION

- At the same time, a growing and changing regulatory environment puts pressure on waste management operators to find solutions
- When organic material breaks down it creates gas (methane and carbon dioxide among others at smaller levels)
- When agricultural processing waste and municipal waste breaks down it also creates methane gas and carbon dioxide
- Methane gas contributes to New Zealand's greenhouse gas emissions
- New Zealand has committed to reducing GHG emissions

RESOLUTION

- Mature technology exists to turn municipal food waste and other sources of biomass into sustainable, renewable clean energy
- Technology exists to take concentrated amounts of organic waste and turn it into energy in the form of biogas and biomethane
- Biomethane can substitute for fossil fuels (particularly as a drop-in substitute into the pipeline, as it is chemically equivalent) or converted into compressed natural gas (CNG) or liquefied natural gas (LNG) for vehicles

Source:

This platform assesses replacing fossil fuel gas with biogas

WHAT IS IN AND OUT OF SCOPE

TECHNOLOGY

MANAGEMENT AND COLLECTION SYSTEMS

Solutions that are out of scope for this section

BIOMATERIALS

- Organic biomaterial available in New Zealand as feedstock for biogas:
  - Animal manure
  - Meat processing byproducts (e.g. gut contents)
  - Other agricultural and food processing waste
  - Municipal waste/Food waste
  - Waste treatment plants 'sludge'
- Biomethane (upgraded biogas) removes impurities including carbon dioxide and is a higher quality gas, and chemically equivalent to fossil gas

Source: Coriolis from various sources

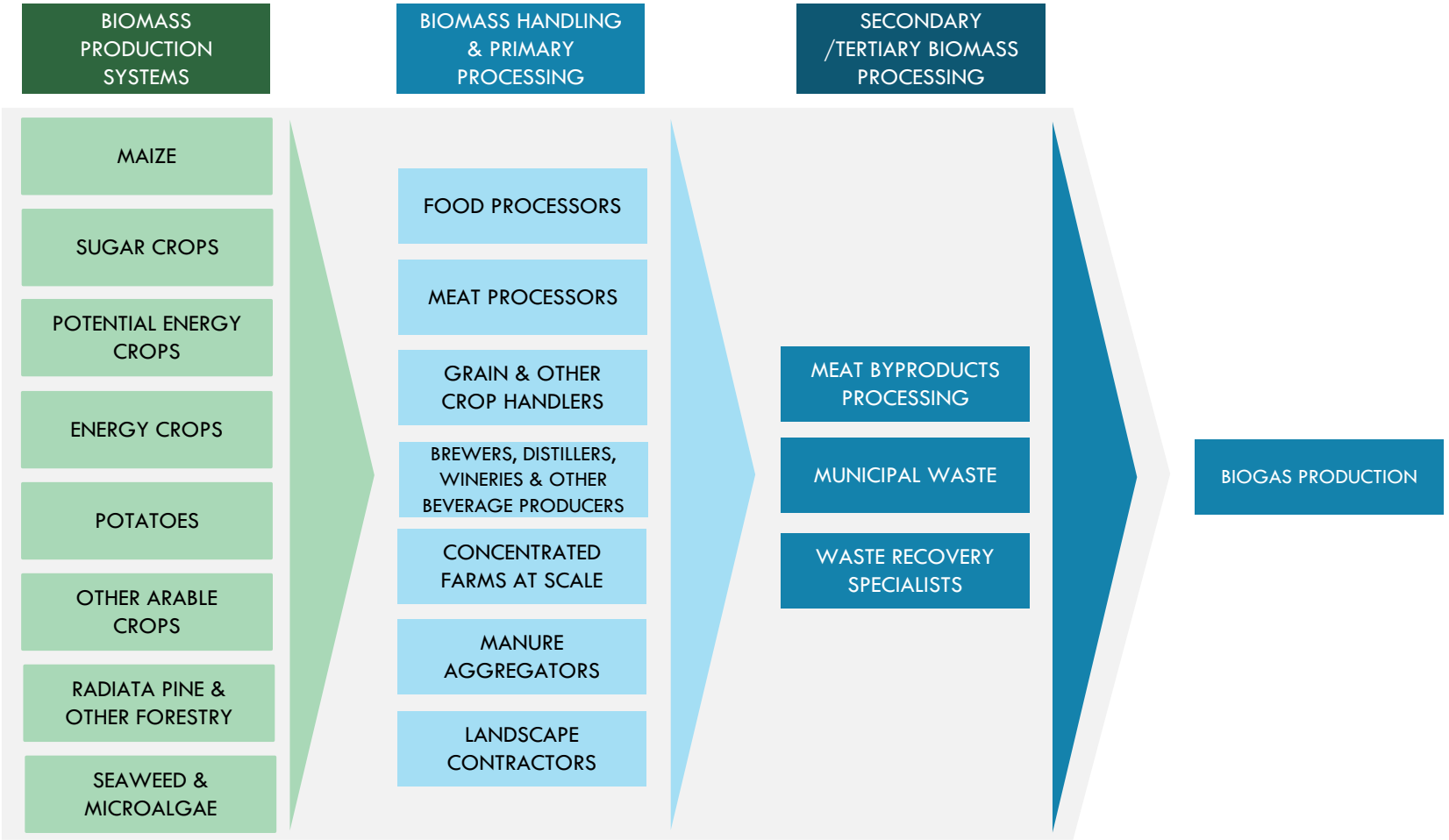
This platform uses organic waste from biomaterials to produce biogas

WHAT IS THE FEEDSTOCK?

* *gut contents from abattoirs, cow stomach contents weighs between 10-15kg; Image credit: Wikimedia CC ASA 2.0, 4.0*

Biogas production can occur at locations with high concentrations of plant and animal waste

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



As a simplified model organic material is collected, digested and fermented to produce biogas or biomethane

WHAT IS THE PROCESS?

FEEDSTOCK COLLECTION

- Feedstock production (e.g. municipal waste management sites, chicken farms, meat abattoirs, potato farm)
- Feedstock collection (e.g. city compost recycling system, direct from farms)

PRE-TREATMENT

- Feedstock pre-treated to remove contaminants (e.g. city urban compost, food production facility)
- Potentially shred/grind (e.g. old bread)
- Adjust levels and conditions to maximise digestion (e.g. pH)

ANAEROBIC DIGESTION

- Feedstock in sealed container so anaerobic digestion occurs
- Micro-organisms break down organic matter
- Digestor optimum conditions to aid the process (pH, temperature, nutrient levels)

FERMENTATION PROCESS

- Micro-organisms break down complex compounds further producing biogas (primarily methane and carbon dioxide)

BIOGAS COLLECTION

- Gas collected from digester, either used directly onsite, stored for future use

UTILITY

- Biogas used for generating electricity, producing heat (smaller scale applications)
- Biomethane - further processed biogas for heating, power generation - piped into existing natural gas system. Direct replacement to fossil gas
- Digestate (residues from digestor) used as compost or fertiliser (back to the land)

New Zealand has a number of feedstock options for biogas

POTENTIAL FEEDSTOCK ADVANTAGES AND DISADVANTAGES

FEEDSTOCK	BRIEF DESCRIPTION	ADVANTAGE	DISADVANTAGE
Animal Waste	- Large scale concentrated animal production systems (e.g. pig and chicken farms) able to collect and use manure as feedstock for biodigester to produce and use gas to power farm equipment or heat buildings - Waste from animal gut content or waste from seafood processing used as organic material	- Closed loop system – digestate used on farm as nutrient rich fertiliser - Waste used to offset factory energy use - Waste produces on-site power, no distribution costs	- Scale not sufficient to make biodigester viable on most farms - Competition from existing uses of 'waste'. - Increased competition results in increased price
Agricultural crop residues	- Large scale agricultural farms and production facilities use residue as feedstock (e.g. canola, maize production)	- Closed loop system - Waste used to offset factory energy use - Waste produces on-site power, no distribution costs	- Requires scale - Competition from existing uses of 'waste'. - Increased competition results in increased price
Food waste	- Food waste is centralised and fed into a biodigester which produces gas for local electricity, heat generation, or pipeline injection (e.g. Ecogas Reporoa) - Food waste from processing (peelings, trimmings, fruit waste) can be used to produce gas onsite	- Can be piped directly to co-located facilities for heating (e.g. Ecogas heating glass houses from household food waste) - Digestate available for fertiliser and compost	- Feedstock availability and quality variable - Large systems require significant investment - Transportation and logistics
Sewage waste	- Gas a byproduct from digestion of sewage waste in wastewater treatment plants	- Biogas used to generate electricity for the plant's operations - Excess gas available to community or wider system - Digestate available as soil amendment (not compost)	- Odour and noise concerns
Municipal landfill	- Methane gas is created as organic material in landfills breaks down - Gas is able to be captured from sites	- Large number of municipal landfills across the country able to collect and produce useable gas for electricity or heating - Constant production of waste	- Significant capital and on-going costs must be managed at the local level - Feedstock not always reliable quality (e.g low levels of organic material) resulting in inconsistent output – increasingly so in the future - Regulations and permits very costly and time consuming

Source: various articles and reports; Coriolis research and analysis

Biogas bioenergy production is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

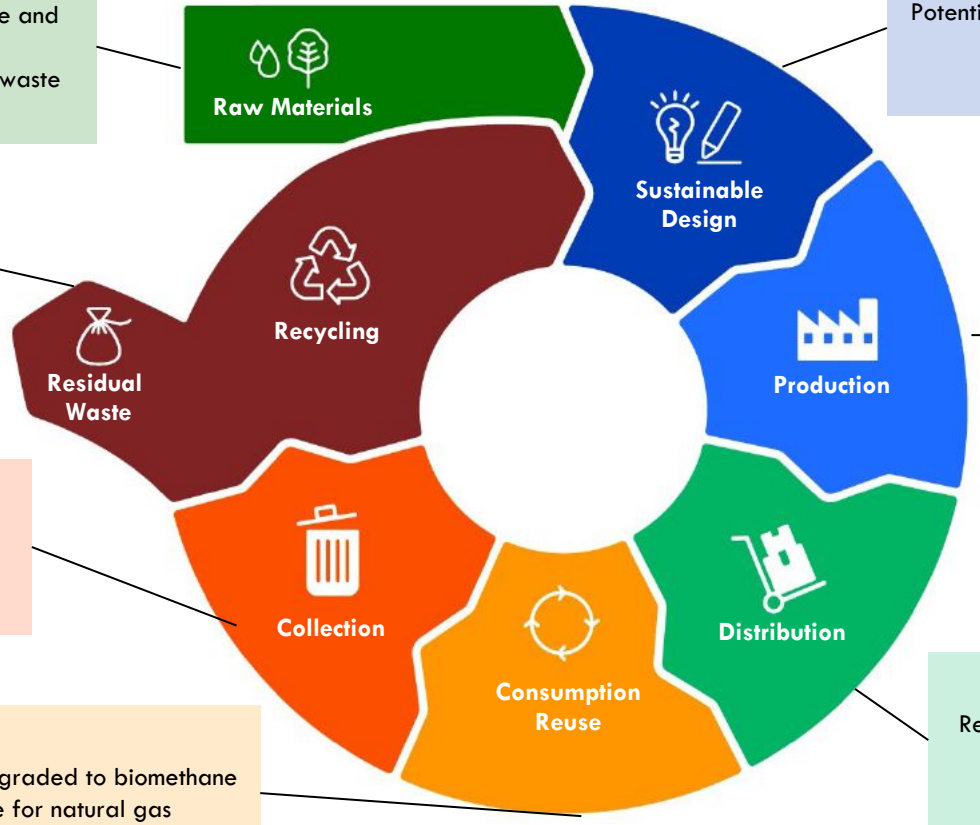
1 **INCREASING BIOMASS**	- At any material scale, this product will require virgin biomass (i.e. energy crops)
2 **INCREASING VALUE-ADDED**	- Potential to add value to existing agricultural waste streams or residues
3 **BUILDING RESILIENCE**	- Domestic production of gas builds resilience - Regional resilience with diversifying energy sources and providing energy in the regions - Increases social and economic capital
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Potential to use waste from agricultural operations to produce biogas, significantly reducing the GHG emissions from waste
5 **REPLACING FOSSIL FUELS**	- Biogas replaces fossil fuel based energy for electricity and heating - Opportunity to develop sustainable and renewable energy sources
6 **RETHINKING WASTE**	- Agricultural/food waste streams a resource that can be converted into bioenergy - Municipal waste and treatment plants a resource and feedstock for biodigesters - New advanced systems design creates less waste and increased efficiencies

Biogas production is a key input into the circular economy system turning waste streams into energy

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Raw material inputs sustainable and renewable (in particular sewage and manure)
Many potential inputs currently waste streams and residues

Efficient production
Potential to design full circular economy thinking in new production
Co-location of facilities



Residual waste across multiple systems can be used for biogas
Digestate used for nutrient-rich fertiliser and compost

Biogas produced from internal waste contributes to energy

Reverse supply chain from distant locations
Collection often on-site

Reduced distribution distances with co-location of operations

Biogas can be upgraded to biomethane to substitute for natural gas

Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

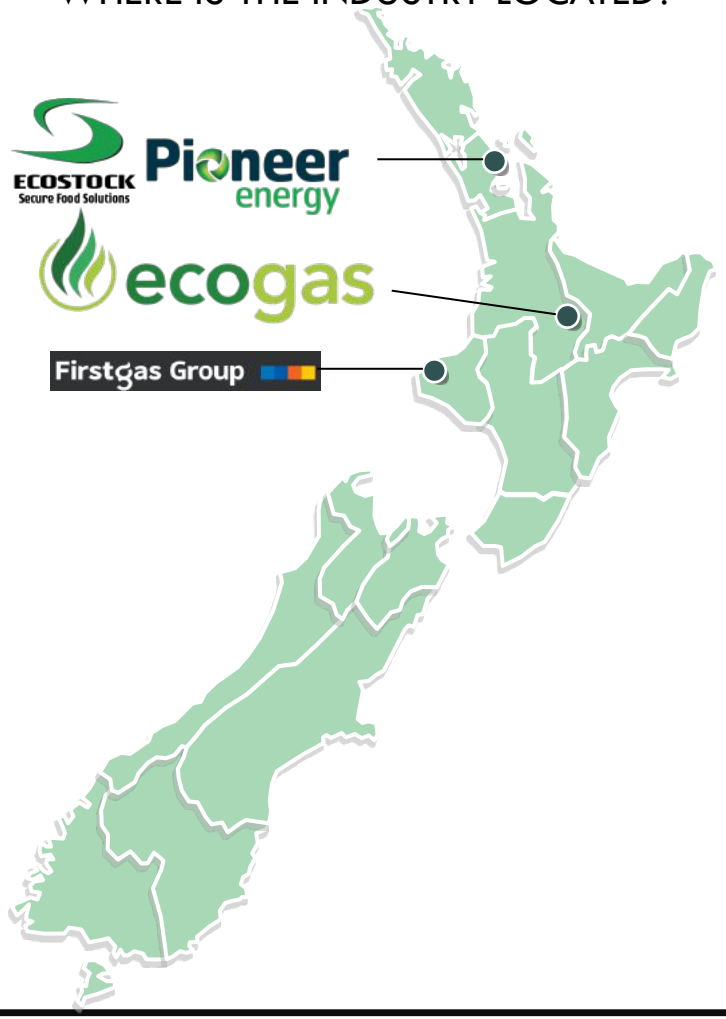
There are a number of biogas digestors located across New Zealand

WHERE IS THE INDUSTRY LOCATED?

SELECT FIRMS
Not a complete list

OBSERVATIONS

- Landfills, municipal waste operations and waste water treatment plants across the regions produce biogas for local use (e.g. Nelson landfill powers 60% Nelson hospital thermal energy needs)
- Pioneer and Ecostock formed Ecogas taking food waste and creating biogas, carbon dioxide and bio-fertiliser at their new site in Reporoa
- Trials by Zespri (kiwifruit waste), Inghams (chicken waste)
- Fonterra installed two digestors in Tirau and Darfield, also converted two factories to wood pellets
- Firstgas Group trialling options for BioLPG – also partner in EcoGas kerbside collection facility



NOTE: Select firms only

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

INDUSTRY ORGANISATIONS

- A range of organisations support firms producing and researching Biofuels and bioenergy

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities are researching topics within this platform

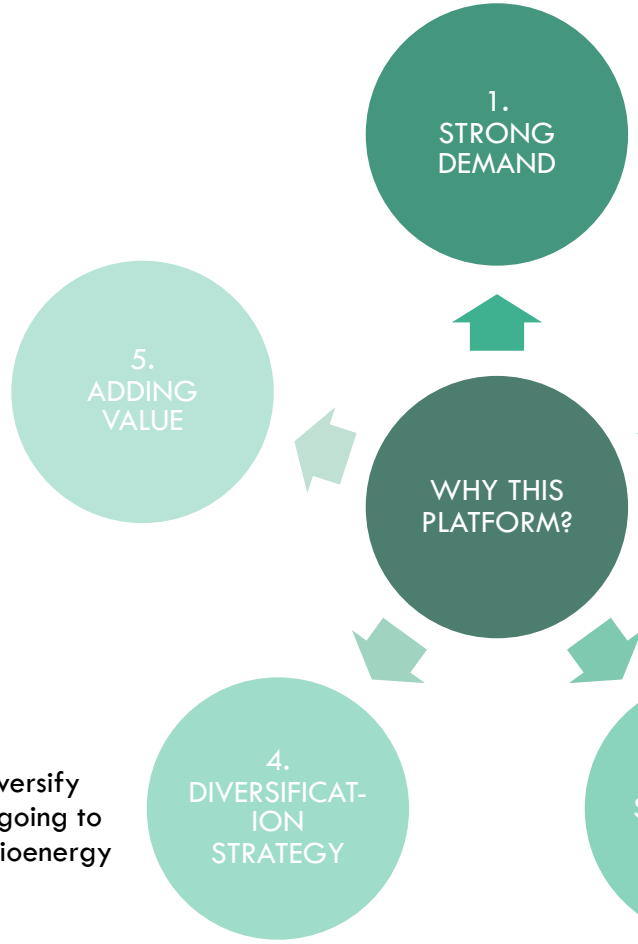
GOVERNMENT / CRI'S

- Crown Research Institutes
- Scion research around forestry biomass and developing tools
- EECA and Callaghan Innovation funding programmes

Source: various company and organisation websites; Coriolis analysis

There are a range of arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- On-going demand for biogas
- Government regulation driving increase in requirements for bioenergy vs fossil based energy

- Capability in developing and using conventional biofuels
- Biogas and biomethane are both known and commercialised systems

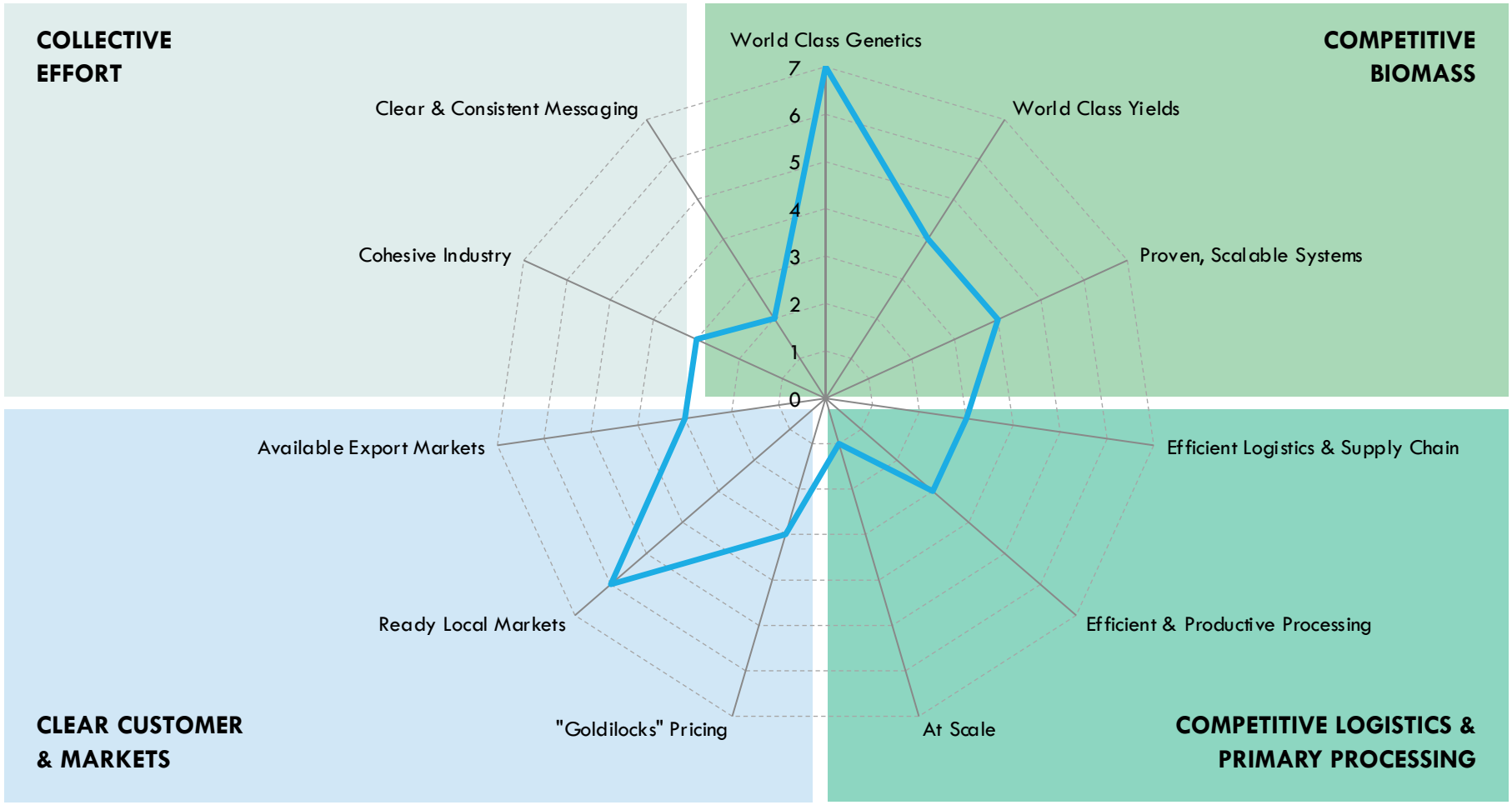
- Strong group of successful pioneering firms (e.g. Ecogas)

- New Zealand needs to diversify energy sources if it is not going to be reliant on imports of bioenergy

- Biogas derived from waste streams and residues can be used to produce new products

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

What is the sustainability and reliability of the feedstock?

- How do we guarantee access to the feedstock? Other sectors will compete for the easily available and convertible feedstock

Do we have the technical know how and regulatory standards?

- Producing 'advanced' biomethane is expensive
- New Zealand needs to certify green energy to ensure consistency and quality of green energy and fertilisers
- How do we best leverage off international developments (e.g. EU)?

How do we distribute gas in areas with no distribution network?

- Many areas (e.g. Canterbury, West coast) do not have a reticulated gas network

Is the sector economically viable without government handouts at any scale?

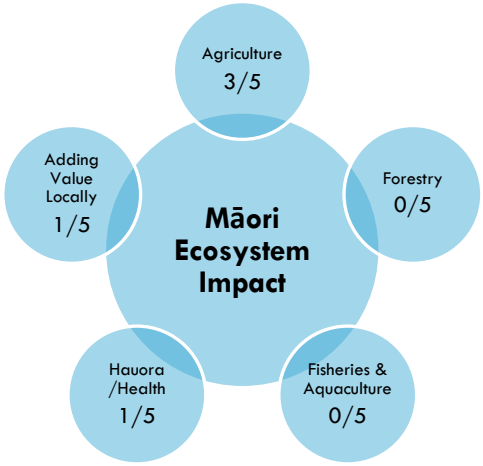
- Can we produce biogas at a competitive price? Natural gas is affordable, waste disposal options are affordable
- Current biogas production costs supply gas at a higher price
- Direct gas from the digestor is viable

Source: Coriolis analysis

Biogas / Methane / Capturing Methane From Waste Sources

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Utilisation of waste as feedstock for a fuel will resonate with some Māori groups. But hard to see how it can be done at significant enough scale to warrant industry transformation.
- Little industry connection for Māori unless involved in manufacturing waste. Local groups will have some input with local government landfills and so environmental arms of these will be interested in this opportunity more from a social good perspective.
- Hard sell to Māori investors given technology challenges, localised market with little industry cut through currently and unknown research and infrastructure spend required.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**40/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

Mature technology exists to turn municipal food waste and other sources of biomass into sustainable, renewable clean energy

1 REDUCING NET **FEEDSTOCK COSTS**

- Research into volumes, locations and types of feedstocks available
- Including opportunity cost of competing uses of feedstock
- Sustainability of production and supply

2 INVESTING IN **PRODUCTION TECHNOLOGIES**

- R&D into lowering production costs
- R&D into increasing efficiency of production
- Funding of trials at various stages
- Supporting commercialisation of technology

3 INVESTING IN **SUPPLY CHAIN AND LOGISTICS**

- Infrastructure and logistics required for transportation, storage and handling facilities across the supply chain

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

DEVELOPING BIOPLASTICS

TOTAL SCORE 37/50

INTERNATIONAL STANDARD CODES

ANZSIC	1821/1829
NACE (European Union)	20.16
NAICS (North America)	325211

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.

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.

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.

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

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

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

This platform scales up production of compostable bioplastics from local biomass to replace traditional fossil fuel based products

WHY DO WE CARE?

SITUATION

- Plastics are ubiquitous in modern society, used in products and packaging
- New Zealand imports more than half a million tonnes of plastic annually (HS39)
- There are numerous plastic grades with numerous functional benefits (hard plastics, soft plastics)
- Products rely on the functionality of plastics: protecting goods in transit, food safety, strong/light products (e.g. electric fan), light weight clothing (e.g. polyester fibres)

COMPLICATION

- Plastics are a major user of non-renewable fossil fuels
- Plastics and microplastics are a major polluter of the land and waterways as they accumulate and do not biodegrade
- Plastics can contain persistent organic pollutants (POPs), chemicals and heavy metals
- The production of plastics generate high levels of GHGs
- Plastic accumulates as waste in landfills as recycling rates are low
- New Zealand currently has limited uses for recycled plastics (all grades)
- New Zealand on-going policy to phase-out plastics*

RESOLUTION

- Bringing together New Zealand's solid capabilities in biomass production and processing can enable the scale up of numerous small scale bioplastic innovators can address this issue
- Leverage existing capabilities in (fossil-based) plastics industry

** Waste Minimisation (Plastic and Related Products) Regulations 2022; Source:*

This opportunity focuses on replacing fossil fuel based plastics with bioplastics that are biodegradable or compostable

WHAT IS IN AND OUT OF SCOPE

TECHNOLOGY

- Bioplastics Machinery

MANAGEMENT

- Waste management
- Managing, sorting, collecting systems

AVAILABLE BIOMASS

- What biomass is available in New Zealand as feedstock
  - Wood/Forestry waste
  - Maize
  - Hemp
  - Potatoes
  - Seaweed (rich in polysaccharides)
  - Waste streams

Solutions that are out of scope for this section

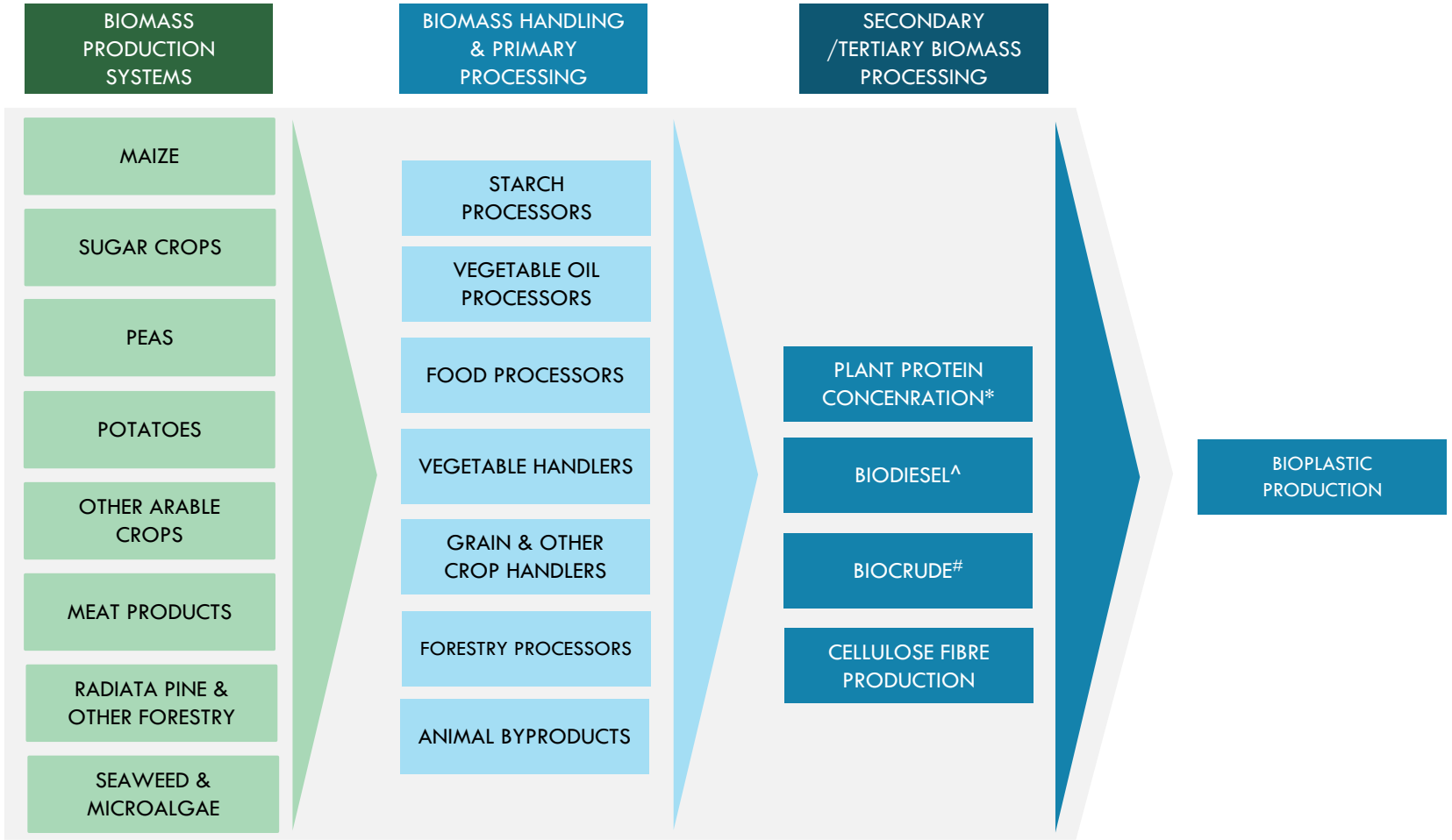
This opportunity uses biomass or biomaterials to produce bioplastic

WHAT IS THE FEEDSTOCK?

**Hemp fibre, sawdust, straw, etc. Image credit: Wikimedia Public Domain; CC ASA 3.0, 2.5, 4.0; Wilkinson; fair use/fair dealing; low resolution; complete product/brand for illustrative purposes; transformative, criticism, comment, scholarship & research*

Bioplastics production has the potential to draw in numerous streams of biomaterials from across the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



** Starch coproduct; ^Glycerin often ingredient in Bioplastics (byproduct of biodiesel production) # if the economics stacks up for production*

New Zealand has a number of feedstock options for bioplastics

POTENTIAL FEEDSTOCK ADVANTAGES AND DISADVANTAGES

FEEDSTOCK	BRIEF DESCRIPTION	ADVANTAGE	DISADVANTAGE
FORESTRY WASTE	- Utilising forestry slash and waste from processing to produce bioplastics	- Large volumes available - Less carbon footprint during processing - Promotes circular economy - Mechanical processing vs. chemical extraction more environmentally attractive	- May compete with other uses (e.g. biofuel, soil amendments, etc.) - Collection challenges (distance, cost, logistics) - Technically more challenging composition for consistent production - High cost
AGRICULTURAL WASTE	- Utilising waste from agricultural waste (e.g. pea straw, sunflower stems, hemp)	- Available in concentrated areas- local sourcing (e.g. hemp production in Taranaki, Sunflowers in Canterbury) - Promotes circular economy and waste minimisation	- Large volumes of waste required - Competition for biomass, waste unavailable to other systems - More challenging if inconsistent input and requires cleaning etc. = higher cost
MAIZE	- Used for its high starch content - Processed via fermentation or through chemical processing	- Replaces packaging and disposable items - Well known process - Maize grows well across NZ	- Displaces maize for humans and animal feed - Large areas of arable land required
POTATO	- Used for its high starch content - Able to use starch from potato cleaning process	- Replaces food packaging and disposable cutlery - Grows well across NZ - Starch able to be extracted from potato processing system	- Displaces potatoes for humans and animal feed - Large areas of arable land required
ALGAE	- Macro algae AKA seaweed able to be used to make bioplastics	- Renewable resource - Sustainable, does not require arable land - Absorbs CO2 - Potentially versatile functionality	- Scalability; currently no viable farming system - High energy use - Regulatory hurdles with production and production certification
BACTERIA/YEAST	- Fermentation process genetically engineers various yeasts and bacteria to produce bioplastics - Complex process	- Renewable and sustainable resource - Reduced carbon footprint vs plastic - Flexible and versatile functionality	- Cost and scalability - Currently no viable production system - Very susceptible to contamination - Regulatory hurdles with production, production certification, end-of-life

Source: various articles and reports; Coriolis research and analysis

Bioplastics production is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

1 **INCREASING BIOMASS**	- Potential feedstock crops achieve high biomass yields (e.g. seaweed)
2 **INCREASING VALUE-ADDED**	- Potential to add value to existing waste streams
3 **BUILDING RESILIENCE**	- Employment and industry created in the regions in growing and processing - Higher wages available in processing in particular - Increases social and economic capital
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Low emission farming system available (e.g. seaweed) - Enhances environmental capital
5 **REPLACING FOSSIL FUELS**	- Bioplastics replace fossil fuel based plastics - Opportunity to develop sustainable and renewable energy sources at production
6 **RETHINKING WASTE**	- Processing byproducts and coproducts into bioplastics - New systems design creates less waste

Bioplastics production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Raw material inputs sustainable and renewable
Inputs currently waste streams
Potential for biodiesel in processing

Efficient production
Potential to design full circular economy thinking in new production
Eco-design and innovation
Design for longer lifespan

Encouraging composting, less waste in landfill

Modern plant and equipment
Renewable energy use
Raw material and production in close proximity – co-located

Reverse supply chain from major users

Reduced distribution distances
Potential for alternative energy sources in distribution

Encouraging co-product development
Bioplastics reused in system

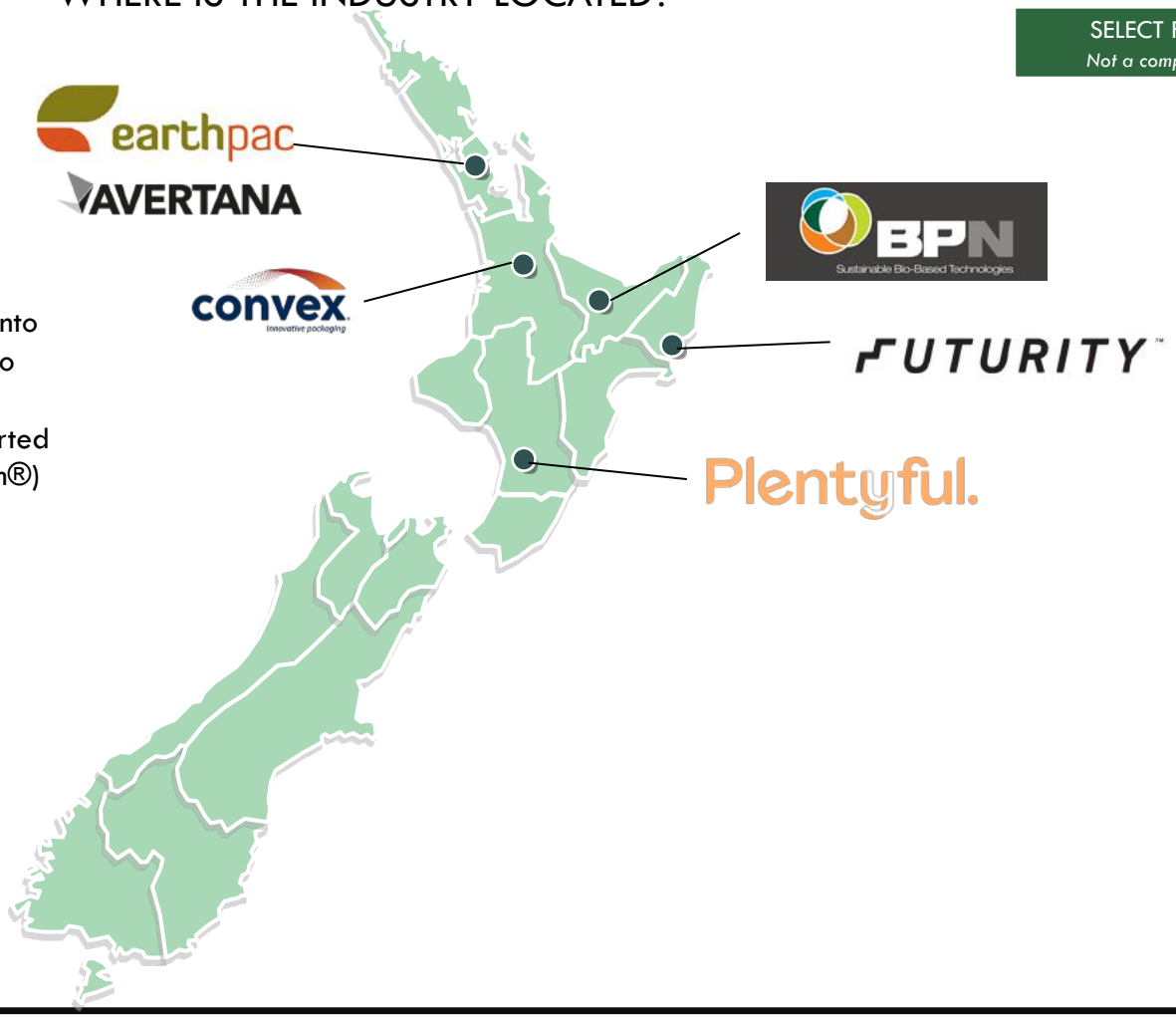
Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

There are a handful of bioplastics companies based in the North Island

WHERE IS THE INDUSTRY LOCATED?

OBSERVATIONS

- A handful of bioplastic firms are located across the North Island
- Earthpac produce potato-starch products from cleaning potatoes
- The majority of bioplastics are imported into New Zealand (e.g. BPN products use Ingeo PLA resin to make Ecobeans, PLA (thermoplastic polyester) beads are imported to make various products using Zealafoam®)
- Plentyful is importing PHA* (microbial polyesters) until production in Marton is developed



**PHA Naturally occurring Polyhydroxyalkanoates or microbial polyesters; NOTE: Select firms only*

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

INDUSTRY ORGANISATIONS

- A range of organisations support firms producing and researching bioplastics and biopolymers

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities are researching topics within this platform (e.g. Natural Materials and Biocomposites Research Group at University of Canterbury and the Waikato University Unit of Advanced Materials and Manufacturing)

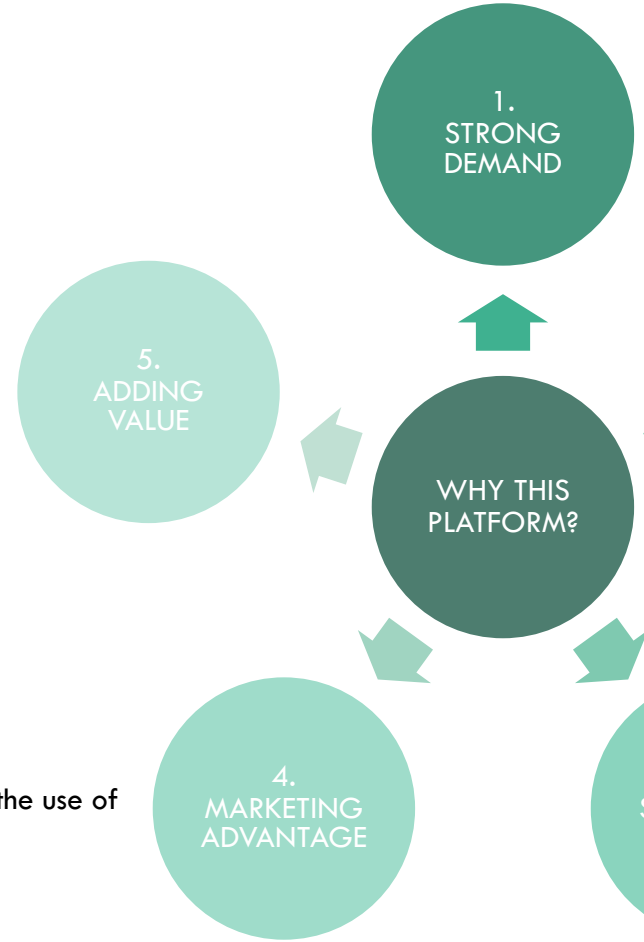
GOVERNMENT / CRI'S

- Crown Research Institutes
- Scion leading forestry bioplastics, wood science and polymers research

Source: various company and organisation websites; Coriolis analysis

There are a range of arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- On-going demand for a full range of bioplastics and biopolymers
- Government regulation driving reduction in fossil fuel based plastics

- Capability in developing biopolymers in numerous organisations (e.g. Scion)
- Demonstrated early-stage capability to produce bioplastics

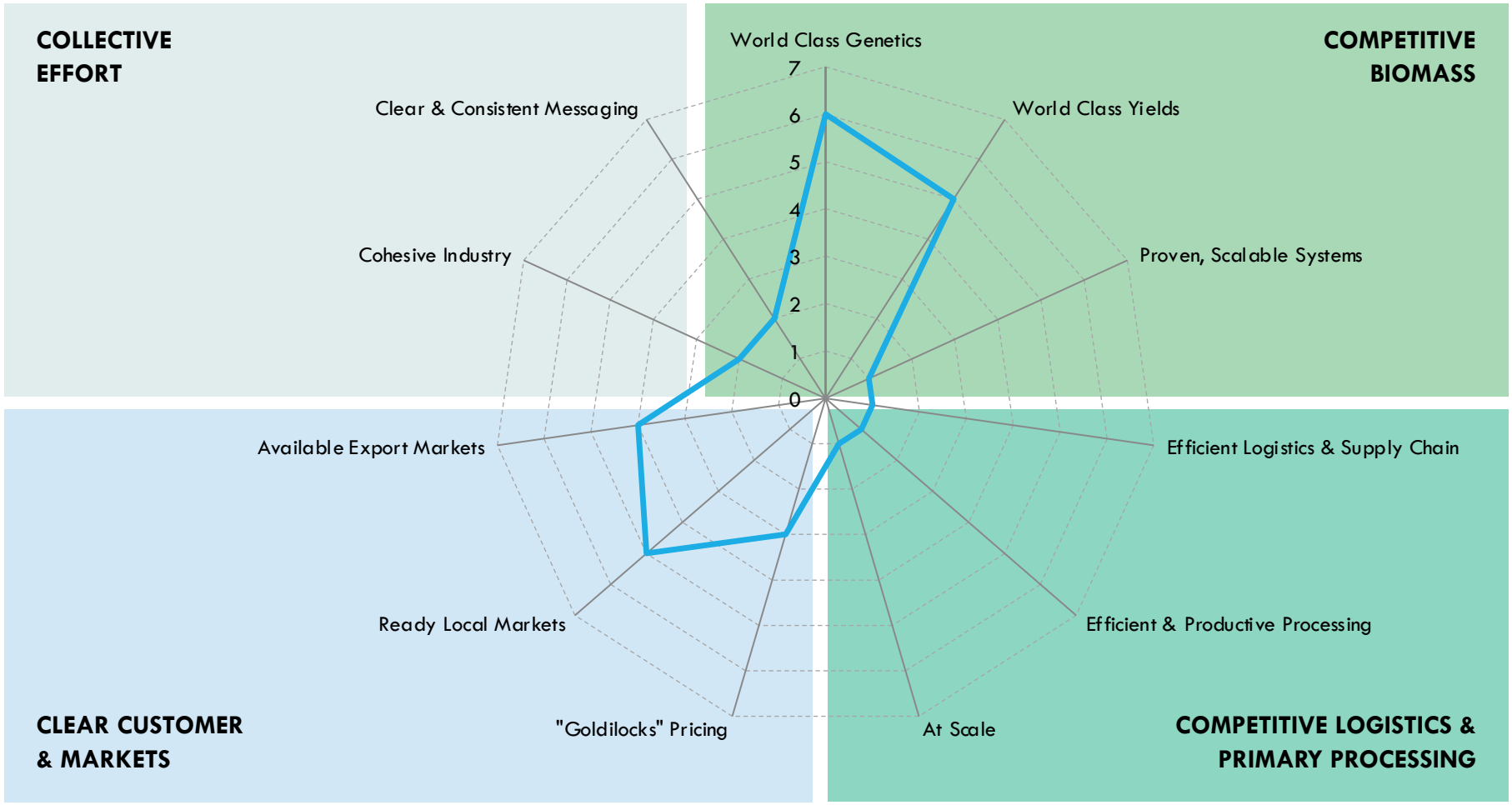
- Strong group of successful pioneering firms

- Advantage in marketing the use of bioplastics

- Ingredients derived from waste streams can be used to produce new products

Improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

How will NZ compete with leading producers?

- It is difficult to compete in particular with sectors with significant scale advantages (e.g. USA maize and sugarcane production)
- USA has strong R&D investment and capabilities
- Germany has a strong emphasis on sustainability and environmental protection with a solid manufacturing base to support bioplastics production
- China uses R&D incentives to support the sector

Why you? Why NZ? What is your unique selling proposition?

- How will the sector stand out and succeed?
- What is New Zealand's proprietary technology or unique approach to producing bioplastics?
- What is the market demand for this product?

Do we have enough waste feedstock in the right places to support the sector?

- Beyond forestry, are the other potential feedstocks available in large enough quantities to be meaningful and commercially viable?
- Is the feedstock in the right place in the right volumes? Is there a backup feedstock?

What are the timeframes to commercial viability?

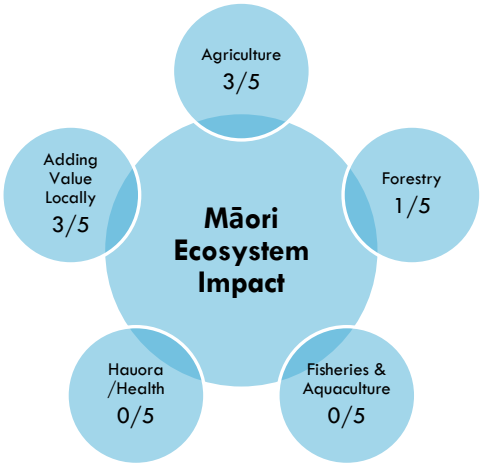
- Microalgae and precision-fermentation are both high risk and very long timeframe opportunities
- Manufacturing seaweed based biopolymers is also a long term opportunity

Source: Coriolis analysis

Bioplastics

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆ ☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆ ☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR **MĀORI**, WHAT ARE THE MAIN CONSIDERATIONS?:

- Hard to see a compelling collective Māori industry response to this opportunity with so few industry cases
- Resonates with te Ao Māori – environmentalism and kaitiakitanga.
- Again, interesting option for underutilised Māori land as biomass supplier to the bioplastic manufacturers. However, margins and likely demand will dominate any conversation around conversion to this opportunity.
- Māori investors will likely struggle to find point of leverage in this opportunity.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆ ☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆ ☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**47/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

Bringing together New Zealand's solid capabilities in biomass production and processing can enable the scale up of numerous small scale bioplastic innovators

1 INVESTING IN DEVELOPING PROPRIETARY TECHNOLOGY

- Investing in a unique approach with a competitive advantage
- Investing in functionality of leading types of bioplastics

2 INVESTING IN FEEDSTOCK FEASIBILITY STUDIES

- Research into volumes, locations and types of feedstocks available
- Including opportunity cost of competing uses of feedstock
- Sustainability of production and supply

3 INVESTING IN CERTIFICATION AND STANDARDISATION

- R&D around biodegradability, compostability and sustainability

INDEX/TABLE OF CONTENTS: STAGE II PLATFORMS

FOREST-BASED BIOMASS PRODUCTION SYSTEMS

NATIVE BOTANICALS 8

MEDICINAL MUSHROOMS 23

WATER-BASED BIOMASS PRODUCTION SYSTEMS

SEAWEED 38

MICROALGAE 53

LAND-BASED BIOMASS PRODUCTION SYSTEMS

PINEAPPLES 68

INDUSTRIAL HEMP 98

BANANAS 83

PINE NUTS 113

WOOD CONSTRUCTION

RECONSTITUTED WOOD PRODUCTS 128

VENEER /PLYWOOD 142

WOOL CONSTRUCTION

NATURAL INSULATION 156

HOUSEHOLD & BEAUTY

BIOCOSMETICS 171

ESSENTIAL OILS 186

BIO-BASED CLEANERS 201

NEEDED ENABLERS

VEGETABLE OILS 216

BEVERAGES

WINERIES 231

ALCOHOLIC SPIRITS 247

PLANT-BASED FOODS

ALTERNATIVE MEAT 262

ALTERNATIVE DAIRY 277

HEALTH & NUTRITION

NUTRACEUTICALS 292

DAIRY NUTRITIONALS 307

SPORTS NUTRITION 322

MEAT BIOACTIVES 337

MARINE BIOACTIVES 354

FARM INPUTS

ANIMAL FEED 369

SOIL AMENDMENTS 384

FOSSIL FUEL REPLACEMENT

SOLID BIOENERGY 399

BIOETHANOL /BIODIESEL 416

BIOGAS 433

BIOPLASTICS 449

FORESTRY BIOCHEMICALS 467

APPENDIX 01
CIRCULAR ECONOMY: SUMMARY OF OPTIONS AND OPPORTUNITIES

MONTEREY PINE / PINUS RADIATA

TOTAL SCORE 41/50

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 m^3 standing volume of which 34.4m m^3 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

- 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

SOURCES OF VALUE CREATION

- 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

- 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)

VALUE CHAIN LINKAGES

Sawmilling	XXX
Forestry product mnfg.	XXX
Biofuel	XXX
Nutraceuticals	X
Biochemical extracts	?
Essential oils	?
Soil amendments	?

FORESTRY-BASED BIOCHEMICAL EXTRACTION

TOTAL SCORE 28/50

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

Uses ANZSIC 1812 (basic organic chemicals)	
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

This platform utilises waste residues, from forestry harvesting in particular, to produce high value forestry biochemicals

WHY DO WE CARE?

SITUATION

- New Zealand has 1.7m ha in plantation forestry (0.6% of global); 531m m^3 standing volume of which 34.4m m^3 harvested in 2020
- 88% of NZ plantation forestry is radiata
- NZ exported 23m m^3 of saw logs in 2021 (i.e. in raw form lengths with the bark removed)
- 3.5m tonnes of harvest residue remains in the production forest annually, estimated 1.6m tonnes of slash could be recovered from landing sites*.
- This slash can have significant environmental impacts in heavy rain events (washing down hills and causing significant damage)

COMPLICATION

- Overseas markets willing to pay a high price for export logs (e.g. China), therefore resource sent overseas (limits amount of residue from domestic processing)
- Lack of sawmills (and falling numbers) generating residues
- Existing technologies to process residues into high value biochemicals still at pilot stage
- Significant investment required to establish commercial scale facilities
- Currently uneconomic to recover slash from most harvest landing sites

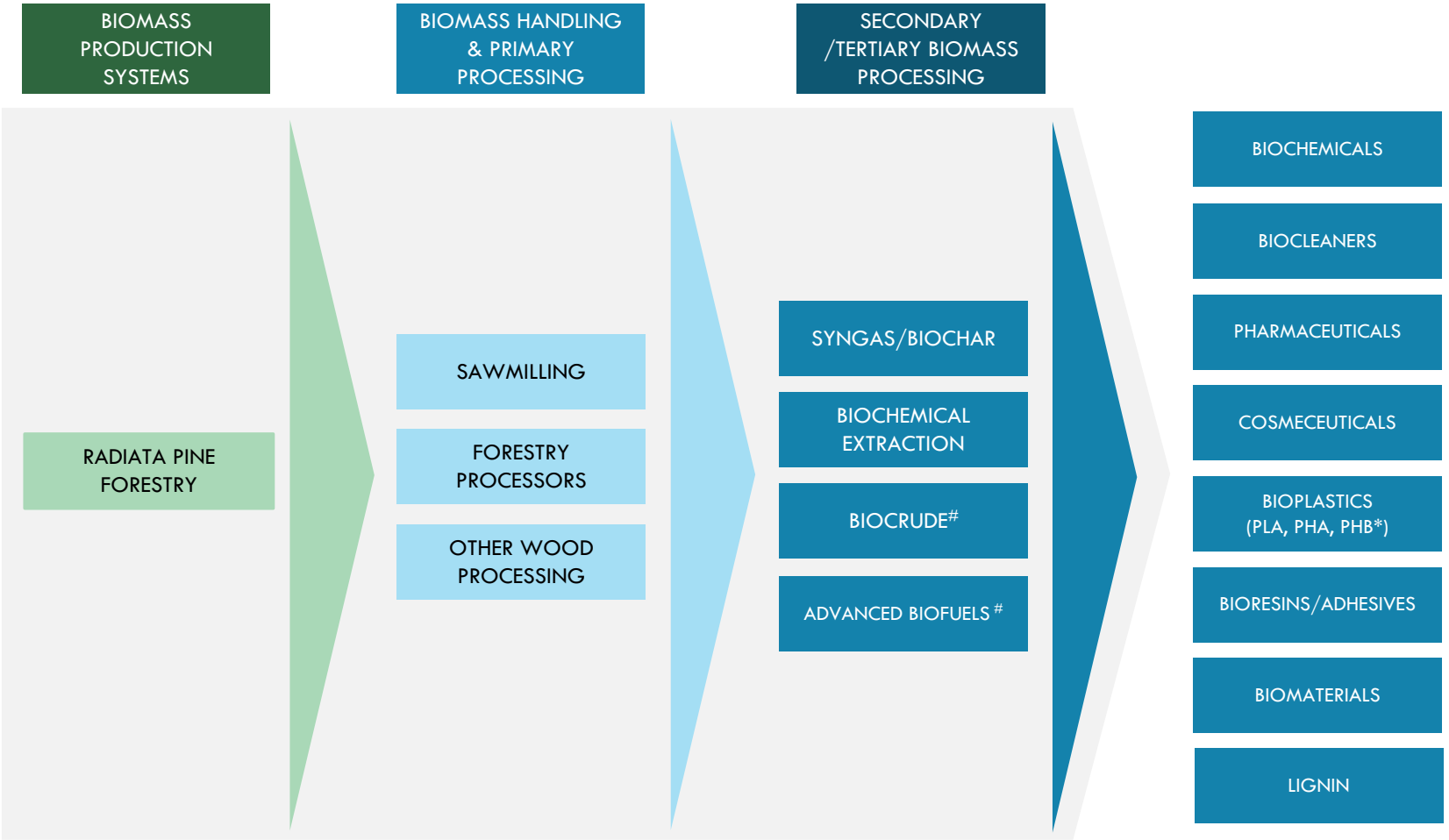
RESOLUTION

- Utilise the forestry bioresource to produce energy, high value biochemicals extracts etc.
- Bringing together New Zealand's solid capabilities in biomass production and processing can enable the scale up of innovators to address this issue
- Support investment in high value bio-extractions and systems

** Scion; Source: Forestry and Wood Processing Transformation Plan, NZ*

Forestry biochemical extraction has the potential to feed into multiple stages of the bioeconomy

WHAT ARE THE CURRENT & POTENTIAL LINKAGES INTO THE WIDER NEW ZEALAND BIOECONOMY?



*# If the economics stacks up; *PLA - Polylactic Acid, PHA - Polyhydroxy-Alkanoates, PHB - Polyhydroxy-Butyrates; looking to replace fossil fuel based Polypropylene (PP) and Polyethylene (PE)*

Biochemical extractions from forestry is in line with the desired direction for the bioeconomy

HOW DOES THIS PLATFORM SUPPORT A BETTER FUTURE?

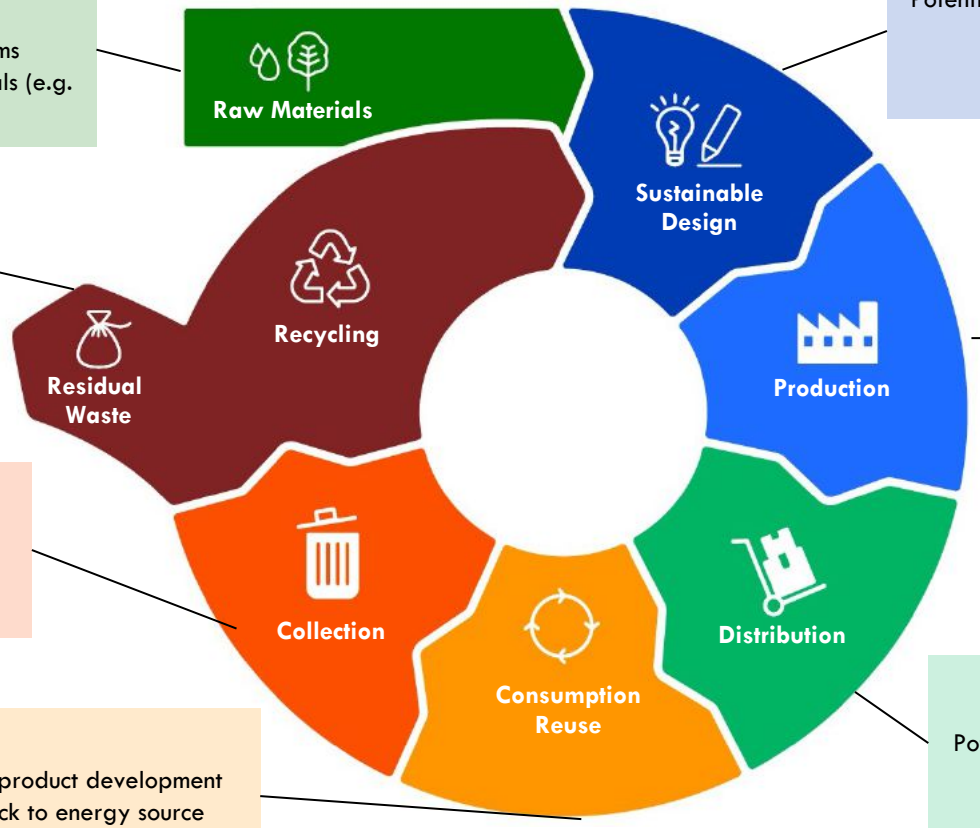
1 **INCREASING BIOMASS**	- More biomass remains in NZ (vs exporting logs) - Able to utilise a higher volume of forestry
2 **INCREASING VALUE-ADDED**	- Potential to add value to existing waste stream in forestry sector and system
3 **BUILDING RESILIENCE**	- Employment and industry created in the regions in growing and processing - Higher wages available in processing in particular - Increases social and economic capital
4 **REDUCING AGRICULTURAL GHG EMISSIONS**	- Options to utilise the outputs from the waste on-farm - Enhances environmental capital
5 **REPLACING FOSSIL FUELS**	- Forestry waste can be used to produce many bioresources to replace fossil fuel options - Options to make biocrude with subsequential versatile applications including biochemicals - Opportunity to develop sustainable and renewable energy sources at production
6 **RETHINKING WASTE**	- Processing the current and often destructive waste stream from forestry into a high extract - New systems design creates less waste

Biochemical extractions production can be part of a wider circular system

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Raw material inputs sustainable and renewable
Inputs currently waste streams
Energy provided by raw materials (e.g. wood pellets)

Efficient production
Potential to design full circular economy thinking in new production
Eco-design and innovation
Design for longer lifespan



Waste reused in system - no or very limited waste

Modern plant and equipment
Renewable energy use
Raw material and production in close proximity – co-located

Reverse supply chain from major users

Reduced distribution distances
Potential for alternative energy sources in distribution

Encouraging co-product development
Waste fed back to energy source

Image credit: European Parliament; NOTE: Summary of Circular Economy Options and Opportunities in Appendix 01

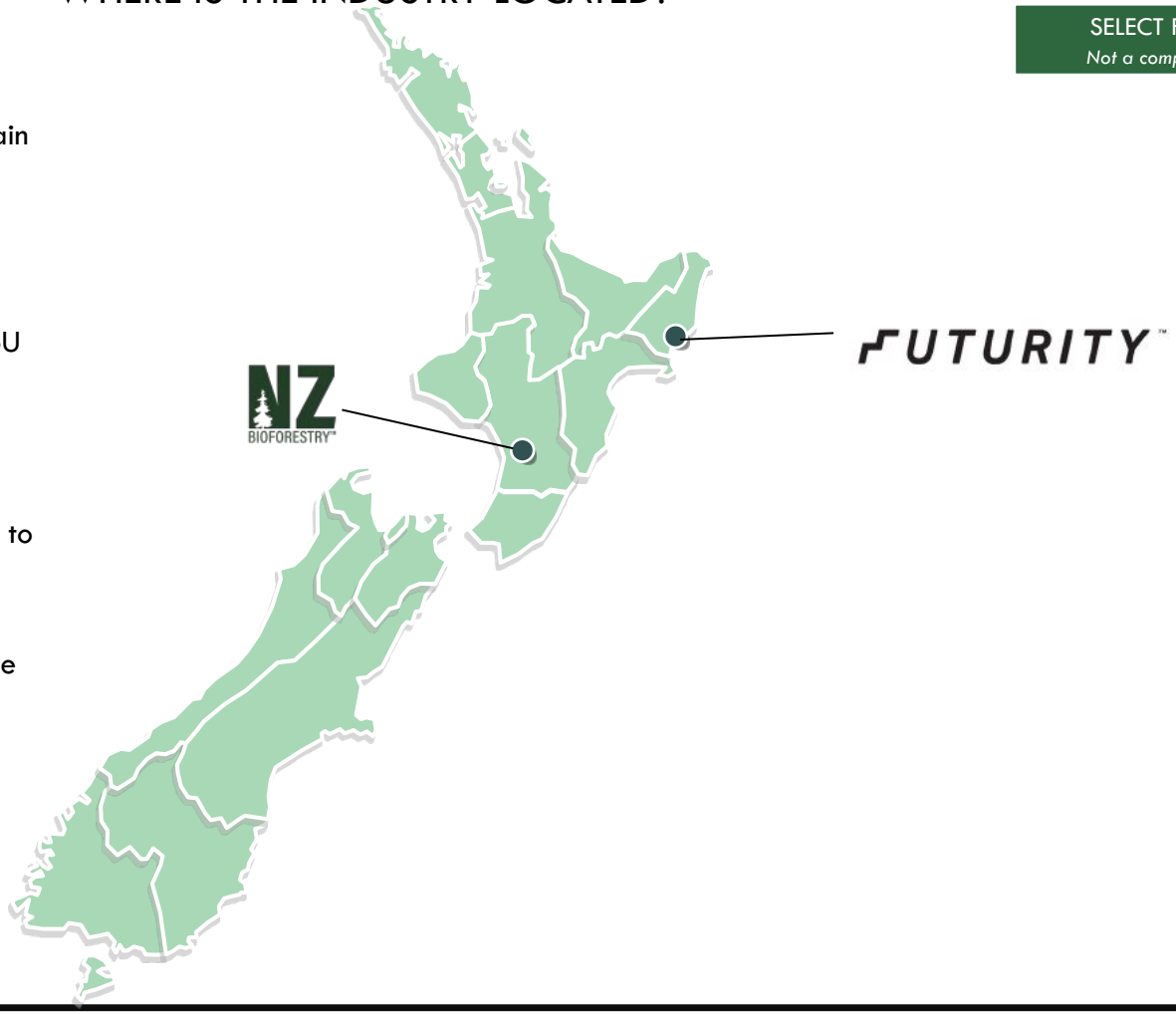
There are a handful of biochemical extract companies in New Zealand with plans to utilise forestry waste in their system

WHERE IS THE INDUSTRY LOCATED?

SELECT FIRMS
Not a complete list

OBSERVATIONS

- NZ Bioforestry partnerships across the chain to establish bio-facilities across NZ to transform biomass into bio-fuels, bio-chemicals and innovative materials; MOU Genesis (biofuel)
- MOU Japanese Refine Holdings "This MoU outlines a joint research and commercial programme to develop a suite of biochemicals from Pinus radiata for the automotive, technology, EV battery, and solvent markets."; currently capital raising to establish first operation.
- Futurity Bio-Ventures is a biochemical company buying lignin from Oji to produce high value extracts, currently pilot scale operations



* https://www.nzbioforestry.co.nz/post/more-momentum-nz-bio-forestry-and-japanese-refine-holdings-sign-mou; *NOTE: Select firms only*

There are a wide range of other current and potential stakeholders that would be interested in the opportunity to grow this platform

WHO ARE SOME OF THE OTHER CURRENT/POTENTIAL STAKEHOLDERS IN THIS OPPORTUNITY?

INDUSTRY ORGANISATIONS

- A range of organisations support firms producing and researching biochemical extracts

UNIVERSITIES / RESEARCH

- A wide range of NZ Universities are researching topics within this platform (e.g. Natural Materials and Biocomposites Research Group at University of Canterbury)

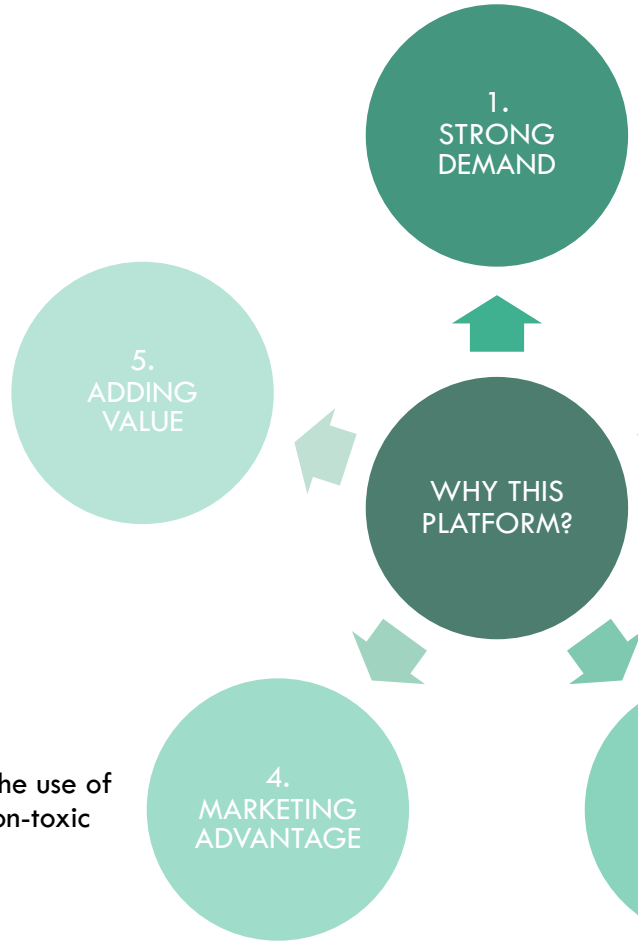
GOVERNMENT / CRI'S

- Crown Research Institutes
- Scion leading forestry wood science and polymers research

Source: various company and organisation websites; Coriolis analysis

There are a range of economic arguments for this platform being a growth opportunity going forward

WHY THIS PLATFORM? FIVE REASONS



- On-going demand for a full range of bio-based products to reduce fossil fuel dependence and liabilities
- Government regulation driving reduction in fossil fuel based products
- Global drivers (e.g. Carbon Border Adjustment Mechanism*)

- Early stage demonstrated capability in developing biochemical extracts from forestry products

- Emerging pioneering firms (e.g. NZ BioForestry, Futurity)

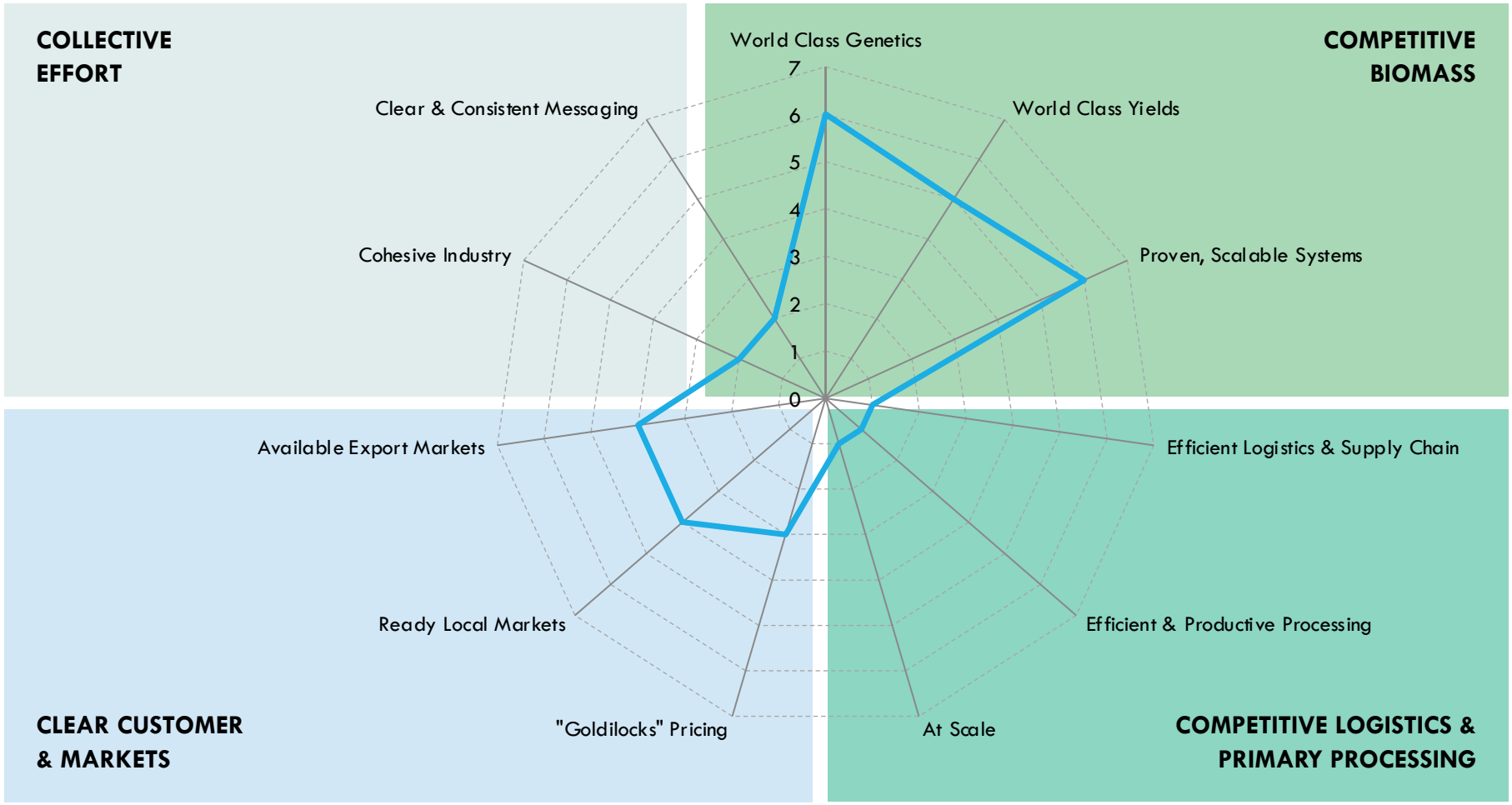
- Advantage in marketing the use of biobased products and non-toxic options

- Ingredients derived from a significant waste streams
- Opportunity to significantly add value to waste stream
- Opportunity to add value to low grade logs

* https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en

While the biomass is available, improvements are required to get the platform growth ready

IS THE PLATFORM GROWTH READY? WHERE ARE THE EXECUTION GAPS?



Source: Coriolis analysis

0 Underperforming - 7 Best Practice

CORIOLIS

An independent investor might ask four broad questions

WHAT ARE THE KEY QUESTIONS AN INDEPENDENT INVESTOR WOULD ASK?

How will NZ compete with leading countries?

- It is difficult to compete in particular with sectors with significant technological advantages
- Sweden and Finland have a strong emphasis on sustainability and environmental protection with a solid manufacturing base to support forestry-based biochemical production
- The USA and Canada have been investing in the advanced biochemical sector (known technology)

Why you? Why NZ? What is your unique selling proposition?

- How will the sector stand out and succeed?
- What is New Zealand's proprietary technology or unique approach to producing biochemicals?
- What is the market demand for these products?
- Is there an environmentally friendly extraction method?

Do we have enough waste feedstock in the right places and format to support the sector?

- Is the waste product in the right place in the right volumes?
- How will the industry overcome the existing cost issues with getting the waste slash to the production facilities? Slash is often widely distributed.
- How will the industry overcome the variability quality of the waste products?

What are the timeframes to commercial viability?

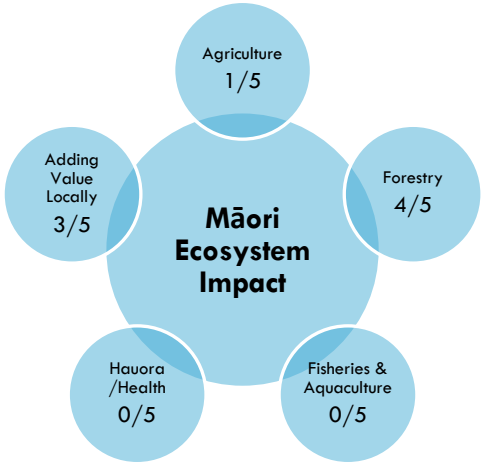
- While there is a commercial operation with product on the market, how long until a commercial industry is established and taking share?
- What regulatory hurdles need to be understood for various quality standards for the end products?
- Current high costs of biocrude extraction

Source: Coriolis analysis

Forestry Based Biochemical Extraction

TUIA GROUP

HOW BIG IS THE MĀORI ECOSYSTEM IMPACT?



DOES THIS CROSS INVESTMENT THRESHOLDS FOR MĀORI CAPITAL?

WILL IT GENERATE HIGH YIELDS/RETURNS?	☆ ☆
CAN IT SUPPORT OUR BALANCE SHEET?	☆ ☆
DO WE HAVE COLLECTIVE LEVERAGE?	☆ ☆
IS IT POTENTIALLY TRANSFORMATIVE?	☆
IS THE RISK MANAGEABLE?	☆

SPECIFICALLY FOR MĀORI, WHAT ARE THE MAIN CONSIDERATIONS?:

- A material part of the Māori primary sector involves forestry assets. There is some ability to collectivise resources for leverage but unclear of level of resource required for extraction of biochemicals commercially.
- Some cultural alignments but hard to identify any natural connection with te Ao Māori or Brand Māori.
- There will be Māori interest in global opportunity to deliver biochemicals for various industries, but Māori commercial investors will be less likely to play in the current R & D start-up phase of this opportunity.

MĀORI SECTOR SCORECARD

CONNECTIVITY?	☆
Can we build new or utilise existing international connections for expanding markets?	
TREATY ASSET?	☆
Does this platform have a connection to a Treaty asset or is there a Treaty perspective/position?	
JOBS?	☆ ☆
Will this platform have an employment impact, particularly for rural communities?	
OUR ECONOMY?	☆ ☆
How much of an impact will this platform make on our rural economies / communities?	
TAIAO?	☆ ☆
Will this improve our environment? Is there a regenerative or circular economy opportunity?	
MĀTAURANGA?	☆
Can we bring insights from Mātauranga Māori to this platform to create value?	
BRAND MĀORI	☆
Can we wrap this in a package? Can we bring something to this with no cultural IP issues?	
LEVERAGE?	☆
Any advantage to leverage Māori assets or utilise Māori / indigenous in the platform?	

OVERALL ATTRACTIVENESS	**53/100**

Te Ao Māori: The Māori world experience including language, culture, economy etc. as distinct from broader mainstream New Zealand
Taiao: The natural environment.
Mātauranga: Māori knowledge - the body of knowledge originating from Māori, including the Māori world view and perspectives, Māori creativity and cultural practices/knowhow.

Three broad categories of investment are highlighted

WHERE IS INVESTMENT REQUIRED?

VISION

Bringing together New Zealand's solid capabilities in biomass production and bioextraction can enable the scale up of numerous small scale biochemical innovators that can address the forestry waste issue

1 INVESTING IN **DEVELOPING PROPRIETARY TECHNOLOGY**

- Investing in a unique approach with a competitive advantage
- Investing in functionality of leading types of biochemical extracts

2 INVESTING IN **LOGISTICS AND SUPPLY CHAINS**

- Investing in infrastructure to effectively access resource
- Investing in implementing efficient collection and transportation systems

3 INVESTING IN **PRODUCTION R&D**

- R&D around options for low energy and low environmental impact extraction options
- Investing in reducing cost of production
- Forming partnerships to share knowledge and technology transfer

APPENDIX 01: CIRCULAR ECONOMY SUMMARY OF OPTIONS AND OPPORTUNITIES

There are opportunities to build a more circular economy in New Zealand's bioeconomy

WHAT ARE THE OPPORTUNITIES TO BUILD A MORE CIRCULAR ECONOMY?

Image credit: European Parliament

1. RAW MATERIALS: More can be done to make the raw materials used in almost any process more circular

1. RAW MATERIALS

AREA	CONCEPT	EXAMPLE	SAMPLE ISSUE(S)
BIOMASS PRODUCTION	High yields	- Australia get 3x NZ kumara yields (t/ha) - Israel get 3x milk per cow/year	- Genetic modification - Biosecurity stopping innovation
	Using regenerative practices	- Biochar made from waste back to farmers	- Scale
	Supporting improved farming systems	- Erosion control on steeper hill country - Branding sustainable production on final product	- Lack of standards (cf. Ireland) - Conflicting objectives
	Using sustainable, circular production systems	- Massively subsidised projects in Europe	- NZ exports most outputs
	Selection of inherently low carbon farming product/system	- Pine nuts	- Not everything is inherently a low carbon system
	Use of alternative energy sources by suppliers	- Micro-hydro on farms	- No EV logging trucks exist
	No herbicides or pesticides required	- Agave (succulent used to make tequila)	- Genetic modification - Biosecurity stopping innovation
	Low/no fertilisers/replacement of synthetic fertilisers	- Use of legumes in crop rotation to fix nitrogen	- 50% of humans on earth exist because of synthetic fertilisers
BIOMASS SELECTION	Utilising waste streams as inputs	- Forestry slash for biochar - Grape must for alcohol	- Doesn't suit every industry
	Deriving inputs from low value streams	- Wool from dags	- May not be cost competitive
	Replace chemical/petroleum based inputs with plant based inputs	- Fossil fuel free cosmetics - Glue sources converted to bio-glues - Natural preservatives, oils - Biodegradable polymers	- Alternative may not exist
	Switching to sustainable inputs	- Wilding pines	- Sustainable alternatives may not exist
	Use of unrefined inputs; multiple use inputs; use of all parts	- All parts of the banana can be used - Bioenergy from gut contents of cattle	- Local production may be uncompetitive
LOCATION	Located adjacent to raw materials supplier	- Pet food processing next to meat plant	- Labour force located in cities

2. SUSTAINABLE DESIGN: More can be done right at the beginning of the design process to build circular thinking into products and processes

2. SUSTAINABLE DESIGN

AREA	CONCEPT	EXAMPLE	SAMPLE ISSUE(S)
LOCATION	Production close to raw material	- Dairy plants in the Waikato	- Lack of regional workforce
	Share space/co-locate with compatible users	- Mussels and offshore wind energy generation	- Conflicting site priorities - Need to relocate
	Co-share primary processing facility	- Clustering together compatible inputs and outputs	- Depreciated capital - Cost of regulations and red tape
PACKAGING	Low packaging/kg product design	- Ethique concentrated shampoo bars	- Increased risk of damage/spoilage
	Reduced packaging per kilogram	- Shift to larger pack sizes (the Costco impact)	- Increase risk of spoilage
	Recyclable packaging	- Paper-based packaging in commercial baking supplies	- Local system may not accept
	Refillable packaging	- Nothing Naughty reusable glass jars and refill pouches	- Higher initial cost
	Biodegradable packaging	- Potato-based 'plastic wrap'	- Higher cost passed on to consumer - Not all systems accept all materials
PRODUCT	Carbon locked into product	- Engineered wood sequesters carbon for long periods	
	Design for longer lifespan	- Replacement of disposable single use plastic with reusable customer owned canvas	- Higher cost raw materials - Consumer may not pay premium
PROCESSING	Potential to design full circular economy thinking in new production	- Lots of examples exist in articles and TED talks, and consultants presentations - Careful processing of seafood ensures carcass and by-products are available for further extraction and utilisation	- Lack of real world models specific to NZ industries available to visit - Export focused island nation - High cost internal transport
	Low/no water systems and extractions	- Many traditional 20th Century systems are water intensive, while new systems are not	- May not suit all processes
	Design for efficient production Low energy production design	- New plants basically always have lower production costs	- Cost of retooling
	Make energy from byproducts; use residual waste for bioenergy feedstock	- Burning sawmill waste for bioenergy on-site - Fibre into bio-pellets	- Many secondary and tertiary production processing stages are waste free (e.g. nutraceuticals, cosmetics)

3. *PRODUCTION: More can be done in production to ensure circularity*

3. PRODUCTION

AREA	CONCEPT	EXAMPLE	SAMPLE ISSUE(S)
PROCESS ENERGY	Modern plant and equipment	- New Zealand's newer milk dryers are the most efficient in the world	- Cost - Life left in existing capital
	Renewable energy use and goals	- Fonterra target of -20% reduction in energy intensity	- Current technology - Physical limits
	Creating energy from own waste	- Sawmills creating energy from own waste - Pine nut pinecones for energy	- Most non-primary products basically waste-free processing (e.g. cosmetics)
USE OF ALL BYPRODUCTS/ WASTE VALORISATION	Efficient use of resource – no waste	- Aquaculture stacking and layering (e.g with bivalves) - Reuse of mushroom growing substrate (growing medium)	- Scale - Efficiency (e.g. in harvesting)
	Maximise coproducts (e.g. starch, fibre)	- Potential to co-produce biochar with syngas - Separation of red wine pomace (for polyphenol refining)	- Scale - Sorting cost versus recover value
LOCATION	Farmers co-located by processors	- Clustering of chicken farms and processing plants	- Regulations - Disease - Noise and smell
	Co-located with waste treatment	- Greenhouses collocated with biogas production	- Scale - Conflicting objectives for best location (e.g. near customer vs resource or transport hub vs waste source)
	Key inputs and production in close proximity or co-located	- Heinz Watties packaging manufacturing (canning) co-located with Hastings plant	- Labour force located in cities - Cost of rebuilding at new location - Regulations/regulatory complexity - Cross-contamination - Conflicting objectives for best location (e.g. near customer vs resource or transport hub vs waste source)
CARBON CAPTURE	Capturing CO2 in production	- Long life wood based products	- Cost - Scale

4. DISTRIBUTION: More can be done in distribution

4. DISTRIBUTION

AREA	CONCEPT	EXAMPLE	SAMPLE ISSUE(S)
ENERGY	Potential for alternative energy sources in distribution	- Multiple alternative energy distribution systems are emerging (e.g. EV)	- Technology unavailable - Technology unproven
	Improve vehicle efficiency	- Newer vehicles are more efficient	- Cost
	Use low fossil fuel/kg transport	- Transport by train or sea	- Cost - Speed
MANAGEMENT	Reduced distribution distances with optimised route management	- Significant savings possible from better scheduling	- Demand situation is dynamic not static - Need to adapt to NZ conditions - Speed vs. cost
	Share distribution with other suppliers	- Multiple frozen foods firms sharing a single truck	- Best partners are competitors
	Industry level agreements on lower frequency	- Retailers and suppliers agreeing on lower delivery frequency	- Conflicting objectives - Less frequency = more food waste
	Encouraging/requiring sustainability of logistics partners	- Customers can have a large influence on logistics suppliers behaviour and investment decisions	- Cost
PRODUCT	Less packaging per kilogram	- Shifting to single layer packaging	- Increased loss and damage in supply chain
	Less weight per usage occasion	- Shifting to concentrates (less/serve) - Removing fillers to reduce weight	- Educating the consumer - Competitor behaviours
	Encouraging filtering and reuse	- Filtering and reusing water and oils	- Contamination risk - Flavour challenges - Fire risk
LOCATION	Co-location of activities to reduce transport costs	- Heinz Watties packaging manufacturing (canning) co-located with Hastings plant	- Labour force located in cities - Cost of rebuilding at new location - Regulations/regulatory complexity - Cross-contamination - Conflicting objectives for best location (e.g. near customer vs resource or transport hub vs waste source)
	Cluster production systems on-farm or co-located	- Multi-species aquaculture centred on mussels	

5. CONSUMPTION/REUSE: More can be done to reduce consumption without impacting the customer/consumer outcome

5. CONSUMPTION/REUSE

AREA	CONCEPT	EXAMPLE	SAMPLE ISSUE(S)
USE LESS	Concentrations in liquids and powders	- Ecostore detergent concentrates	- Educating the consumer - Competitive activity
	Reduced serving sizes	- Widespread use of "weight out" to address cost inflation (e.g. fewer potato chips in the package)	- Educating the consumer - Competitive activity - Consumer behaviour
CONSUMER EDUCATION	Encouraging more circular consumer behaviour	- Encouraging filtering and reuse of cooking oils - Pineapple skins can be used to make tepache beverage - Encouraging home composting - Reuse of glass bottles	- Achieving message cut-through - Building new habits - Collective solutions required - Conflicting objectives

6. *WASTE COLLECTION: More can be done to ensure waste collection is efficient*

6. COLLECTION

AREA	CONCEPT	EXAMPLE	SAMPLE ISSUE(S)
SHIPPING 'OUTERS'/ EXTERIOR PACKAGING	Use of reusable packaging	- Use of reusable pallets, bins, reusable plastic containers (RPC's) and beverage trays	- Cost - Contamination - Coordination and system management - Surplus/deficit regions - Doesn't work for exports
	Reverse supply chain from major users	- Milk crates - Opportunity for backhaul loads (trucks running empty)	
DESIGN OUT WASTE	Potential for reuse	- Glass jars with reusable lids	- Contamination/consumer safety - Global industry standards - Cost
	Recyclable/recycling and reusing major packaging (e.g. aluminium cans)	- Global resin identification codes (RIC) system	- Scale - Management - Contamination - Cost - Conflicting objectives
WASTE RECOVERY	Valorisation of waste (finding value in all waste)	- Nutraceuticals from grapeseed - Nitrogen recovery from waste biomass using anaerobic digestion, composting, biochar production - Biogas can be upgraded to biomethane to substitute for natural gas	- Scale - Identification - Cost

7. RECYCLING/RESIDUAL WASTE: More can be done to maximise recycling and minimise residual waste

7. RECYCLING /RESIDUAL WASTE

AREA	CONCEPT	EXAMPLE	SAMPLE ISSUE(S)
VISION INSIGHT	Refuse to believe in 'waste'; potential for additional extraction of waste streams Focus on finding high value use for all co-products	- Whey used to be dumped in rivers - Pine oil from forestry waste - Used vegetable oil to biofuels - Wool scouring by-products to fertiliser and cosmetics - Digestate used for nutrient-rich fertiliser and compost	- Recovery costs - Sorting costs
	Deal with waste streams at time of production All streams fed back into system or extracted	- On-boat rendering industry uses all products (no waste) - Meat rendering industry uses all products (no 'waste')	- Waste may be part of package (e.g. banana skins)
	Make energy from byproducts; use residual waste for bioenergy feedstock	- Burning sawmill waste for bioenergy on-site - Fibre into bio-pellets	- Many secondary and tertiary production processing stages are waste free (e.g. nutraceuticals, cosmetics)
DESIGN	Packaging can be reused	- Use of waste free returnable shipping bins and pallets	- Cost (e.g. glass vs. plastic)
	Packaging can be composted	- Wool products shipped in wool-based packaging	- May contaminate local recycling
	Ensure whole of life taken into consideration	- Reuse of wood on demolition of building	- Difficult to predict the future
MARKETING MESSAGING	Encourage composting of all consumer waste	- Messaging on packaging - Use of compostable packaging	- Not all consumers have a backyard - Not all systems accept all materials
	Encouraging recycling of packaging	- Messaging on packaging	- Not all systems accept all materials
LOCATION	Residual waste across multiple systems can be used for biogas	- Co-locate multiple producers to achieve minimum scale	- Conflicting objectives (colocation vs. location near specific inputs)