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MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

NEW ZEALAND SITUATION & CAPABILITIES

Emerging and future platforms in New Zealand's bioeconomy

FINAL REPORT
June 2023; v1.00a

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KEY CONTACTS FOR THIS REPORT

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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

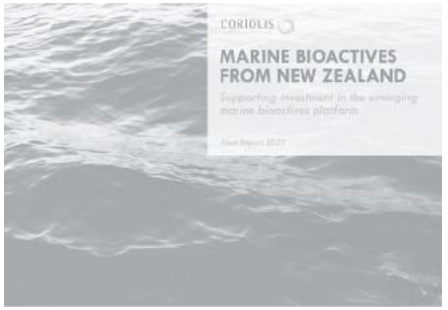
Finding and screening all emerging and future platforms in the New Zealand bioeconomy

STAGE II – 30 OPPORTUNITIES

Developing thirty emerging and future opportunities in the New Zealand bioeconomy

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

THIS REPORT

BACKGROUND & SUPPORTING MATERIAL

SITUATION & CAPABILITIES

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

This report outlines the current situation and capabilities

BACKGROUND & SUPPORTING MATERIAL

SITUATION & CAPABILITIES

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

This section provides data and analysis on New Zealand's current available bioresources only, and does not directly consider issues relating to sustainability or the merits or otherwise of different production systems.

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The New Zealand seafood industry has been going down not up

New Zealand is capable and competitive in seafood

- The New Zealand seafood industry has capabilities in place across the supply chain
- New Zealand has a stable and sustainable position in the global seafood industry, albeit with declining quantities of product
- The seafood production system is internationally competitive, but there are numerous opportunities for improvement across the chain
- Competitiveness is calculated at the border; New Zealand's seafood capabilities lead to high but declining global competitiveness, particularly in fish

On paper, New Zealand is well endowed with fresh and salt water resources

- New Zealand has 4.4m km^2 of controlled ocean space (15x land area); much of this is relatively unproductive water over a kilometre deep
- 94% of the area of the planet controlled by New Zealand is water and the country has the ninth largest area of claimed/controlled ocean space of any country in the world
- New Zealand has the tenth largest coastline of any country; Southland, Northland, Auckland and Marlborough stand out

In practice, seafood production is small and highly regulated; New Zealand produces more total barley biomass than wild captured seafood

- The amount of seafood produced in New Zealand is almost exclusively a function of government regulations (and the economics they create)
- New Zealand wild capture production peaked in 1997/98 and has been trending down since as quotas are reduced to maintain stocks
- Falling allowable capture and growing economies of scale have led to falling commercial vessel numbers; landed tonnes/vessel has been stable at ~350

Aquaculture has stalled in New Zealand

- New Zealand aquacultural production grew through around ~2004; growth has stalled since; all new species attempted in the past fifty years have failed

The industry has been consolidating and this is expected to continue

- The seafood industry has declining unit numbers
- The seafood industry has growing employment at sea and on-farm, but declining employment on land in primary processing/handling
- The industry is not increasing productivity; tonnes per employee is falling, suggesting further consolidation is likely going forward

The New Zealand seafood industry has capabilities in place across the supply chain

NEW ZEALAND CAPABILITIES DRIVEN SUPPLY CHAIN: SEAFOOD

SELECT FIRMS

AQUACULTURE GENETICS

Salmon Smolt NZ Ltd · Clearwater Salmon Hatchery · spatNZ · CAWTHRON

FUEL & LUBRICANTS

GO Fuel · Mobil · bp · CLIPPER OIL

EQUIPMENT/SUPPLIES

MESH Industries Group · fresh by design · AKVA GROUP · SEAFISH Systems · Southshore Marine Ltd. · COOKES · DEEPDRAG COMMERCIAL · SMART MARINE · BURNSCO · TENOB · CR EQUIPMENT · STORMLINE · Discount Fishing Supplies – The Saltwater Specialists

FEED IMPORTERS

BigNutrition · BioMar · SKRETTING

AREA

4.4m sqkm water
15,134km coast
~7,700ha aquaculture

PEOPLE IN SEAFOOD

1,030 aquaculture
2,593 fishing/capture
4,790 processing/wholesaling

AQUACULTURE

New Zealand King Salmon · Mt COOK alpine salmon · KONO · SANFORD · MOANA NEW ZEALAND · Talley's · OPC · North Island Mussels Ltd · Te Ohu Kaimoana · AKAROA SALMON · UNITED · SEALORD · Clevedon Coast OYSTERS · Kaipara Oysters · HIGH COUNTRY SALMON

FISHING/PROCESSING

Talley's · SANFORD · SEALORD · UNITED · NGĀI TAHU SEAFOOD · Te Ohu Kaimoana · MOANA NEW ZEALAND · Solander OCEAN TO PLATE · VELA FISHING LTD · Independent · Takitimu SEAFOODS · CLOUDY BAY CLAMS · pāuaco · Ngati Porou Seafoods Group · PelcoNZ · WF WESTFLEET SEAFOODS EST 1979 · FIORDLAND LOBSTER COMPANY

BYPRODUCTS

MacLab · SEADRAGON · SANFORD · Alaron · Anagenix · GO · SEPEREX NUTRITIONALS · vitaco

PET FOOD

Nestlé Good Food, Good Life · PURINA · Heinz · Chunky · rpf · Bpf · Natural Pet Food Group · ZIWI · TU MEKE FRIEND · zealandia · Natural · NRG

SHIPPING

MAERSK LINE · HAMBURG SÜD · msc · CMA CGM · Hapag-Lloyd · EVERGREEN · COSCO SHIPPING · YANG MING

LOGISTICS

Move Freight · MAINFREIGHT

INDUSTRY ORGANISATIONS

Seafood New Zealand · deepwater group · Aquaculture New Zealand · PĀUA INDUSTRY COUNCIL · mfa Marine Farming Association · FISHERIES INSHORE NEW ZEALAND · Rock Lobster Industry Council · NZ FISH FED · CoroMFA · New Zealand Salmon Farmers Association Inc.

New Zealand has a stable and sustainable position in the global seafood industry, albeit with declining quantities of product

SWOT ANALYSIS: NEW ZEALAND SEAFOOD

STRENGTHS	WEAKNESSES
- Clean water and generally healthy aquatic environment - Unsubsidised industry - Early introduction of quota management system prevented collapse of stocks through overfishing - Stocks generally at sustainable levels or rebuilding - Regularly ranked in top three sustainable regions - Efficient, modern industry with large modern boats, in particular the deep sea freezer trawlers - Stable, long-term ownership in place across most major firms - Only country farming green lipped mussels (Perna canaliculus); others farm a different green shelled species (perna viridis, etc.) or blue mussels (mytilus sp.) - Limited presence of disease in aquaculture species - Unique access to some bio-secure markets (particularly Australia & Japan) - Parts of domestic industry protected from imports by biosecurity measures - Government support of industry R&D	- Most industry wild capture growth metrics negative (Quota system) - Wild catch volume has fallen almost continuously for ~25 years (since 1998) leading to reduced throughput - Relatively small producer on a global scale - Supply fluctuates year-to-year with availability of wild capture fish - Large number of species (100+ catch and bycatch) and variable volumes therefore difficult to have a consistent resource (automated processing, bioactives extraction) - Mussels and oysters have low value per hectare; salmon development limited by regulatory challenges - Most EEZ space low productivity deep water - Industry is bulk supply driven, rather than specialised/consumer focused - Most firms small/sub-scale with limited access to capital, particularly inshore - Competing users of coastal space for aquaculture (e.g. holiday houses) - No competitive advantage around aquaculture feed production due to low scale - Lack of market integration, not capturing in-market value; limited in-market knowledge
OPPORTUNITIES	**THREATS/ISSUES/CHALLENGES/RISKS**
- Consumer perceptions of health benefits of seafood - Large amounts of fish body currently going to meal and waste (only ~60% of fish is fillet) - New regulations mandating landing of bycatch (also a challenge) - Use of by-products for nutraceuticals /cosmetics sector; identification of new compounds, bioactives - Growing interest by some more wealthy consumers in Western markets for eco-labelling and environmental certification (driven by retailers) - Growing middle class in China and SE Asia - Gradual removal of global fishing subsidies - Ongoing removal of trade barriers and negotiation of new free trade agreements - Streamline regulations - New/improved supply chain technology	- New Zealand's wild capture continues to decline - Other countries "catching up" on sustainability (e.g. Argentina) - Low cost competitors in low wage/low regulation/higher productivity warm waters - NIMBY (not in my back yard) attitudes limiting industry activity - Single issue special interest groups driving domestic regulatory agenda - Rising costs of airfreight reducing feasibility of fresh exports - Climate change impacting aquaculture and in-shore species

The seafood production system is internationally competitive, but there are numerous opportunities for improvement across the chain

DRIVERS OF AN INTERNATIONALLY COMPETITIVE BIOECONOMY: SEAFOOD

Source: Coriolis

Competitiveness is calculated at the border; New Zealand's seafood capabilities lead to high but declining global competitiveness, particularly in fish

ANNUAL REVEALED COMPARATIVE ADVANTAGE INDEX: NEW ZEALAND BY SELECT SITC3

1=Average of New Zealand across all exports; 1995-2021

Source: UNCTAD STAT; Coriolis analysis

New Zealand has 4.4m km² of controlled ocean space (15x land area); much of this is relatively unproductive water over a kilometre deep

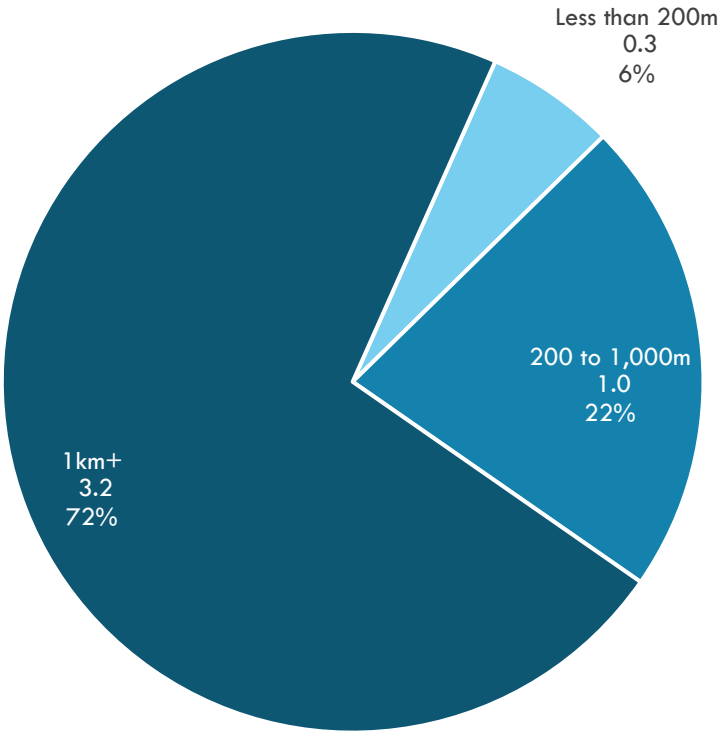
EXCLUSIVE ECONOMIC ZONE (EEZ)*

km²; depth; 2023

Defined as 200 nautical miles from coastline

AREA OF EEZ BY DEPTH

km²; % of area; 2023



TOTAL AREA IN EEZ = 4.4m km²

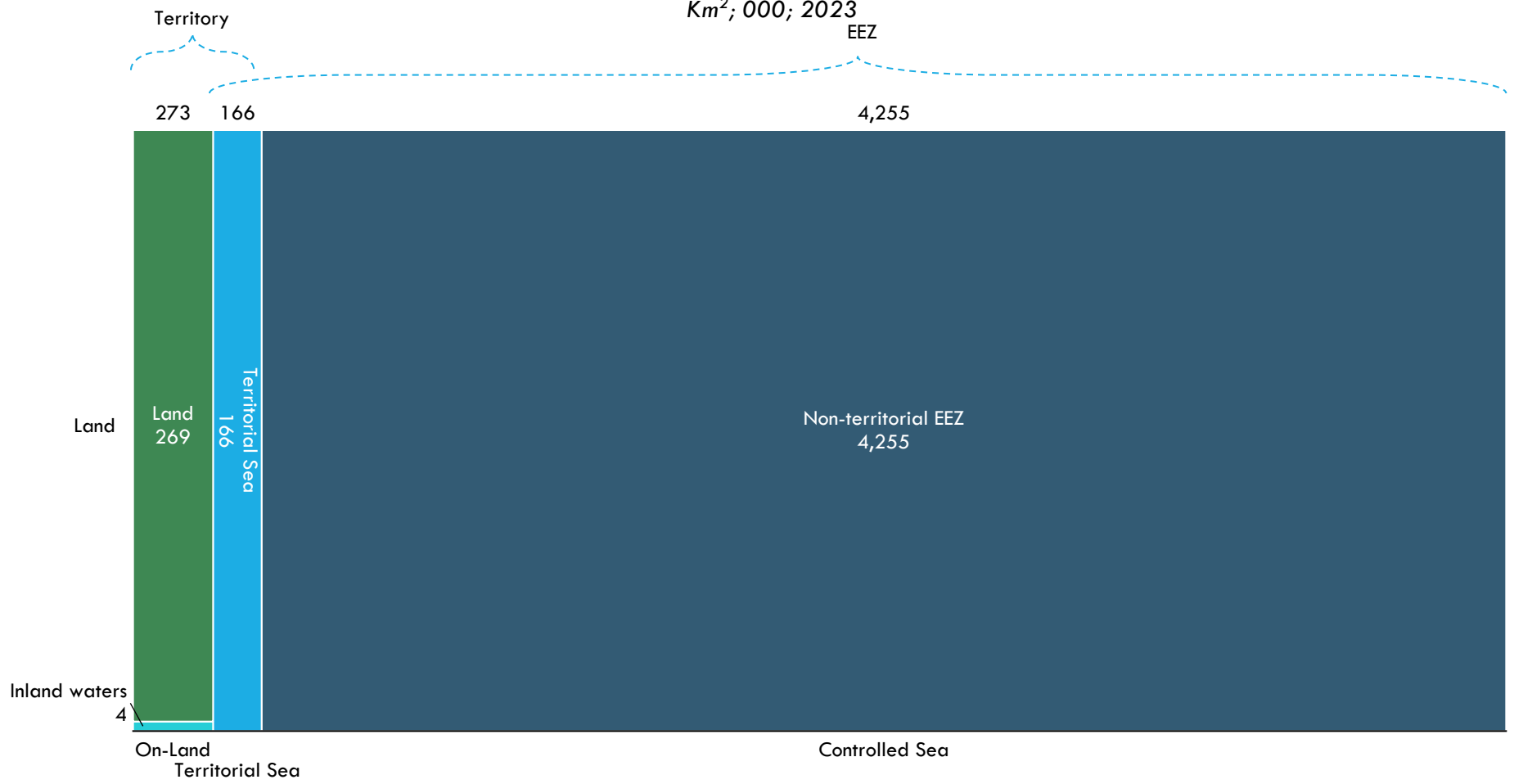
** Excluding the Cook Islands (1.96m) and Niue (0.3m); note: a nautical mile is 1,852 metres; Source: Wikipedia (http://en.wikipedia.org/wiki/Exclusive_Economic_Zone); Sealord; Coriolis analysis*

*94% of the area of the planet controlled by New Zealand is water**

NEW ZEALAND LAND/WATER USE DISTRIBUTION BY TYPE

TOTAL = 4,860km² (000)

Km²; 000; 2023

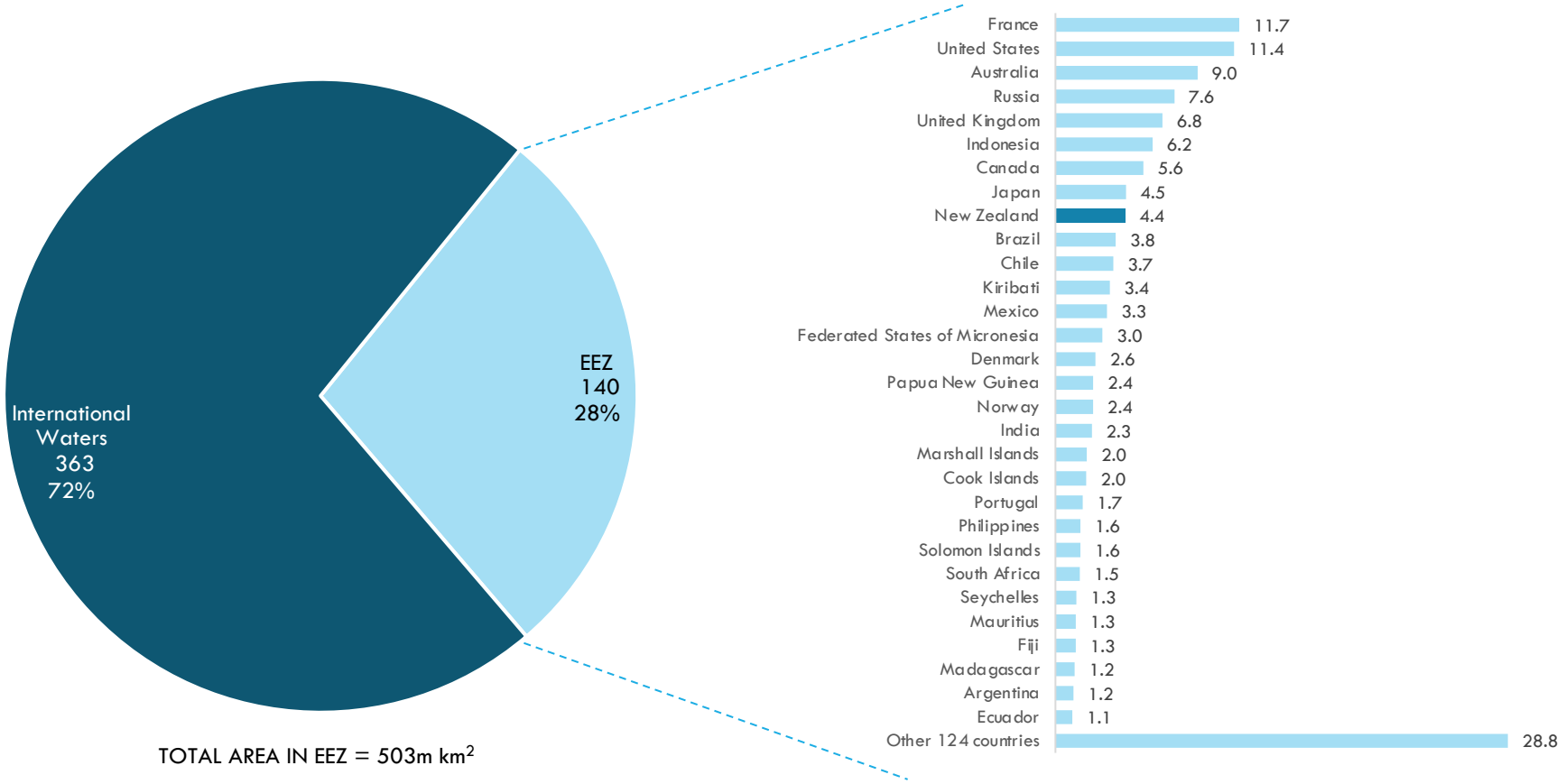


** Excluding Ross Dependency, Niue and Cook Islands; Source: CIA World Fact Book; LINZ; Coriolis analysis and estimates*

New Zealand has the ninth largest area of claimed/controlled ocean space of any country in the world

TOP 30 COUNTRIES AND TOTAL GLOBAL CLAIMED EXCLUSIVE ECONOMIC ZONE (EEZ)

km^2; m; 2023

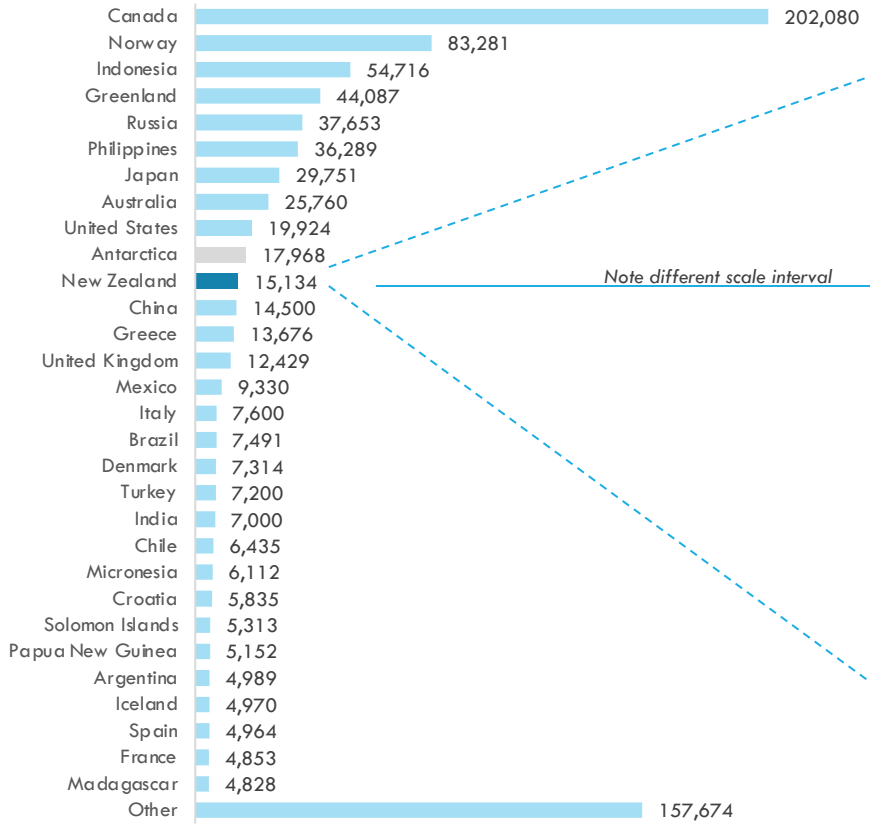


Note: New Zealand excludes the Cook Islands (1.96m) and Niue (0.3m); data is generally claimed; some areas are disputed; Source: Wikipedia (from other sources) [http://en.wikipedia.org/wiki/Exclusive_Economic_Zone]

New Zealand has the tenth largest coastline of any country; Southland, Northland, Auckland and Marlborough stand out

TOP 30 COUNTRIES BY COASTLINE LENGTH

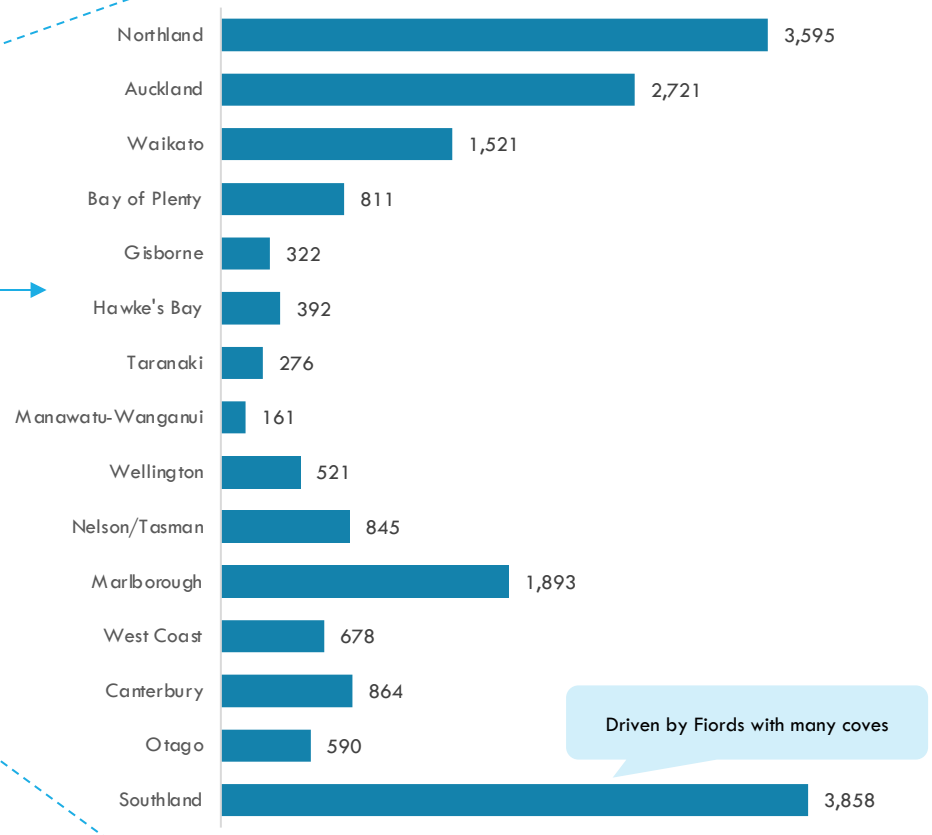
km; 2023



Note different scale interval

NZ COASTLINE LENGTH BY REGION

km; 2023



Note: coastline lengths are fractal and different scale intervals give different answers; data presented is a constant scale interval on each chart (but not across both) and is generally as claimed; some areas are disputed; total NZ coastline length chart right is 19,049km due to different interval length; Source: CIA World Fact Book (https://www.cia.gov/the-world-factbook/); LINZ; Coriolis analysis

The amount of seafood produced in New Zealand is almost exclusively a function of government regulations (and the economics they create)

KEY DRIVERS: NEW ZEALAND SEAFOOD BIOMASS

WILD CAPTURE

Tonnes of total allowable commercial catch (by managed species)[TACC]

X

% of TACC which is actually captured

=

Tonnes of wild catch seafood of quota species

+

Tonnes of wild catch seafood of non-quota species

=

Tonnes of landed catch

The amount of wild capture seafood removed from the sea is likely close to the sustainable limit (based on current science)

AQUACULTURE

Area where aquaculture is permitted (hectares)

X

Production per hectare of specific species permitted in this area

=

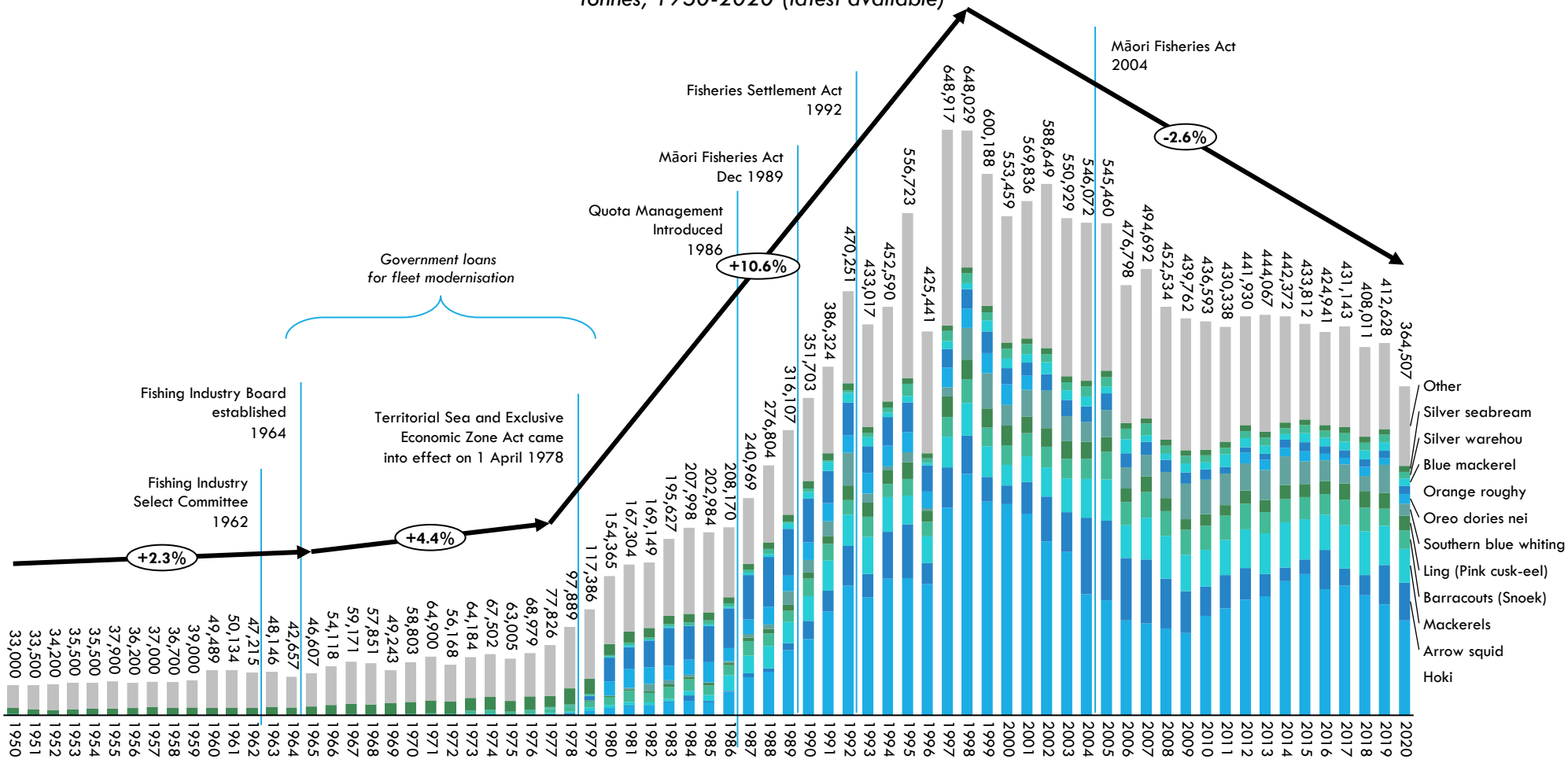
Tonnes of aquaculture seafood

New Zealand could produce 100x or 1,000x more seafood from aquaculture with different rules. However, this is unlikely to occur.

New Zealand wild capture production peaked in 1997/98 and has been trending down since as quotas are reduced to maintain stocks

NEW ZEALAND BIOMASS WILD HARVEST FROM WILD CAPTURE

Tonnes; 1950-2020 (latest available)

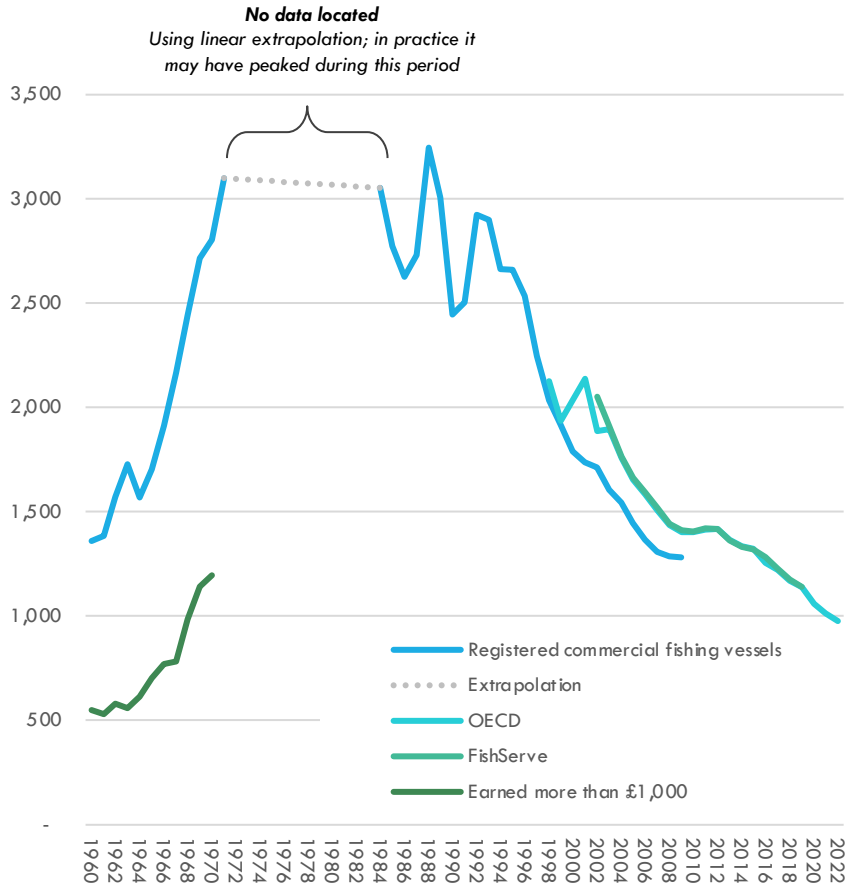


Source: UN FAO Fishstat database; Coriolis classification and analysis

Falling allowable capture and growing economies of scale have led to falling commercial vessel numbers; landed tonnes/vessel has been growing

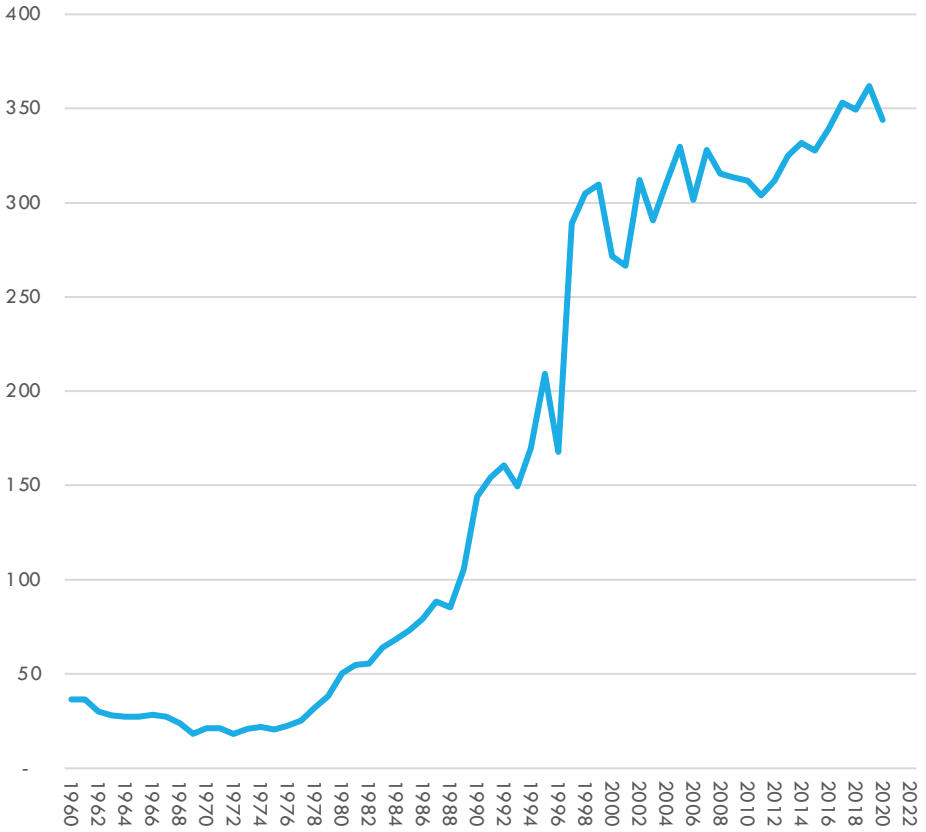
REGISTERED FISHING BOATS IN NZ WATERS

Vessels; 1960-2022



AVERAGE LANDED TONNES PER VESSEL

Tonnes/unit; 1960-2022

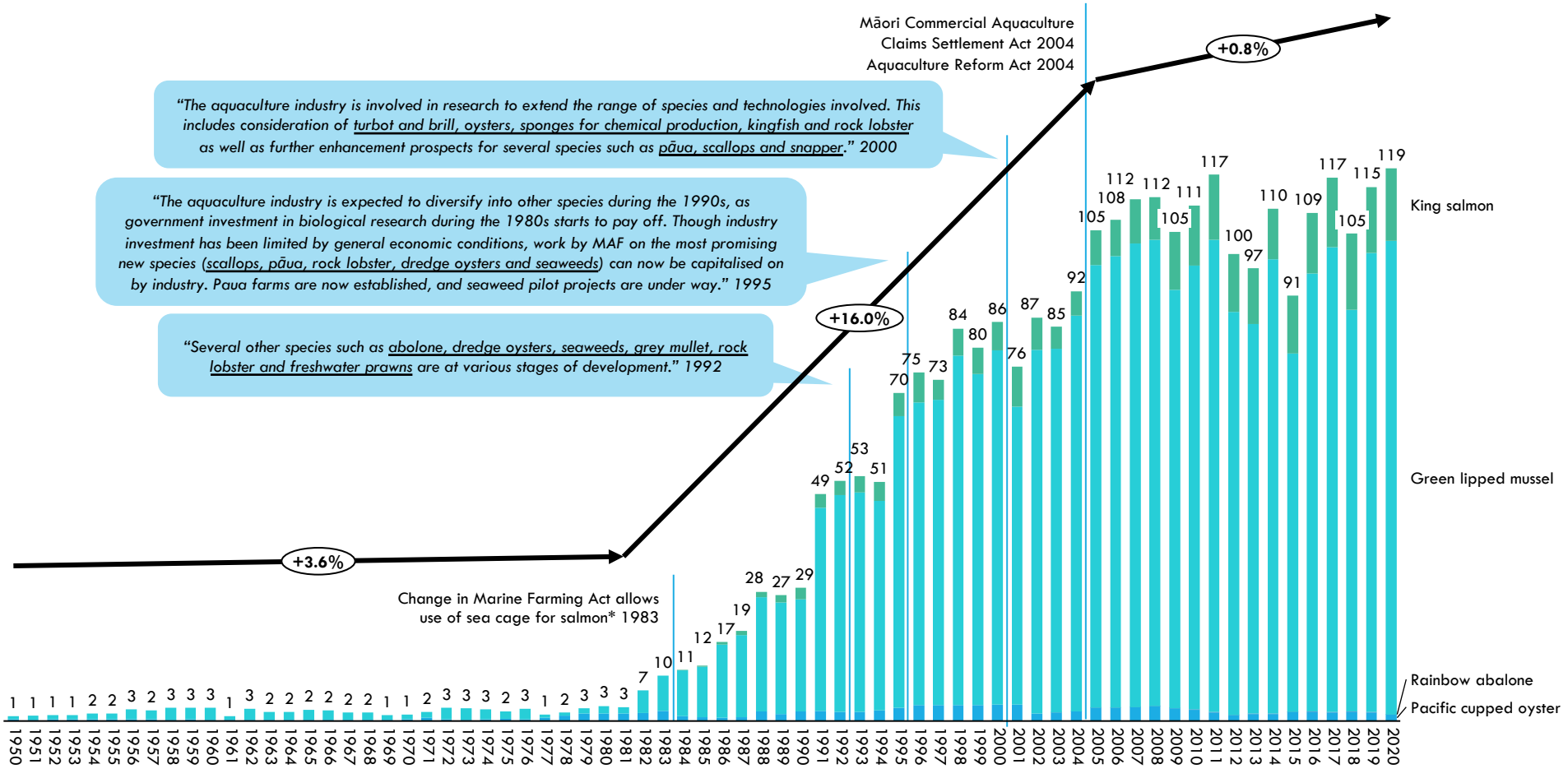


Note: Excludes recreational fishing vessels; Source: Ministry of Fisheries (historical); StatisticsNZ (historical); FishServe; Coriolis analysis

New Zealand aquacultural production grew through around ~2004; growth has stalled since; all new species attempted in the past fifty years have failed

NEW ZEALAND BIOMASS HARVEST FROM AQUACULTURE

Kilotonnes (t; 000); 1950-2020 (latest available)



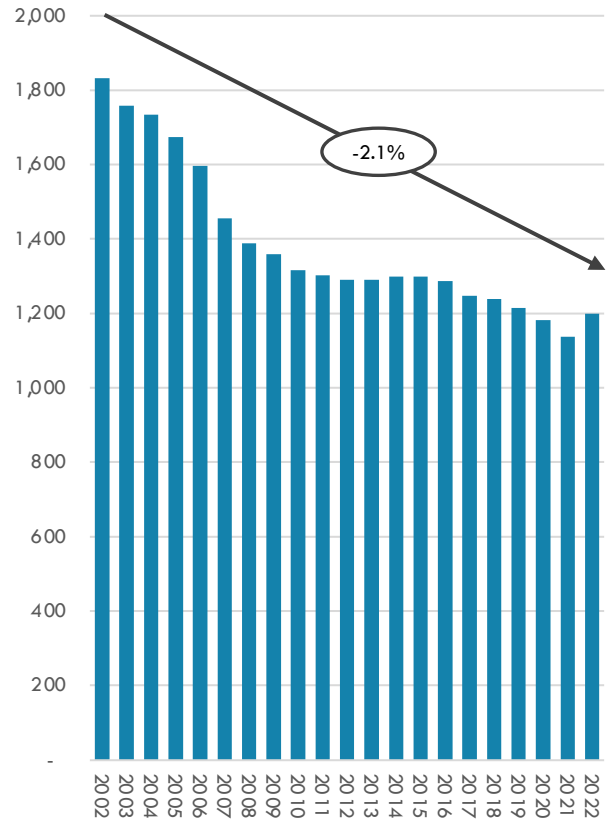
** Prior to this, river and "ocean ranching" of salmon had been conducted in NZ; Source: UN FAO Fishstat database; Coriolis classification and analysis*

The seafood industry has declining unit numbers

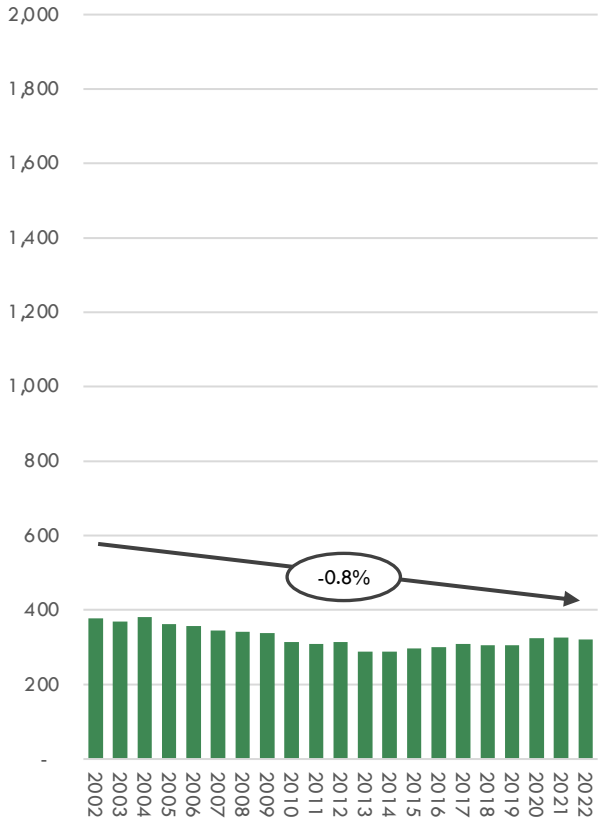
NUMBER OF ACTIVITY/GEOGRAPHIC UNITS BY SECTOR

Business units ("front doors"); 2002-2022

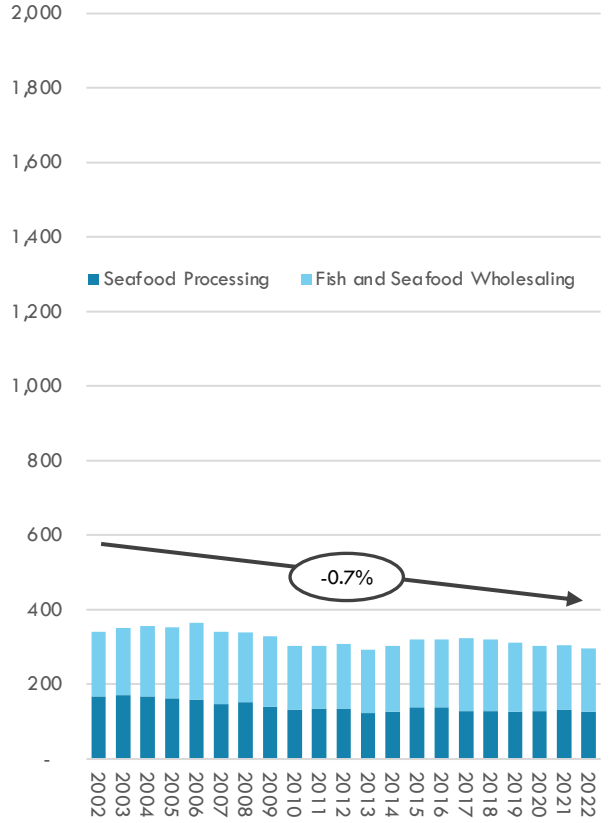
WILD CAPTURE



AQUACULTURE



PRIMARY PROCESSING



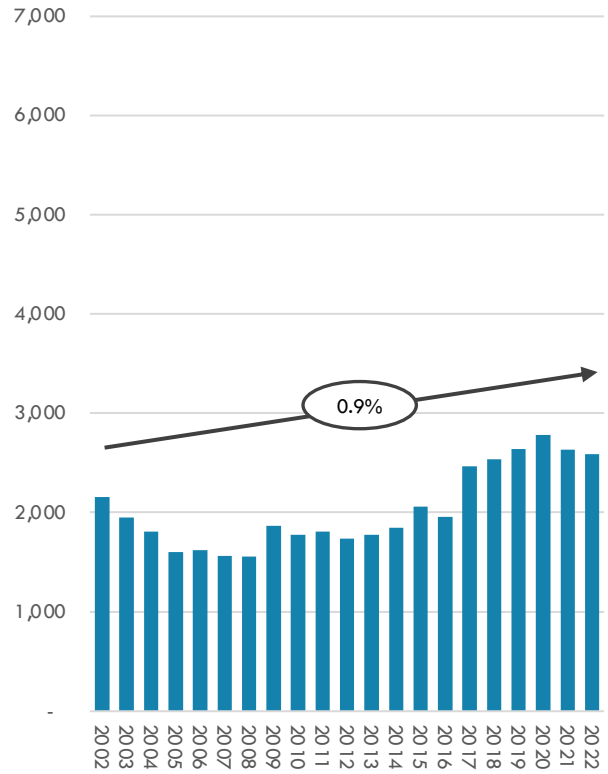
Source: StatisticsNZ (business demographics); Coriolis analysis

The seafood industry has growing employment at sea and on-farm, but declining employment on land in primary processing/handling

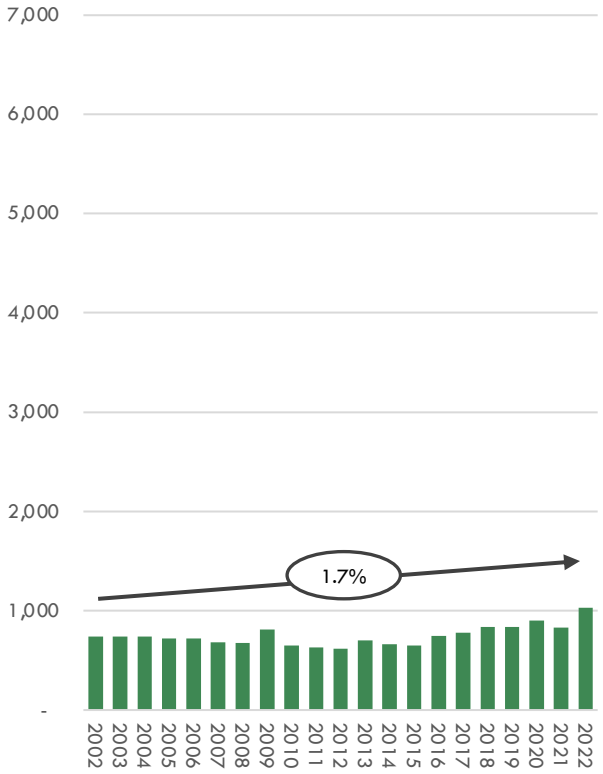
NUMBER OF EMPLOYEES BY SECTOR

Headcount; 2002-2022

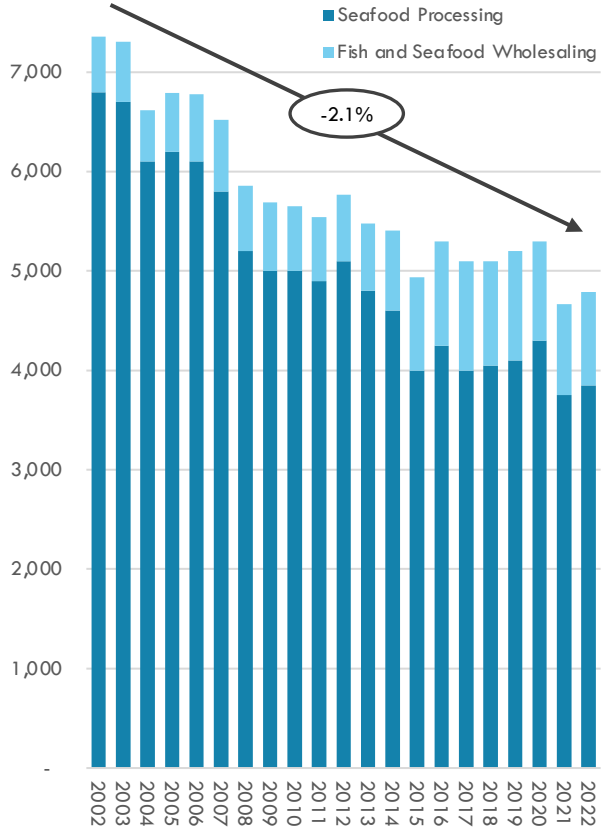
WILD CAPTURE



AQUACULTURE



PRIMARY PROCESSING

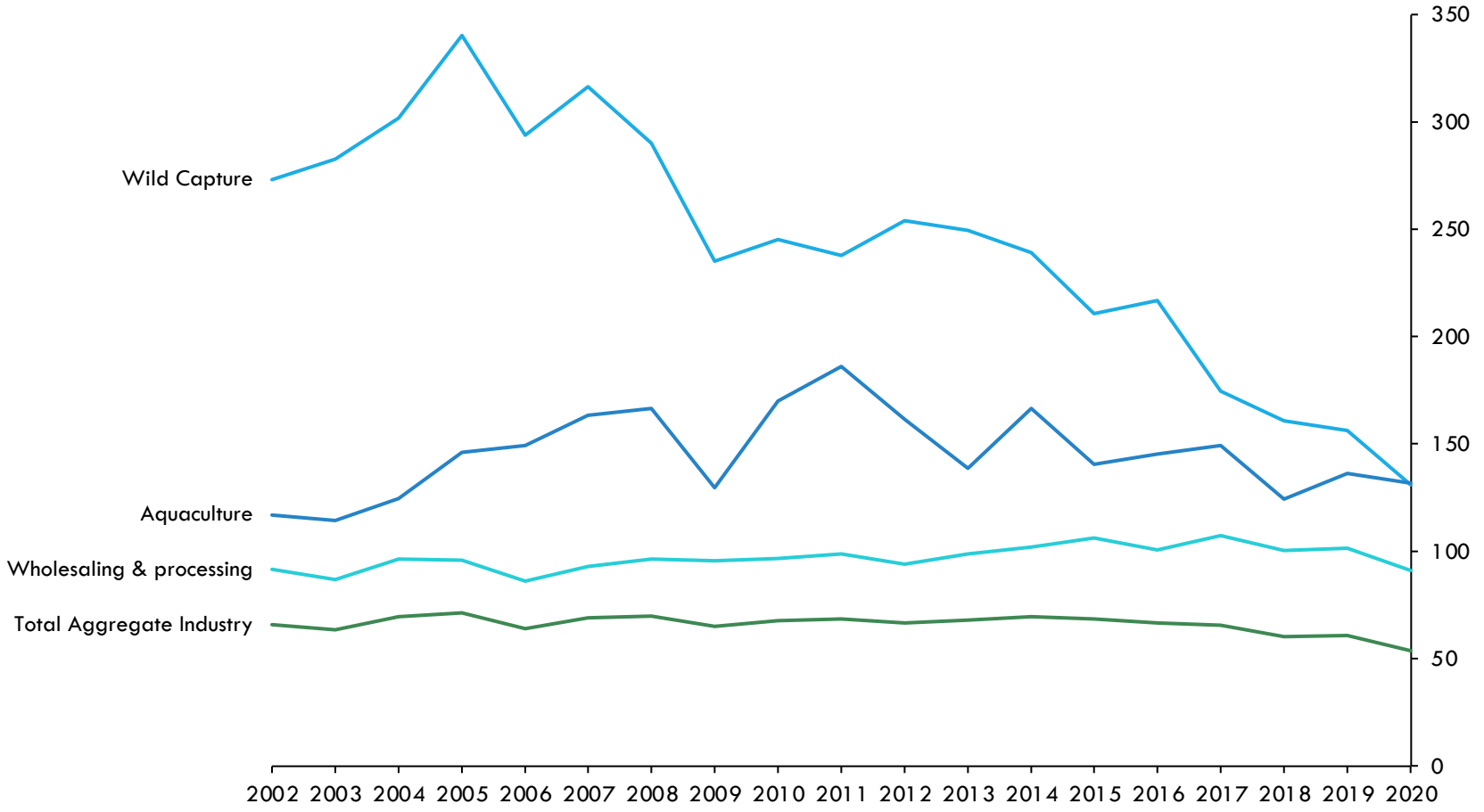


Source: StatisticsNZ (business demographics); Coriolis analysis

The industry is not increasing productivity; tonnes per employee is falling, suggesting further consolidation is likely going forward

TONNES PER EMPLOYEE BY SECTOR

Tonnes/headcount; 2002-2020 (latest available)



Source: StatisticsNZ (business demographics); UN FAO Fishstat database; Coriolis classification and analysis

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Market forces had stalled afforestation in New Zealand for almost two decades; significant recent government intervention may have changed this…

New Zealand is capable and competitive in forestry

- The New Zealand plantation forestry industry has access to all required capabilities across the supply chain
- New Zealand has a stable and sustainable position in the global forestry industry, albeit with unclear ability to expand value add
- Not every driver of the plantation forestry chain is perfect; New Zealand has capabilities in growing and primary processing, but challenges at value added
- Competitiveness is calculated at the border; New Zealand has growing competitiveness in whole logs and declining competitiveness in wood products

New Zealand is a minor forestry producer, with a similar share of area in forest as peers, and limited overall growth; ~20% of forest is bioeconomic

- New Zealand accounts for 0.2% of global forestry area and 0.7% of global planted forest area
- About a third of New Zealand is covered in forest or 42.6% including scrublands; 7.8% in exotic forests
- The total amount of forest and scrubland in New Zealand has been incredibly flat for the past two decades plus; however, looking at the long term, the area of New Zealand in forest is back where it was in ~1880
- A larger share of New Zealand is forested than many climatic peer group countries; drilling in on a tight group of similar sized, developed, temperate climate countries suggests New Zealand is not particularly over or under forested
- About 20% of the standing volume of trees in New Zealand are plantation forestry which may be harvested for biomass; 94% of this is radiata pine

… *continued*

New Zealand plantation forestry area has not moved significantly in the past two decades; recent area gains have started to offset historical area losses

- Total New Zealand forestry area peaked in 2003 and has generally drifted down since then; modest recovery in last two years
- Restocking of existing forestry lands is relatively consistent; it is new area entering forestry that declined then recently recovered
- Net area in plantation forestry was in decline through 2019; recent growth in clear-felling, restocking and new plantings
- After a long period of harvesting greater than replanting, there have been three years of net area gains
- Most forestry area in New Zealand is privately owned; changes in forestry will be driven by business cases
- Around 70% of New Zealand plantation forestry area is in the North Island, with the Central N.I. alone accounting for a third

Historic decisions mean that New Zealand is experiencing growing wood volumes that will last for another ~8 years, followed by a sharp decline

- New Zealand has seen long term growth in harvested volumes of wood
- However, planting decisions made ~30 years ago mean that future harvest volumes will stabilise and then begin to decline
- BioPacific's recent wood availability model forecasts an additional eight years of volume growth followed by a sharp decline
- New Zealand trees are grown and harvested on clear cycles; the "wall of wood" bulge will pass through over the next 10+ years
- Since around 2000, effectively all growth in harvest volumes has been going to export markets as whole logs; the export log market will likely act as the "shock absorber" for harvest volumes, with domestic further processing stable

The New Zealand plantation forestry industry has access to all required capabilities across the supply chain

NEW ZEALAND CAPABILITIES DRIVEN SUPPLY CHAIN: PLANTATION FORESTRY

SELECT FIRMS

TREE GENETICS

PFOLSEN, ArborGen, PROSEED

VEHICLES/MACHINERY

TERRA CAT, JOHN DEERE, ALPINE, Sumitomo, KOMATSU, MADILL, DOOSAN, Tigercat, Vermeer, HYUNDAI

FORESTRY SUPPLIES

LOGGERS, TIMBERSAWS, TERRAIN, GOLDPINE, FORESTRY SUPPLIERS, FARM SOURCE, Farmlands, PGG Wrightson

FERTILISER

Ballance, ravensdown

LAND IN FORESTRY

1.7m hectares

LANDOWNERS

3,100 forestry enterprises
3,600 forestry units

PEOPLE IN FORESTRY

~ 4,100 forestry
~3,700 logging
~ 5,500 sawmilling
~33,000 processing

GROWER ORGANISATIONS

FOREST OWNERS ASSOCIATION, woodco WOOD COUNCIL OF NZ INC, FARM FORESTRY NEW ZEALAND, FEDERATED FARMERS OF NEW ZEALAND

FORESTRY OWNERS/MANAGERS

KAINGAROA TIMBERLANDS, Rayonier matariki Forests, Manulife Investment Management, ERNSLAW ONE LIMITED, TASMAN PINE FORESTS LTD, One Forty One, SUMMIT FORESTS, JNL JUKEN NEW ZEALAND LTD, PAN PAC FOREST PRODUCTS LTD, Forest Enterprises, PORT BLAKELY, ARATU FORESTS LIMITED, crown forestry, Roger Dickie, FMNZ, NGĀI TAHU Farming, GFP GLOBAL FOREST PARTNERS LP, WENITA FOREST PRODUCTS, LAKE TAUPO FOREST TRUST, LAKE ROTOAIRA FOREST TRUST

MANAGERS/CONSULTANTS

PFOLSEN, FOREST360, JOHN TURKINGTON LIMITED, PF Growth, Forest Management Group, N.Z. FOREST MANAGERS

LOG TRADERS & EXPORTERS (60%)

PACIFIC FOREST PRODUCTS NZ LTD, TPT, Aowhanui Wood, FORTUNA, TENCO, CHINA FORESTRY GROUP NEW ZEALAND

DOMESTIC WOOD PROCESSING (40%)

JNL JUKEN NEW ZEALAND LTD, CarterHoltHarvey Woodproducts New Zealand, NelsonPine LVL, OJI Oji Fibre Solutions, RED STAG TIMBER, TIMPACK, DAIKEN new zealand limited, Norske Skog Tasman, Westco Lumber Limited, PAN PAC FOREST PRODUCTS LTD, KiwiLumber, PINEPAC GROUP, claymark, essity, Fletcher Building, Sorbent, Laminex NEW ZEALAND

SHIPPING

SWIRE SHIPPING, NYK BULK & PROJECTS, GRIEG STAR, THORNICO, Pacific Basin, MUR, GEARBULK, YANG MING, OLDENDORFF, COSCO SHIPPING, WL

LOGISTICS

HARVEST LOGISTICS, LOG LOGISTICS

INDUSTRY ORGS.

NZTIF, wpma

Source: Coriolis

New Zealand has a modest forestry industry by global standards that is relatively well organised, but lacks scale

SWOT ANALYSIS: NEW ZEALAND FORESTRY

STRENGTHS	WEAKNESSES
- Total industry focused almost exclusively on a single, fast growing species (Radiata/Monterey Pine) - Growing supply from 'Wall of Wood' reaching harvest age - Unsubsidised industry - Limited presence of disease - Government support of industry R&D - Consolidated industry with large forestry owners at scale (6% of owners accounted for 68% area) - Regional scale, particularly in North Island - Professional industry across all stages of the chain - International investment across all stages of the chain - Breeding programs improving genetics (e.g. PF Olsen)	- Radiata pine is a fast growing softwood and isn't in any way a 'perfect' timber species - Radiata 'perceived' to perform poorly against other competing timbers in other markets - 15+ years of no market signals to significantly increase forestry area (only ended with dramatic government stimulus and regulatory change) - All volume growth in last ~25 years has gone to exports of whole logs primarily to China - 'Wall of Wood' will come to an end in about eight years and volumes will drop off dramatically - Processed wood products almost totally domestic focused - Not a major plantation operator relative to key competitors - Small domestic markets of 5m people inside a small trading block with Australia (23m people) - Lack of market integration, not capturing in-market value - Limited in-market knowledge
OPPORTUNITIES	**THREATS/ISSUES/CHALLENGES/RISKS**

- Government seeking to address emissions with forestry (Land Use, Land-Use Change and Forestry)
  - Government zero carbon emissions target
  - Government subsidies (e.g. One Billion Trees)
  - Rising carbon prices medium-long term
  - Changes to Overseas Investment Act
- Latest government-led industry strategy/plan saying 'all the right things'
- Constant and ongoing changes in government building/construction regulations
- Scaling up of use of by-products for nutraceuticals /cosmetics sector
- Optimising forestry value (e.g. bioextracts, biomaterials, biochemicals, biofuels); in particular from slash
- Speculative research and emerging technologies for producing biofuels, bioplastics and other bio-stuff from forestry/wood byproducts
- Growing interest by some more wealthy consumers in Western markets for eco-labelling and environmental certification (e.g. FSC)
- Chinese economic growth being supported by large infrastructure projects
	- Recent growth is driven by government not markets; were government to again change focus, for example to permanent carbon forestry built around native trees, growth will stop
	- Industry is extremely dependent on domestic construction and China
	- Growing domestic wood imports
	- Ongoing consolidation in wood processing
	- Declining industry employment across almost every part of the chain
	- Processed wood products not achieving success in export markets (outside a few narrow exceptions)
	- Disease, particularly as industry is effectively a monoculture
	- Numerous past industry strategies that have failed to achieve or deliver
	- Clear disconnect between high-level narrative and facts-on-the-ground
	- NIMBY (not in my back yard) attitudes limiting industry activity
	- Growing negative environmental impacts of clear-felling (e.g. Cyclone Gabrielle and erosion) and questions over appropriateness of radiata pine on erosion prone land (e.g. in Tairawhiti)
	- Single issue special interest groups driving domestic regulatory agenda
	- Emissions Trading Schemes forcing a shift from plantation to carbon forestry

Not every driver of the plantation forestry chain is perfect; New Zealand has capabilities in growing and primary processing, but challenges at value added

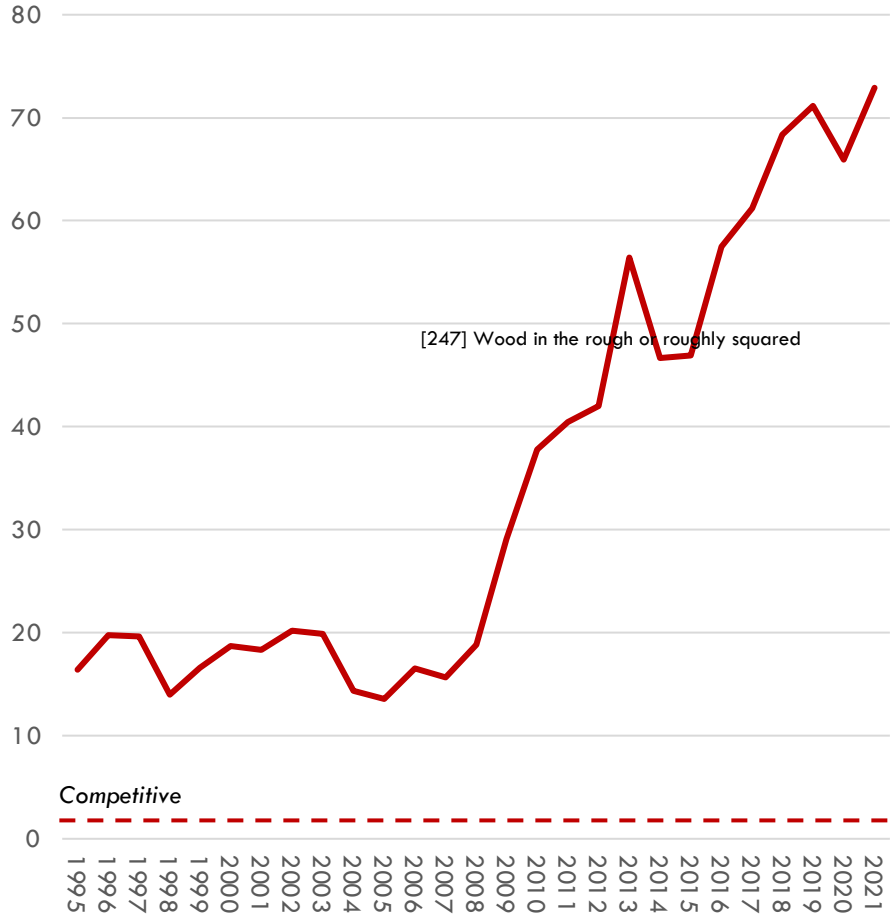
DRIVERS OF AN INTERNATIONALLY COMPETITIVE BIOECONOMY: FORESTRY

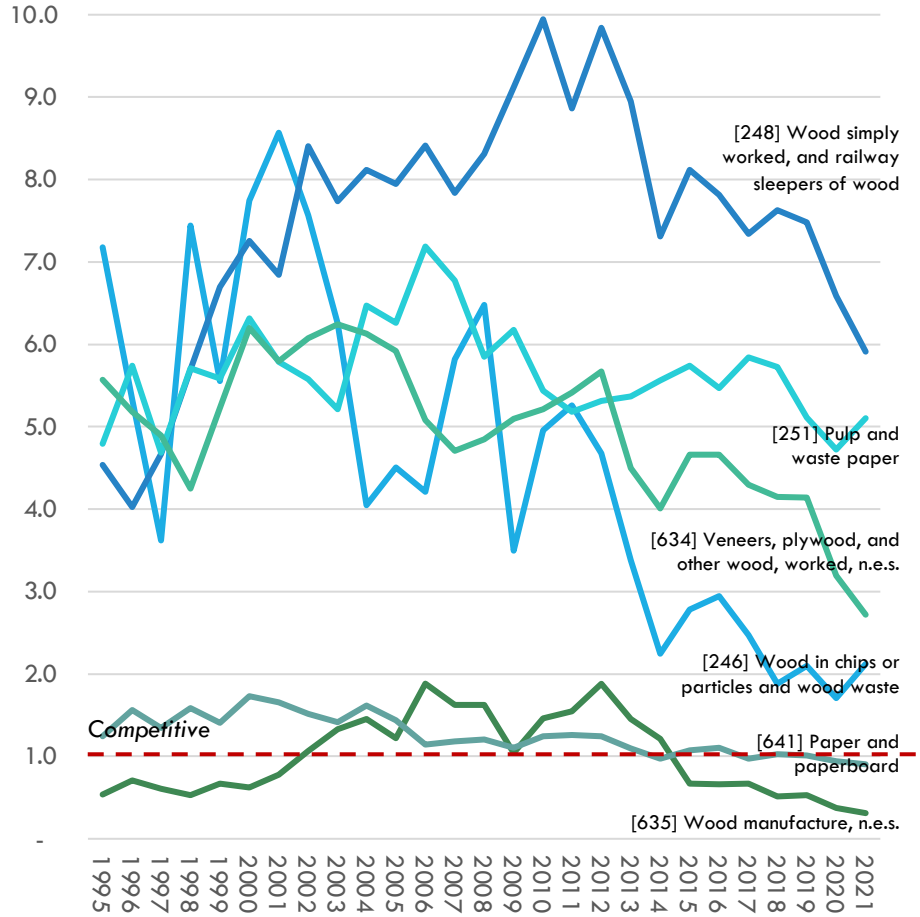
Source: Coriolis

Competitiveness is calculated at the border; New Zealand has growing competitiveness in whole logs and declining competitiveness in wood products

ANNUAL REVEALED COMPARATIVE ADVANTAGE INDEX: NEW ZEALAND BY SELECT SITC3

1=Average of New Zealand across all exports; 1995-2021



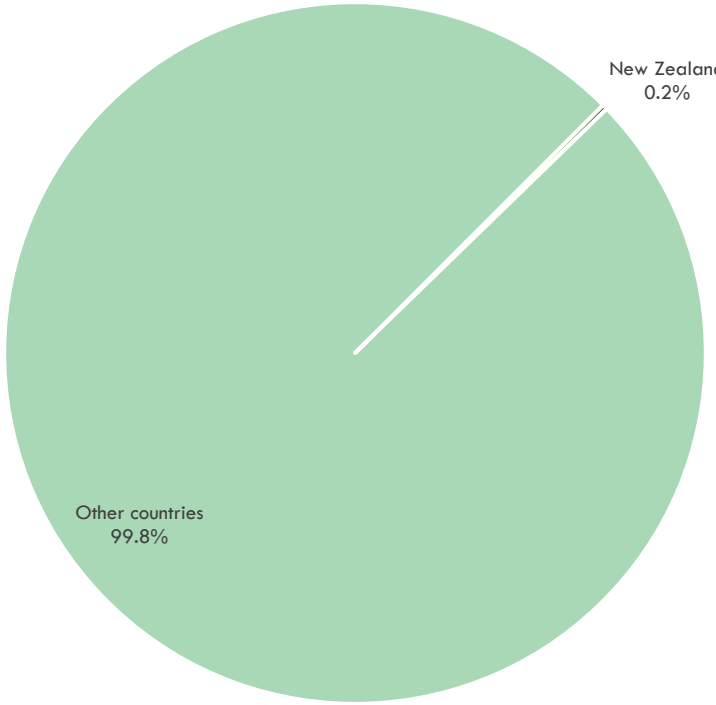


Source: UNCTAD STAT; Coriolis analysis

New Zealand accounts for 0.2% of global forestry area and 0.7% of global planted forest area

TOTAL GLOBAL FOREST AREA

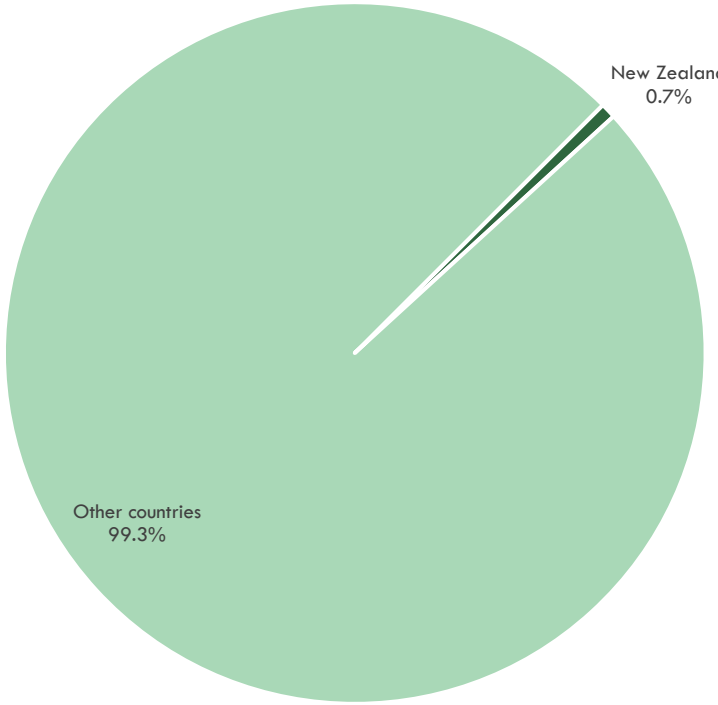
Ha; m; 2020



TOTAL = 4,059m hectares

GLOBAL PLANTED FOREST AREA

Ha; m; 2020



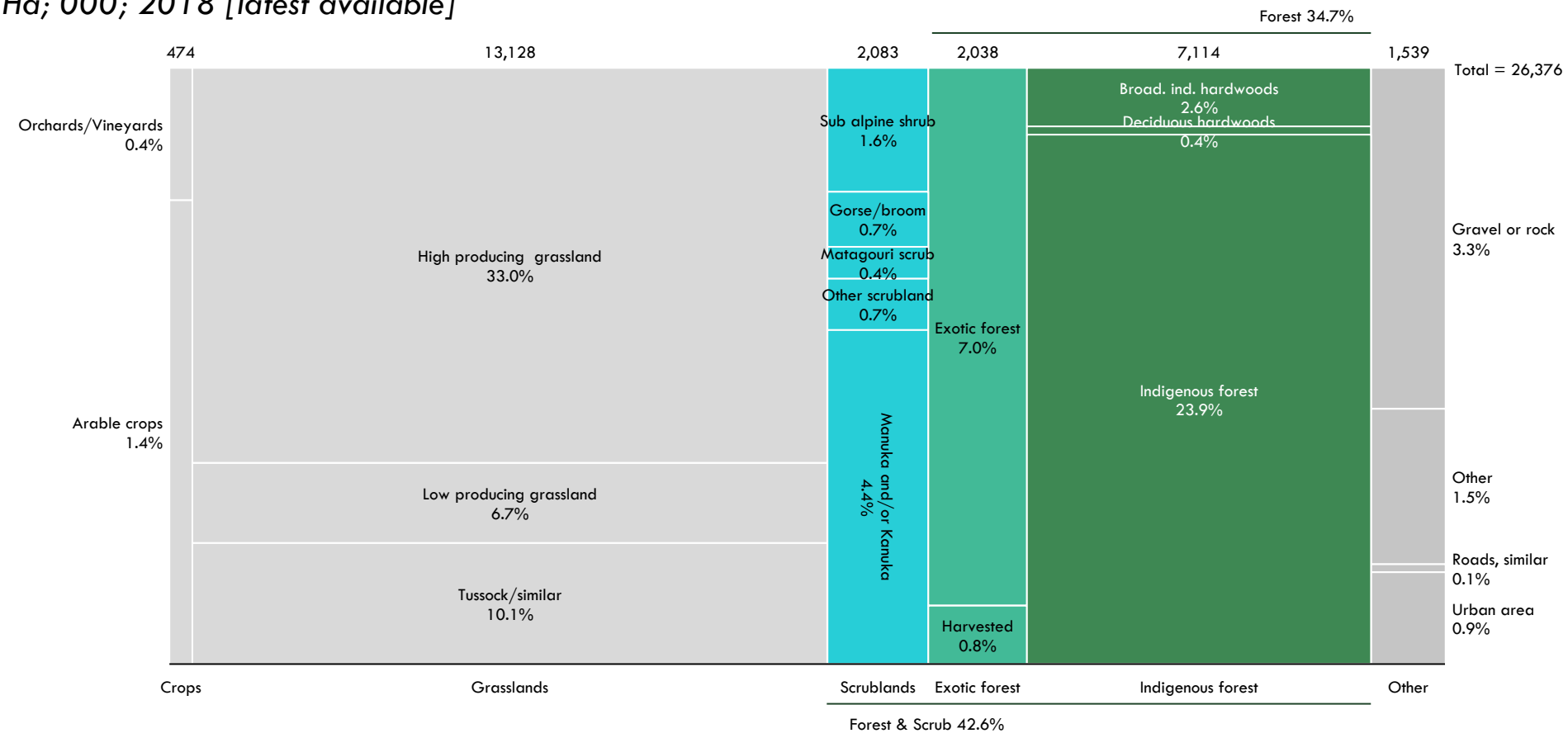
TOTAL = 293m hectares

Source: UN FAO Global Forest Resource Assessment 2020; Coriolis classification and analysis

About a third of New Zealand is covered in forest or 42.6% including scrublands; 7.8% in exotic forests

NEW ZEALAND LAND AREA BY LAND COVER CLASSIFICATION

Ha; 000; 2018 [latest available]



Source: MfE/StatsNZ New Zealand Land Cover Data Base (LCDB5); Coriolis analysis

The total amount of forest and scrubland in New Zealand has been incredibly flat for the past two decades plus

NEW ZEALAND LAND AREA IN FOREST AND SCRUBLAND

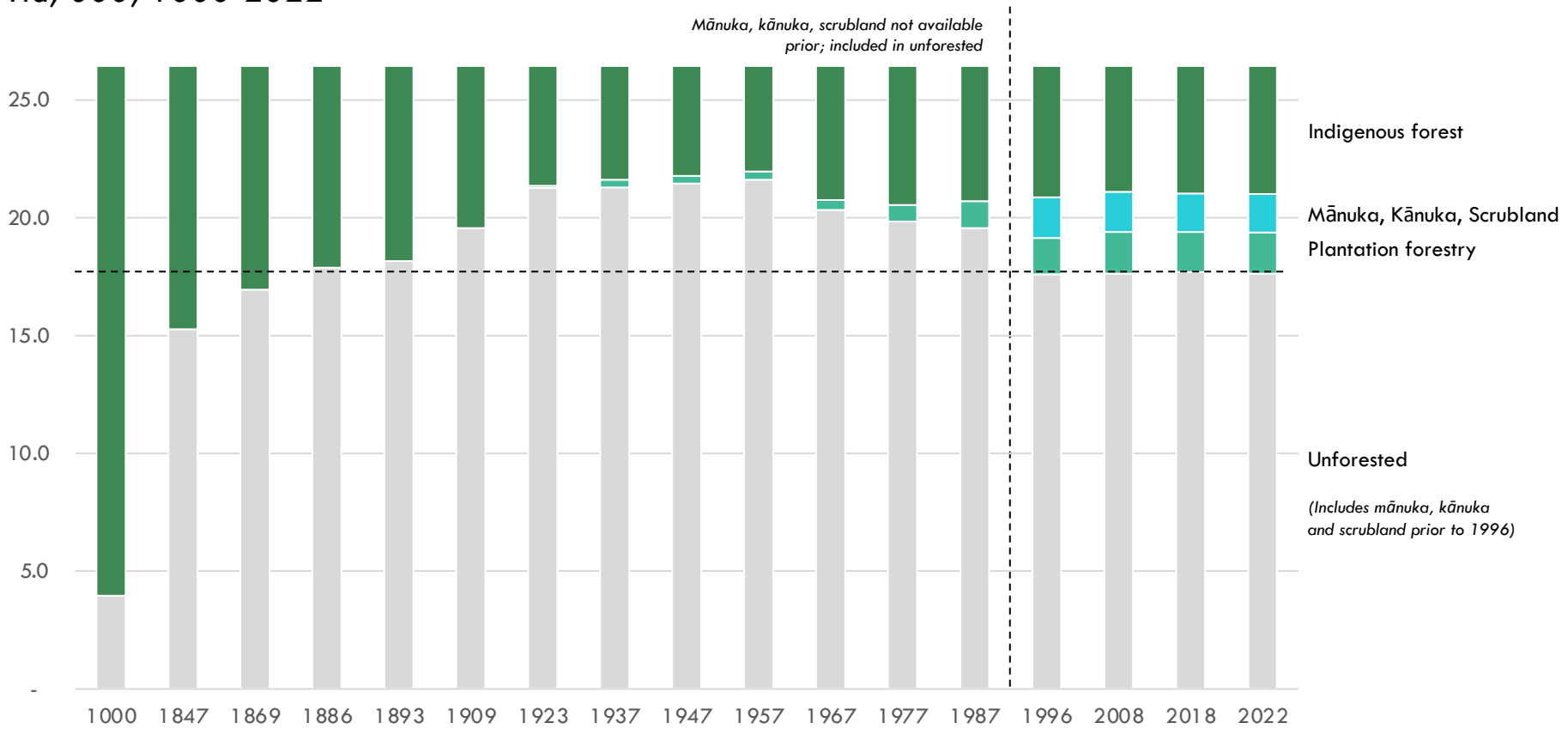
Ha; 000; 1996-2018 [latest available]

Source: MfE/StatsNZ New Zealand Land Cover Data Base (LCDB5); Coriolis analysis

However, looking at the long term, the area of New Zealand in forest is back where it was in ~1880

NEW ZEALAND LAND AREA IN FOREST AND SCRUBLAND

Ha; 000; 1000-2022

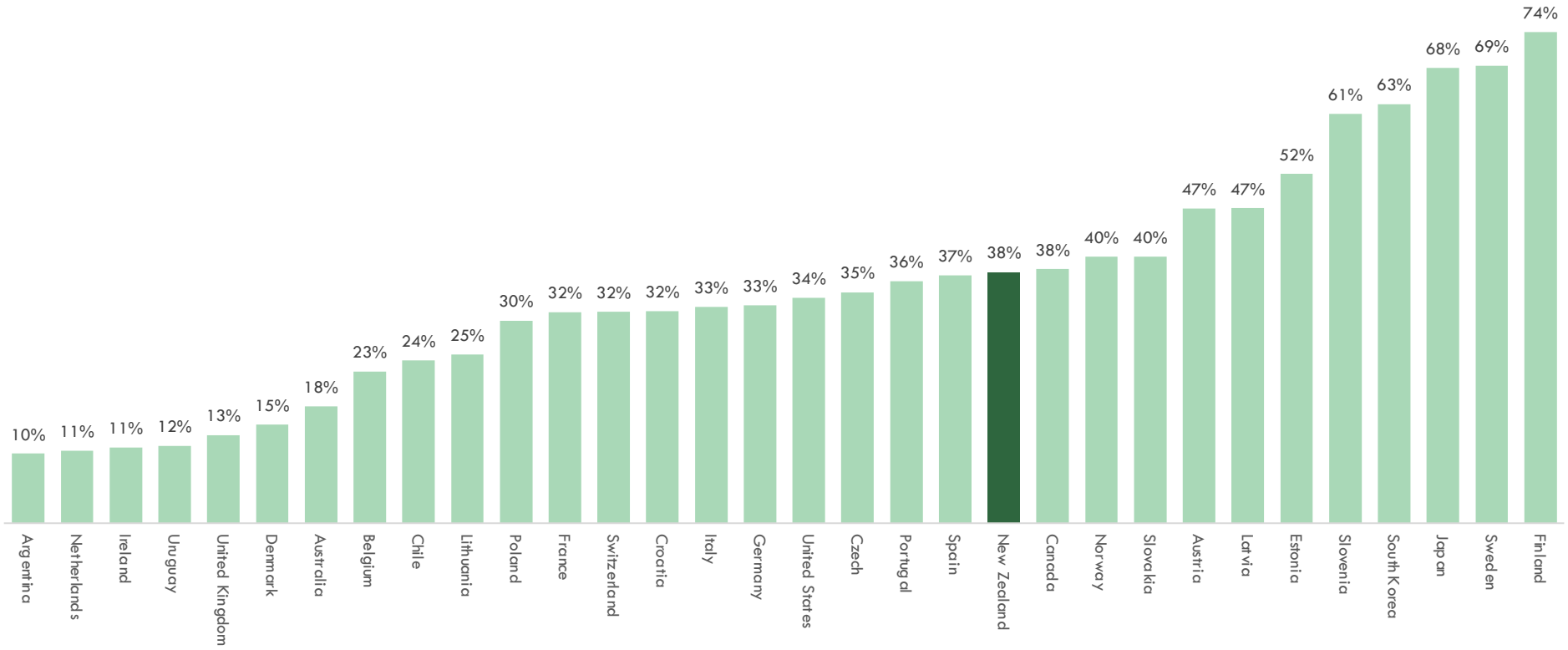


Note: Prior to 1840 "use of fire by the Māori substantially reduced the forest area" by ~11m hectares; Source: A Statistical Account of the Seven Colonies of Australasia (various years); New Zealand Department of Statistics (various years); Statistics New Zealand (various years) itself from various other government sources; MfE/StatsNZ New Zealand Land Cover Data Base (LCDB5); Coriolis analysis

A larger share of New Zealand is forested than many climatic peer group countries

PERCENT OF LAND AREA THAT IS FORESTED: NEW ZEALAND VS. SELECT CLIMATIC PEERS

% of ha; 2020

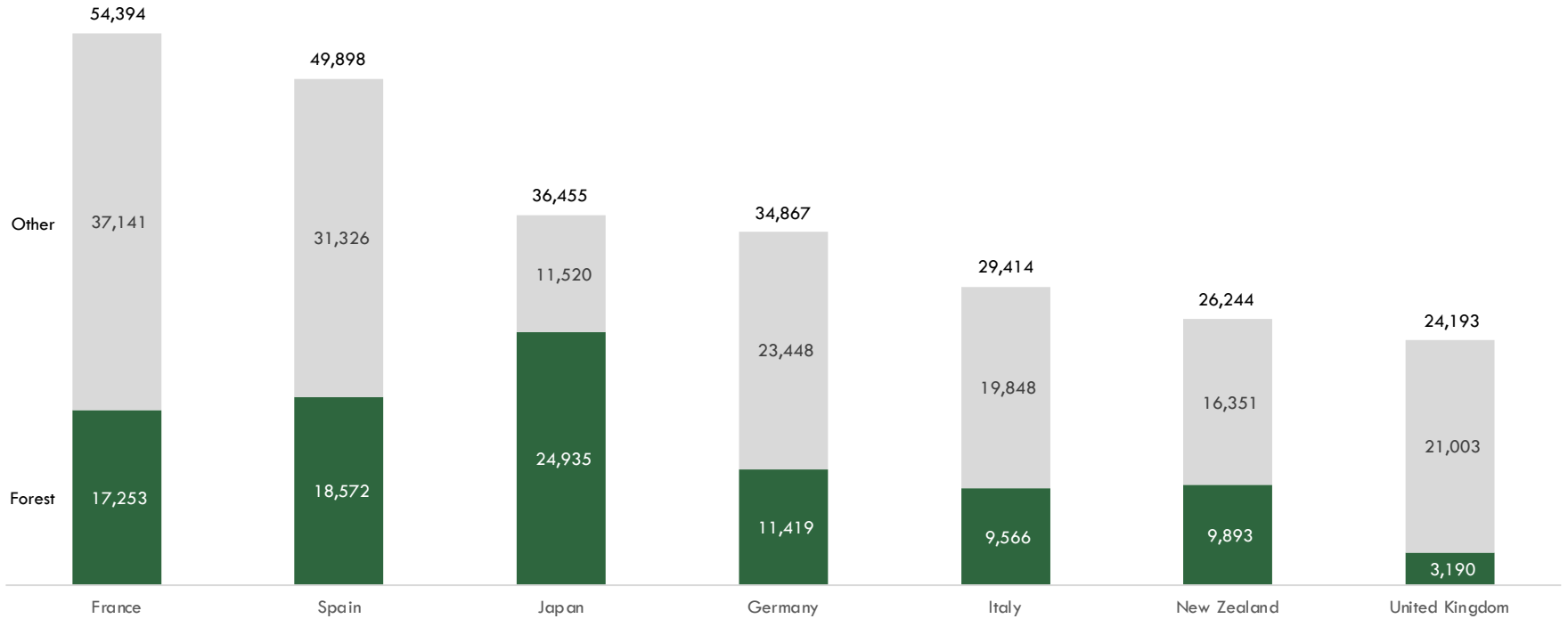


Source: UN FAO Global Forest Resource Assessment 2020; CIA World Fact Book; Coriolis classification and analysis

Drilling in on a tight group of similar sized, developed, temperate climate countries suggests New Zealand is not particularly over or under forested

LAND AREA THAT IS FORESTED: NEW ZEALAND VS. SELECT SIZE PEERS

Ha; m; 2020



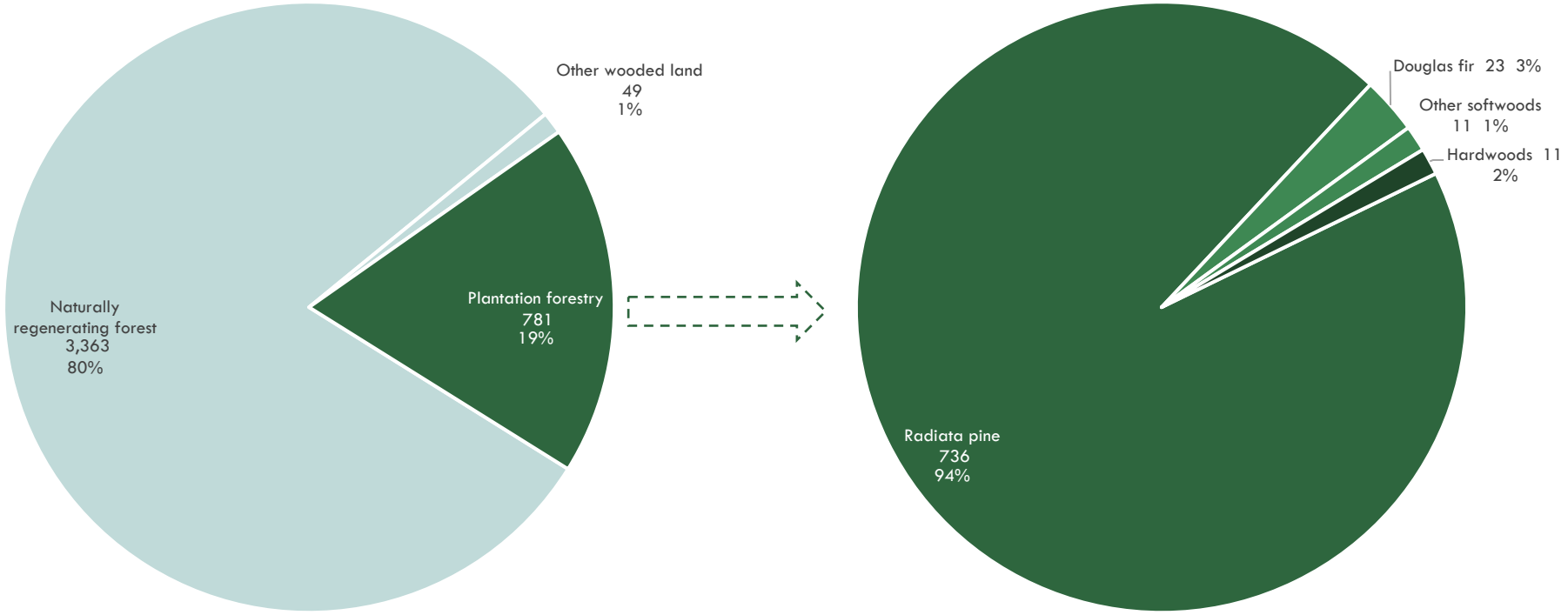
	France	Spain	Japan	Germany	Italy	New Zealand	United Kingdom
% forested	32%	37%	68%	33%	33%	38%	13%

Source: UN FAO Global Forest Resource Assessment 2020; CIA World Fact Book; Coriolis classification and analysis

About 20% of the standing volume of trees in New Zealand are plantation forestry which may be harvested for biomass; 94% of this is radiata pine

TOTAL STANDING VOLUME (GROWING STOCK) IN NEW ZEALAND BY TYPE

Cubic metres; m; over bark; 2020



TOTAL = 4,193m m³ in 2020

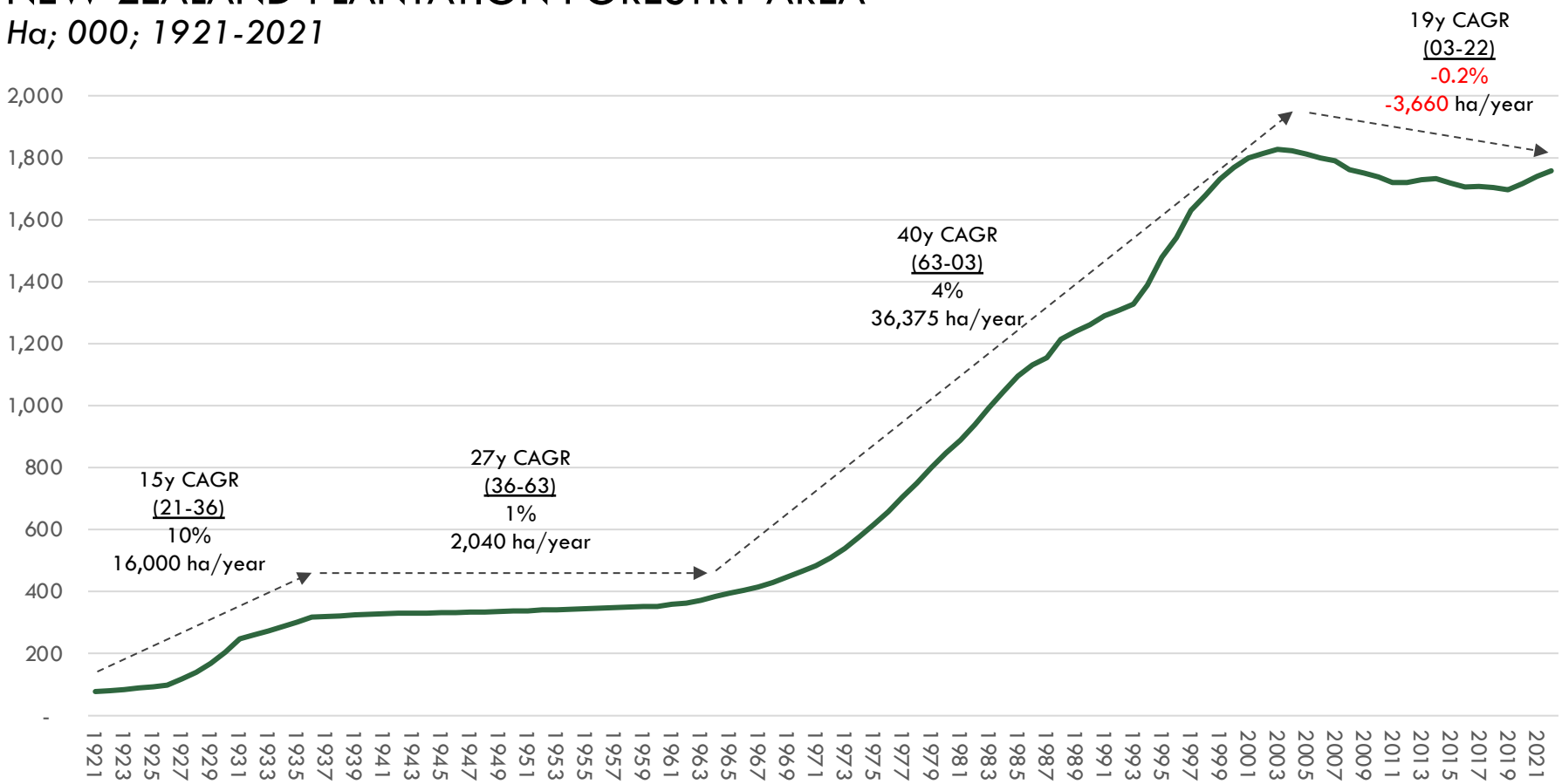
TOTAL = 781m m³ in 2020

Source: UN FAO Global Forest Resource Assessment: New Zealand 2020

Total New Zealand plantation forestry area peaked in 2003 and has generally drifted down since then; modest recovery in last two years

NEW ZEALAND PLANTATION FORESTRY AREA

Ha; 000; 1921-2021

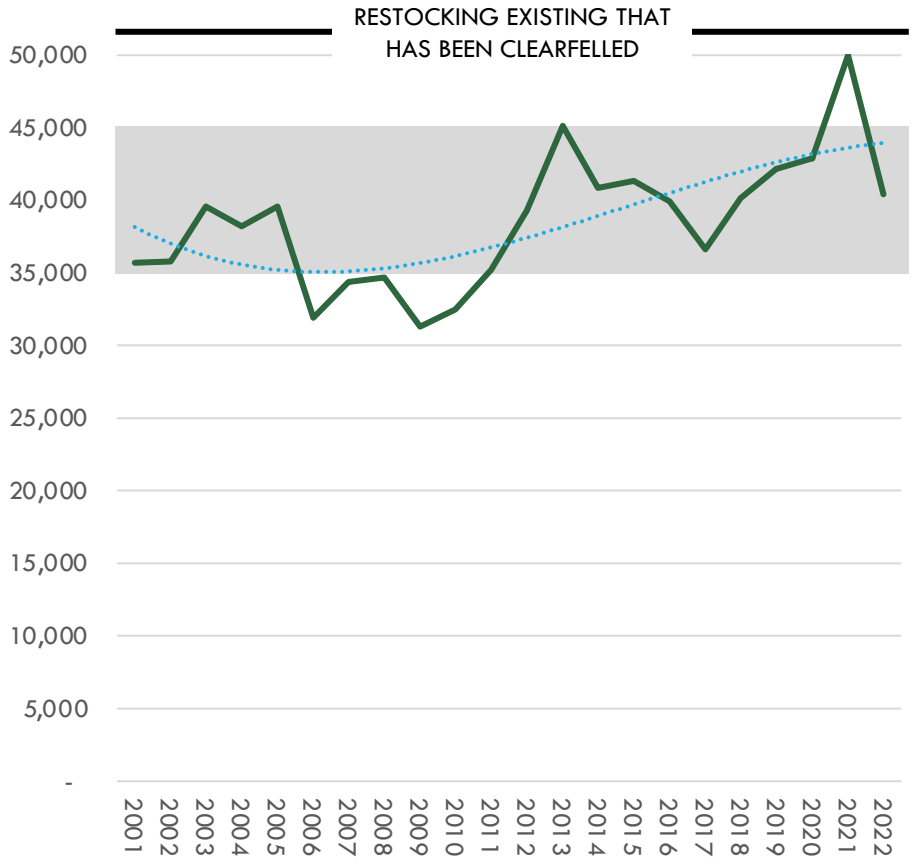


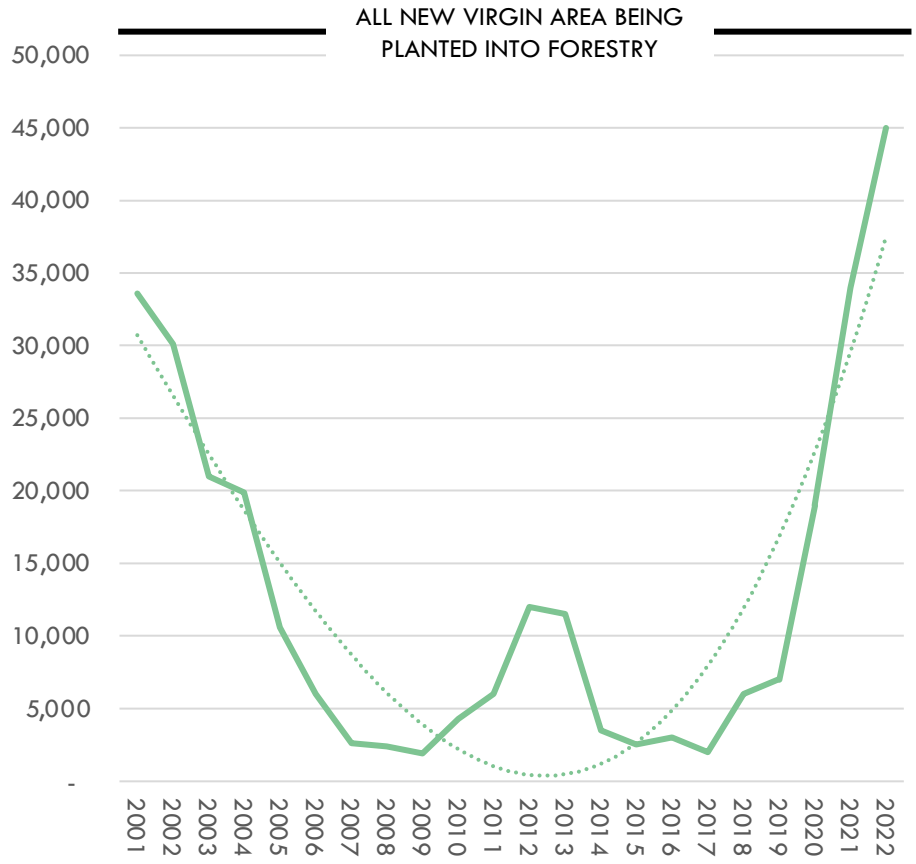
Source: MPI; Coriolis analysis

Restocking of existing forestry lands is relatively consistent; it is new area entering forestry that declined then recently recovered

HOW MUCH AREA IS BEING PLANTED ANNUALLY INTO FORESTRY IN NEW ZEALAND?

Ha/year; 2001-2022



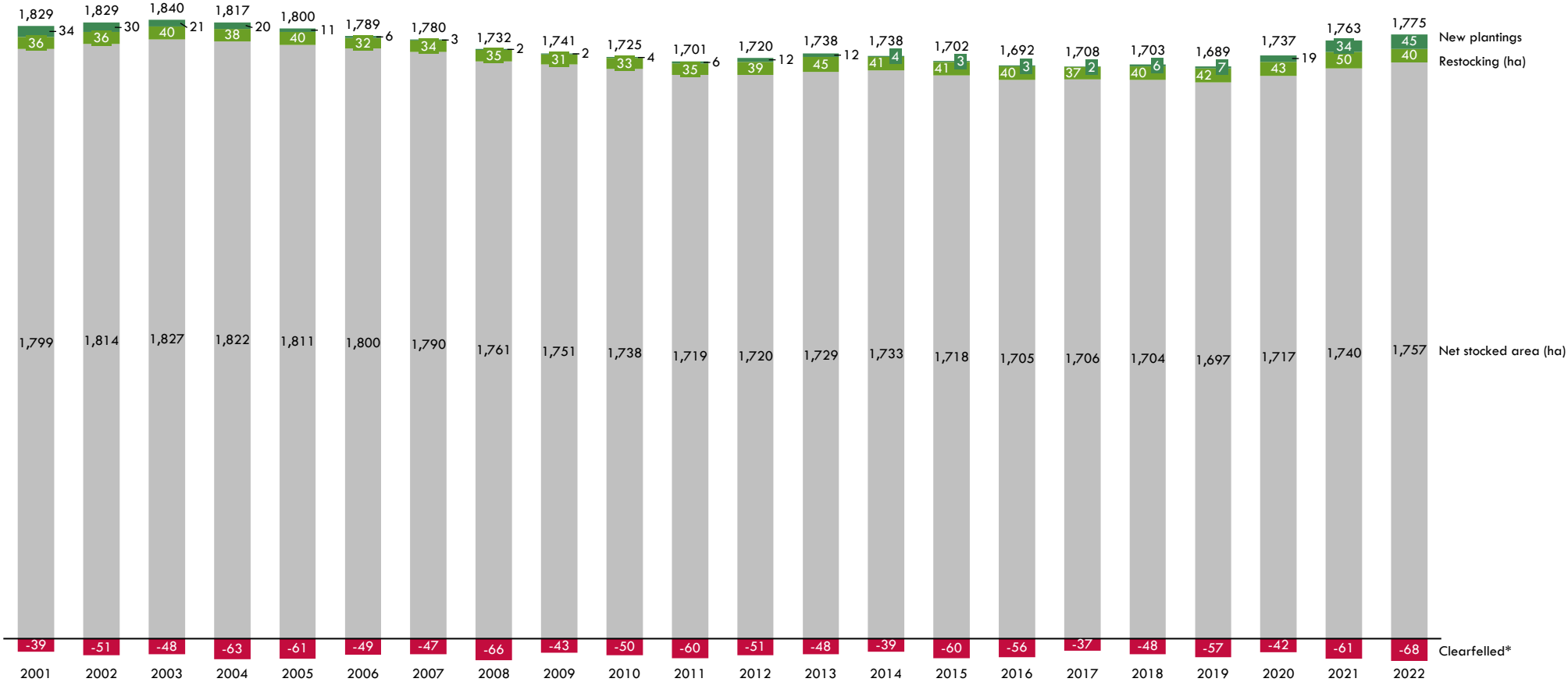


Source: MPI; NZFOA; Coriolis analysis

Net area in plantation forestry was in decline through 2019; recent growth in clear-felling, restocking and new plantings

ANNUAL IN-YEAR MOVEMENT IN NEW ZEALAND FOREST AREA

Ha; 000; 2001-2022

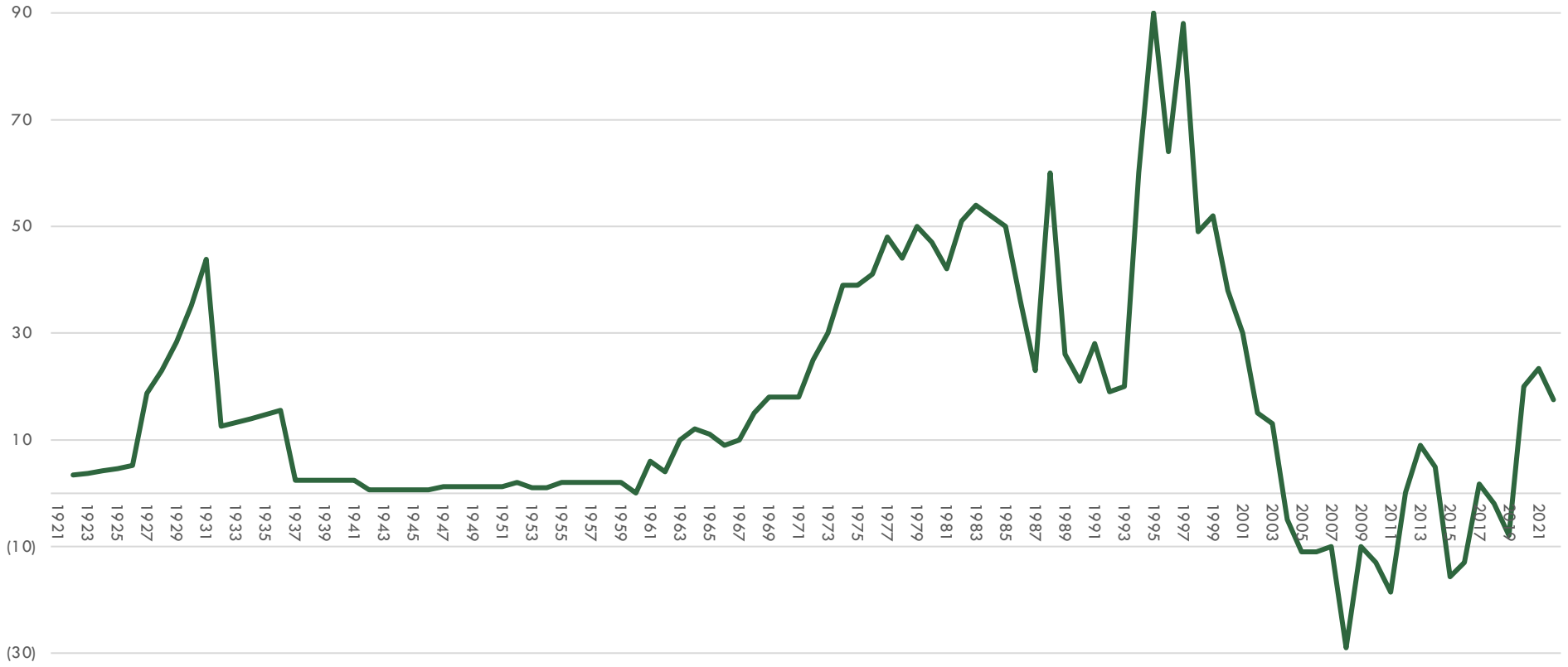


** Uses apparent or implied; NOTE: Source: MPI; NZFOA; Coriolis analysis and estimates*

After a long period of harvesting greater than replanting, there have been three years of net area gains

ANNUAL NET CHANGE IN TOTAL NEW ZEALAND PLANTATION FORESTRY AREA

Ha; 000; 1921-2022

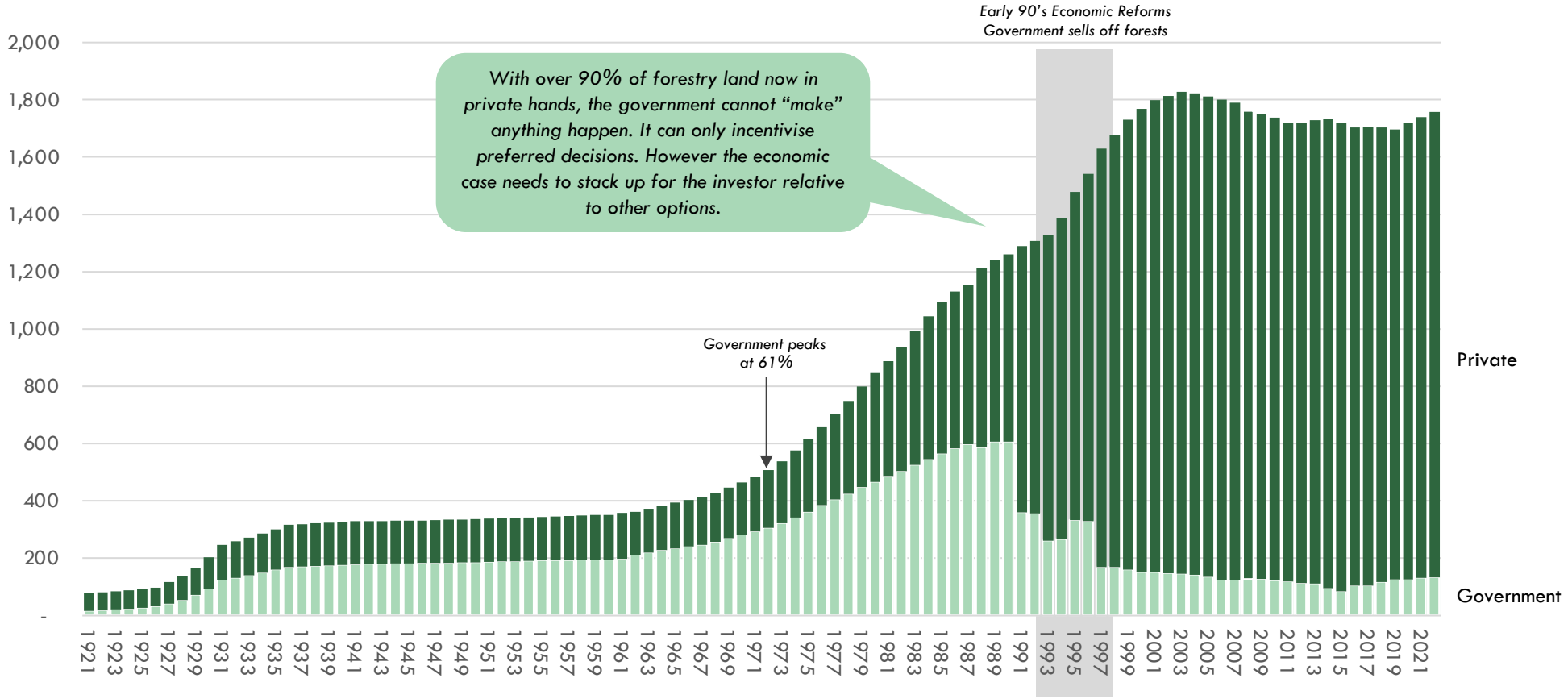


Source: MPI; Coriolis analysis

Most forestry area in New Zealand is privately owned; changes in forestry will be driven by business cases

NEW ZEALAND PLANTATION FORESTRY AREA BY OWNERSHIP

Ha; 000; 1921-2022

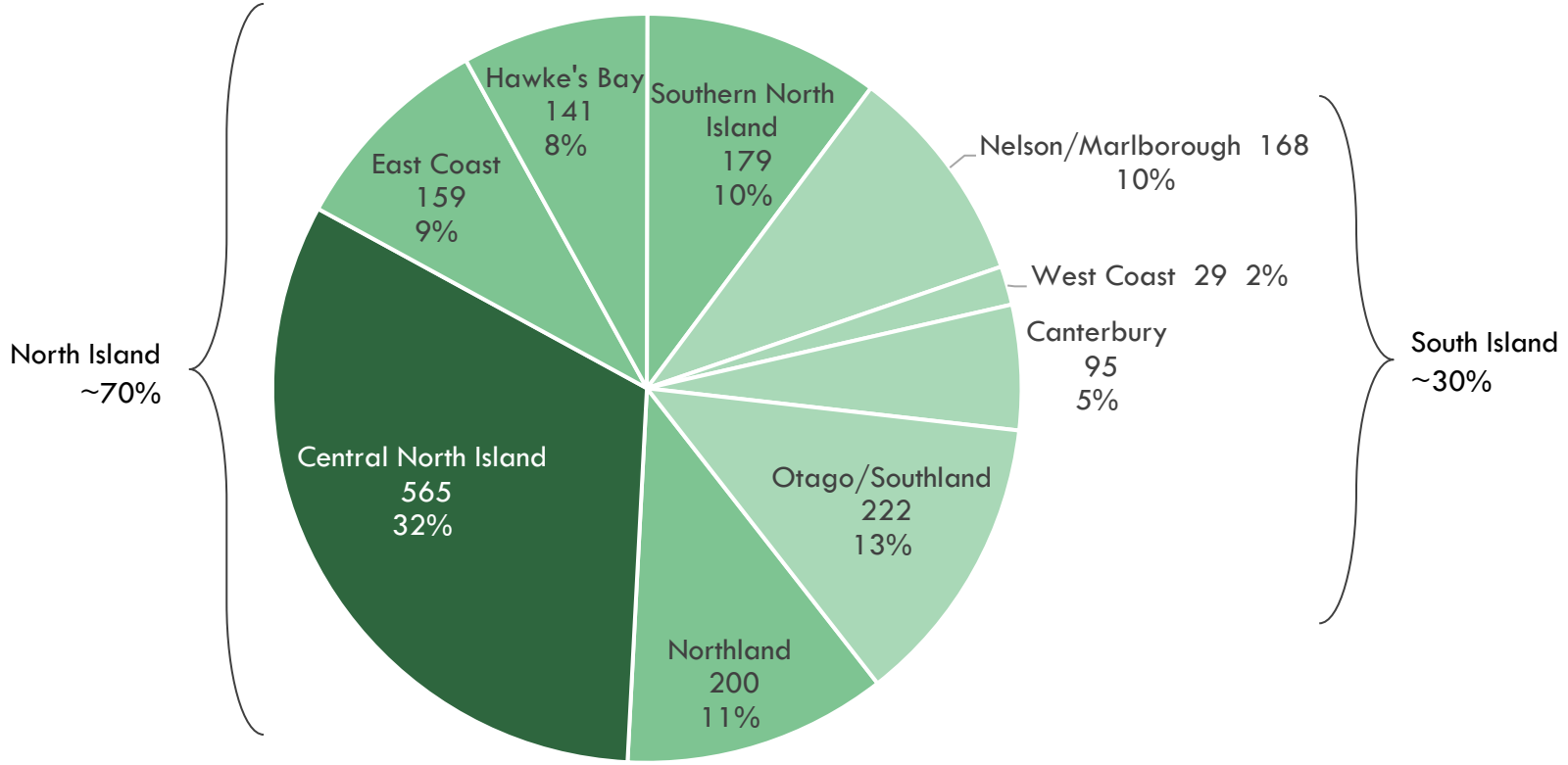


Source: MPI; Coriolis analysis

Around 70% of New Zealand plantation forestry area is in the North Island, with the Central N.I. alone accounting for a third

NEW ZEALAND REGIONAL STANDING VOLUME

Ha; 000; YE 31 March; 2022



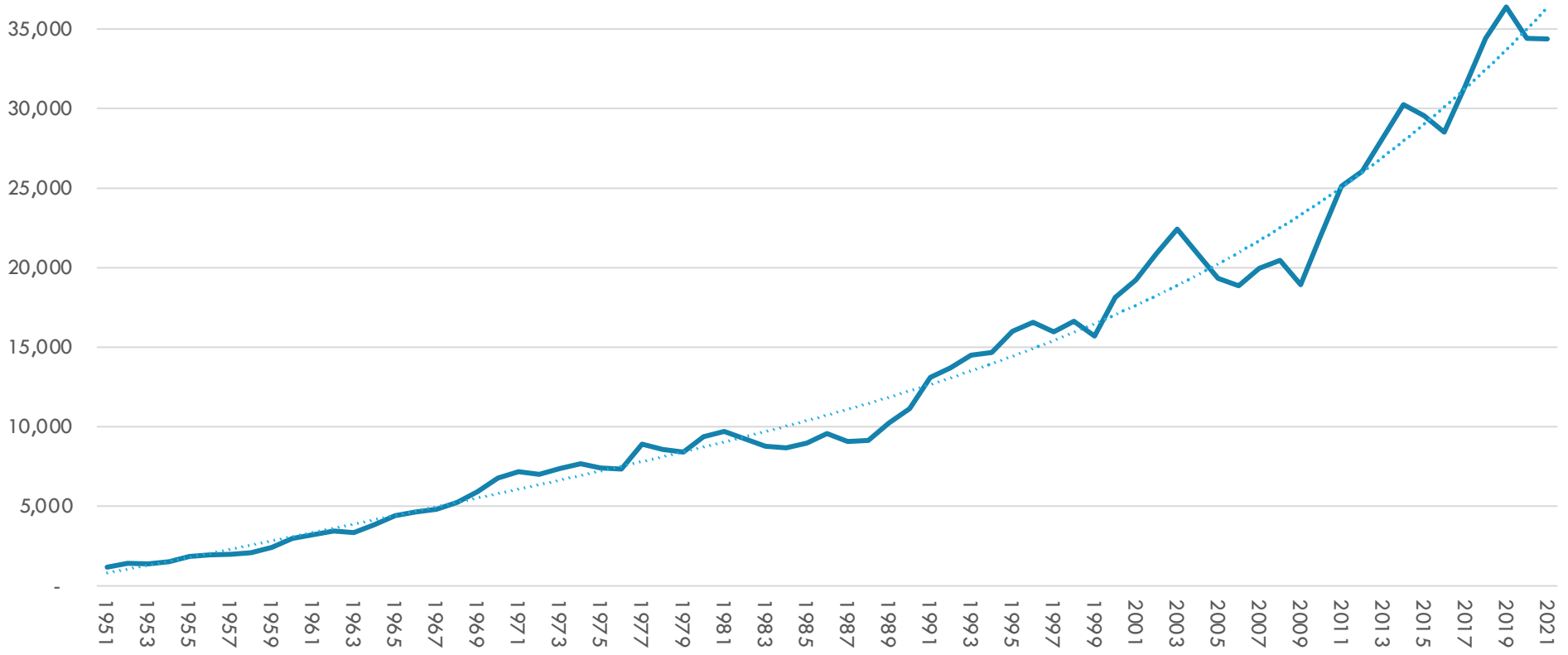
TOTAL = 1,757 (000) hectares

Source: MPI NEFD 2020; Coriolis analysis

New Zealand has seen long term growth in harvested volumes of wood

ESTIMATED ROUNDWOOD REMOVALS FROM NEW ZEALAND FORESTS

M^3; 000; YE 31 March; 1951-2021

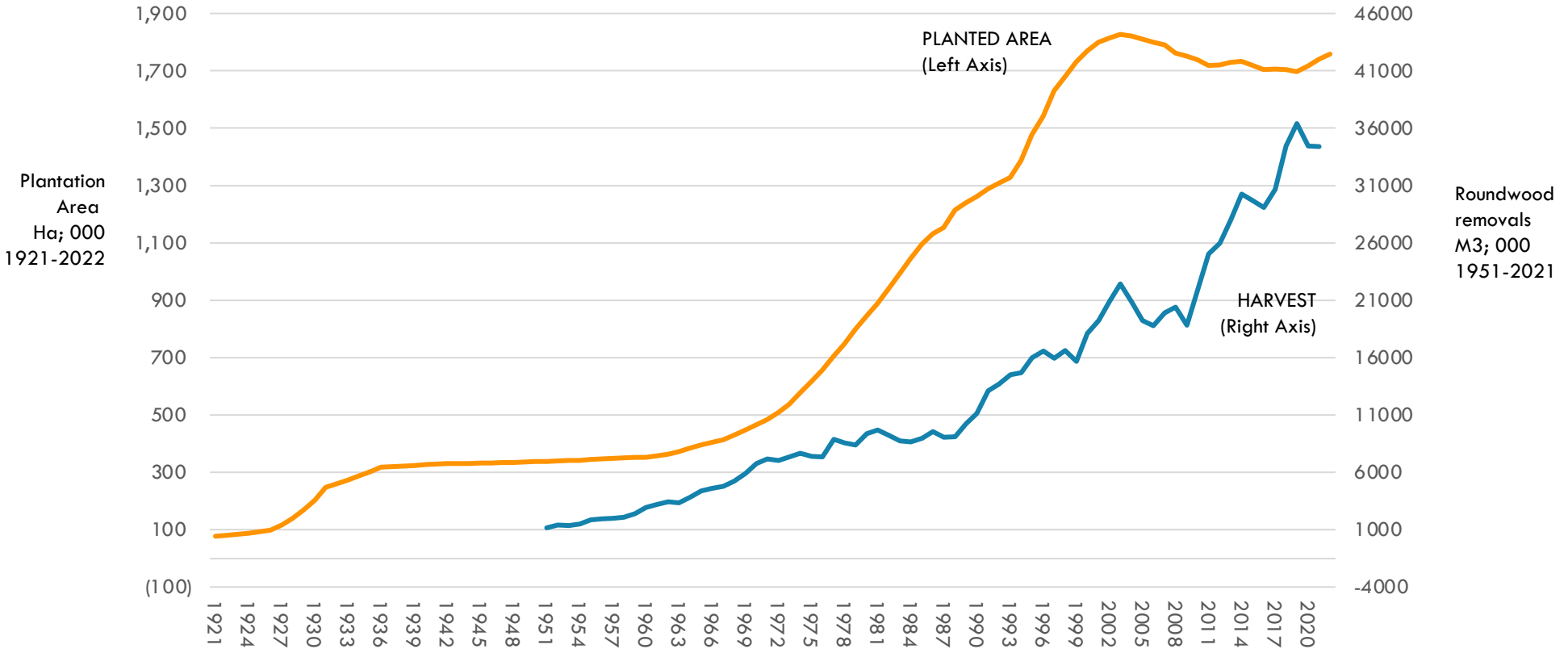


Source: MPI; NZFOA; Coriolis analysis

However, planting decisions made ~30 years ago mean that future harvest volumes will stabilise and then begin to decline

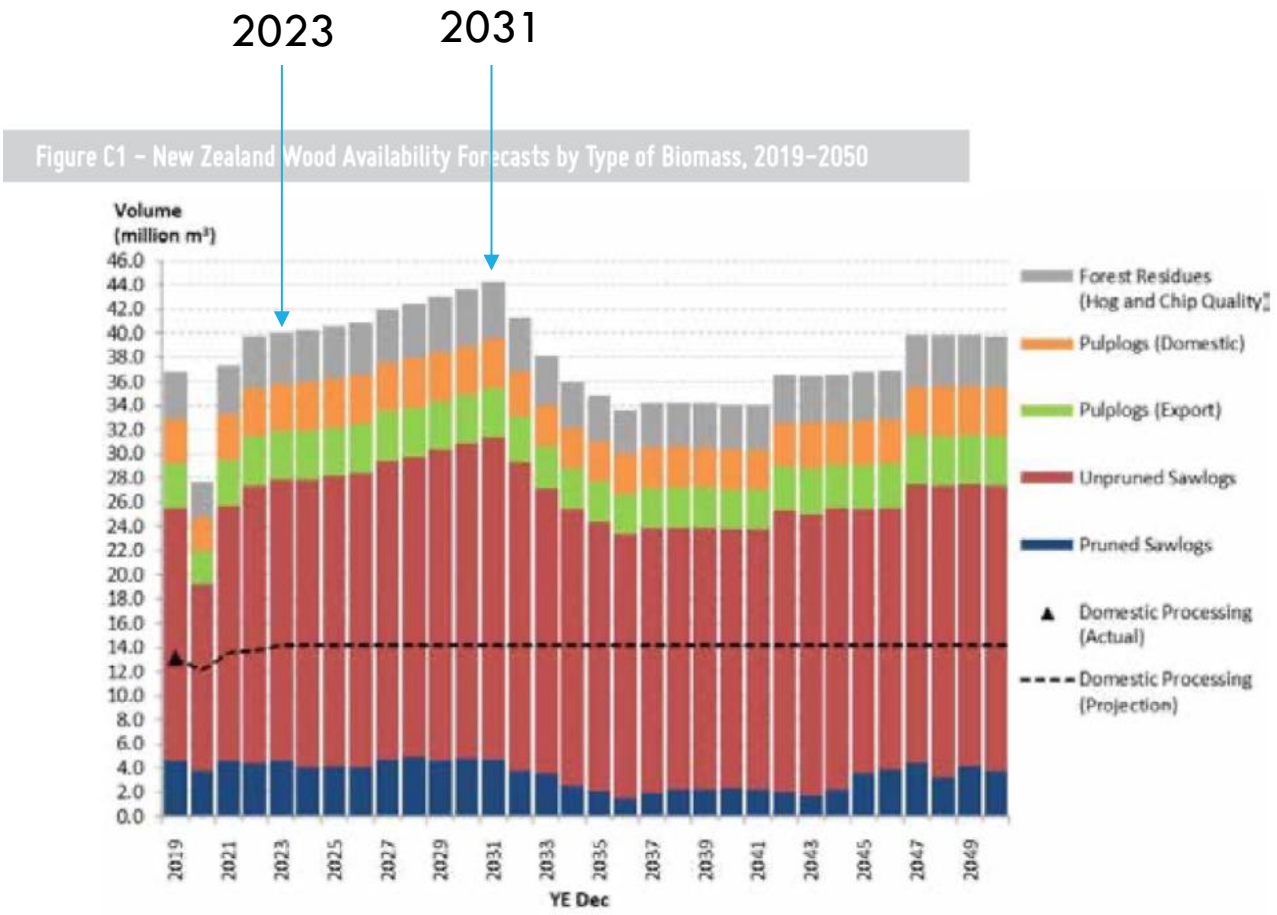
FORESTRY AREA VS. ROUNDWOOD REMOVALS

Ha; 000; 1921-2022; M^3; 000; YE 31 March; 1951-2021



Source: MPI; NZFOA; Coriolis analysis

BioPacific's recent wood availability model forecasts an additional eight years of volume growth followed by a sharp decline

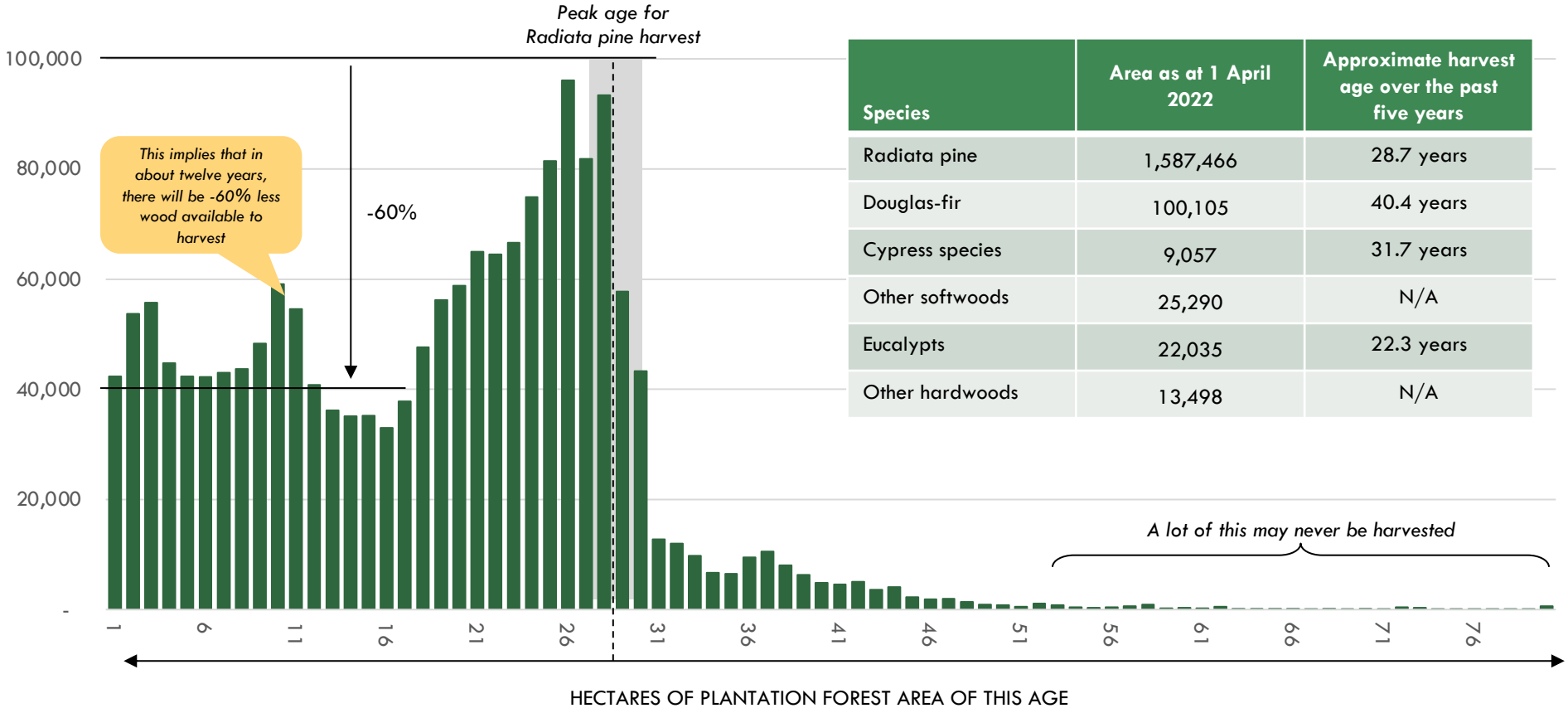


Source: BioPacific Partners Wood Fibre Future Stage I Report (p88) (APPENDIX C: WOOD AVAILABILITY MODEL)

New Zealand trees are grown and harvested on clear cycles; the "wall of wood" bulge will pass through over the next 10+ years

NEW ZEALAND FOREST AREA BY ANNUAL AGE CLASS

Ha; as at 1 April 2022



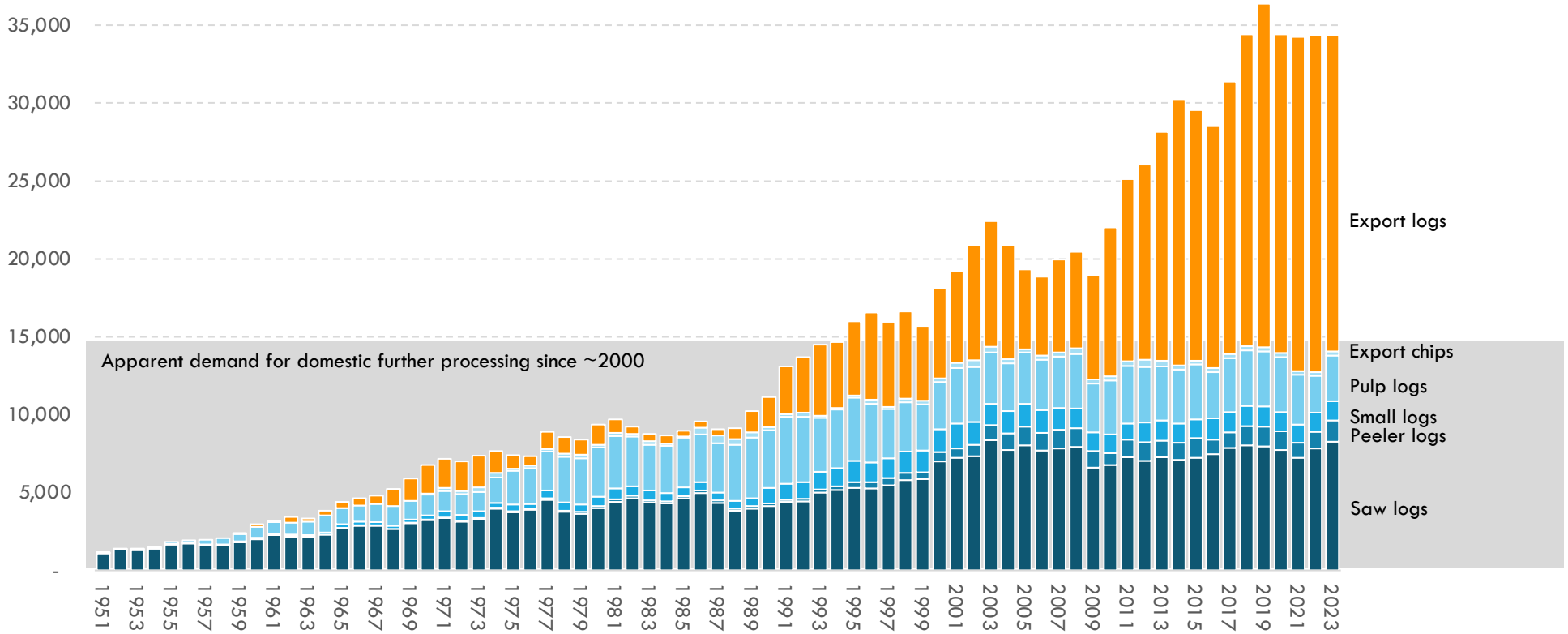
Species	Area as at 1 April 2022	Approximate harvest age over the past five years
Radiata pine	1,587,466	28.7 years
Douglas-fir	100,105	40.4 years
Cypress species	9,057	31.7 years
Other softwoods	25,290	N/A
Eucalypts	22,035	22.3 years
Other hardwoods	13,498	N/A

Source: MPI NEFD 2022; Coriolis analysis

Since around 2000, effectively all growth in harvest volumes has been going to export markets as whole logs

ESTIMATED ROUNDWOOD REMOVALS FROM NEW ZEALAND FORESTS

*M^3; 000; YE 31 March; 1951-2023**

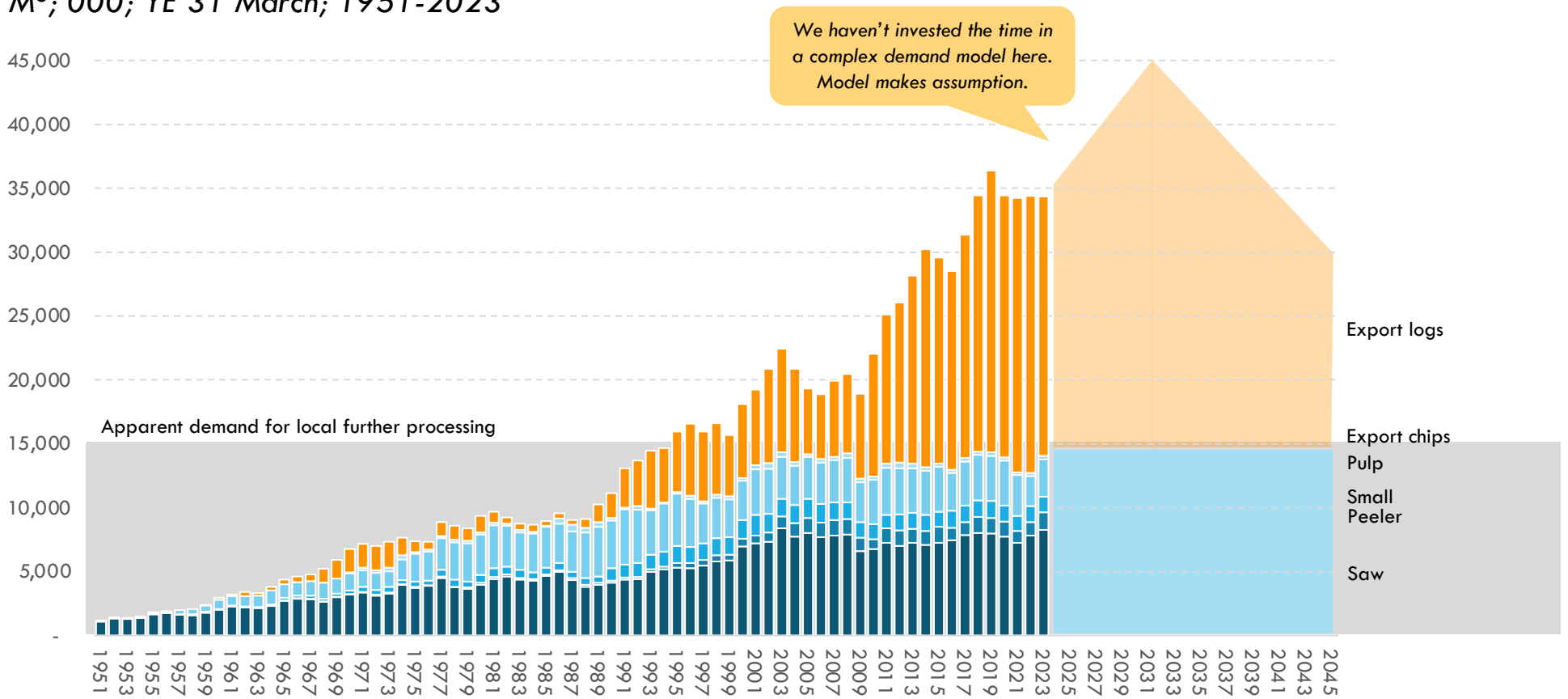


* *2023 used Dec YE 2022 (until latest data is available); Source: MPI; NZFOA; Coriolis analysis*

The export log market will likely act as the "shock absorber" for harvest volumes, with domestic further processing stable

ESTIMATED ROUNDWOOD REMOVALS FROM NEW ZEALAND FORESTS

M^3; 000; YE 31 March; 1951-2023



Source: MPI; NZFOA; Coriolis analysis

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PAGES 206-241

New Zealand arable crop (and pasture) systems are focused on animal feed; human targeted arable crop area declining almost continuously

New Zealand is declining in arable crops

- The New Zealand arable crop industry has a complex and well developed ecosystem with all key capabilities in place across the supply chain
- Despite high yields and years of experience, New Zealand's arable crop industry struggles to compete with dairy and lifestyle blocks for landuse
- New Zealand does not currently have all the capabilities required to change the situation in arable crops; improvements are needed in numerous areas
- Competitiveness is calculated at the border; New Zealand is not currently competitive in major arable crops

A small and falling amount of land is used to produce a reasonable amount of output

- Arable crops account for 1.4% of New Zealand land use
- Arable (or broadacre) crops encompass a wide range of plants with multiple subcategories

The New Zealand arable land and arable crop industry is currently focused on feeding animals

- Very little of New Zealand's arable and pastureland is currently used to produce grains, oilseeds or non-grass fodder crops; most produces grass
- Most (82%) arable crops grown in New Zealand are fed to animals; only 18% goes into human-focused chains
- The area in human-focused arable crops has been declining
  - New Zealand area in key arable grains is trending down long term
- The area in animal-focused arable crops has been increasing
- New Zealand has seen consolidation in traditional grain growing and an explosion of "other crop"* growing

The New Zealand arable crop industry has a complex and well developed ecosystem with all key capabilities in place across the supply chain

NEW ZEALAND CAPABILITIES DRIVEN SUPPLY CHAIN: ARABLE CROPS

SELECT FIRMS

VEHICLES/MACHINERY

John Deere, CNH Industrial, Massey Ferguson, AGCO, Kubota, Claas, Mahindra, Horsch, Gascon, Merlo, Pöttinger, Alpego, Fendt, Yamaha, Yanmar, Toyota

FUEL & LUBRICANTS

Gull, Allied Petroleum, npd, RD Petroleum, McFall Fuel, SHF

FARM SUPPLIES

New Zealand Farm Source, PGG Wrightson, Farmlands, Horticentre Group, Turton Farm Supplies, ATS, Rural

PLANT GENETICS

Corteva agriscience, Bayer, Sinochem Syngenta, BASF, Barenbrug, Pacific Seeds, RAGT, Pioneer, PGG Wrightson Seeds (MDLF, Corson Maize, Agricom)

PESTICIDES & HERBICIDES

Bayer, Sinochem Syngenta, BASF, Corteva agriscience, Adama, FMC, Sumitomo Chemical, Nufarm, American Vanguard, UPL, Mitsubishi Chemical Group

LAND IN ARABLE CROPS

0.3m hectares

PEOPLE IN ARABLE FARMING

~500 specialised grain farmers
Total growers #s unclear

FERTILISER

Ballance, Ravensdown

FENCING

Summit Steel & Wire, Gallagher, Goldpine

200+ sawmills

FARMER ORGANISATIONS

Federated Farmers of New Zealand, FAR

FEED PROCESSING

Tegel, Ingham's, MainFeeds, NRM Feed to Succeed, Weston Milling Stockfeed, Taranaki Feeds, Sharpes Farm Feeds, Agrifeeds, Nutrinza, Golden Grain, Advanced Feed, SF Supa Feeds

HUMAN GRAIN PROCESSING

Champion, GrainCorp, Malteurop, GWF George Weston Foods Limited, Allied Pinnacle, Harraways Oats, goodman fielder, Griffin's Food Company, New Zealand Starch, Farmers Mill, Hubbards, Sanitarium

SHIPPING

Maersk Line, Hamburg Süd, MSC, CMA CGM, Hapag-Lloyd, Evergreen, Cosco Shipping, Yang Ming

LOGISTICS

CODA, Mainfreight

INDUSTRY ORGS.

NZGSTA, AFIC Arable Food Industry Council, nzfma, Baking New Zealand, FG:C New Zealand Food & Grocery Council

Source: Coriolis

Despite high yields and years of experience, New Zealand's arable crop industry struggles to compete with dairy and lifestyle blocks for landuse

SWOT ANALYSIS: NEW ZEALAND ARABLE CROPS

STRENGTHS	WEAKNESSES
- Counter seasonal to Northern Hemisphere in a narrow climatic window only shared by 4-5 competitors (Chile, Argentina, South Africa, Southern Brazil and Australia) - Historic strength of grains/crops industry, particularly in Canterbury - Strong biosecurity; free from many diseases and pests - High yields per hectare relative to peers, particularly Australia - Unsubsidised industry competing in world markets and at world prices - Industry consolidating into fewer, larger operations at scale - Supportive, cohesive industry structure - Pockets of strength in select specialty crops and seeds/genetics - Proximity to Australia and fast growing Asian markets	- Difficult to compete with dairy for prime arable land due to lower returns in most regions - Higher cost structure than larger competitors due to numerous inefficiencies and a lack of scale across all stages of the supply chain (e.g. versus Western Australia with CBH) - Still too many smaller fields and farms; peer group benchmarking strongly suggests NZ needs fewer, larger farms - Falling planted area across all three major traditional crops (wheat, oats and barley) - Small scale in many niche and emerging sectors limits availability of key agrichemicals - The size of Italy with the population of Singapore; lack scale in grains across most regions - Labour challenges - High internal domestic transport costs; often cheaper to ship to Auckland from Sydney than Christchurch
OPPORTUNITIES	**THREATS/ISSUES/CHALLENGES/RISKS**
- Series of recent crises, including COVID-19, War in Ukraine and ongoing price inflation changing attitudes and opinions of key buyers of imported grains, oilseeds and other arable crops - New Zealand animal protein production systems quietly needing increasing quantities of feed - Aging baby boomers focusing on healthy living & eating for illness prevention - Growing hype and investment in plant-based meat and dairy analogues - Growth of nutraceuticals and functional foods; fruits as "superfoods" (e.g. hemp) - Continued work on FTAs to develop tariff free markets (e.g. ASEAN); especially focussing on the high volume, high impact products and markets - Growing demand for protein in developed markets - Continued technological innovation and management improvement leading to increased yields	- Ongoing price movements - Industry currently shrinking/struggling - Lifestyle blocks consuming huge amounts of land around population centres - Emissions Trading Scheme and carbon forestry - Disease outbreaks - Changing climatic conditions impact production rates - Larger ships and larger grain specific ports driving down cost of imports

New Zealand does not currently have all the capabilities required to change the situation in arable crops; improvements are needed in numerous areas

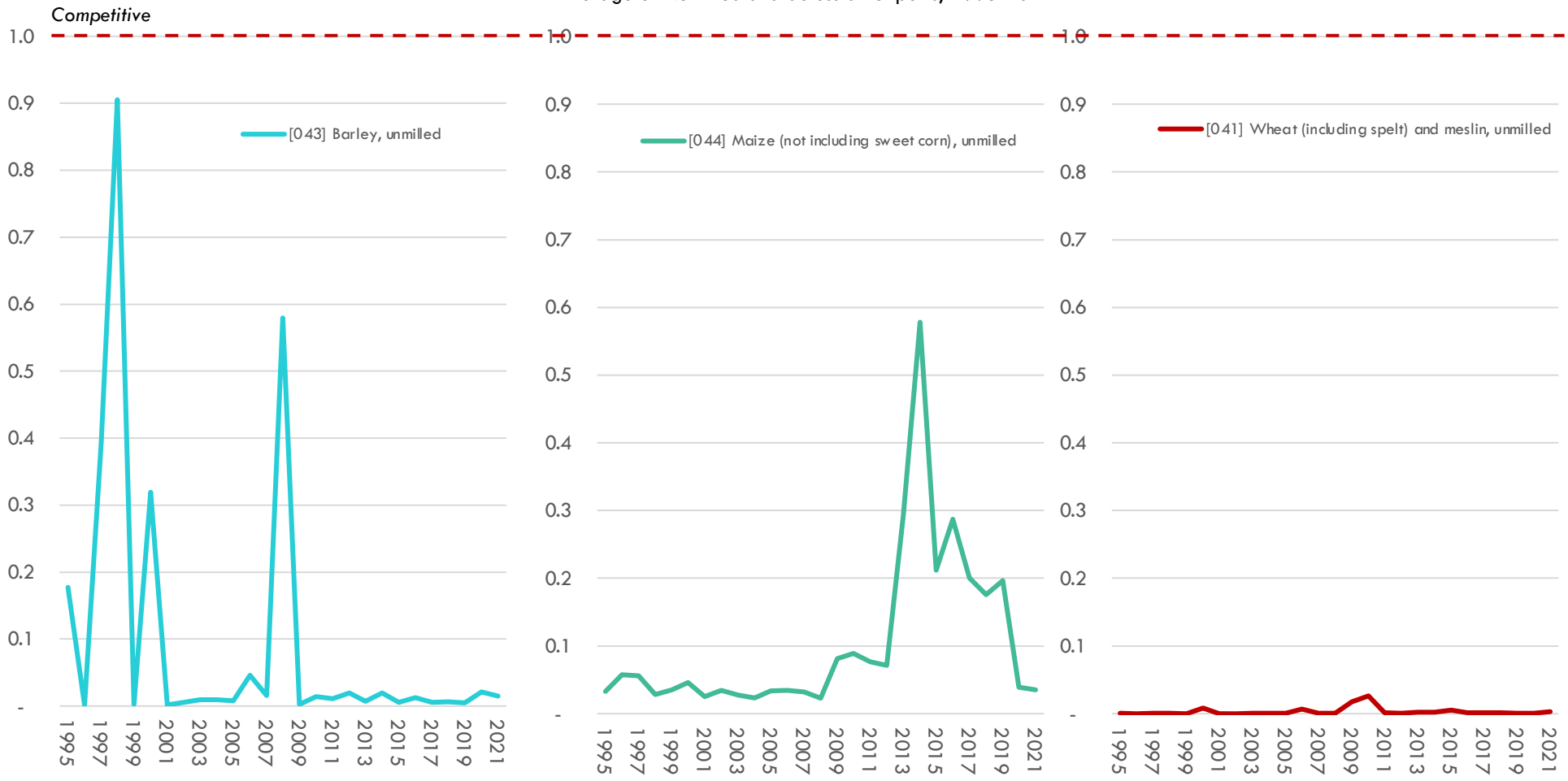
DRIVERS OF AN INTERNATIONALLY COMPETITIVE BIOECONOMY: ARABLE CROPS

Source: Coriolis

Competitiveness is calculated at the border; New Zealand is not currently competitive in major arable crops

ANNUAL REVEALED COMPARATIVE ADVANTAGE INDEX: NEW ZEALAND BY SELECT SITC3

1=Average of New Zealand across all exports; 1995-2021



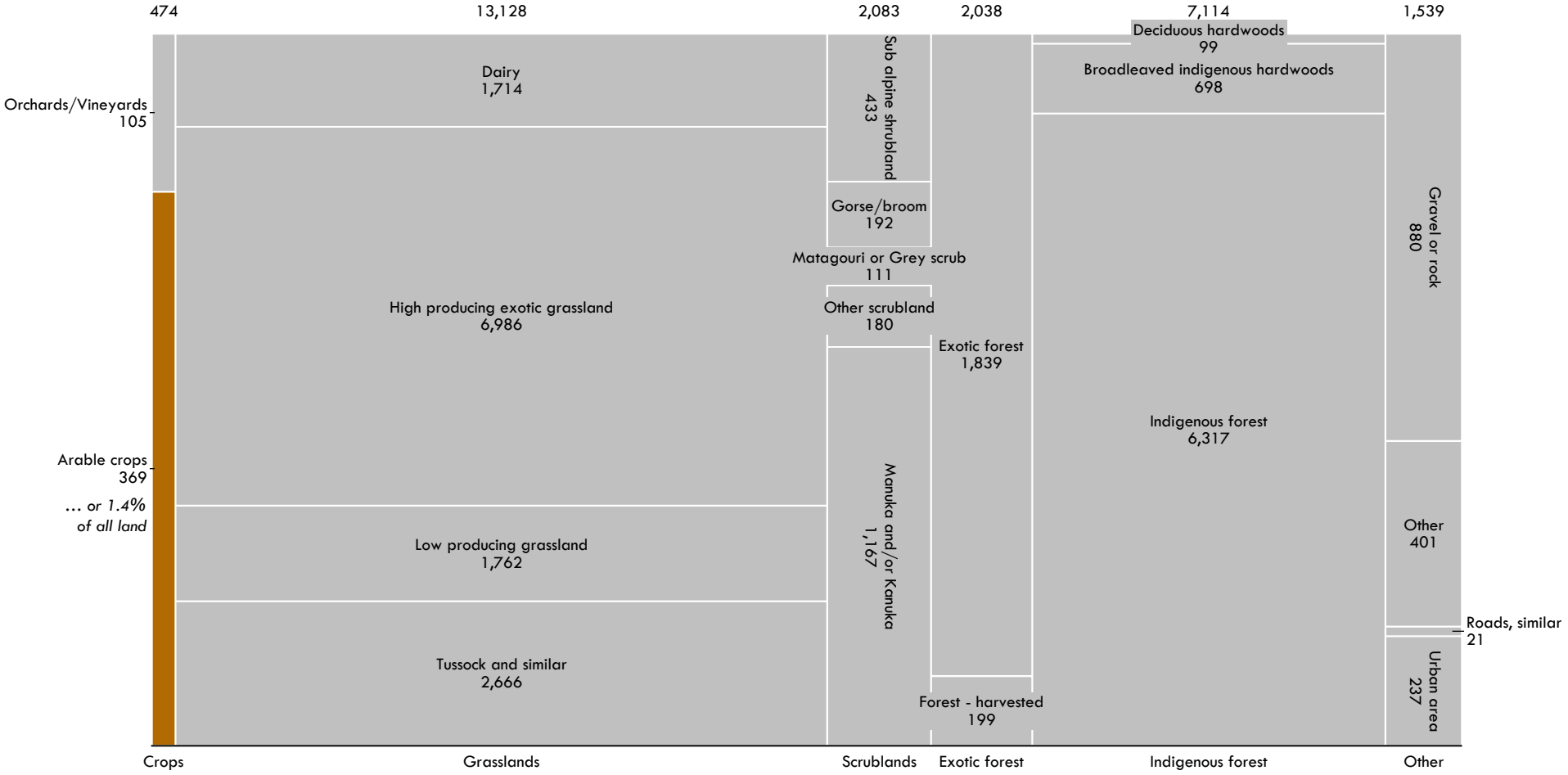
Source: UNCTAD STAT; Coriolis analysis

Arable crops account for 1.4% of New Zealand land use

NEW ZEALAND LAND AREA BY TYPE

Ha; 000; 2018 or as available

TOTAL = 26,376 (000) hectares



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

Arable (or broadacre) crops encompass a wide range of plants with multiple subcategories

WHAT ARE THE MAJOR ARABLE CROPS (INC. GRASSES) THAT ARE GROWN IN NZ?

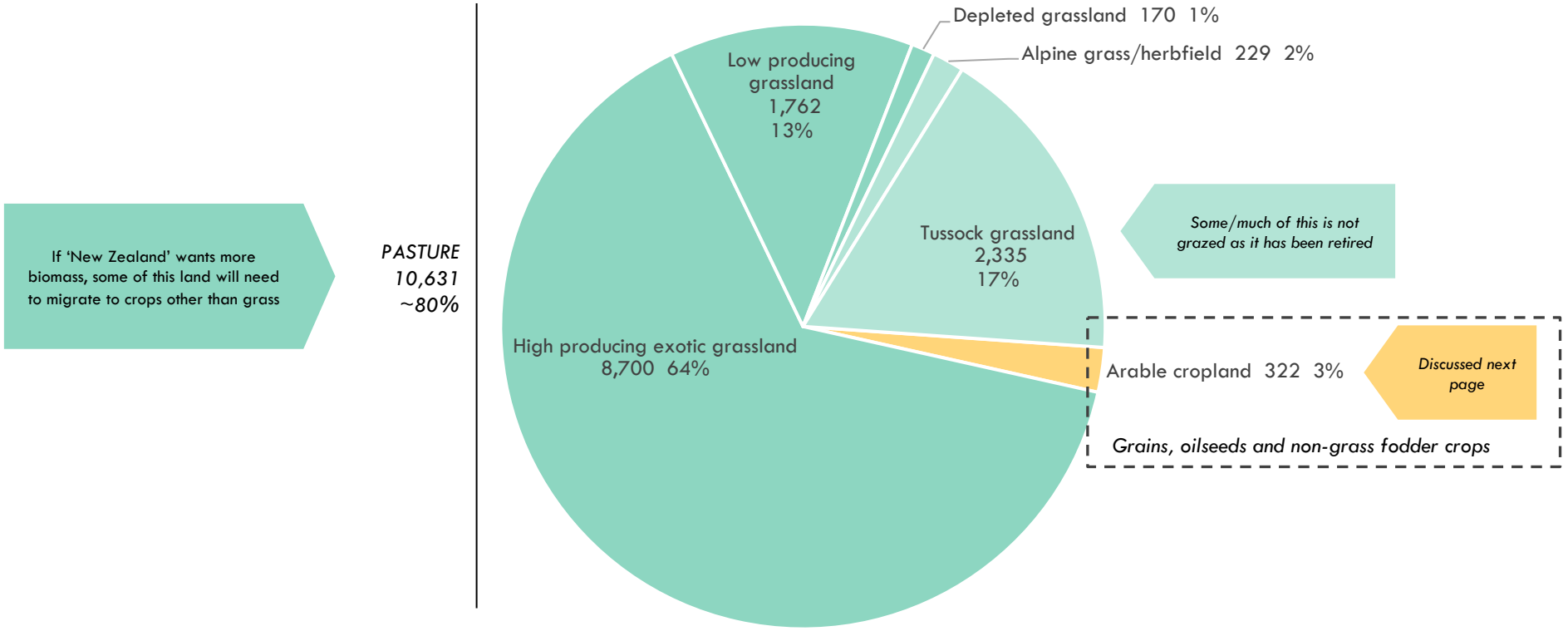
		TARGETING ANIMALS		TARGETING HUMANS BY-PRODUCT TO ANIMALS	
		On-Site/In Situ Forage Crops	**Feed/Feed Milling Crops**		
	Fibre Crops	-	-	Common flax Hemp	
ARABLE GRAINS	**Grains**	Feed Wheat Feed Barley Feed Oats Maize Silage Triticale		Milling Wheat Malting Barley Milling Oats Maize Grain	
NON-GRASS FODDER CROPS	**Oilseeds**	Rape/Canola (Brassica napus)	-	Linseed Canola (Brassica napus)	*OILCROPS*
	Root Crops	Turnip/Swede/Rutabaga Mangold/Fodder Beets	-	Potatoes Onions Carrots	*ROOT VEGETABLES*
	Legume/Pulses (Nitrogen fixing)	Alfalfa/Lucerne White/Red Clover	-	Field Peas & Beans (various) Lentils	*FIELD PEAS/ BEANS/PULSES*
PASTURE *Not considered a 'crop' as such in NZ unless harvested by humans as hay, etc.*	**Grasses**	Ryegrass (Lolium sp.) Fescue (Festuca sp.) Browntop (Agrostis capillaris) Chicory (Cichorium intybus) Plantain (Plantago lanceolata) Various other grasses Tussock or Danthonia	-	-	

Arable crops are also known as broadacre crops. The definition is clear in the middle but can vary at the edges. We are leaving out squash and pumpkin, though these can be fed to animals as fodder. There are numerous other smaller arable crops grown in New Zealand (e.g. mustard, quinoa).

Very little of New Zealand's arable and pastureland is currently used to produce grains, oilseeds or non-grass fodder crops; most produces grass

NEW ZEALAND ARABLE CROP & PASTURELAND AREA BY TYPE

Ha; 000; 2018 or as available



TOTAL = 13,564 hectares of arable crops and pasture (000)

Source: SNZ/MftE land use data; Coriolis classification and analysis

Most (82%) arable crops grown in New Zealand are fed to animals; only 18% goes into human-focused chains

NEW ZEALAND ARABLE CROP & PASTURELAND AREA BY TYPE

Ha; 000; 2022 or as available

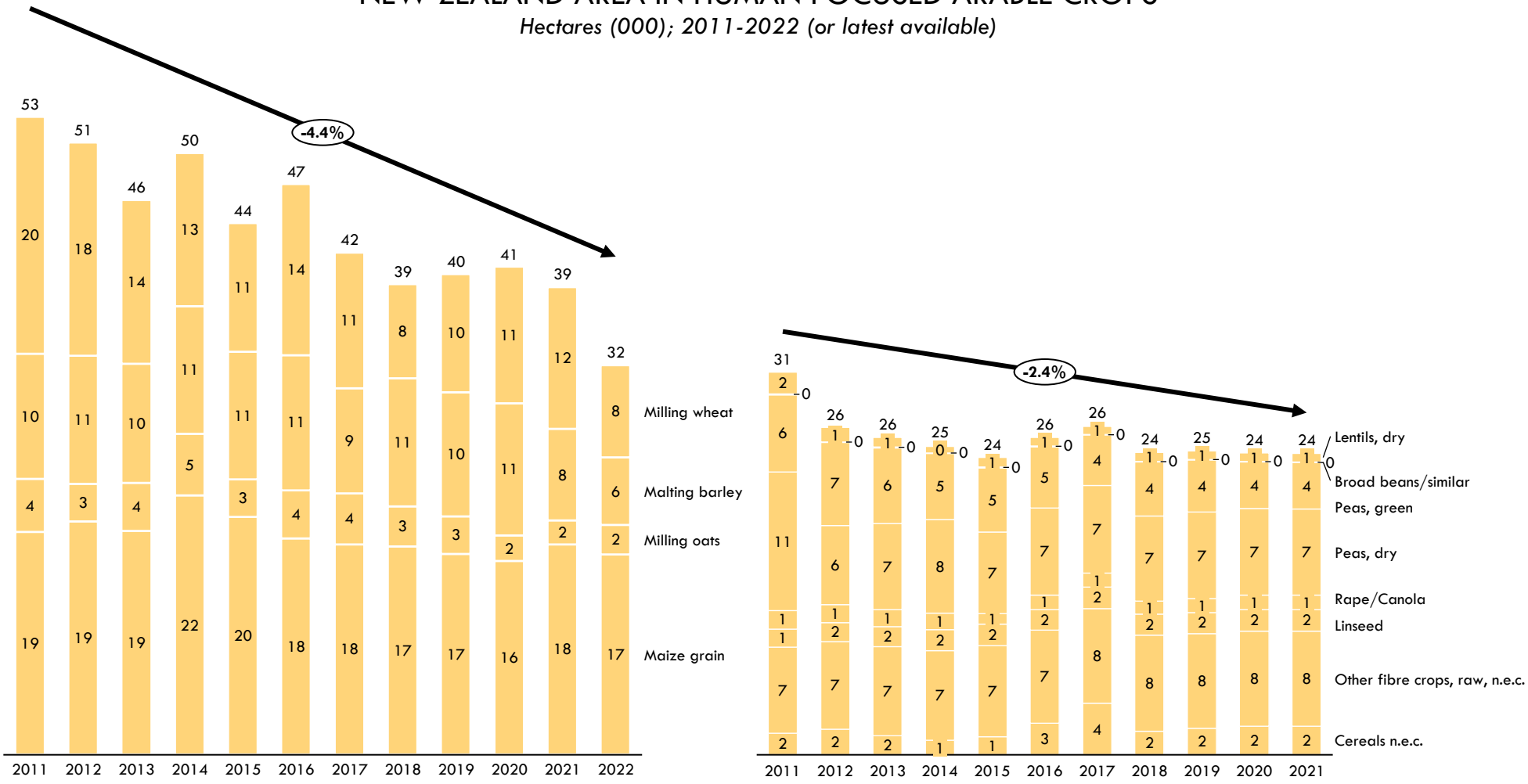
TOTAL = 322 (000) hectares of arable crops

Note: Fodder is calculated as remainder of (MfE short-rotation cropland – reported area in vegetables, root crops and arable crops); Source: SNZ/MfE land use data; FAR Arable Industry Marketing Initiative; UN FAOStat (itself from MPI); Coriolis classification and analysis

The area in human-focused arable crops has been declining

NEW ZEALAND AREA IN HUMAN FOCUSED ARABLE CROPS

Hectares (000); 2011-2022 (or latest available)



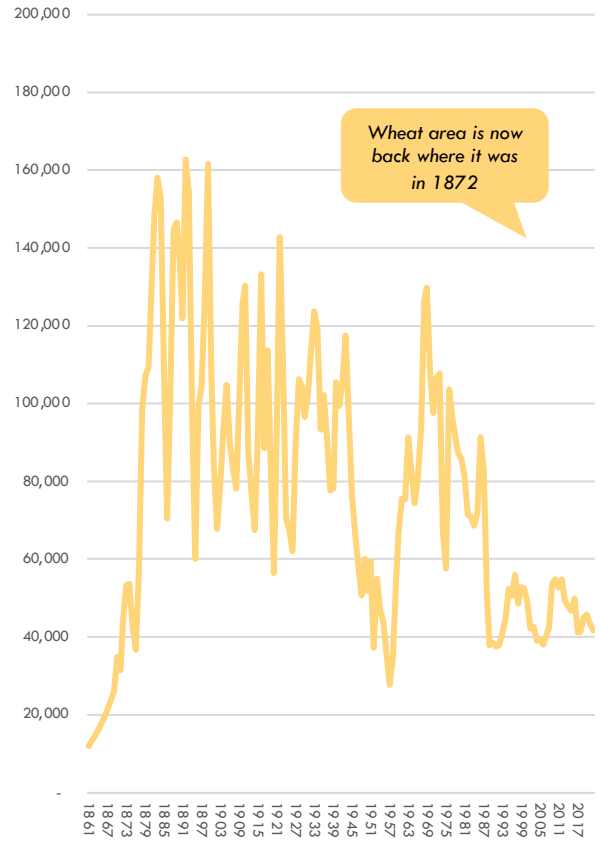
Source: SNZ/MftE land use data; FAR Arable Industry Marketing Initiative; UN FAOStat (itself from MPI); Coriolis classification and analysis

New Zealand area in key arable grains is trending down long term

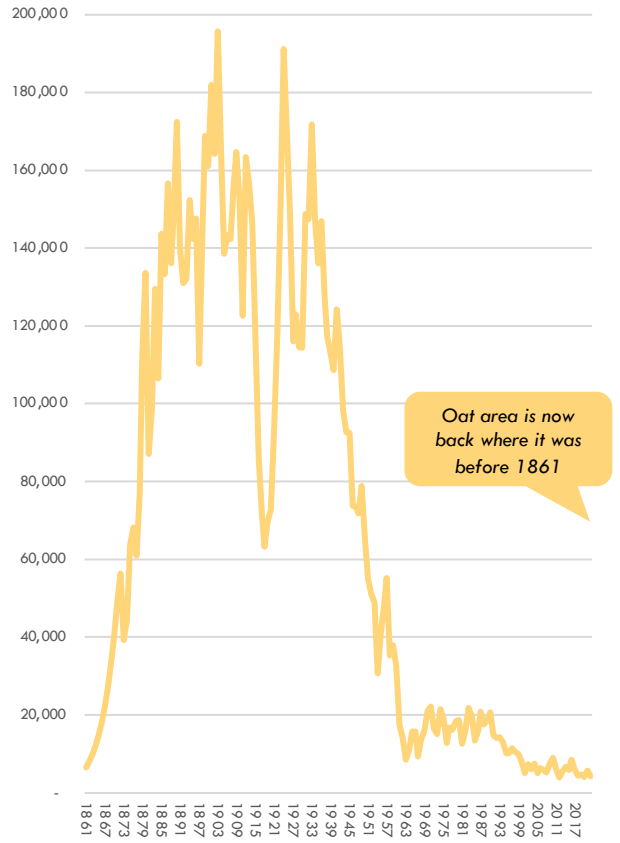
NEW ZEALAND AREA IN SELECT CROPS: TOTAL AS PUBLISHED

Hectares; 1861-2022 (or latest available)

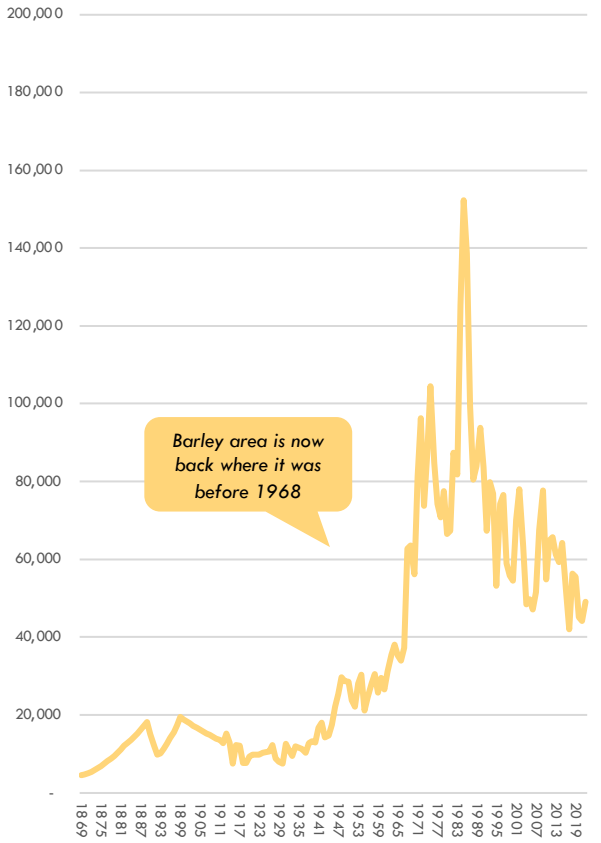
WHEAT



OATS



BARLEY

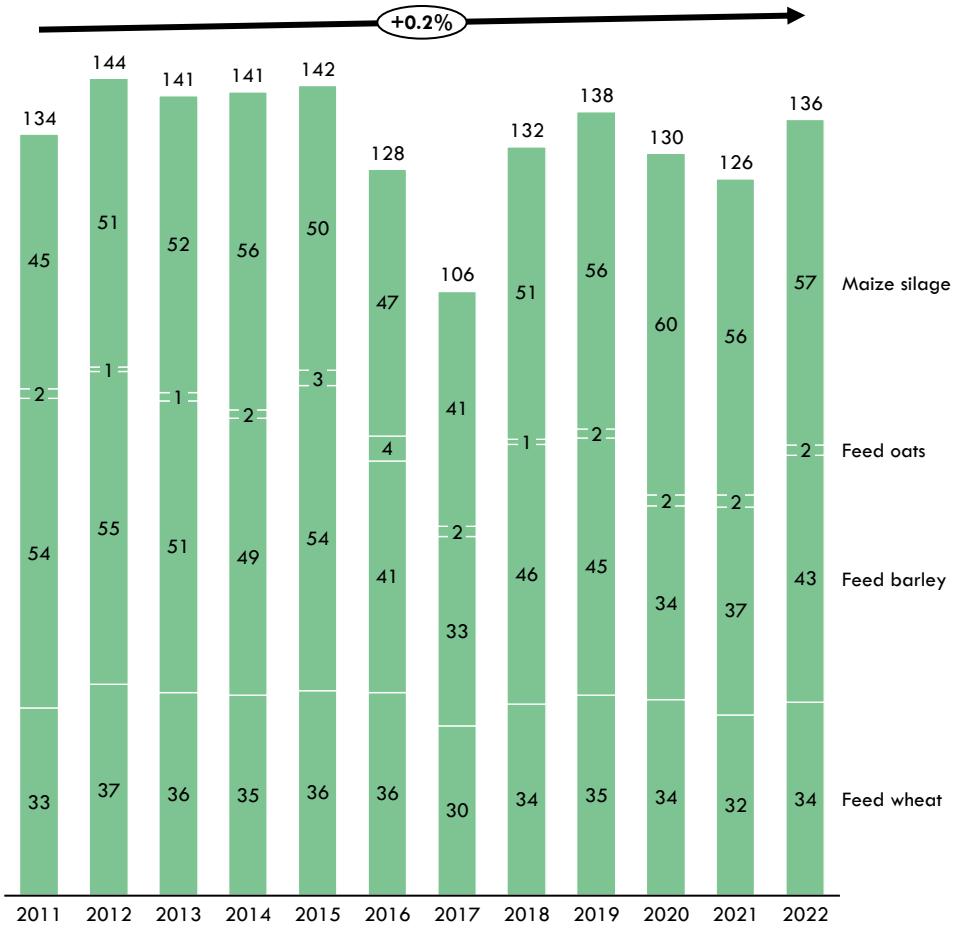


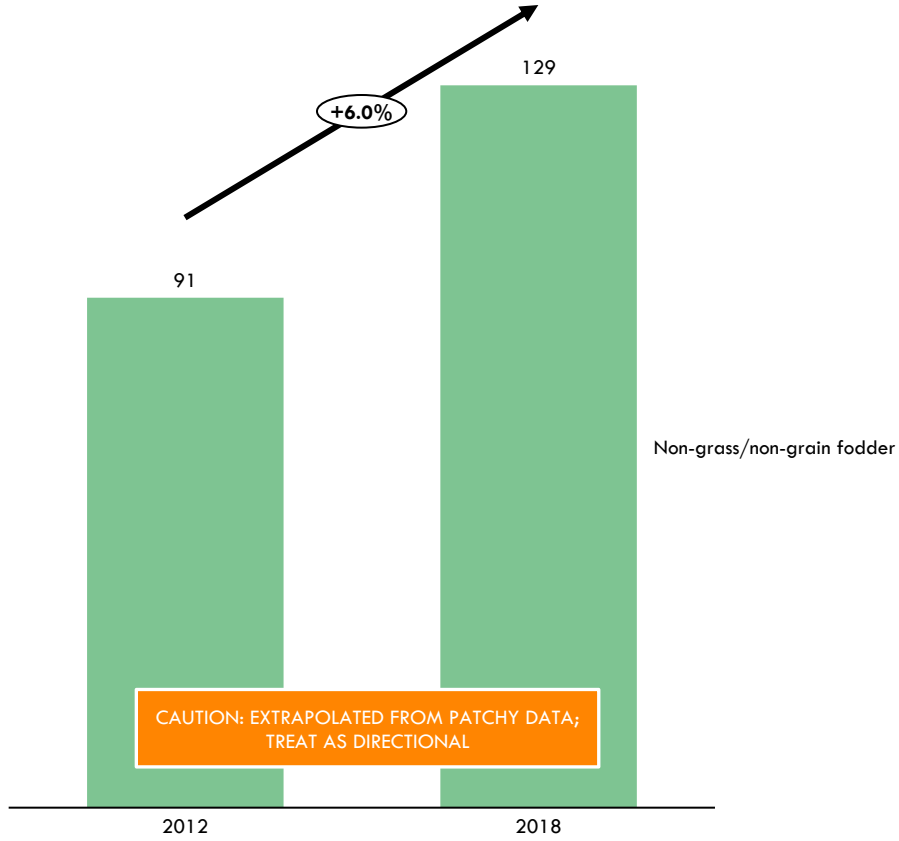
Source: FAR Arable Industry Marketing Initiative (2010-2022); UN FAOStat (itself from MPI) (1961-2009); SNZ Yearbooks (1901-1960); A Statistical Account of the Seven Colonies of Australasia (1861-1900); Coriolis classification and analysis (some missing years extrapolated)

The area in animal-focused arable crops has been increasing

NEW ZEALAND AREA IN ANIMAL FOCUSED ARABLE CROPS

Hectares (000); 2011-2022 (or latest available)



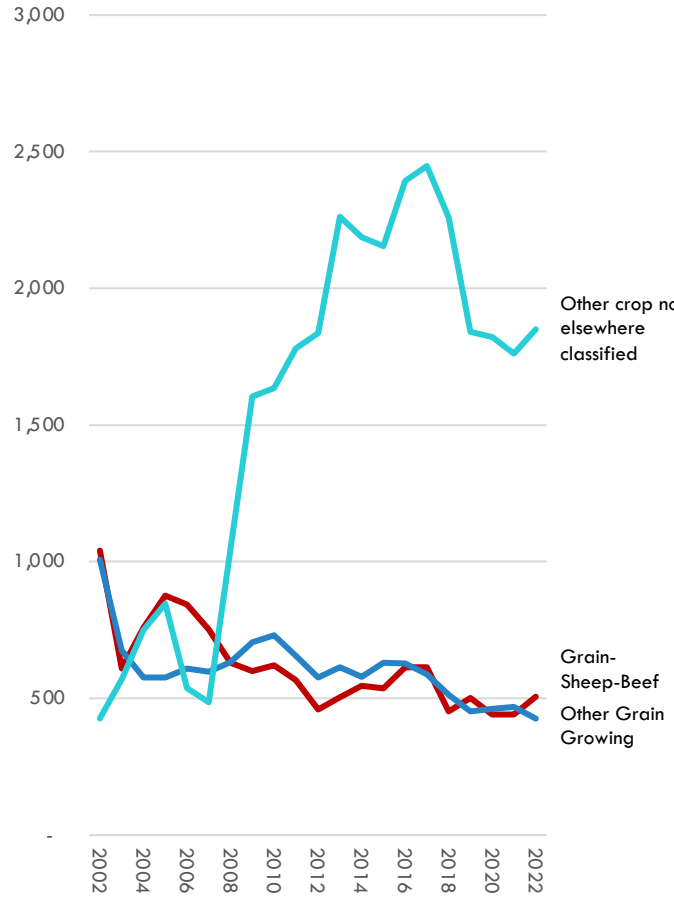


Note: Fodder is calculated as remainder of (MfE short-rotation cropland – reported area in vegetables, root crops and arable crops); Source: SNZ/MfE land use data; FAR Arable Industry Marketing Initiative; UN FAOStat (itself from MPI); Coriolis classification and analysis

New Zealand has seen consolidation in traditional grain growing and an explosion of "other crop" growing*

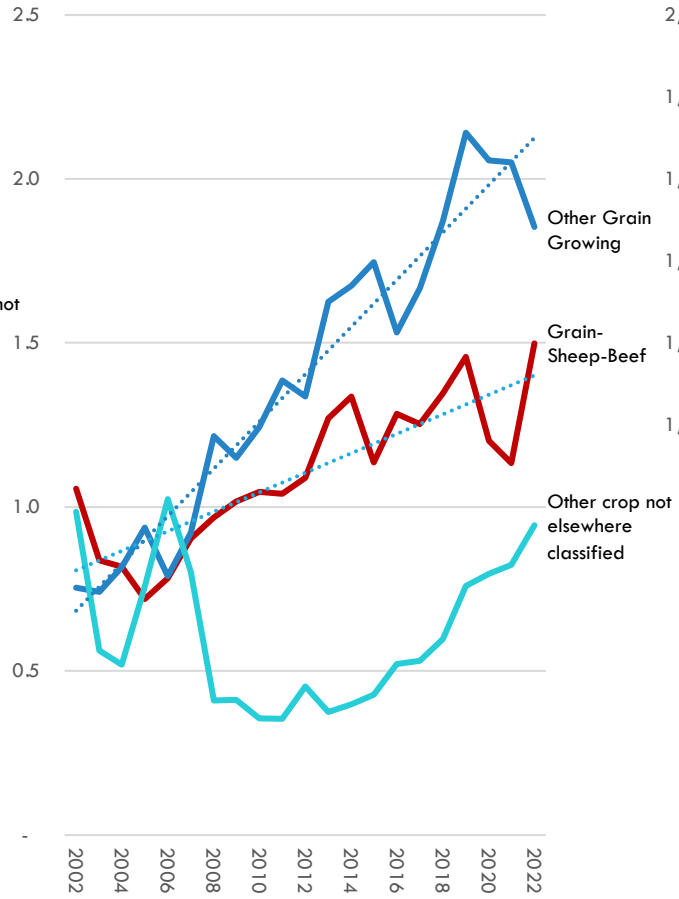
OF FARM UNITS

Geo units; 2002-2022



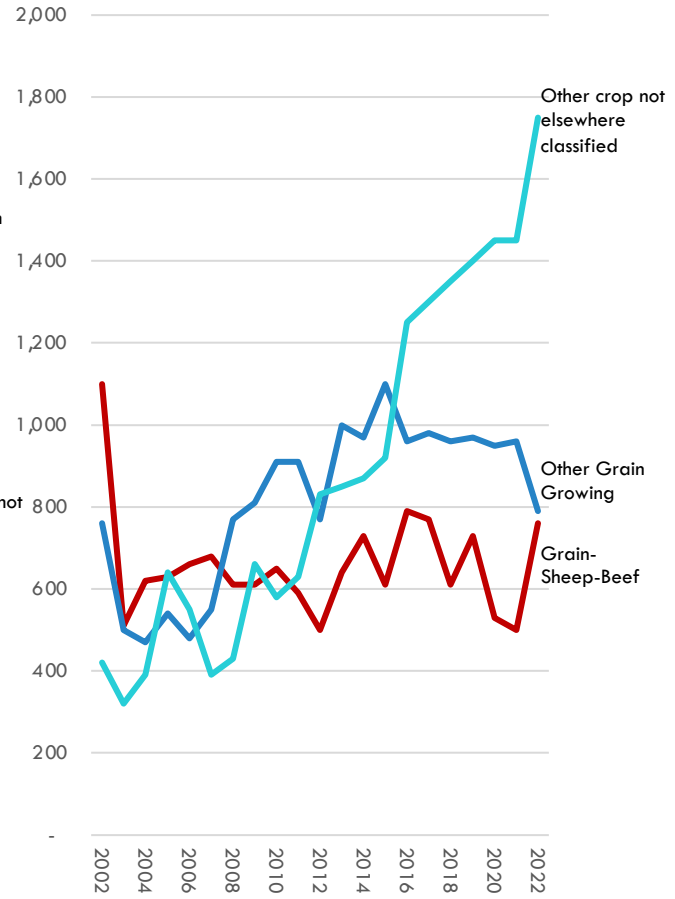
EMPLOYEES/FARM UNIT

Headcount/geo unit; 2002-2022



OF ON-FARM EMPLOYEES

Headcount; 2002-2022



** No, not that one; this is just arable crop farm types that were not considered large when the ANZSIC codes were last updated; Note: Data is PAYE employees; does not include "owner operator" farmers; Source: StatsNZ (business demographics); Coriolis analysis*

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WHY IS IT SO HARD TO DEVELOP NEW PLATFORMS IN THE BIOECONOMY?

PAGES 206-241

Wine has been a fantastic success for New Zealand

New Zealand has a globally competitive wine industry built around Marlborough Sauvignon Blanc

- The New Zealand wine grape industry has a complex and well developed ecosystem with all key capabilities in place across the supply chain
- New Zealand's wine industry has built a strong and distinct position in global markets
- New Zealand is still a "one-trick-pony" with a single, dominant regional variety (Marlborough Sauvignon Blanc) driving growth
- New Zealand has all the capabilities needed for further success in wine
- Competitiveness is calculated at the border; New Zealand has experienced growing competitiveness in wine, though this has stabilised in the past decade

New Zealand has managed to build a wine industry despite the obstacles

- The history of the New Zealand industry can be summarised as a long line of immigrants trying to build a wine industry despite all the obstacles

Wine production is polarising into two groups: large and small

- The number of wineries has stabilised in the past decade, while the number of grape growers is flat-to-declining
- New Zealand has a large and growing number of small wineries and a small and shrinking number of large wineries

Regions beyond Marlborough need to continue to work on improving and refining all aspects of their global offer

- Wineries are spread out across the country, with Marlborough (160), Central Otago (137), Hawke's Bay (107) and Auckland (98) leading
- In terms of scale economics, Marlborough is the leading region, followed by Hawke's Bay, Gisborne and Central Otago

The New Zealand wine grape industry has a complex and well developed ecosystem with all key capabilities in place across the supply chain

NEW ZEALAND CAPABILITIES DRIVEN SUPPLY CHAIN: WINE GRAPES

SELECT FIRMS

VEHICLES/MACHINERY
John Deere, New Holland Agriculture, Gregoire, Pellenc, Toyota, Collard

FUEL & LUBRICANTS
Gull, Allied Petroleum, npd, RD Petroleum, McFall Fuel, SMF

TRELLIS & FENCING
Summit Steel & Wire, Gallagher, Goldpine
200+ sawmills

FARM SUPPLIES
Farmlands, PGG Wrightson, Horticentre Group, New Zealand Farm Source, WaterForce

PESTICIDES & HERBICIDES
Bayer, Nufarm, Sinochem Syngenta, BASF, Corteva Agriscience, Mitsubishi Chemical Group, Sumitomo Chemical, Adama

GRAPE GENETICS
Riversun, VNNZ, Stanmore Farm Nursery, Corban's Nurseries, Ormond Nurseries Ltd

FERTILISER
Ballance, ravensdown

LAND IN WINE GRAPES
41,603 hectares
2,101 vineyards

PEOPLE IN GRAPE GROWING & WINEMAKING
3,100 in grape growing
3,850 in winemaking
Plus seasonal labour

INDUSTRY COOP
Marlborough Grape Growers Cooperative

WINE BUSINESSES
Foley Wines, Yealands, Babich, Seifried, Allan Scott, Hunter's Marlborough, Mills Reef Winery, Amisfield, Gibbston Valley, Kono Wakatu, Mount Riley, The Wine Portfolio, Coopers Creek, Mission Estate Winery, Craggy Range, Oyster Bay, Invivo, Ata Rangi, K|R, Felton Road, Te Mata Estate, Esk Valley, Martinborough Vineyard, Neudorf, Palliser, Fromm Winery, Trinity Hill, Dog Point Vineyard, Quartz Reef, Two Paddocks, Forrest, booster, Sileni Estates, Bannock Brae, Awatere River

CONTRACT BOTTLING
Wineworks, indevin, Kings, Soljans Estate Winery, The Bottling Company, Small-Scale Bottling

LARGER WINEMAKERS
Constellation Brands, Pernod Ricard, Cloudy Bay, Saint Clair Family Estate, Giesen, Accolade Wines, Treasury Wine Estates, Pegasus Bay, Sacred Hill, Delegat, Villa Maria

SHIPPING
Maersk Line, Hamburg Süd, msc, CMA CGM, Hapag-Lloyd, Evergreen, Cosco Shipping, Yang Ming

LOGISTICS
Mainfreight

NATIONAL & REGIONAL INDUSTRY ORGS.
New Zealand Wine, Altogether Unique., Wine Marlborough New Zealand, Wairarapa Wine Region, FGC New Zealand Food & Grocery Council, Central Otago, Hawke's Bay Wine New Zealand, Gisborne Wine, Federated Farmers of New Zealand

Source: Coriolis

New Zealand's wine industry has built a strong and distinct position in global markets, but is still a "one-trick-pony" (Marlborough Sauvignon Blanc)

SWOT ANALYSIS: NEW ZEALAND WINE INDUSTRY

STRENGTHS	WEAKNESSES
- Islands in the middle of the South Pacific that have the area of Italy, but with only the population of Singapore; therefore relatively unspoilt - Strong and growing success in premium/super-premium wine - Achieves a strong price premium for wine in key markets (similar to France) - New Zealand Sauvignon Blanc now a "must have" globally in high end foodservice and retail - Growth in market share in key markets (e.g. USA) - Innovative and quality-focused producers - Closer shipping distances to Asia compared to European competitors - Demonstrated capabilities in beverage production - Strong sustainability practices and growing consumer mesaging	- "Snow White and the Seven Dwarves" Syndrome; Marlborough Sauvignon Blanc and everything else - Large number of small producers with limited economies of scale - Many smaller producers over-dependant on cellar door and direct sales; COVID-19 impact - High debt levels of many small and medium sized producers - Highly dependant on four countries (AU, UK, USA and Canada) - Increasing exports of bulk wine - Lack strong super-premium heritage brands as demanded by brand and status conscious Asian consumers - Unlike traditional sectors, no major ($1b+) New Zealand owned champion growing and driving New Zealand brand position in beer, wine or other beverages - Limited culture of super-premium branding or positioning (e.g. relative to France)
OPPORTUNITIES	**ISSUES/THREATS/RISKS**
- Emerging regions finding "their" wine - New varieties - Emerging markets - Selling more to China and other developed Asia - Continued income growth in Asian markets - Growing network of trade agreements (e.g. recent NZ-UK) improving market access - Rapidly growing demand for premium alcoholic beverages in Asia - Low share in Europe (two thirds of global wine consumption) outside British Isles - Joint in-market activity spreading cost of marketing - Strong and growing demand in Asia for premium fortified wines/wine based spirits (e.g. cognac) - Reduction of global "wine ocean" supporting higher prices	- Climate change - Exchange rates - Consumer shift away from wine; low/no alcohol wines - Ongoing consolidation of the industry - Difficult finding good distributors to gain access into key markets - Continued exports of bulk wine trade reducing the value of locally bottled wine - Continued growth of retail brands/store brands in wine - Changing consumer sentiment or government policy - Hollowing out of management skills in New Zealand industry due to foreign ownership (relative to Denmark or Holland for example)

New Zealand has all the capabilities needed for further success in wine

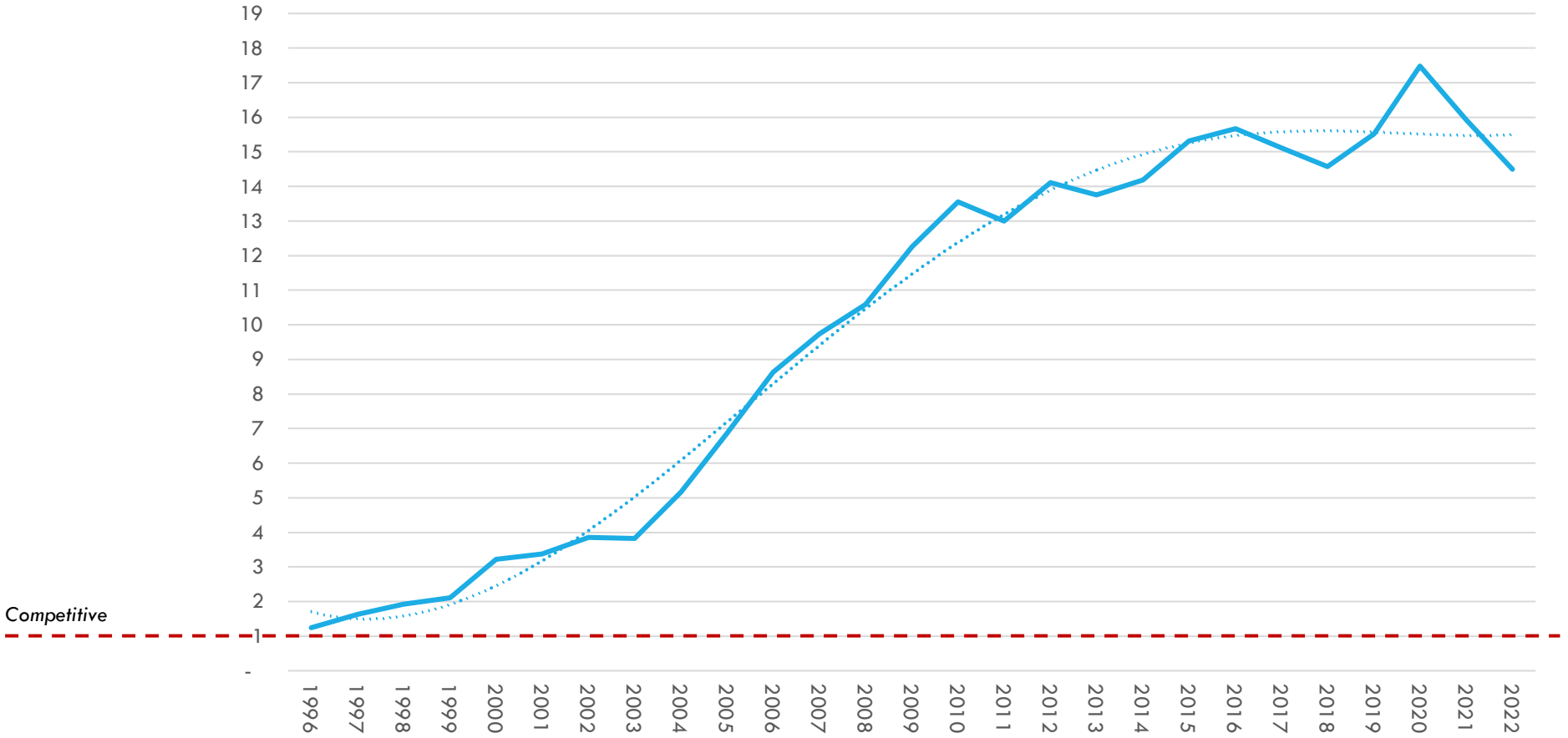
DRIVERS OF AN INTERNATIONALLY COMPETITIVE BIOECONOMY: WINE GRAPES

Source: Coriolis

Competitiveness is calculated at the border; New Zealand has experienced growing competitiveness in wine, though this has stabilised in the past decade

ANNUAL REVEALED COMPARATIVE ADVANTAGE INDEX: NEW ZEALAND WINE (HS2204)

1=Average of New Zealand across all exports; 1996-2022



Source: World Bank WITS; UNCTAD STAT; Coriolis analysis

The history of the New Zealand industry can be summarised as a long line of immigrants trying to build a wine industry despite all the obstacles

NEW ZEALAND AREA IN GRAPES

Hectares; 1819-2021 (latest available)

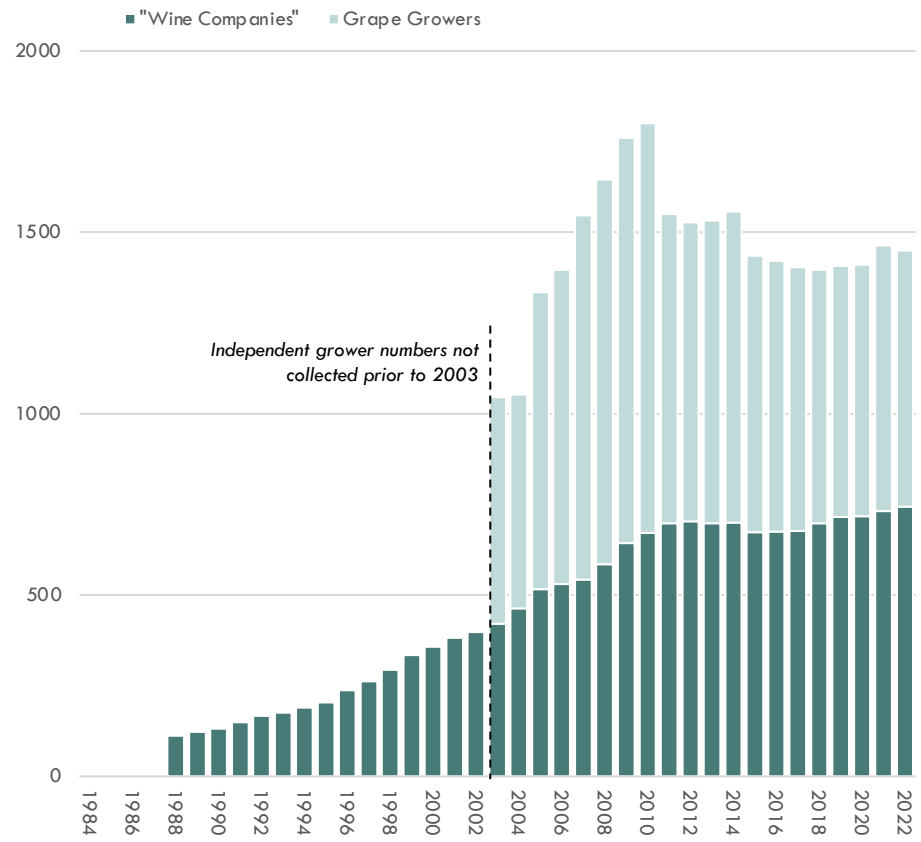
Source: Statistics NZ, NZ Wine Growers; Dept Agriculture; Coriolis analysis

The number of wineries has stabilised in the past decade, while the number of grape growers is flat-to-declining

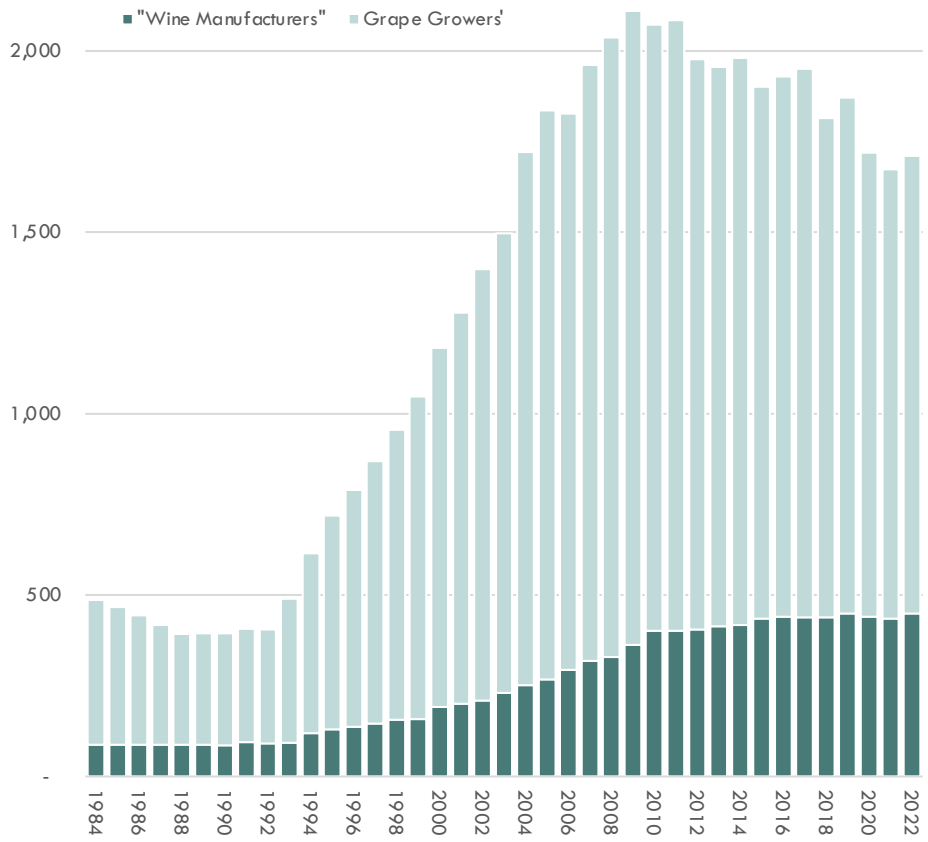
NUMBER OF WINE INDUSTRY BUSINESS UNITS IN NEW ZEALAND

Units; 1984-2022 (latest available)

NZ WINEGROWERS COUNT



STATISTICS NZ ACTIVITY UNITS



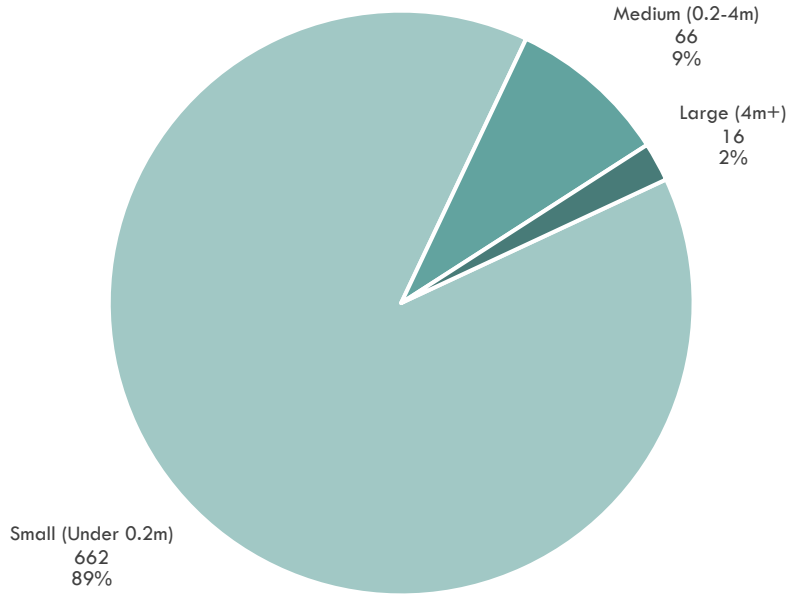
Note: These different organisations use different definitions; an "activity unit" or "geographic unit" has been described as a "front door" (or farm gate); not all the NZW "wine companies" will actually manufacture wine (i.e. many will use contract bottlers; "Source: Statistics New Zealand (Business Demographics data); New Zealand Winegrowers (Statistical annuals; other reporting); Coriolis modelling and analysis

New Zealand has a large and growing number of small wineries and a small and shrinking number of large wineries

NUMBER OF "WINE BUSINESSES" BY SIZE CLASS IN NEW ZEALAND

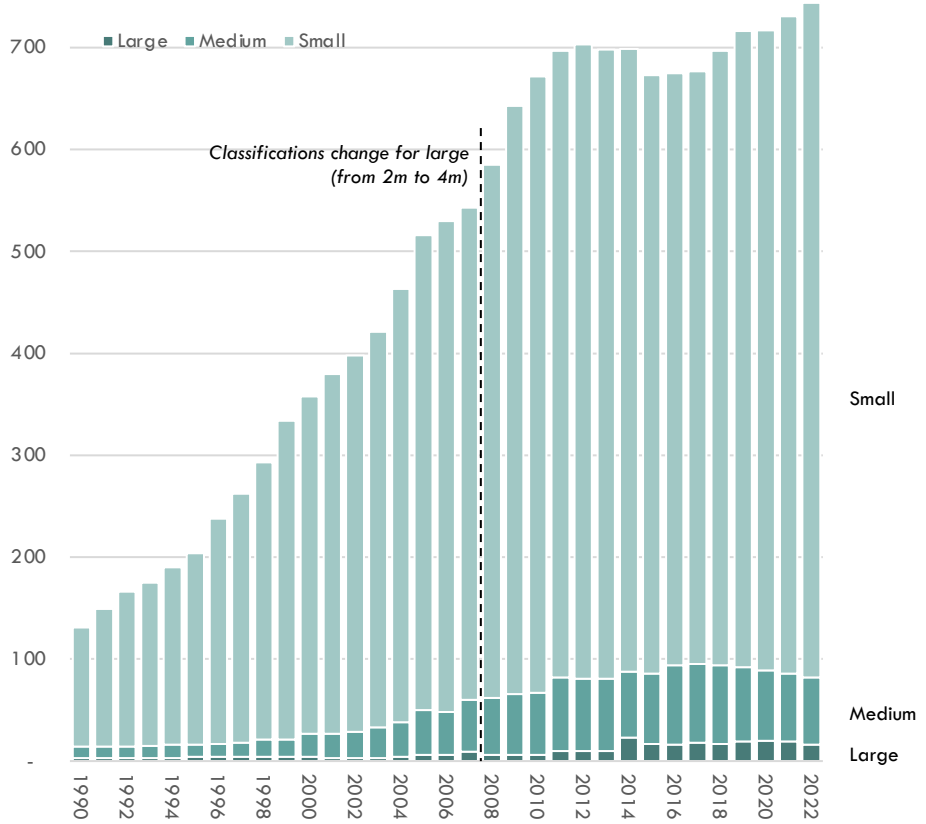
Units; 1984-2022 (latest available)

COUNT IN 2022



TOTAL = 744 "Wine Businesses"

COUNT THROUGH TIME



Source: New Zealand Winegrowers (Statistical annuals; other reporting); Coriolis modelling and analysis

Wineries are spread out across the country, with Marlborough (160), Central Otago (137), Hawke's Bay (107) and Auckland (98) leading

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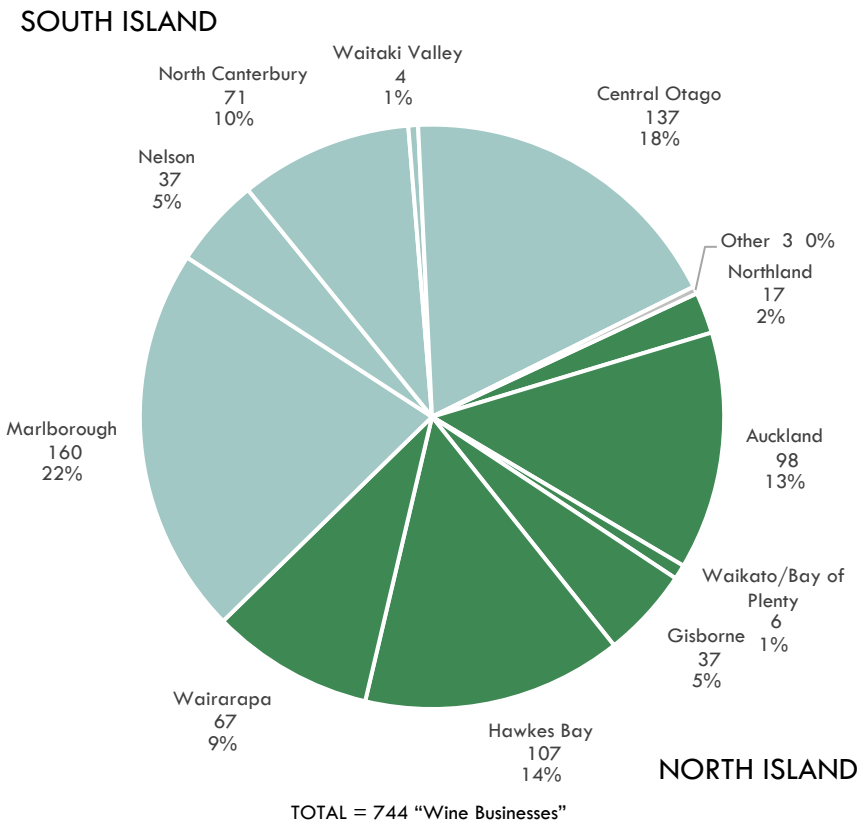
COUNT IN 2022



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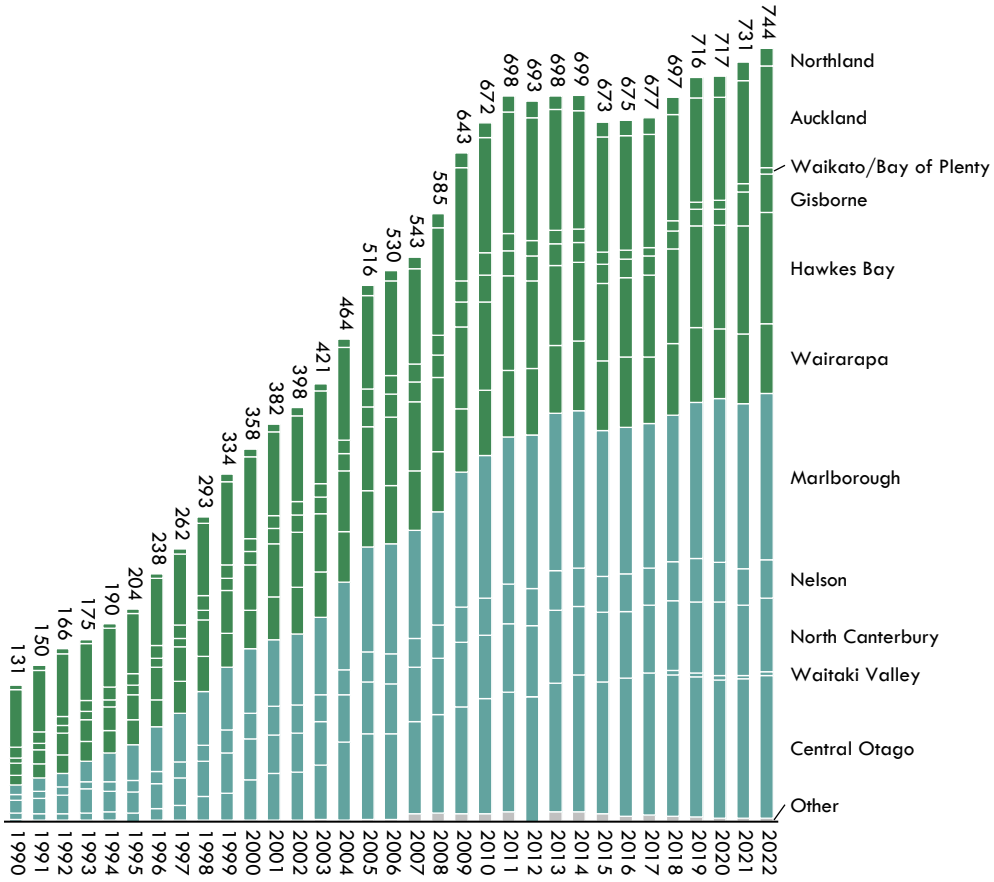
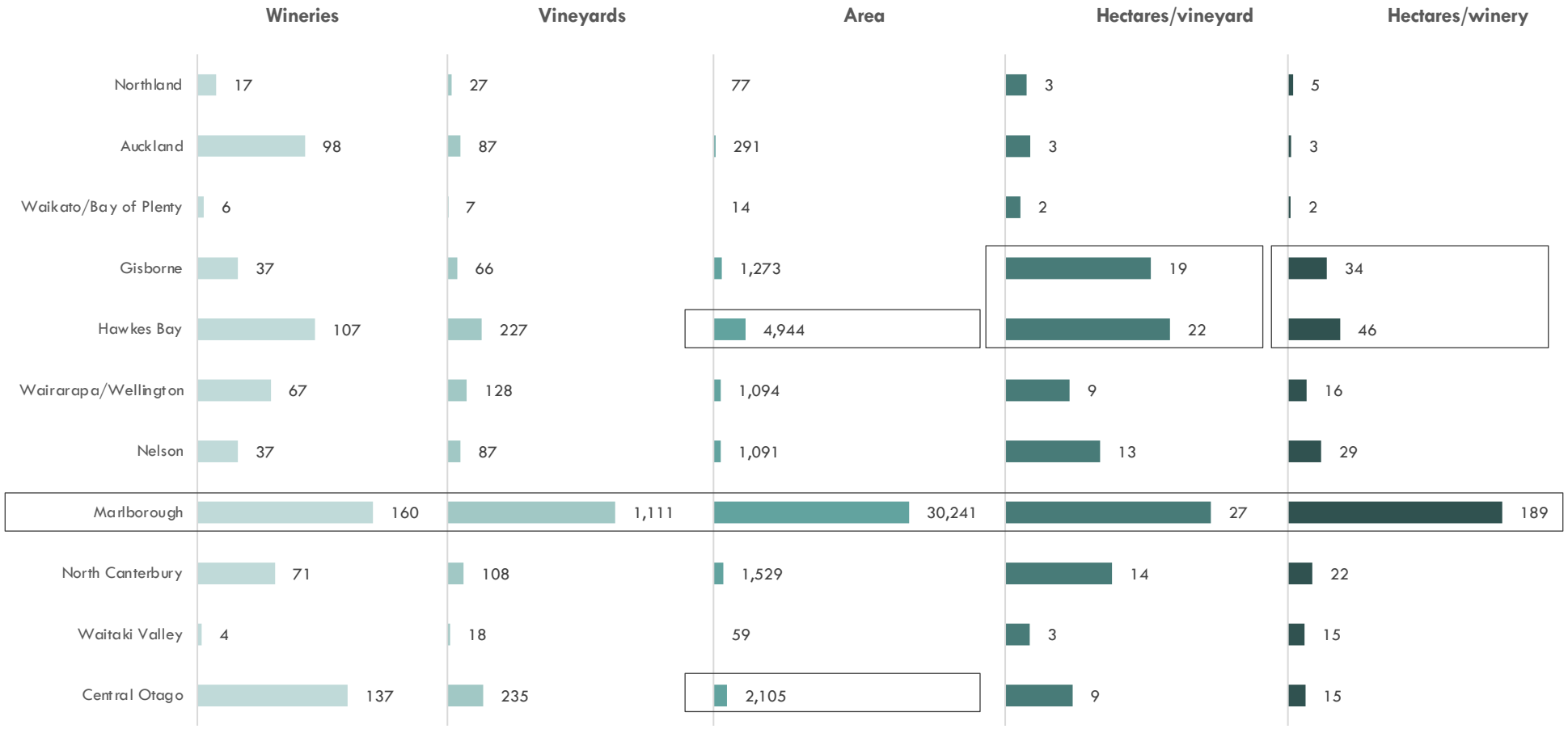


Source: New Zealand Winegrowers (Statistical annuals; other reporting); Coriolis modelling and analysis

In terms of scale economics, Marlborough is the leading region, followed by Hawke's Bay, Gisborne and Central Otago

HOW DO THE REGIONS COMPARE WITH EACH OTHER?

Various metrics as given; 2021 or 2022 (latest available)



Source: NZWine; Statistics NZ; Coriolis

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PAGES 206-241

New Zealand has clear capabilities in fruit, but has been struggling to create real growth beyond kiwifruit; avocados are an opportunity and a challenge

New Zealand is has a strong position in three export focused fruit

- The New Zealand fruit industry has a complex and well developed ecosystem with all key capabilities in place across the supply chain
- New Zealand has a successful fruit industry built around two key fruit: kiwifruit (growing) and apples (stable)
- New Zealand is globally competitive in kiwifruit and apples, but mixed elsewhere
- Competitiveness is calculated at the border; New Zealand is massively competitive in kiwifruit, solid in apples and declining in avocados

The New Zealand fruit industry currently uses a tiny amount of land

- Non-wine fruit crops account for 0.1% of New Zealand land use

Growth is coming primarily from yield increases rather than land expansion

- After a strong period of growth, total area in fruit in New Zealand stalled in the late 80's
- New Zealand has driven constant yield improvements in apples, kiwifruit and avocados; all other fruit have made no gains in net terms
- Thanks to these yield gains, total volume of fruit produced in New Zealand continues to grow, driven by kiwifruit

The New Zealand fruit industry is shifting to fewer, larger farms

- The fruit industry has declining unit numbers across the long term in every defined sector
- There is growing on-farm employment in kiwifruit, berries and stone fruit, but declining on-farm employment in apples, citrus, olives and 'other'

The New Zealand fruit industry has a complex and well developed ecosystem with all key capabilities in place across the supply chain

NEW ZEALAND CAPABILITIES DRIVEN SUPPLY CHAIN: FRUIT

SELECT FIRMS

VEHICLES/MACHINERY
John Deere, New Holland Agriculture, Massey Ferguson, Revo, Pellenc, Hydralada, Toyota, OriginAG, CNH Industrial

FUEL & LUBRICANTS
Gulf, Allied Petroleum, npd, RD, McFall Fuel, SMF

TRELLIS & FENCING
Summit Steel & Wire, Gallagher, Goldpine

200+ sawmills

FARM SUPPLIES
Farmlands, PGG Wrightson, Horticentre Group, New Zealand Farm Source, WaterForce

PESTICIDES & HERBICIDES
Bayer, Nufarm, Sinochem, Syngenta, BASF, Corteva agriscience, Mitsubishi Chemical Group, Sumitomo Chemical, Adama

FRUIT GENETICS
Riversun, L.E. Cooke Nurserymen Ltd, Greenleaf Nurseries, Genesis Nurseries, Te Puke Nurseries, Hideaway Nursery Ltd, waimea nurseries

FERTILISER
Ballance, ravensdown

LAND IN FRUIT (X GRAPES)
35,140 hectares
~3,800 units
(excluding grapes)

PEOPLE IN FRUIT GROWING
~15,200 in fruit growing
(excluding grapes)
Plus seasonal labour

SERVICES/SUPPORT CONTRACTORS
KI Kiwifruit Investments, sch horticulture, PIVOT horticulture, OMS

PACKHOUSES & WHOLESALERS
T&G, mg marketing, Seeka, J&P Turner, first, EastPack, Scales, Primor, freshmax, BOSTOCK New Zealand, Freshco, The Yummy Fruit Company, Frupak, Trevelyan's, Silfon, New Zealand Cherry Corp, OPAC, Darling, 45 South, Apata, Rockit, Gala Betty, DMS Increasing Grower Profit, heartland, PickMee! Fresh, blackcurrant co-operative, KONO Wakatū

GOVERNMENT IMPOSED MONOPSONY
Zespri Kiwifruit

FRUIT PROCESSORS
Heinz Wattie's, Talley's, Frupak, TAURA, Barker's, kiwifruitz

JUICE PROCESSORS
Suntory, frucor Beverages Limited, Homegrown, The Better Drinks Co, JP-NZ, Coca-Cola Europacific Partners

Plus cider & fruit wine producers

SHIPPING
Maersk Line, Hamburg Süd, msc, CMA CGM, Hapag-Lloyd, Evergreen, Cosco Shipping, Yang Ming

LOGISTICS
Linfreight

NATIONAL & REGIONAL INDUSTRY ORGS.
Hawke's Bay Fruitgrowers' Association, Boysenberries New Zealand, Citrus New Zealand, New Zealand Avocado, Tropical Fruitgrowers of New Zealand, FGC New Zealand Food & Grocery Council, New Zealand Fruitgrowers, feijoa, NZKGI, Persimmons, NZBC New Zealand Beverage Council, Federated Farmers of New Zealand, Strawberry Growers NZ, Summerfruit New Zealand, New Zealand Apples & Pears, Passionfruit New Zealand, NZ Kiwiberry Growers Inc, New Zealand Blackcurrants, Tamarillo Fruit for life

Source: Coriolis

New Zealand has a successful fruit industry built around two key fruit: kiwifruit (growing) and apples (stable)

SWOT ANALYSIS: NEW ZEALAND FRUIT

STRENGTHS	WEAKNESSES
- Track record of success in new fruit development (e.g. SunGold kiwifruit) - Track record of success in breeding of new cultivars (e.g. Braeburn, Zespri Gold) - Counter seasonal to Northern Hemisphere in a narrow climatic window only shared by 4-5 competitors (Chile, Argentina, South Africa, Southern Brazil and Australia) - Proximity to fast growing Asian markets - Strong biosecurity; free from many diseases and pests - High yields per hectare/high levels of export packout in export fruits relative to peers - Unsubsidised industry competing successfully in world markets - Industry rapidly consolidating into fewer, larger operations at scale - Transition to integrated grower/packer/shipper model underway - Supportive, collective industry structure, particularly in kiwifruit	- Low/no ability to supply fruit year-round - Higher cost structure than others in seasonal window (e.g. Chile) - Too much area still in yesterday's varieties (e.g. Braeburn apples, Hayward kiwifruit) which are now widely produced by competitors and not IP-controlled - Many smaller orchards and farms; peer group benchmarking suggests NZ needs fewer, larger farms; - Failing to collectively nurture emerging Horizon 2 products to scale - Poor current funding model for new cultivar development - Poor current commercialisation model for new cultivars emerging from breeding programs - Legal separation of apple and kiwifruit exporting (can also be seen as a strength) - Small scale niche sectors limits availability of key agrichemicals - The size of Italy with the population of Singapore; lack scale outside key export products - Lack of large supply of "guest workers" like some countries; seasonal labour shortages
OPPORTUNITIES	**THREATS/ISSUES/CHALLENGES/RISKS**
- Further develop "Fresh" fruit, especially high value, high return fruits (e.g. berries) - Continued growth of middle-class in Asia - Aging baby boomers focusing on healthy living & eating for illness prevention - Growth of nutraceuticals and functional foods; fruits as "superfoods" (e.g. blackcurrants) - Australia, particularly as its biosecurity give high returns to those with access - Continued work on FTAs to develop tariff free markets (e.g. ASEAN); especially focussing on the high volume, high impact products and markets - Growing demand for fresh, convenient produce especially into Asian markets - Continued orchard-level technological innovation (e.g. Hi-Cane) and management improvement (e.g. girdling) leading to increased yields, automated pruning - Production of New Zealand developed/IP controlled varieties in counter-seasonal regions	- Growing production of apples, kiwifruit and other horticulture in China - Further disease outbreaks (cf. PSA) - The risk of disease outbreaks must be balanced against the biosecurity retarding or preventing introduction of new genetics and new species - Foreign phyto-sanitary protocols of other countries are the gap limiting extent and speed to market, particularly Australia - Re-export of foreign produce labelled "Made in New Zealand" endangering NZ reputation - Changing climatic conditions impact production rates - Other global centres of fruit development coming up with better products

New Zealand is globally competitive in kiwifruit and apples, but mixed elsewhere

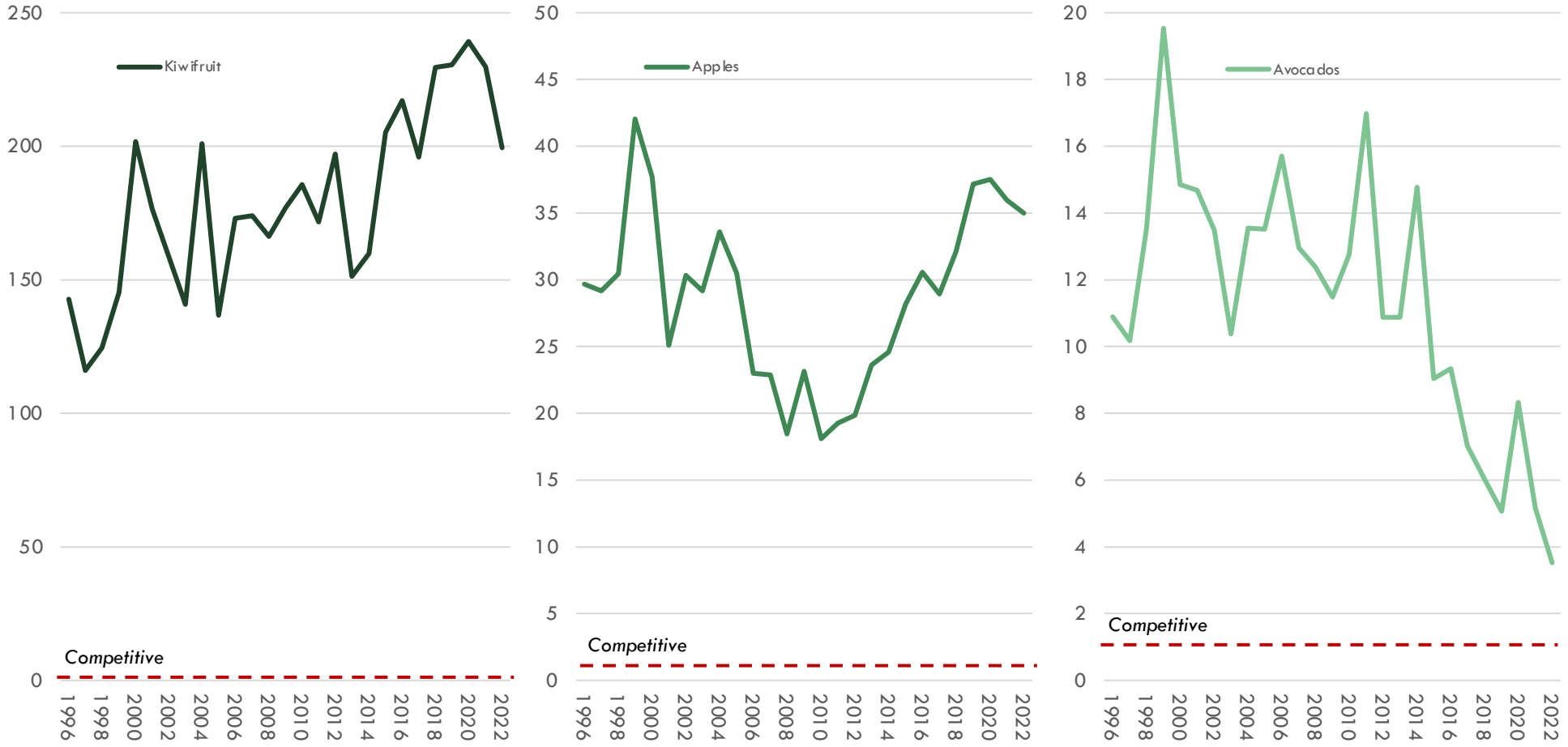
DRIVERS OF AN INTERNATIONALLY COMPETITIVE BIOECONOMY: FRUIT

Source: Coriolis

Competitiveness is calculated at the border; New Zealand is massively competitive in kiwifruit, solid in apples and declining in avocados

ANNUAL REVEALED COMPARATIVE ADVANTAGE INDEX: NEW ZEALAND BY SELECT FRUIT

1=Average of New Zealand across all exports; 1996-2022



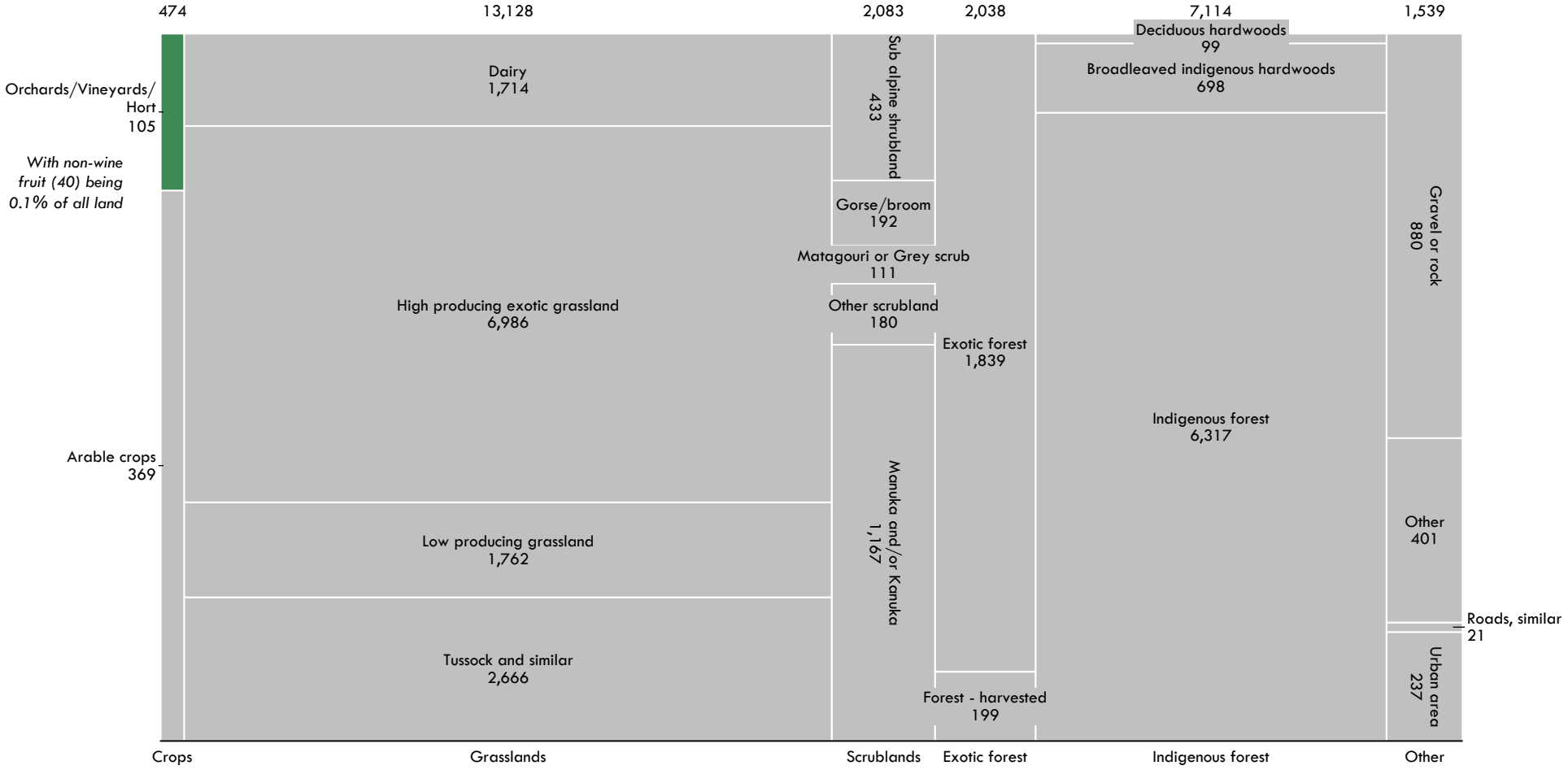
Source: World Bank WITS; UNCTAD STAT; Coriolis analysis

Non-wine fruit crops account for 0.1% of New Zealand land use

NEW ZEALAND LAND AREA BY TYPE

Ha; 000; 2018 or as available

TOTAL = 26,376 (000) hectares

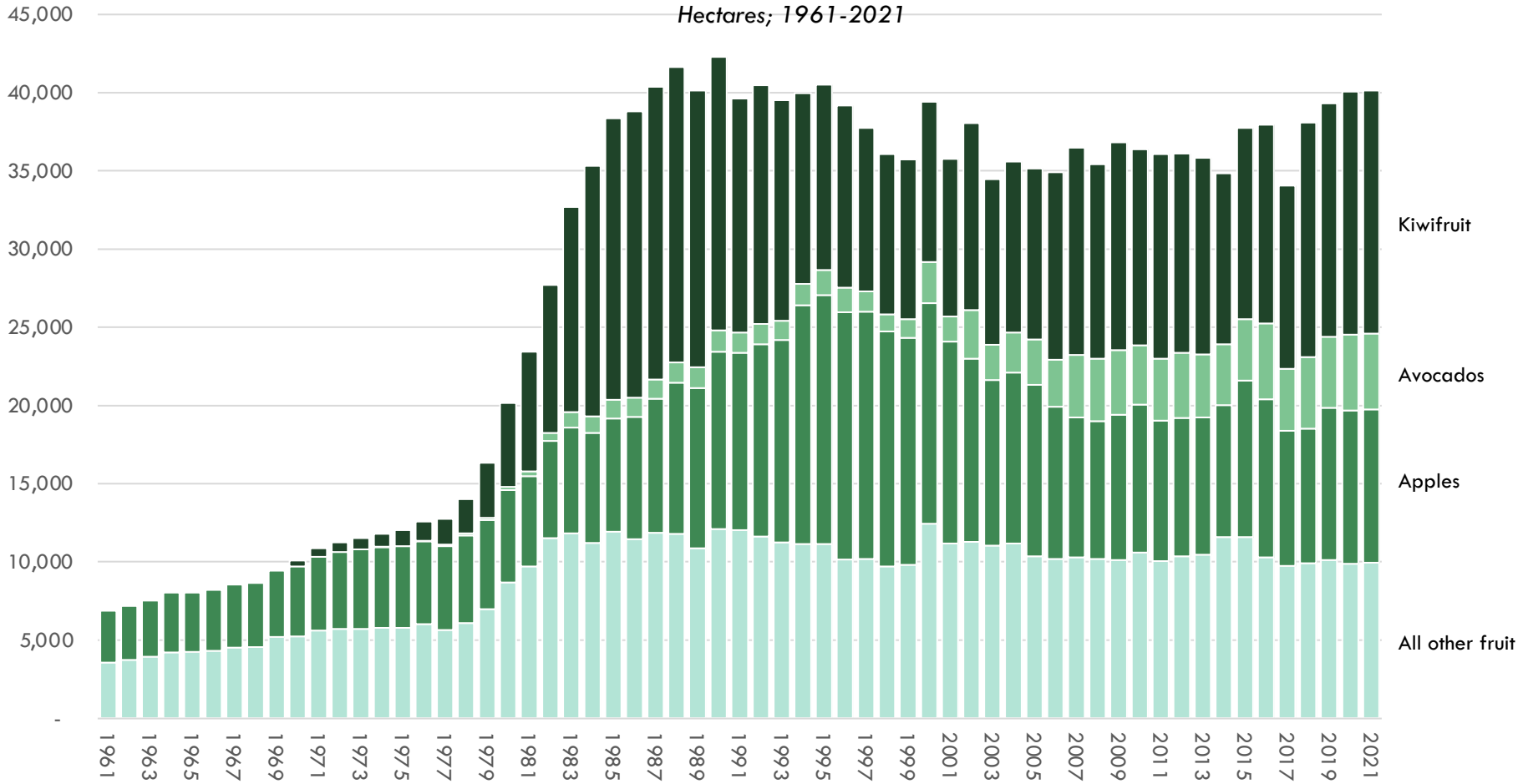


Source: MftE/StatsNZ New Zealand Land Cover Data Base (LCDB5); DairyNZ ("Effective hectares in dairy); Coriolis analysis

After a strong period of growth, total area in fruit in New Zealand stalled in the late 80's

TOTAL AREA IN FRUIT IN NEW ZEALAND (EXCLUDING GRAPES)

Hectares; 1961-2021

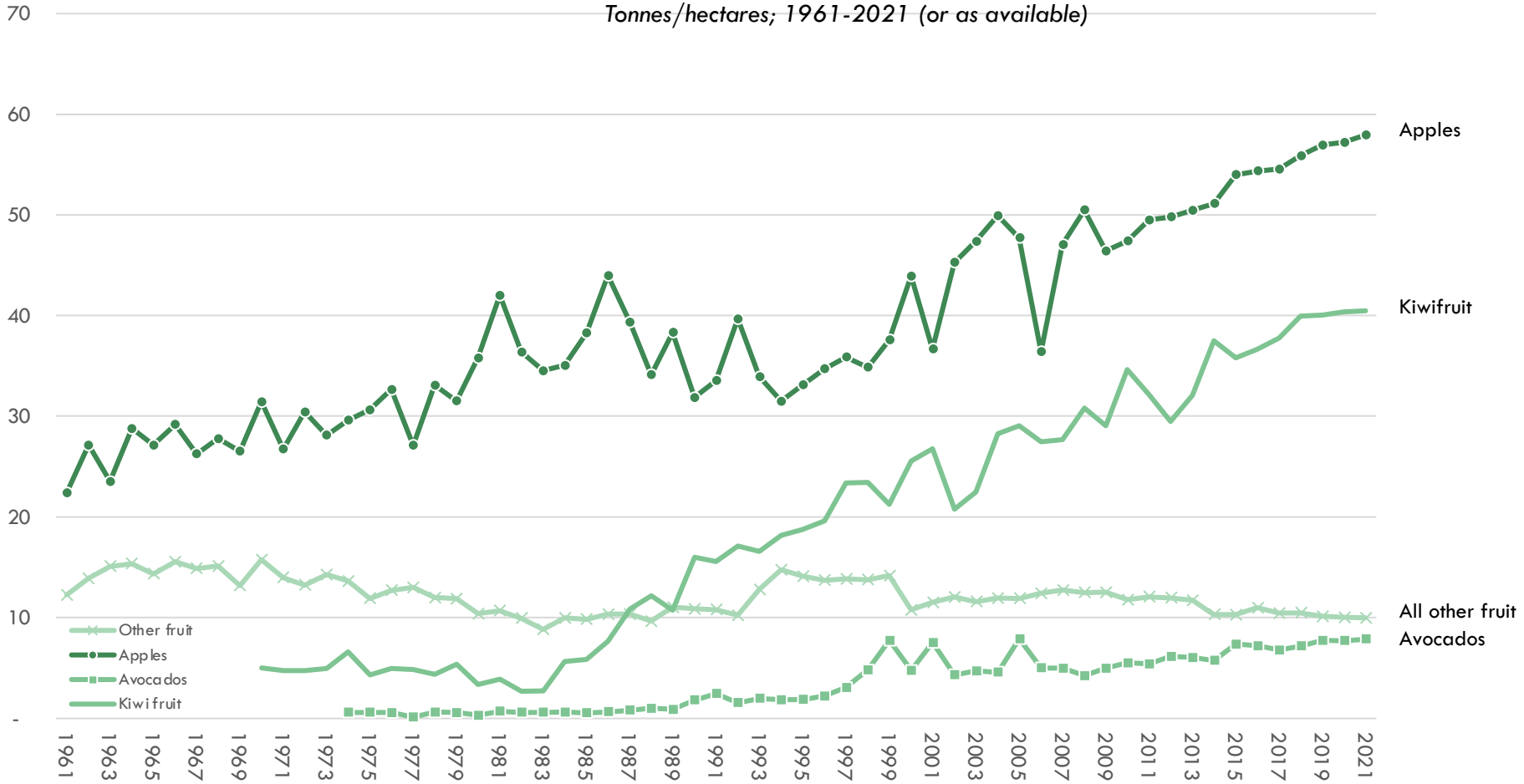


Source: UN FAOStat database; Coriolis classification and analysis

New Zealand has driven constant yield improvements in apples, kiwifruit and avocados; all other fruit have made no gains in net terms

AVERAGE ANNUAL YIELD PER HECTARE OF FRUIT IN NEW ZEALAND (EXCLUDING GRAPES)

Tonnes/hectares; 1961-2021 (or as available)

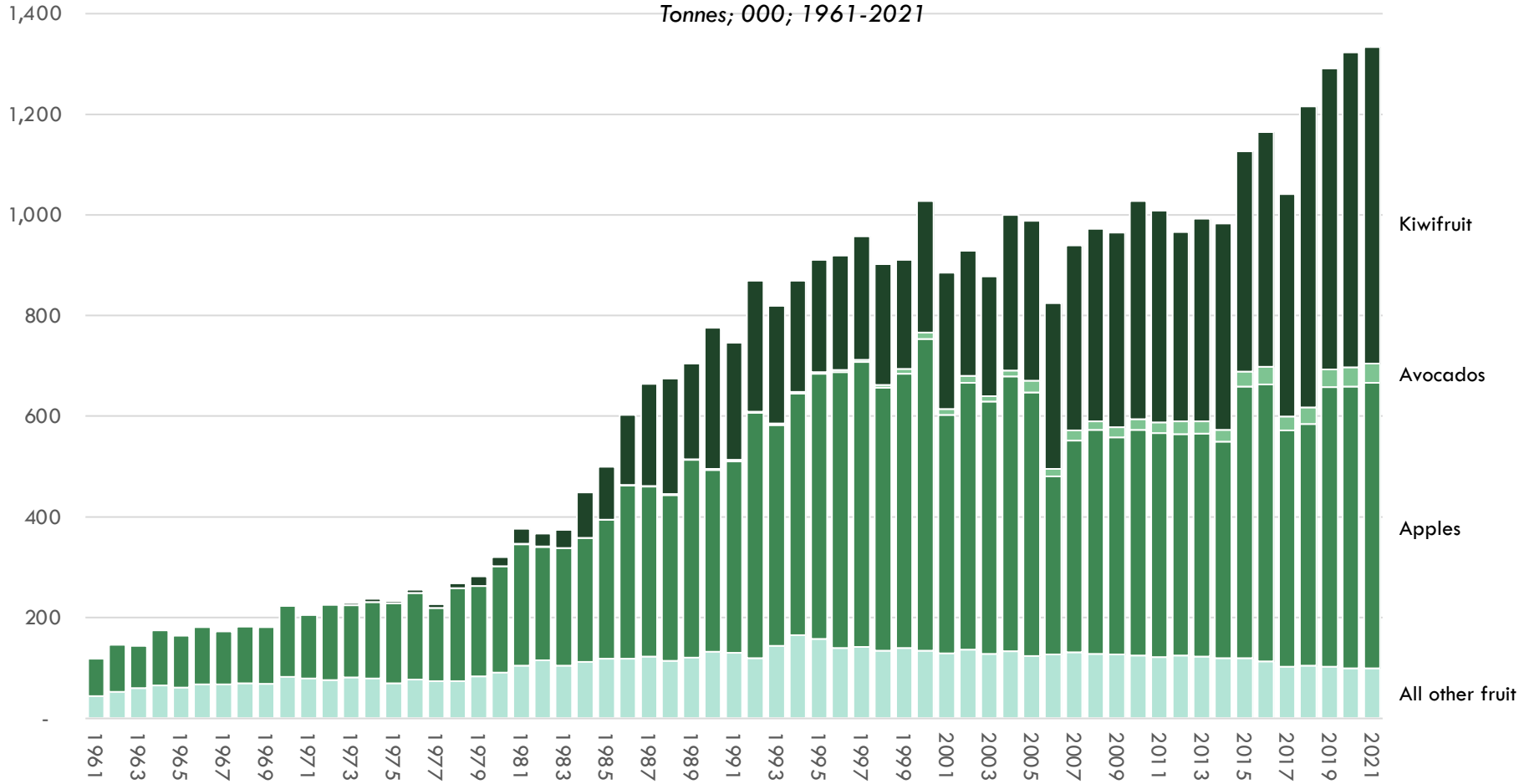


Source: UN FAOStat database; Coriolis classification and analysis

Thanks to these yield gains, total volume of fruit produced in New Zealand continues to grow, driven by kiwifruit

TOTAL PRODUCTION OF FRUIT IN NEW ZEALAND (EXCLUDING GRAPES)

Tonnes; 000; 1961-2021



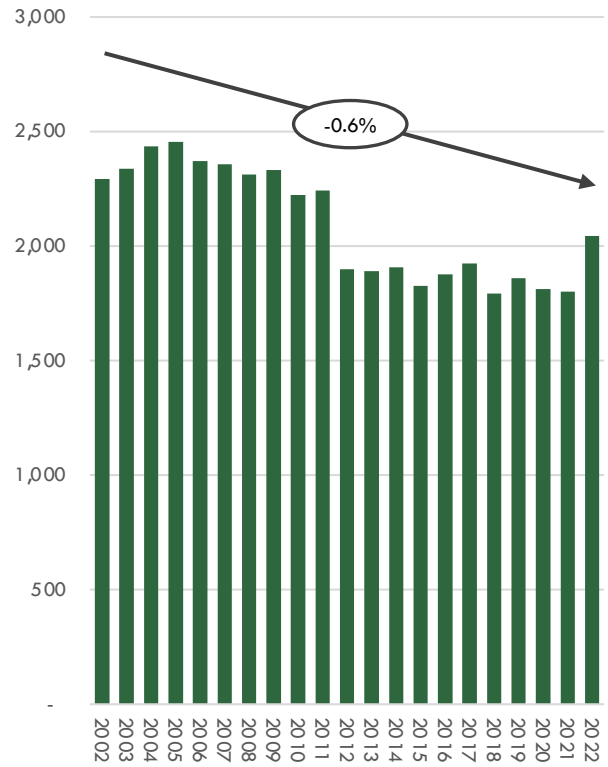
Source: UN FAOStat database; Coriolis classification and analysis

The fruit industry has declining unit numbers across the long term in every defined sector

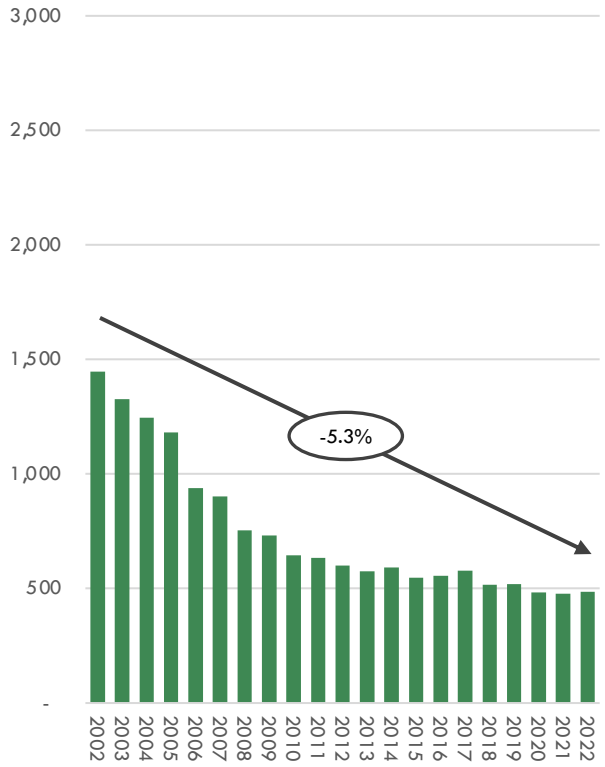
NUMBER OF ACTIVITY/GEOGRAPHIC UNITS BY SECTOR

Business units ("front doors"); 2002-2022

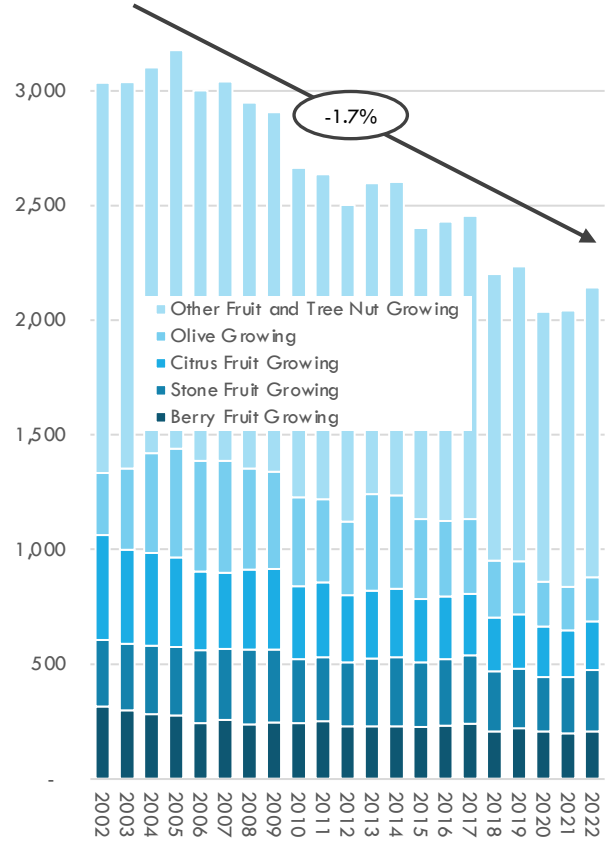
KIWIFRUIT



APPLES



ALL OTHER FRUIT & NUTS



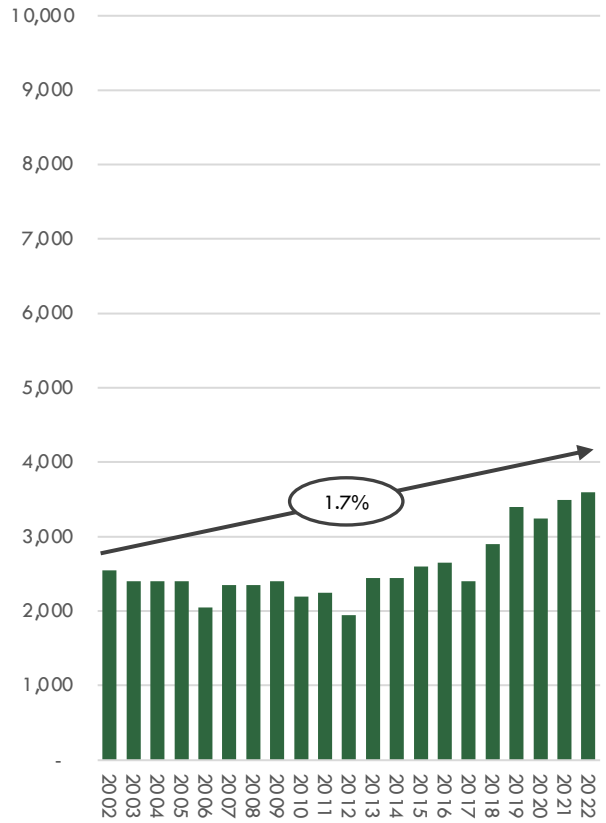
Source: StatisticsNZ (business demographics); Coriolis analysis

There is growing on-farm employment in kiwifruit, berries and stone fruit, but declining on-farm employment in apples, citrus, olives and 'other'

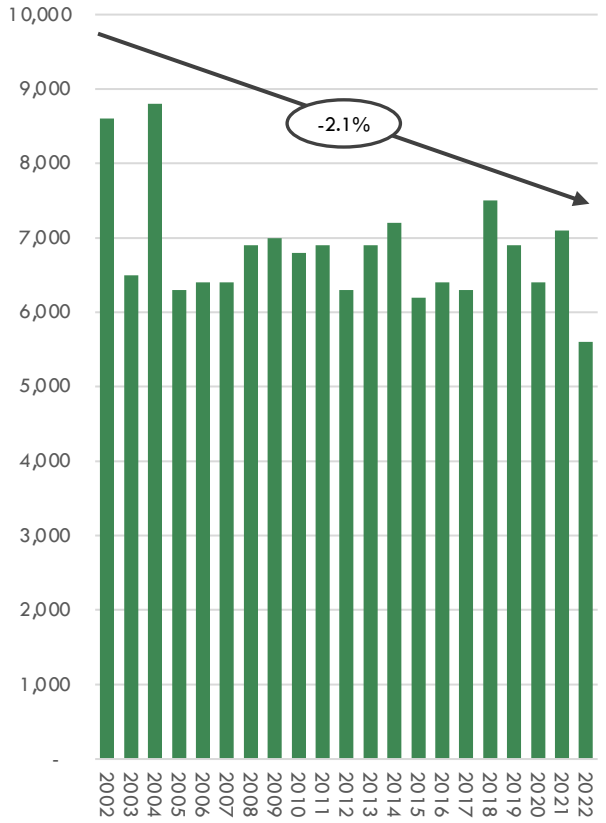
NUMBER OF EMPLOYEES BY SECTOR

Headcount; 2002-2022

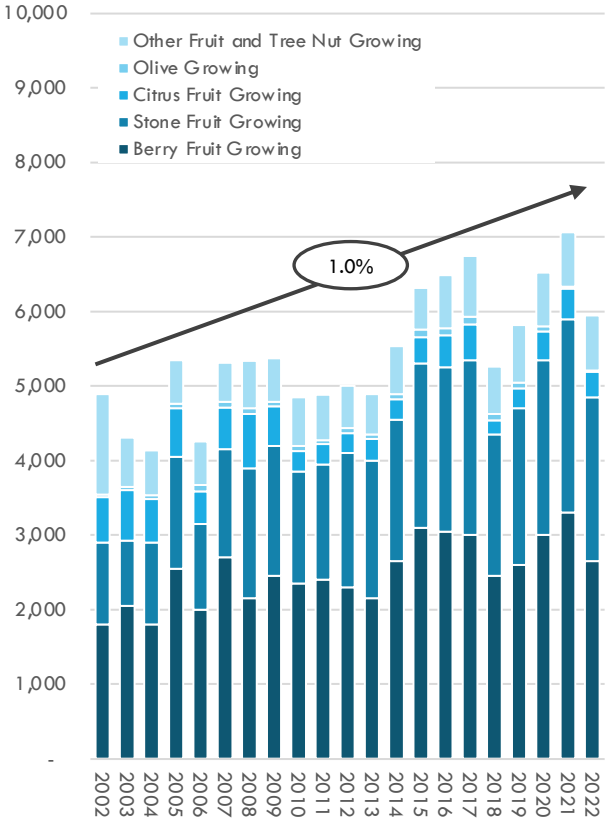
KIWIFRUIT



APPLES



ALL OTHER FRUIT & NUTS



Note: Data is PAYE employees; does not include "owner operator" farmers; Source: StatsNZ (business demographics); Coriolis analysis

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WHY IS IT SO HARD TO DEVELOP NEW PLATFORMS IN THE BIOECONOMY?

PAGES 206-241

Long insulated from global markets, the New Zealand vegetable industry is now undergoing a massive, long term transition to "California-style" farming

The surviving large players from the ongoing shakeout in the New Zealand vegetable industry are happy inside the bubble

- The New Zealand vegetable industry has a complex and well developed ecosystem with all key capabilities in place across the supply chain
- New Zealand's vegetable/root crop industry is consolidating into a smaller and smaller group of larger and larger farmers happy inside the bubble
- New Zealand does not currently have all the capabilities required to increase global competitiveness or productivity
- Competitiveness is calculated at the border; New Zealand is globally competitive in onions and potatoes and struggling or uncompetitive elsewhere

New Zealand vegetable production has stalled

- Vegetables/root crops account for 0.1% of New Zealand land use
- Total area in vegetables in New Zealand stalled in the mid 90's and has been stable-to-down since
- New Zealand has driven yield improvements across most vegetables
- Thanks to these yield gains, total volume of root crops produced in New Zealand continues to grow, and vegetables are stable

The number of vegetable farm operators has dramatically shrunk over the past two decades, as the industry has shifted to fewer, larger operations at scale

- The New Zealand vegetable and horticulture industry is consolidating rapidly into dramatically fewer, larger farms
- There is declining on-farm employment in vegetable and horticulture, with outdoor, nursery and flowers all trending down

The New Zealand vegetable industry has a complex and well developed ecosystem with all key capabilities in place across the supply chain

NEW ZEALAND CAPABILITIES DRIVEN SUPPLY CHAIN: VEGETABLES

SELECT FIRMS

VEHICLES/MACHINERY

John Deere, New Holland Agriculture, Massey Ferguson, AGCO, Kubota, CLAAS, Gascon, Merlo, Fendt, Toyota, Origin Ag, CNH Industrial

FUEL & LUBRICANTS

Gull, Allied Petroleum, npd, RD Petroleum, McFall, SHF

FENCING

Summit Steel & Wire, Gallagher, Goldpine

200+ sawmills

FARM SUPPLIES

Farmlands, PGG Wrightson, Horticentre Group, New Zealand Farm Source, WaterForce

PESTICIDES & HERBICIDES

Bayer, Nufarm, Sinochem, Syngenta, BASF, Corteva agriscience, Mitsubishi Chemical Group, Sumitomo Chemical, Adama

SEEDS/PLANT GENETICS

Bayer, Fairbanks Seeds, South Pacific Seeds, McCain, Limagrain, Eurogrow, Terranova Seeds, Midlands Seed

FERTILISER

Ballance, ravensdown

LAND IN VEGETABLES

~40,000 hectares
~930 units
(excluding grapes)

PEOPLE IN VEGETABLE GROWING

~6,600 in veg growing
Plus seasonal labour

SERVICES/SUPPORT CONTRACTORS

Numerous, primarily small local service providers

PACKHOUSES & WHOLESALERS

T&G, mg marketing, Primor, J&P Turner, freshmax, Balle Bros, Freshco, Meadows, Leaderbrand, Wilcox, NZ Hothouse, GSF Fresh, The Produce Company, Delta Produce, mercer MUSHROOMS, Te Mata Mushroom Co, SPL, tendertips, Superb Herb, Living Foods

VEGETABLE PROCESSORS

Heinz Wattie's, Talley's, McCain, Cedenco, Balle Bros, Mr Chips, TAURA, GreenMount Foods

JUICE PROCESSORS

Suntory, frucor Beverages Limited, Homegrown, The Better Drinks Co, JP-NZ, Coca-Cola Europacific Partners

Plus cider & fruit wine producers

SHIPPING

Maersk Line, Hamburg Süd, msc, CMA CGM, Hapag-Lloyd, Evergreen, Cosco Shipping, Yang Ming

LOGISTICS

Linfreight

NATIONAL & REGIONAL INDUSTRY ORGS.

New Zealand Asparagus Council, Buttercup Squash, onions NEW ZEALAND INC, FGC New Zealand Food & Grocery Council, Potatoes New Zealand, Process Vegetables NZ, Federated Farmers, Vegetables New Zealand Inc, TomatoesNZ, Horticulture New Zealand, NZBC New Zealand Beverage Council

Source: Coriolis

New Zealand's vegetable/root crop industry is consolidating into a smaller and smaller group of larger and larger farmers happy inside the bubble

SWOT ANALYSIS: NEW ZEALAND VEGETABLES/OTHER HORTICULTURE

STRENGTHS	WEAKNESSES
- High prices by global standards - Strong biosecurity; free from many diseases and pests; basically all of domestic industry protected from fresh (non-processed) imports by biosecurity measures - Globally competitive producer of a handful of products, primarily potatoes and onions - Presence of large global multinational vegetable processors (e.g. McCain, KraftHeinz Watties) - Many products are oligopolies where a small number of producers compete without any pressure from world markets - Regular access to global vegetable genetics through biosecurity improving products - Unsubsidised industry rapidly consolidating into fewer, larger operations using efficient, modern technology at scale - Transition to integrated grower/packer/shipper model underway - Proximity to fast growing Asian markets - Unique access for some products to some bio-secure markets (particularly Australia & Japan) - Counter seasonal to Northern Hemisphere in a narrow climatic window only shared by 4-5 competitors (Chile, Argentina, South Africa, Southern Brazil and Australia)	- The size of Italy with the population of Singapore; lack scale outside key export products - Limited range of climates (e.g. versus the US, Australia or Europe/Africa) leading to extremes in both seasonal product availability and price not seen elsewhere on earth - Relatively small producer on a global scale - Inefficient, with low productivity relative to global peers in most vegetables (by number of crops, not volume) - Still too many small producers; in many cases, further consolidation is waiting on retirement of existing aging farmer base - Limited market knowledge beyond 'the biosecurity bubble" (e.g. yields, systems, productivity) - Small scale niche sectors limits availability of key agrichemicals - Lack of large supply of "guest workers" like some countries; seasonal labour shortages - Lifestyle blocks consuming huge amounts of land around population centres
OPPORTUNITIES	**THREATS/ISSUES/CHALLENGES/RISKS**
- Consumer perceptions of health benefits of vegetables - Massive country similar in size to Italy that uses a minuscule amount of total area to produce vegetables - Growing interest by some more wealthy consumers in Western markets for eco-labelling and environmental certification (driven by retailers) - Growing middle class in China and SE Asia - Ongoing removal of trade barriers and negotiation of new free trade agreements - Streamlining regulations - New/improved cool chain chain technology	- More subdivision taking further high productivity land out of production; farmers near major cities have been described as "property developers that dabble in farming to pay the rates" - NIMBY (not in my back yard) attitudes limiting industry activity (e.g. smell) - Shifting consumer perceptions of starchy vegetables, particularly root crops - Further disease outbreaks (cf. PSA) - Single issue special interest groups driving domestic regulatory agenda - Rising costs of airfreight reducing feasibility of some fresh/perishable exports - Climate change - Industry currently shrinking/struggling in terms of farm numbers - Emissions Trading Scheme and carbon forestry - Government regulation

New Zealand does not currently have all the capabilities required to increase global competitiveness or productivity

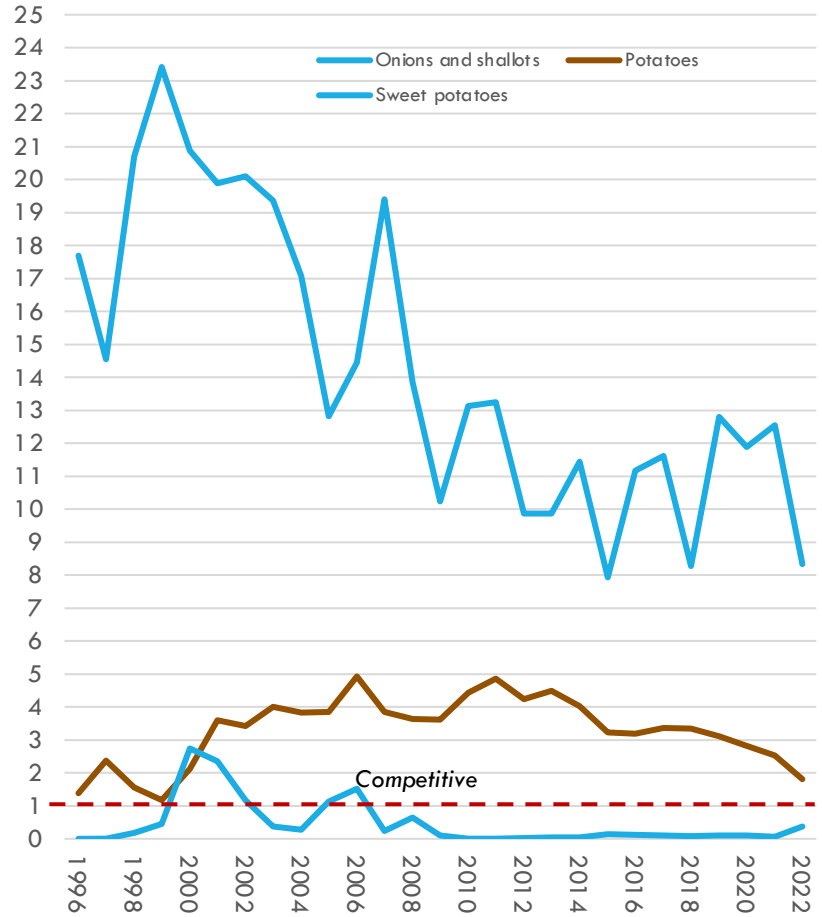
DRIVERS OF AN INTERNATIONALLY COMPETITIVE BIOECONOMY: VEGETABLES

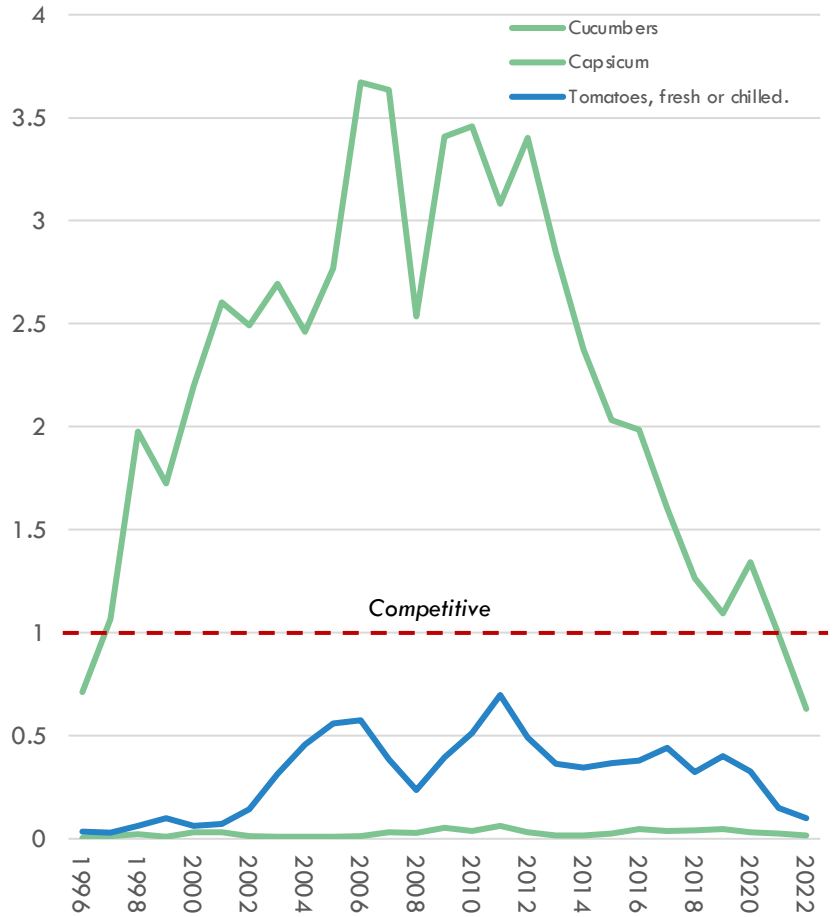
Source: Coriolis

Competitiveness is calculated at the border; New Zealand is competitive in onions and potatoes and struggling or uncompetitive elsewhere

ANNUAL REVEALED COMPARATIVE ADVANTAGE INDEX: NEW ZEALAND BY SELECT VEGETABLES

1=Average of New Zealand across all exports; 1996-2022





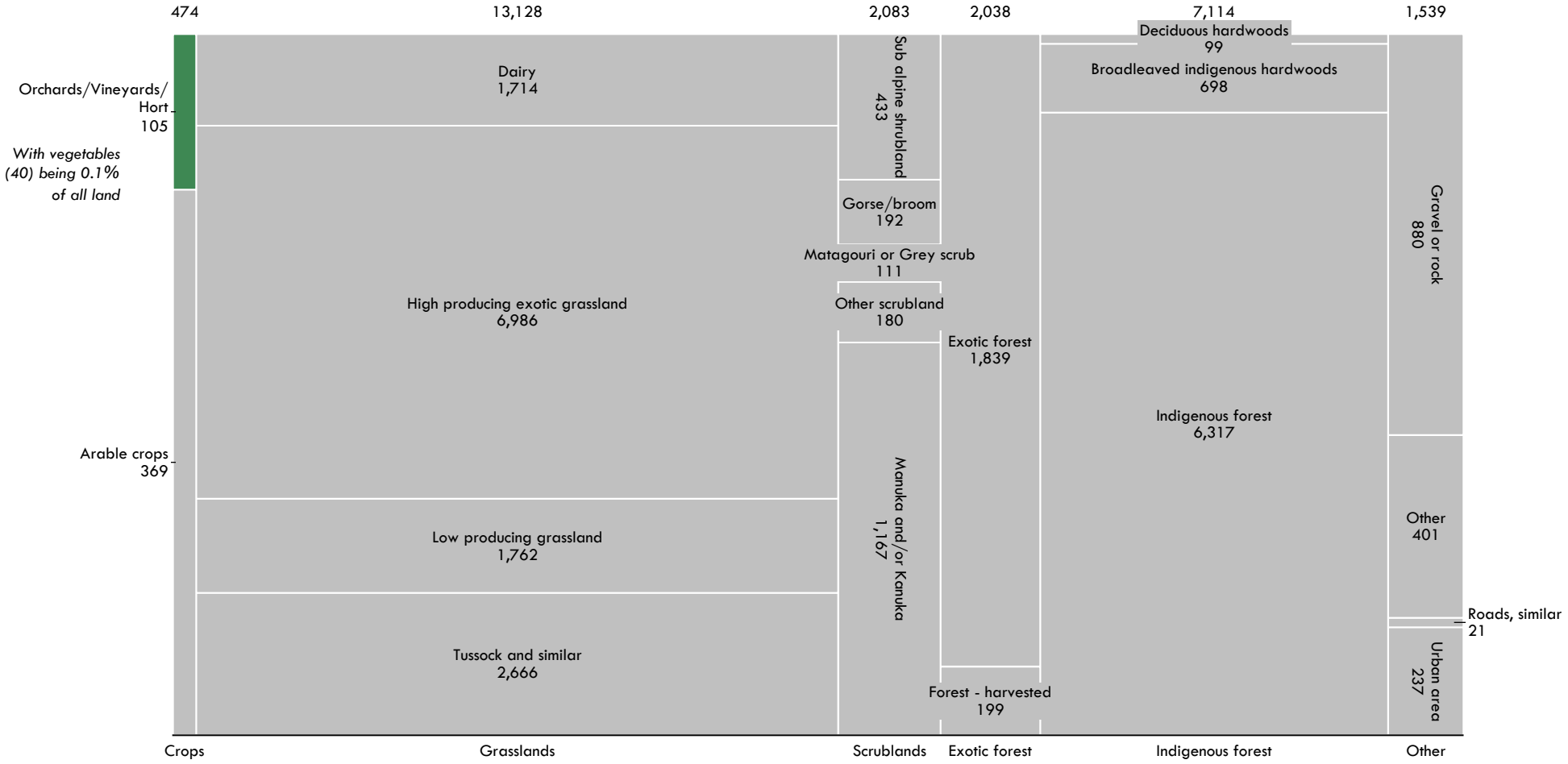
Source: World Bank WITS; UNCTAD STAT; Coriolis analysis

Vegetables/root crops account for 0.1% of New Zealand land use

NEW ZEALAND LAND AREA BY TYPE

Ha; 000; 2018 or as available

TOTAL = 26,376 (000) hectares

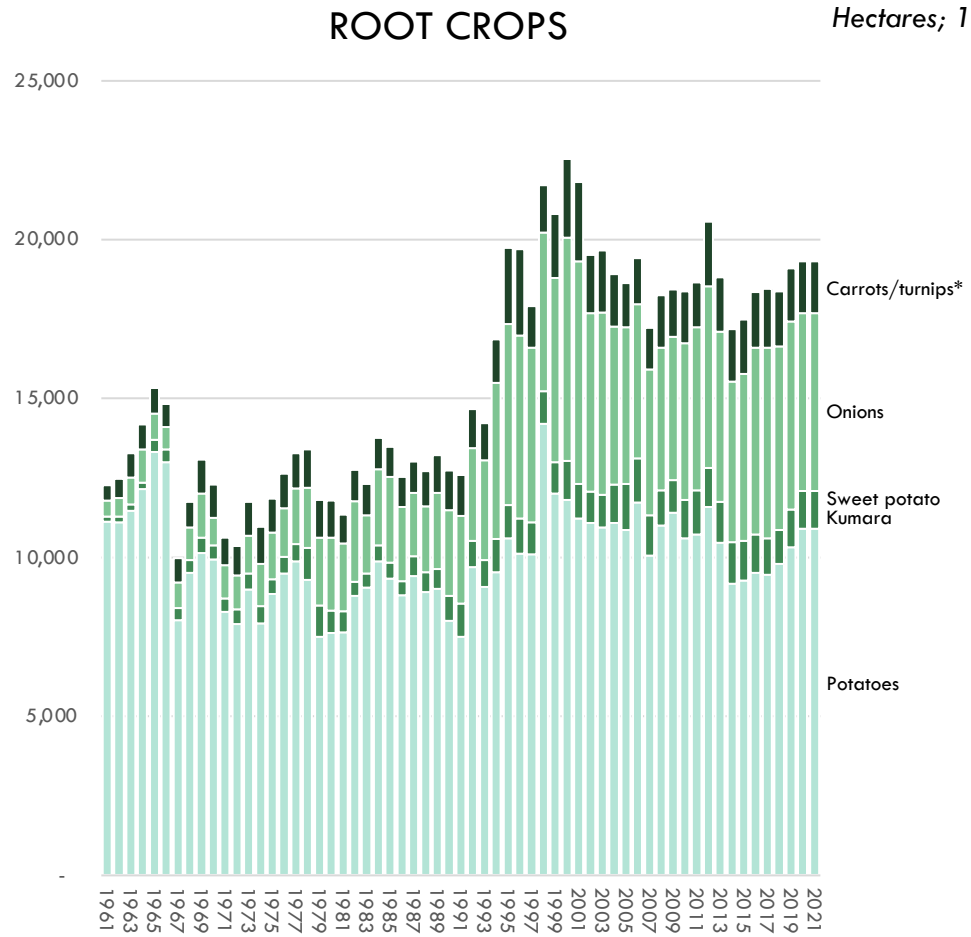


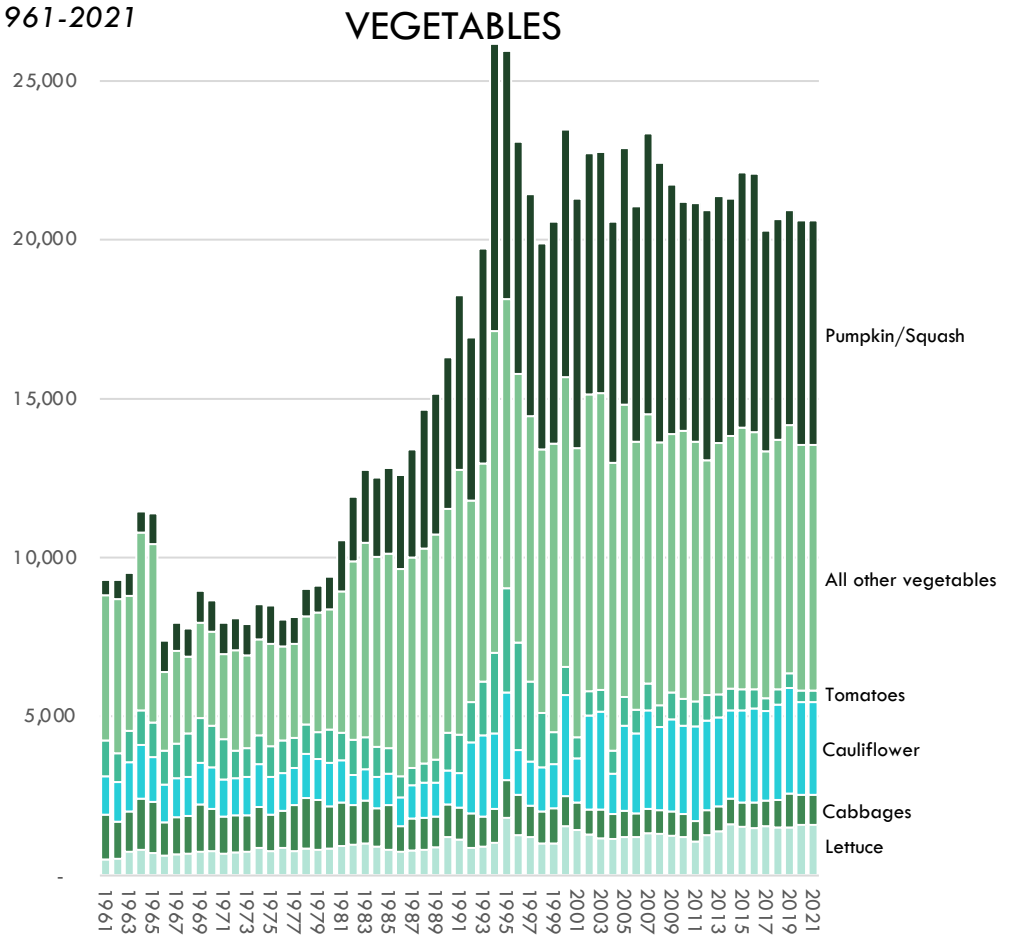
Source: MftE/StatsNZ New Zealand Land Cover Data Base (LCDB5); DairyNZ ("Effective hectares in dairy); Coriolis analysis

Total area in vegetables in New Zealand stalled in the mid 90's and has been stable-to-down since

TOTAL AREA IN VEGETABLES/ROOT CROPS IN NEW ZEALAND

Hectares; 1961-2021



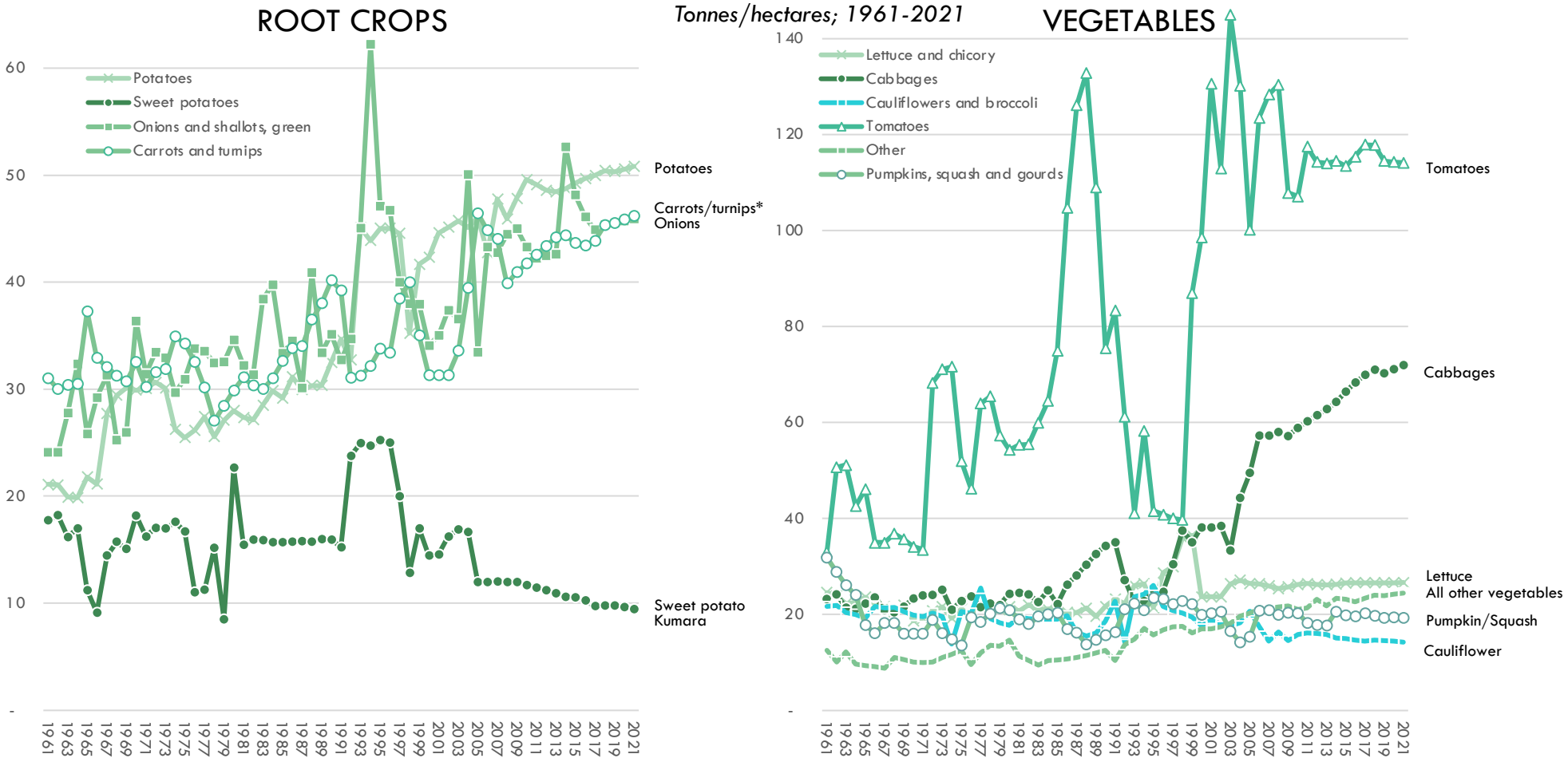


** Excluding fodder turnips (see arable crops); Source: UN FAOStat database; Coriolis classification and analysis*

New Zealand has driven yield improvements across most vegetables

AVERAGE ANNUAL YIELD PER HECTARE OF FRUIT IN NEW ZEALAND (EXCLUDING GRAPES)

Tonnes/hectares; 1961-2021

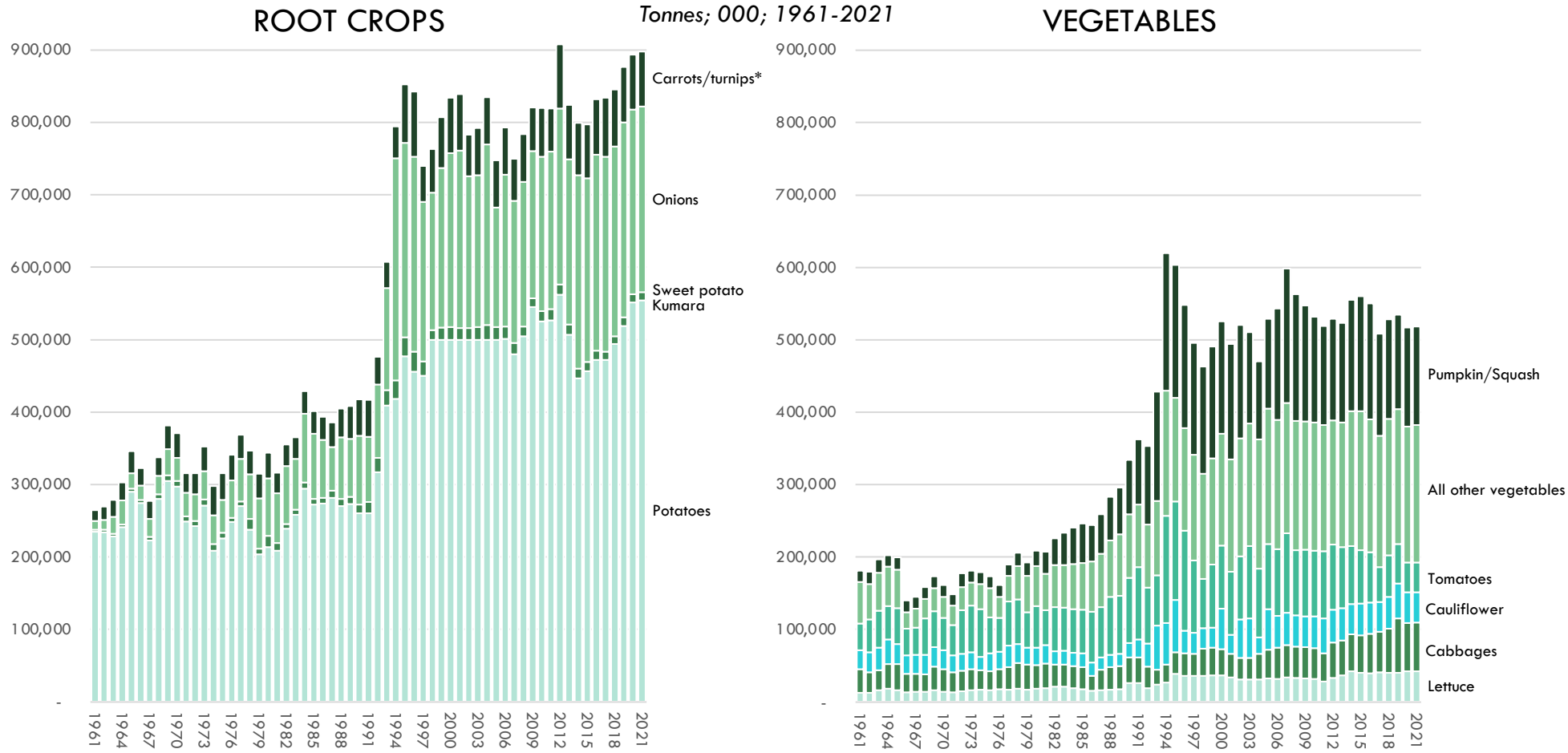


Source: UN FAOStat database; Coriolis classification and analysis

Thanks to these yield gains, total volume of root crops produced in New Zealand continues to grow, and vegetables are stable

TOTAL PRODUCTION OF VEGETABLES/ROOT CROPS IN NEW ZEALAND

Tonnes; 000; 1961-2021



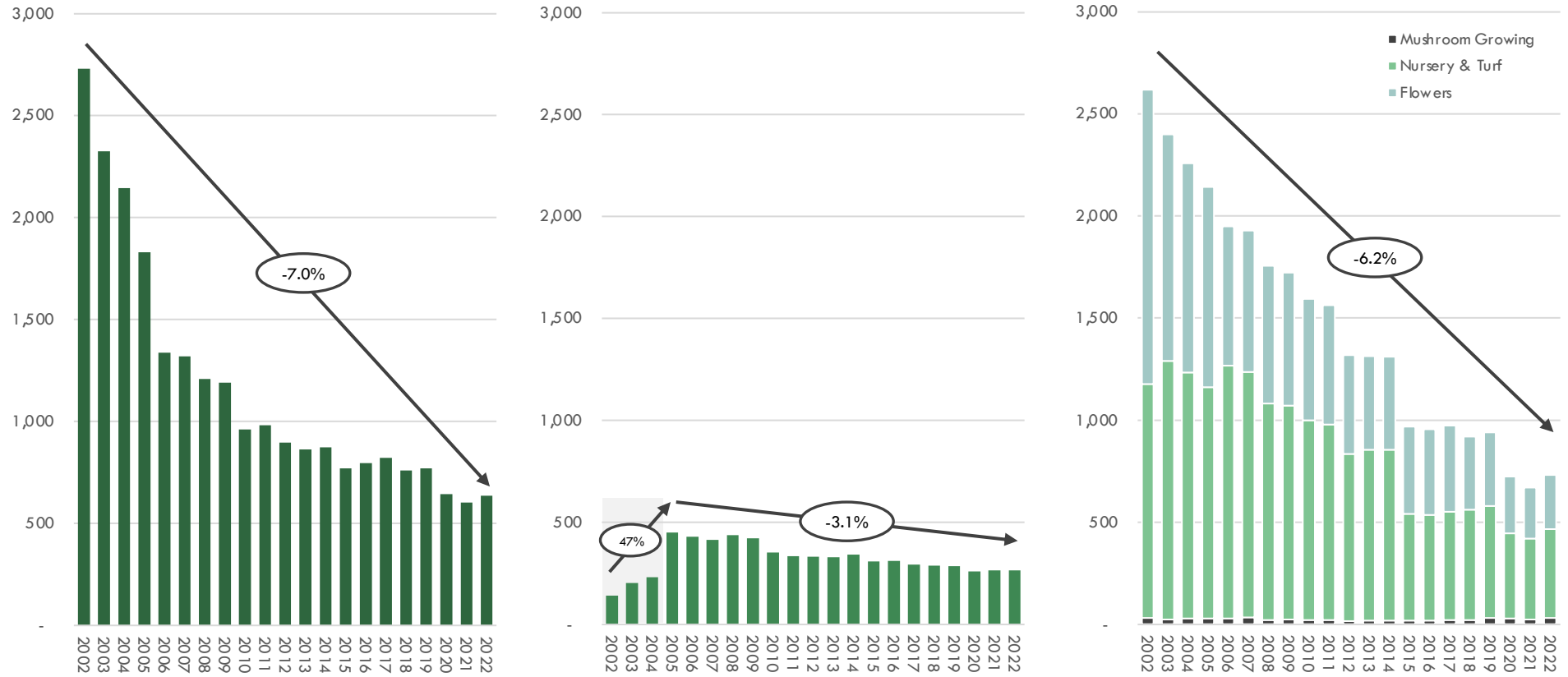
Source: UN FAOStat database; Coriolis classification and analysis

The New Zealand vegetable and horticulture industry is consolidating rapidly into dramatically fewer, larger farms

NUMBER OF ACTIVITY/GEOGRAPHIC UNITS BY SECTOR

Business units ("front doors"); 2002-2022

OUTDOOR VEGETABLES | GLASSHOUSE VEGETABLES* | ALL OTHER HORTICULTURE**



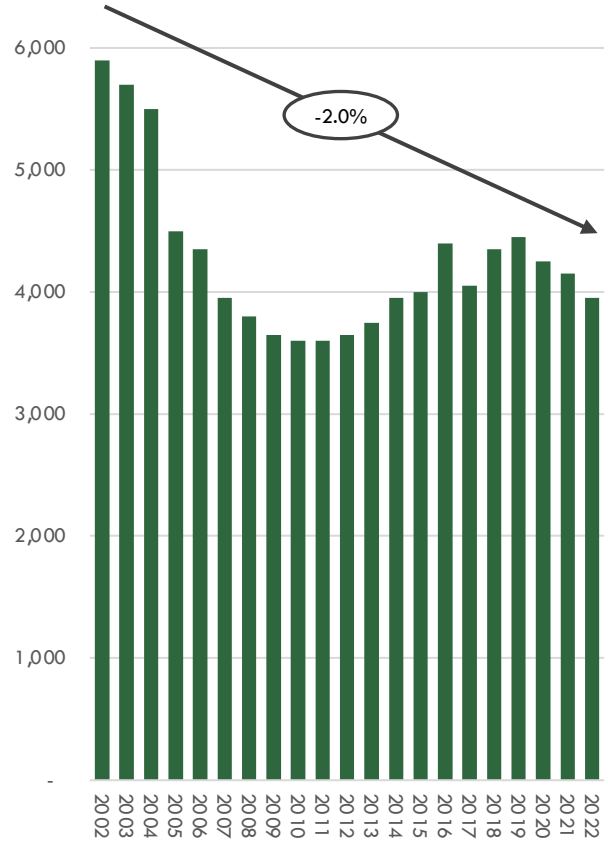
** "Under Cover" including glasshouse, greenhouse, and polytunnel; **Non-fruit, but will include fruit and forestry nursery (inseparable at source); Source: StatisticsNZ (business demographics); Coriolis analysis*

There is declining on-farm employment in vegetable and horticulture, with outdoor, nursery and flowers all trending down

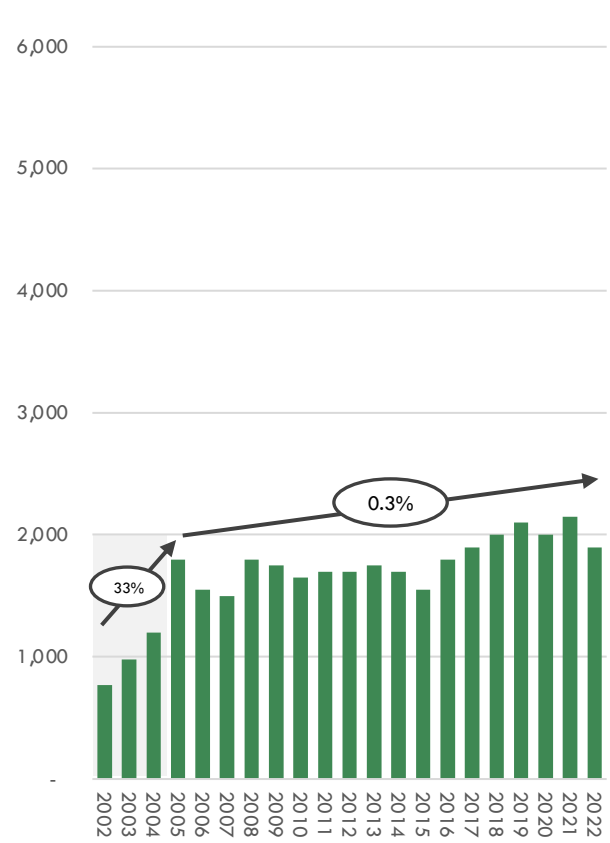
NUMBER OF EMPLOYEES BY SECTOR

Headcount; 2002-2022

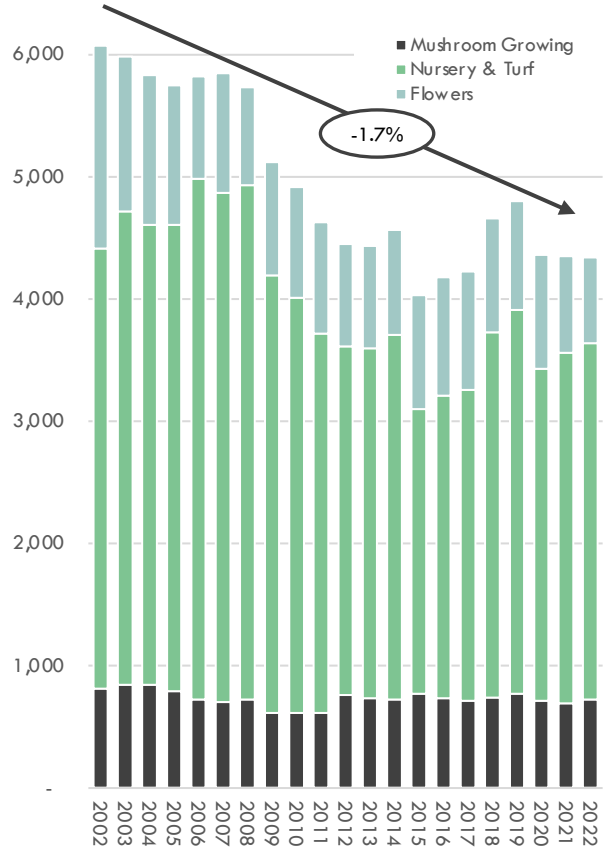
OUTDOOR VEGETABLES



GLASSHOUSE VEGETABLES*



ALL OTHER HORTICULTURE**



Note: Data is PAYE employees; does not include "owner operator" farmers; Source: StatsNZ (business demographics); Coriolis analysis

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PAGES 206-241

New Zealand is globally competitive in cattle meat and dairy

New Zealand has a large, highly capable cattle production system that is globally competitive, but under significant pressure to reduce emissions

- The New Zealand cattle industry has access to all required capabilities across the supply chain
- New Zealand has a strong position in the global dairy industry, and a secondary position in meat, but the environment is becoming more challenging
- While not every driver of the cattle chain is perfect, in aggregate New Zealand's capabilities in the cattle chain lead to high competitiveness

New Zealand's cattle produce a lot more beef or dairy than the relatively small local population can consume; therefore it is a major exporter of these surpluses to deficit regions

- New Zealand has flat domestic dairy consumption (at best) and declining domestic beef consumption, with all excesses going to export markets
- Competitiveness is calculated at the border; New Zealand clear capabilities in the cattle chain lead to global competitiveness in meat and especially dairy

The New Zealand cattle system is a major land user; within this, market forces shift production between meat and dairy

- The New Zealand pastoral based cattle system uses about ~40% of all land; dairy uses 6.5% (plus feed) while cattle/sheep use 33%
- Cattle numbers were growing in New Zealand for a long time; however, growth appears to have plateaued at around 10m head
- The New Zealand cattle system has shifted between a meat and a dairy focus multiple times in its history

The New Zealand cattle industry is at an inflection point; the path forward is clear but controversial (or controversial but clear)

The amount of dairy produced by the New Zealand system is a function of a handful of key drivers, primarily herds, cows and milk per cow

New Zealand is moving to fewer, larger farms

- Dairy is moving to fewer, larger herds through falling herd numbers (-1.1% CAGR 75-21) and growing average herd sizes (3.0% CAGR 75-21)
- The dairy industry has stopped expanding area (stable-to-declining hectares) and is no longer increasing animal density (flat cows/hectare)

The total number of milk cows plateaued and has been in decline for the last decade

- Dairy cow numbers in New Zealand had a long run of growth which appears to have come to an end and the industry has stopped expanding cow numbers

The New Zealand dairy system appears to have upside on milk per cow based on the performance of peers

- Milk per cow continues to grow: the current New Zealand dairy farming system produces very low milk per cow relative to other countries
- Total New Zealand milk production growth stalled around 2015
- Between 1990 and 2015, New Zealand went from Japanese levels of total milk production to almost producing as much milk as France today (but at German animal densities)
- Holding New Zealand milk production constant, different yields would lead to different cow numbers
- In terms of milk per cow, New Zealand is today where many peer group countries and regions were in the 1950's or 60's

New Zealand cattle meat production continues to grow

- New Zealand has growing numbers of cattle processed across shifting cattle meat yields leading to growing production
- New Zealand still has a large number of small cattle producing farms; unlike other sectors (e.g. vegetables), structural changes occur slowly
- Relative to a wide climatic peer group, New Zealand produces a large number of small cattle

The New Zealand cattle industry has access to all required capabilities across the supply chain

NEW ZEALAND CAPABILITIES DRIVEN CATTLE SUPPLY CHAIN

SELECT FIRMS

PLANT GENETICS

BARENBRUG
DLF
PGG Wrightson Seeds
CORSON MAIZE
AGRICOM
RAGT
PIONEER BRAND PRODUCTS

VEHICLES/MACHINERY

JOHN DEERE
MASSEY FERGUSON
YAMAHA
TOYOTA
Hatzenbichler
GASCON
FENDT
moreni
POTTINGER
ALPEGO

FARM SUPPLIES

NEW ZEALAND FARM SOURCE
Fonterra Dairy for life
PGG Wrightson
Farmlands

FERTILISER

Ballance agri-nutrients
ravensdown

ANIMAL FEED

GLENCORE
VITERRA
NRM FEED TO SUCCEED
Weston Milling STOCKFEED
TAKAMINI FEEDS
Sharpes FARM FEEDS
Agrifeeds Balanced Nutrition Better Returns
nutrinza
GOLDEN GRAIN
advanced feed

FUEL & LUBRICANTS

Gulf
Allied Petroleum never run out
npd
RD petroleum
McFALL FUEL
SMF

ANIMAL HEALTH

zoetis
Boehringer Ingelheim
Elanco
MERCK Animal Health
BAYER

MILKING EQUIPMENT

Tetra Laval
LELY
GEA
Fullwood JOZ
WAIKATO MILKING SYSTEMS

LAND IN DAIRY

1.7m hectares

PEOPLE IN DAIRY FARMING

~11,000 farmers
~25,200 employees

CATTLE GENETICS

LIC

FENCING

SUMMIT STEEL & WIRE
GALLAGHER
GOLDPINE

200+ sawmills

FARMER ORGANISATIONS

DairyNZ
FEDERATED FARMERS OF NEW ZEALAND
beef+lamb new zealand

MILK PROCESSING

Fonterra
TATUA
Synlait
伊利 Yili
Talley's
OpenCountry
a2 MILK COMPANY
CHINA ANIMAL HUSBANDRY
Westland Milk Products
goodman fielder
MIRAKA
Maui

MEAT PROCESSING

SILVER FERN FARMS
ALLIANCE FARMERS' PRODUCE
ANZCO FOODS
Talley's
Greenlea
WILSON HELLABY
UNIVERSAL BEEF
TAYLOR PRESTON
BXFOODS

SHIPPING

MAERSK LINE
HAMBURG SÜD
msc
CMA CGM
Hapag-Lloyd
EVERGREEN
COSCO SHIPPING
YANG MING

LOGISTICS

CODA
KOTAHI
MAINFREIGHT

INDUSTRY ORGS.

DCANZ DAIRY COMPANIES ASSOCIATION OF NEW ZEALAND
mia Meat Industry Association
FG:C NEW ZEALAND FOOD & GROCERY COUNCIL

Source: Coriolis

New Zealand has a strong position in the global dairy industry, and a secondary position in meat, but the environment is becoming more challenging

SWOT ANALYSIS: NEW ZEALAND CATTLE DAIRY & MEAT SYSTEM

STRENGTHS	WEAKNESSES
- Low cost predominantly pasture-based production system - Relatively consolidated meat processing industry with three large processors (SFF, Talley's and ANZCO) and 5-6 mid size processors - Highly consolidated dairy industry with national champion Fonterra with resources to address global markets and opportunities; strong second tier of growing firms, many with global investment - Huge dairy processing plants at truly global scale; 8/10 largest milk dryers are in NZ - Largest dairy exporter in the world by value; major beef exporter - High standards of food safety and animal welfare - Over 100+ years experience in exporting meat and dairy - Strong position in global dairy industry outside Europe and North America	- Many/most of "our eggs in one basket" in dairy (Fonterra); Fonterra is limited in its ability to add value due to the risks associated with competing with its own customers - No rich dairy or cured meats cultural heritage or tradition to draw from for new product development (versus France, Italy or Spain) - Only a mid-large sized milk and meat producer, similar in size to many European countries, with many key competitors being larger in an absolute sense (vs. India, Brazil or US) - Limited defensibility of current commodity and ingredient position - Significant trade barriers limiting New Zealand entry to many markets - Dairy land price increases leading to decreased international competitiveness (return on capital) - Despite strong food safety systems & reputation, a few high-profile issues (e.g. whey (2013), nitrates, methane)
OPPORTUNITIES	**THREATS/ISSUES/CHALLENGES/RISKS**
- Ongoing economic development in Africa ("Nigeria is the next China") - Growing global population with growing incomes demanding more protein, particularly dairy and meat - Growing dairy product consumption in developing world; dry and tropical countries not able to produce all the milk they consume - Fast following strong investment going into methane-mitigation technologies, systems and processes across Anglo-European science and innovation systems - Increasing currently low (1) milk per cow and (2) meat per cow to Irish or even German levels - Additional supplementary feed both (1) smoothing seasonal peak increasing total milk production and (2) animal weight at slaughter and thereby improving return on assets at all stages of chain - Chinese dairy and meat consumption per capita continuing to grow - Asians more likely to be dairy intolerant, therefore different consumption patterns (e.g. yoghurt drinks; infant formula) - On-going consolidation of the global dairy and meat industries - Changing global weather patterns (also a threat) - Further investment in in-market activities - Removal of agricultural subsidies into Europe (may also be a threat)	- Total cattle numbers in New Zealand have stalled for a range of reasons - Veganism and environmentalism as "religion for the non-religious" leading to anti-cow attitudes - Cows - as they are currently managed - are a major contributor to global methane emissions - Ongoing animal rights revolution changing expectations by some consumers in some markets - Precision fermentation - Intensive feedlot model (e.g. California) both improving productivity faster than pasture system (e.g. NZ/AU) and at the same time more able to address methane and manure issues - Southern South America rapidly implementing the AU/NZ pasture system (e.g. Uruguay, Brazil) - Push-back due to environmental concerns (e.g. water pollution, groundwater use, methane) - The boom/bust economic cycle expresses itself in China - Experience of Japan & South Korea suggest Chinese dairy and meat consumption growth has another few years to run; after this point, China will likely be self-sufficient and possibly a major exporter - EU regulatory changes leading to increased production by some countries (e.g. Ireland) - Despite a vocal minority, most developing country consumers currently perceive meat and dairy as healthy; however, science, attitudes or opinions could turn negative - Adoption of genetically modified animals or GM feed by poor countries, changing international competitive dynamics - Alternative dairy and alternative meat

While not every driver of the cattle chain is perfect, in aggregate New Zealand's capabilities in the cattle chain lead to high competitiveness

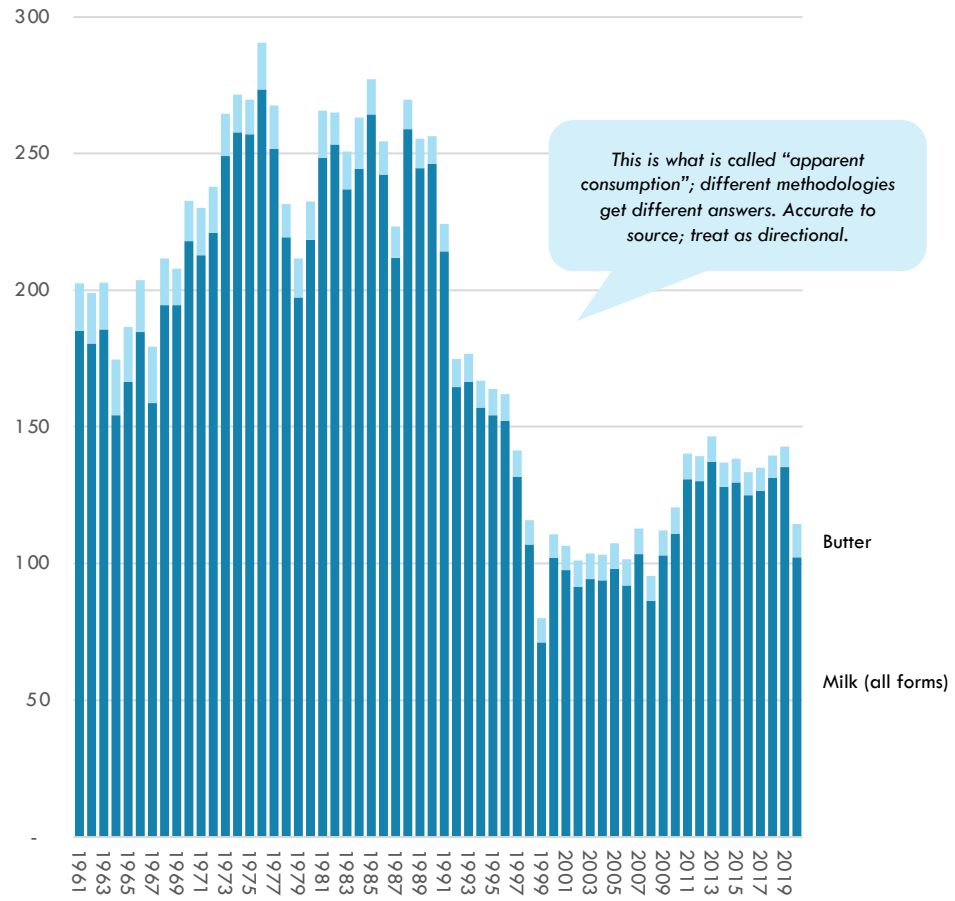
DRIVERS OF AN INTERNATIONALLY COMPETITIVE BIOECONOMY: CATTLE

Source: Coriolis

New Zealand has flat domestic dairy consumption (at best) and declining domestic beef consumption, with all excesses going to export markets

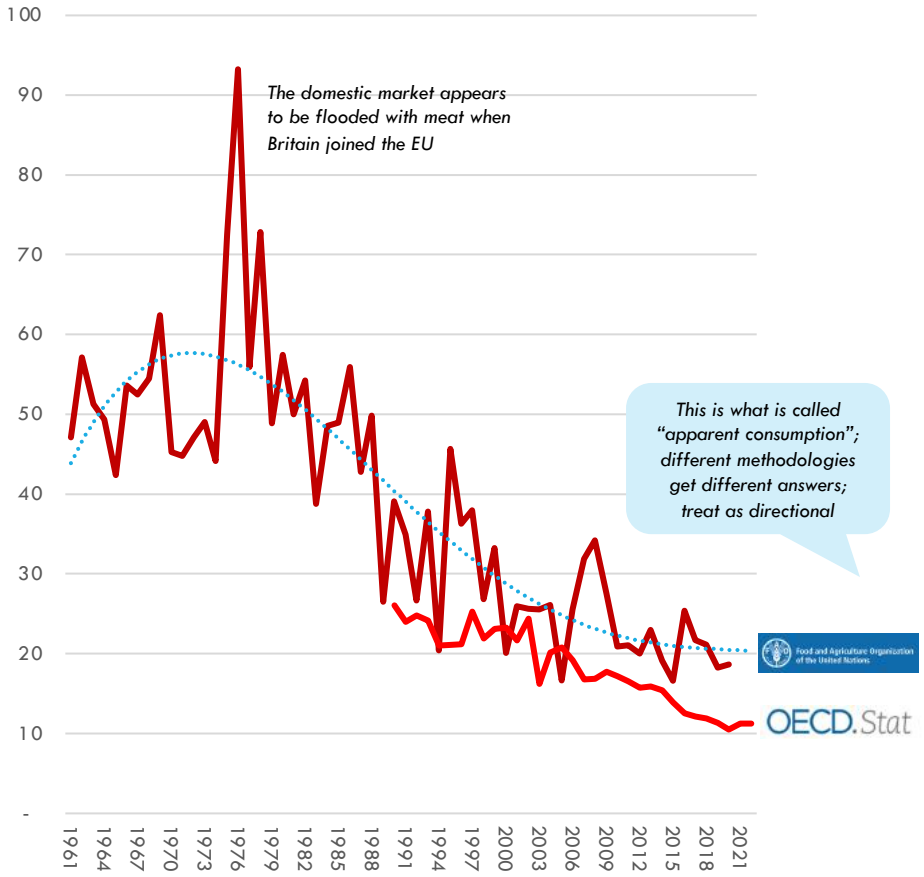
NZ DOMESTIC DAIRY SUPPLY

Kcal/person/day; 1961-2021



NZ CATTLE DOMESTIC MEAT/CAPITA

Kg/person; 1961-2021

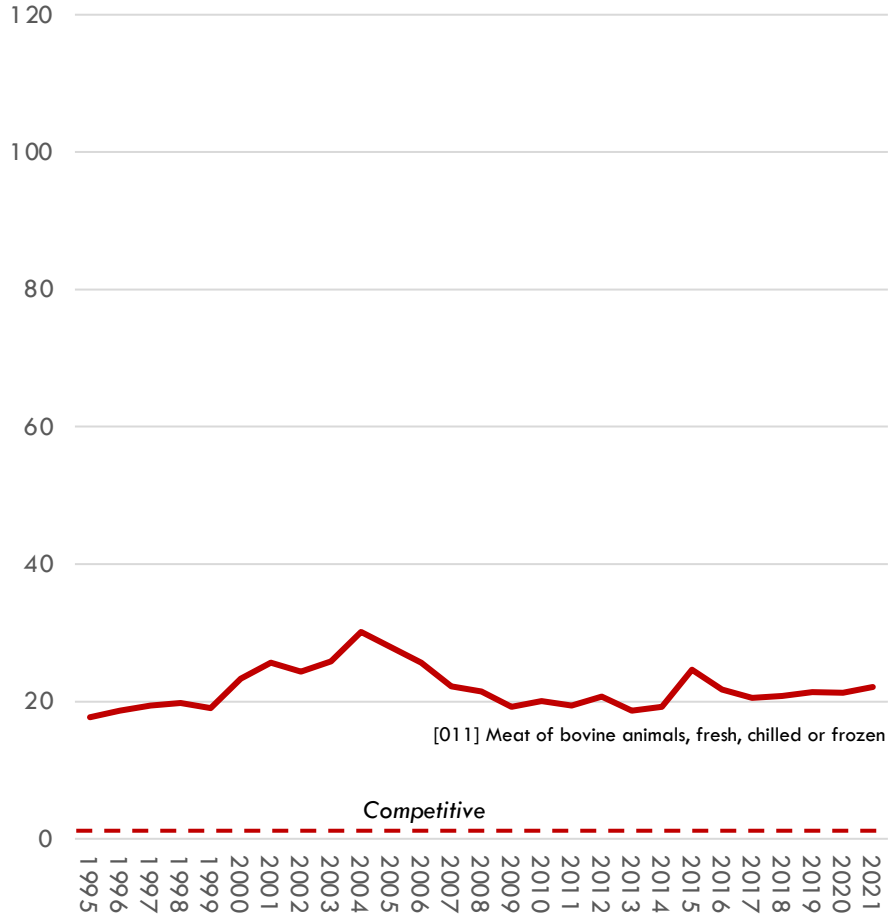


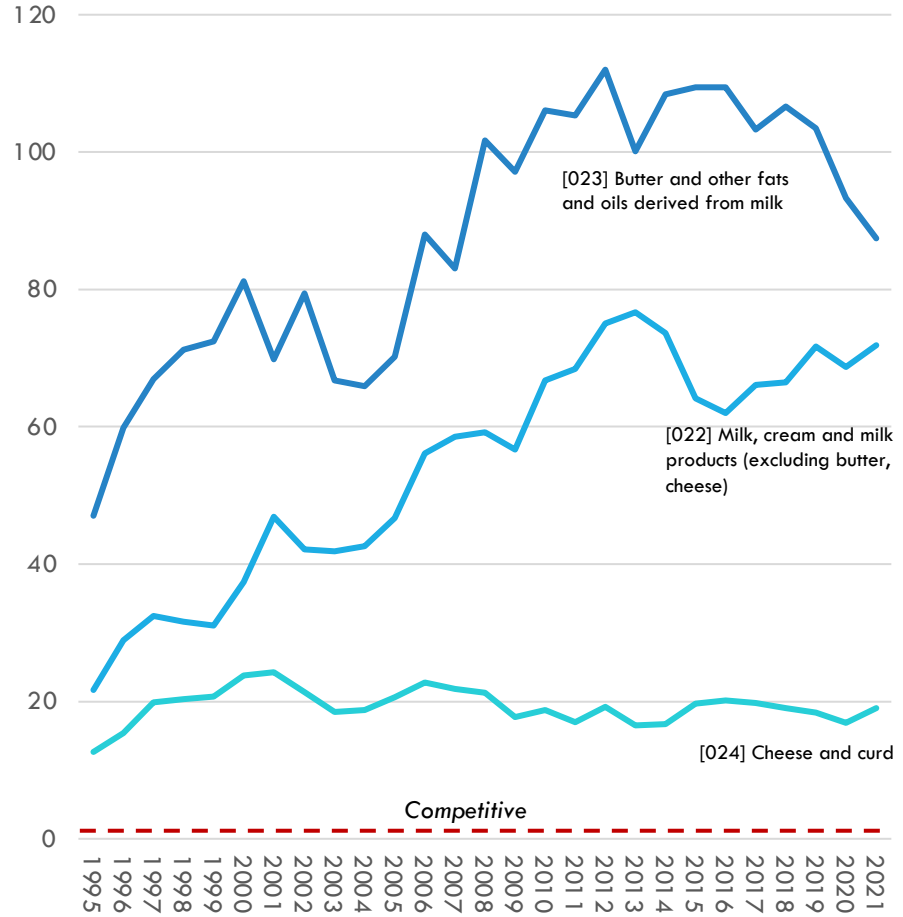
Source: UN FAOStat; Coriolis analysis

Competitiveness is calculated at the border; NZ clear capabilities in the cattle chain lead to high global competitiveness in meat and especially dairy

ANNUAL REVEALED COMPARATIVE ADVANTAGE INDEX: NEW ZEALAND BY SELECT SITC3

1=Average of New Zealand across all exports; 1996-2022





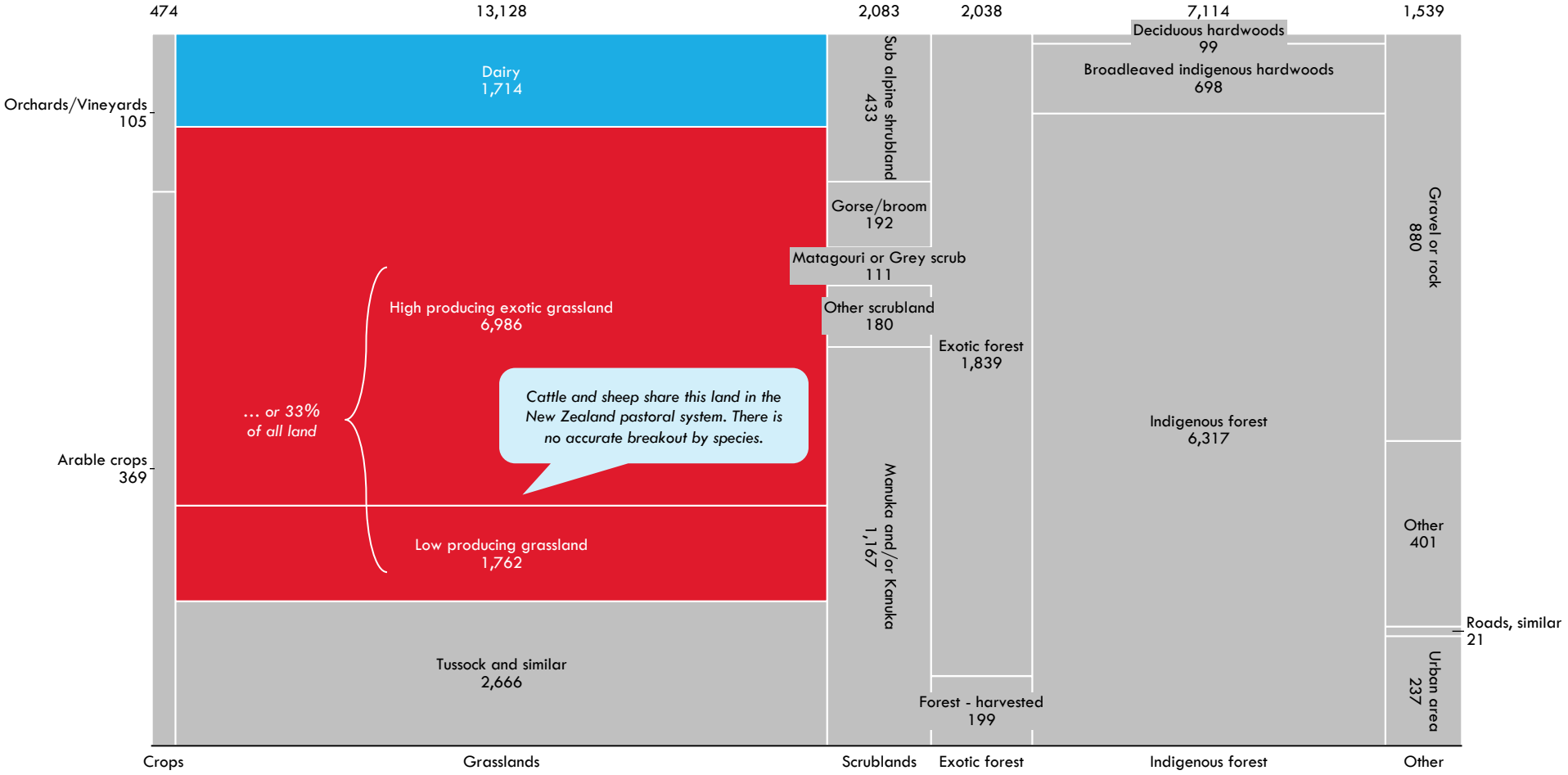
Source: UNCTAD STAT; Coriolis analysis

The New Zealand pastoral based cattle system uses about ~40% of all land; dairy uses 6.5% (plus feed) while cattle/sheep use 33%

NEW ZEALAND LAND AREA BY TYPE

(Ha; 000; 2018 or as available)

TOTAL = 26,376 (000) hectares

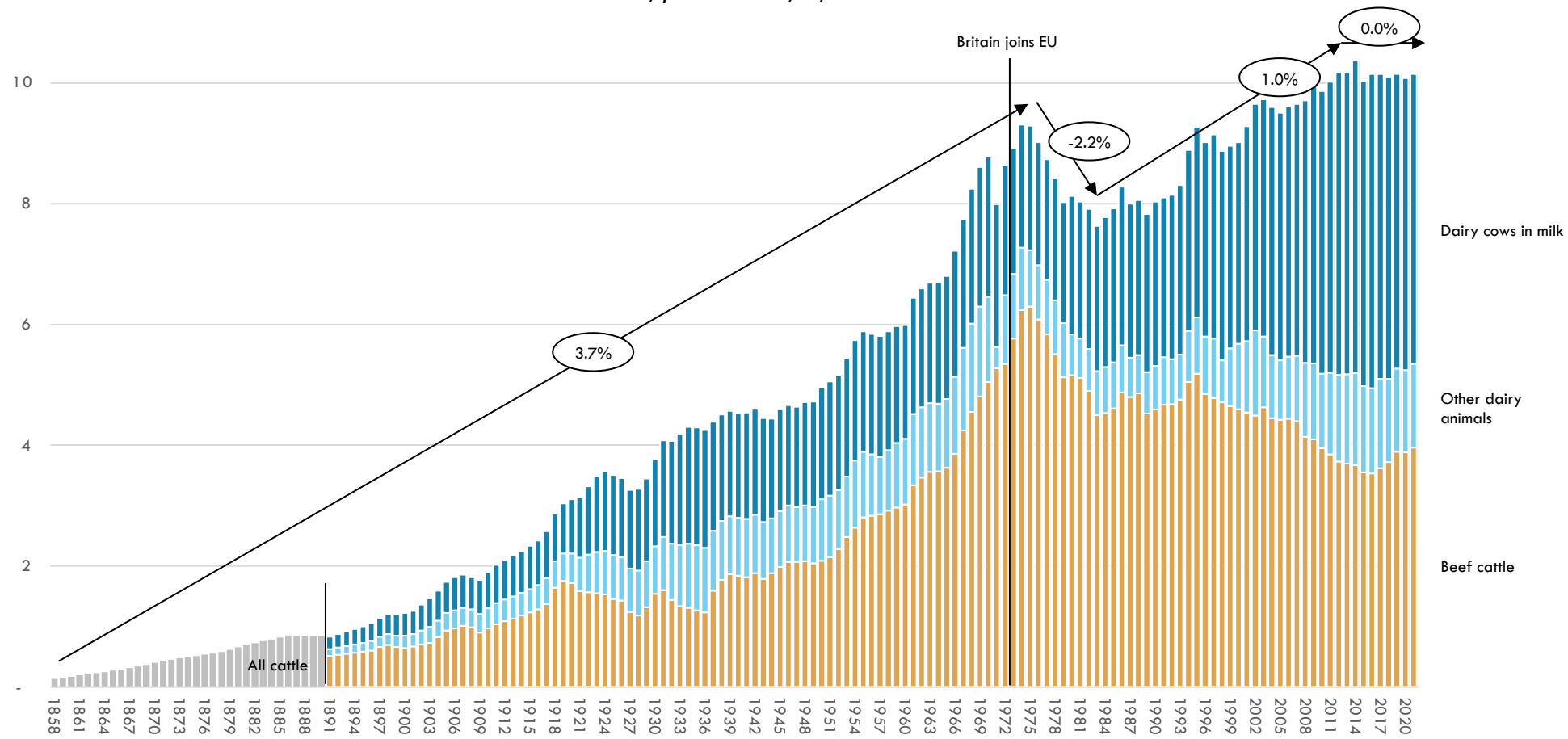


Note: Some "tussock and similar" land will be used for cattle, but most was 'retired"; as this land is low productivity, it is not really material to the answer; Source: MftE/StatsNZ New Zealand Land Cover Data Base (LCDB5); DairyNZ ("Effective hectares in dairy); Coriolis analysis

Cattle numbers were growing in New Zealand for a long time; however, growth appears to have plateaued at around 10m head

NZ CATTLE INVENTORY

Head; point-in-time; m; 1858-2021

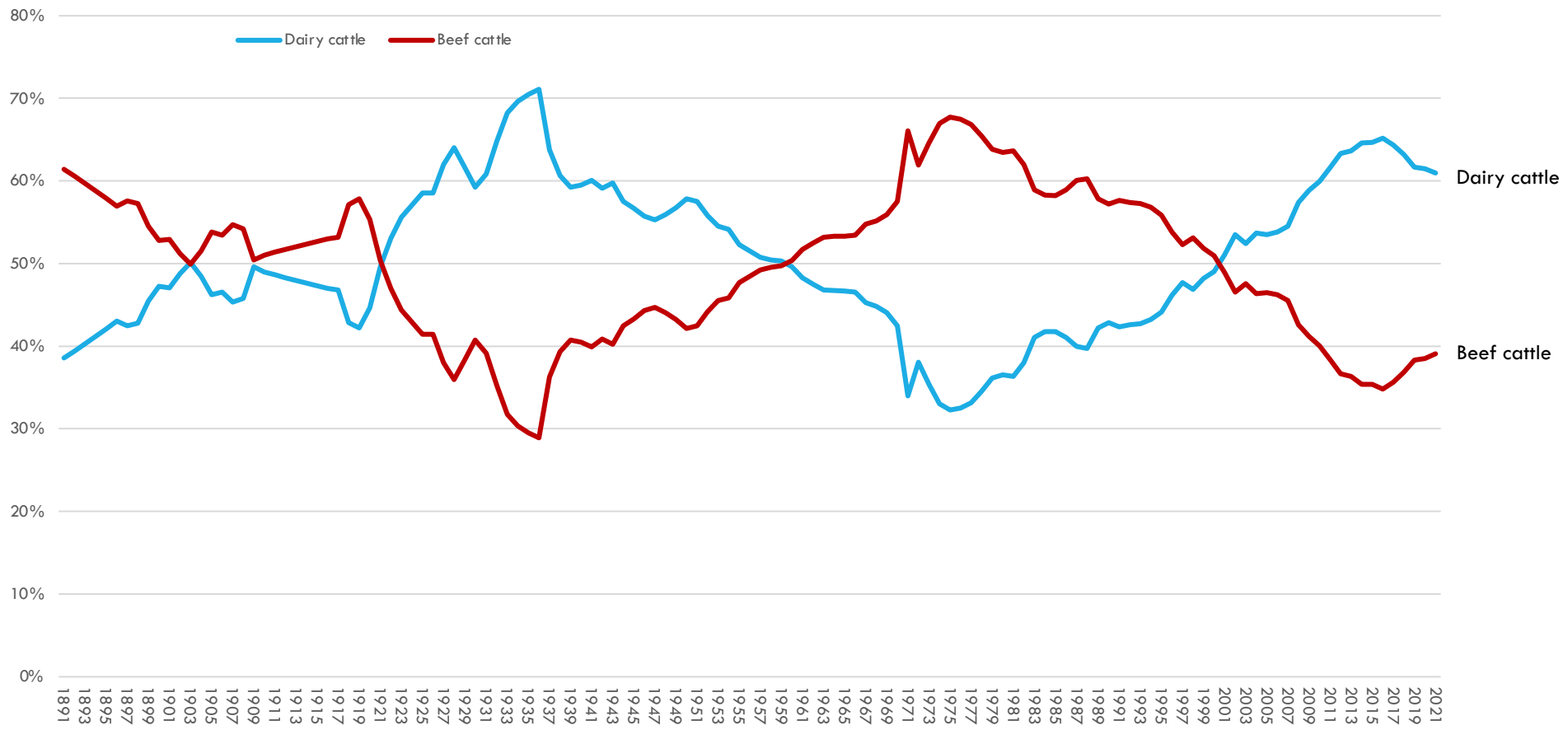


Note: Some missing data extrapolated; Source: StatisticsNZ (various publications); UN FAOStat; Coriolis modelling and analysis

The New Zealand cattle system has shifted between a meat and a dairy focus multiple times in its history

% OF NZ CATTLE INVENTORY BY SECTOR FOCUS

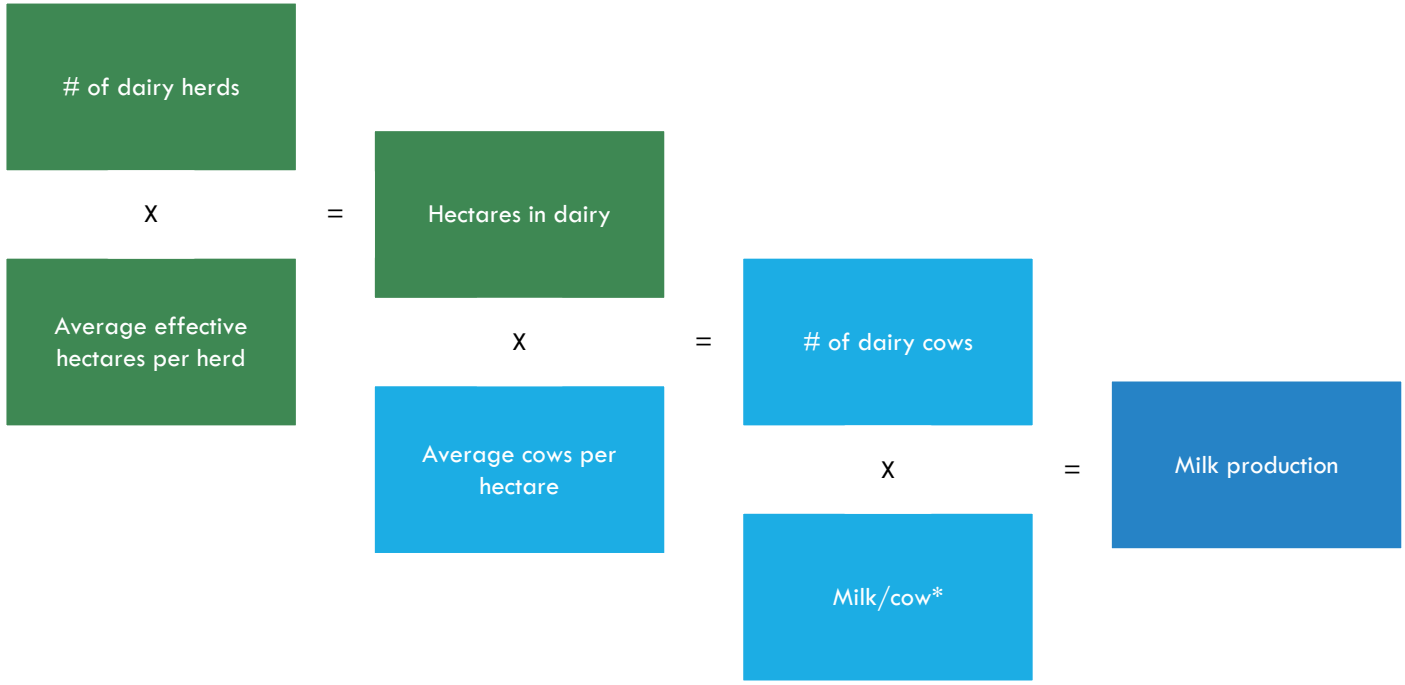
Head; point-in-time; m; 1891-2021



Note: Some missing data extrapolated; Source: StatisticsNZ (various publications); UN FAOStat; Coriolis modelling and analysis

The amount of dairy produced by the New Zealand system is a function of a handful of key drivers, primarily herds, cows and milk per cow

KEY DRIVERS: NEW ZEALAND DAIRY BIOMASS

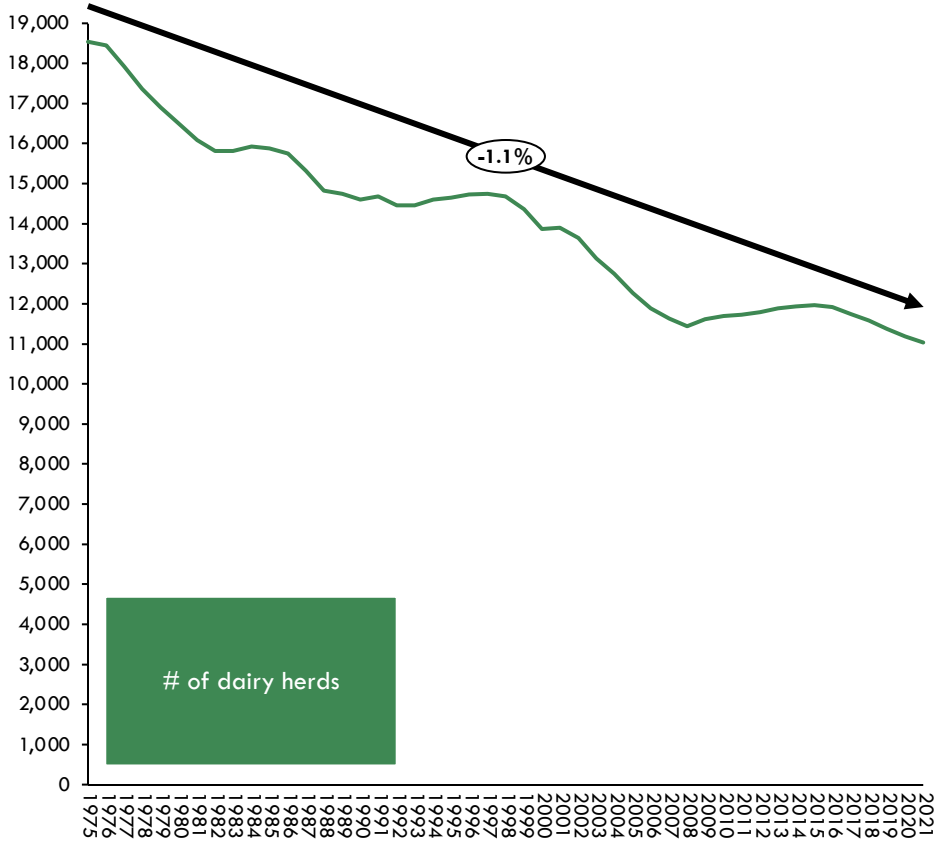


* *Milk per cow is a function of grass/hectare and supplementary feed per hectare*

Dairy is moving to fewer, larger herds through falling herd numbers (-1.1% CAGR 75-21) and growing average herd sizes (3.0% CAGR 75-21)

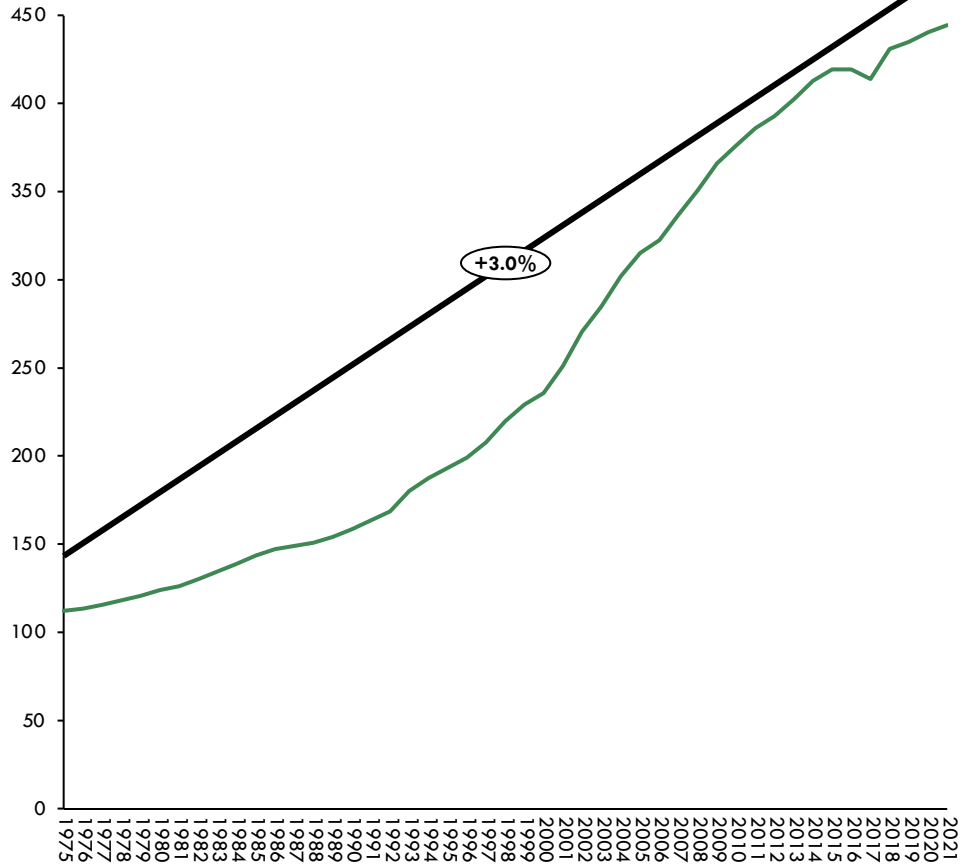
OF COW DAIRY HERDS

Herds; 1975-2021 (latest available)



AVERAGE COWS/HERD

Head; 1975-2021 (latest available)

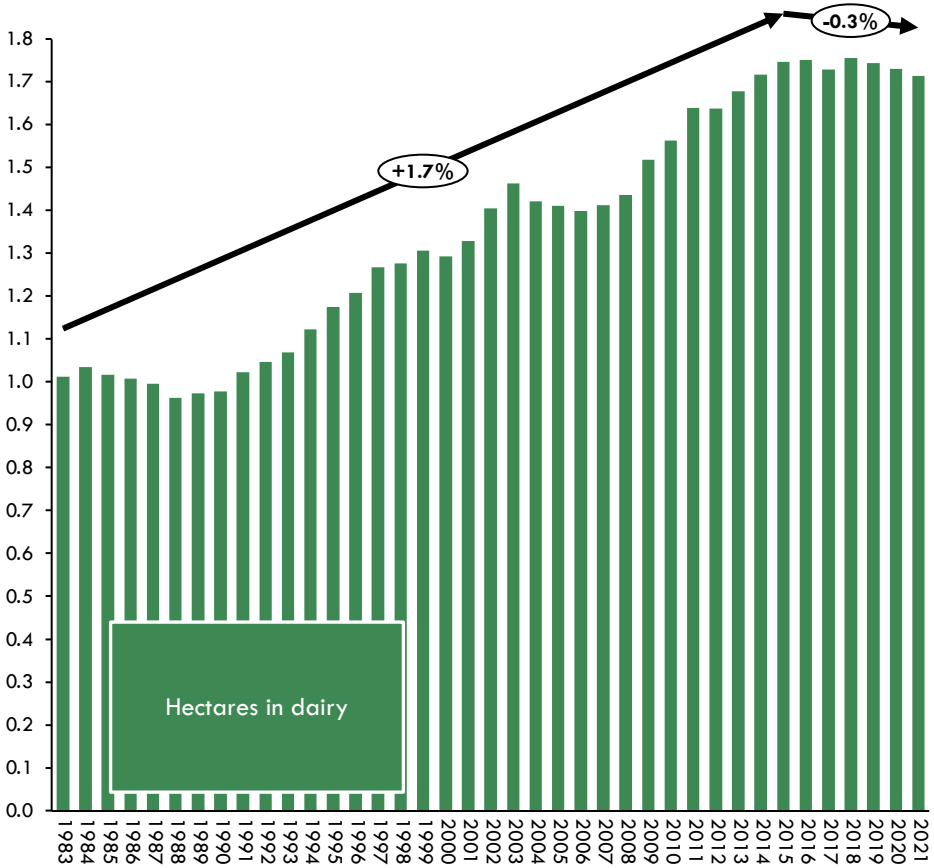


Source: DairyNZ (Dairy Statistics); Coriolis analysis

The dairy industry has stopped expanding area (stable-to-declining hectares) and is no longer increasing animal density (flat cows/hectare)

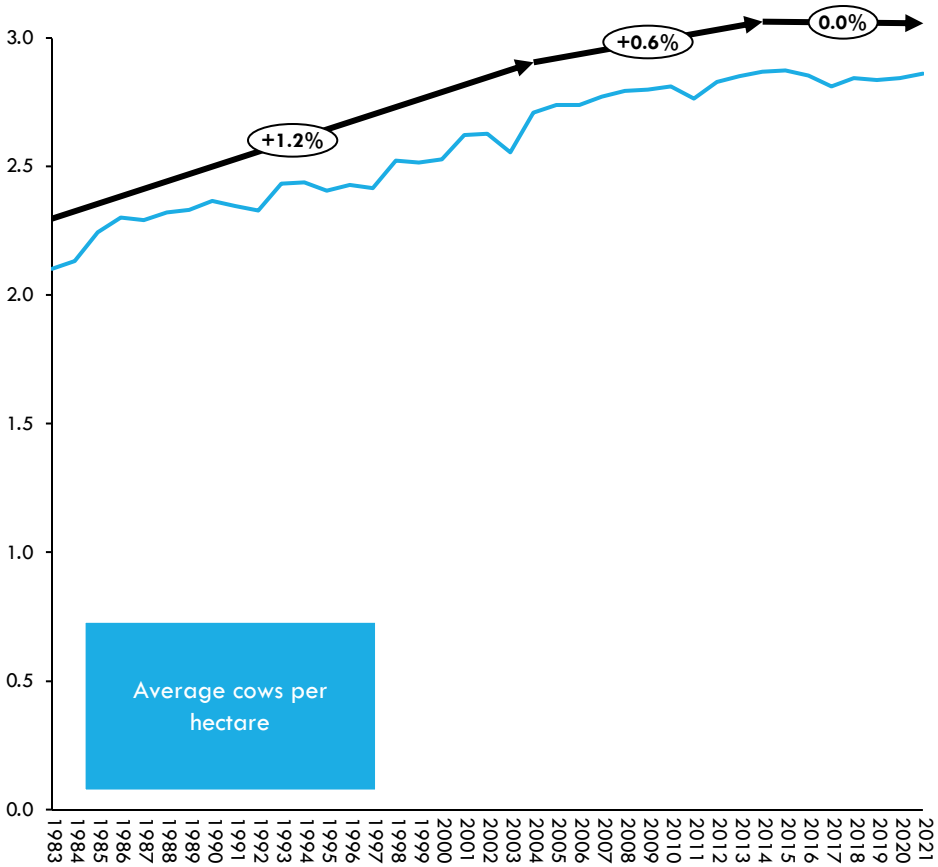
EFFECTIVE COW DAIRY AREA

Hectares; m; 1983-2021 (latest available)



AVERAGE COWS/HECTARE

Head/hectare; 1983-2021 (latest available)



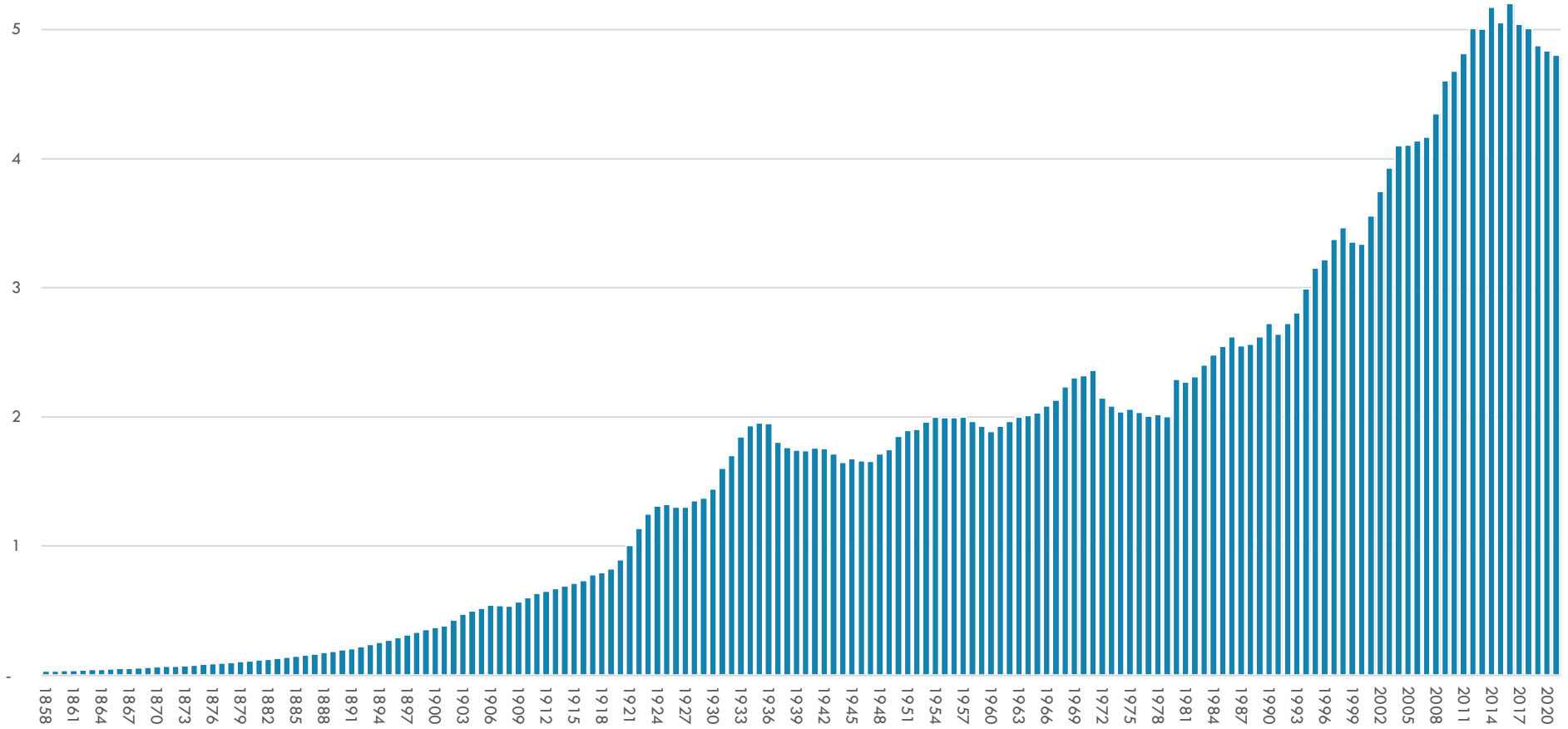
Source: DairyNZ (Dairy Statistics); Coriolis analysis

CORIOLIS

*Dairy cow numbers in New Zealand had a long run of growth which appears to have come to an end**

NZ DAIRY COW IN MILK INVENTORY

Head; point-in-time; m; 1858-2021

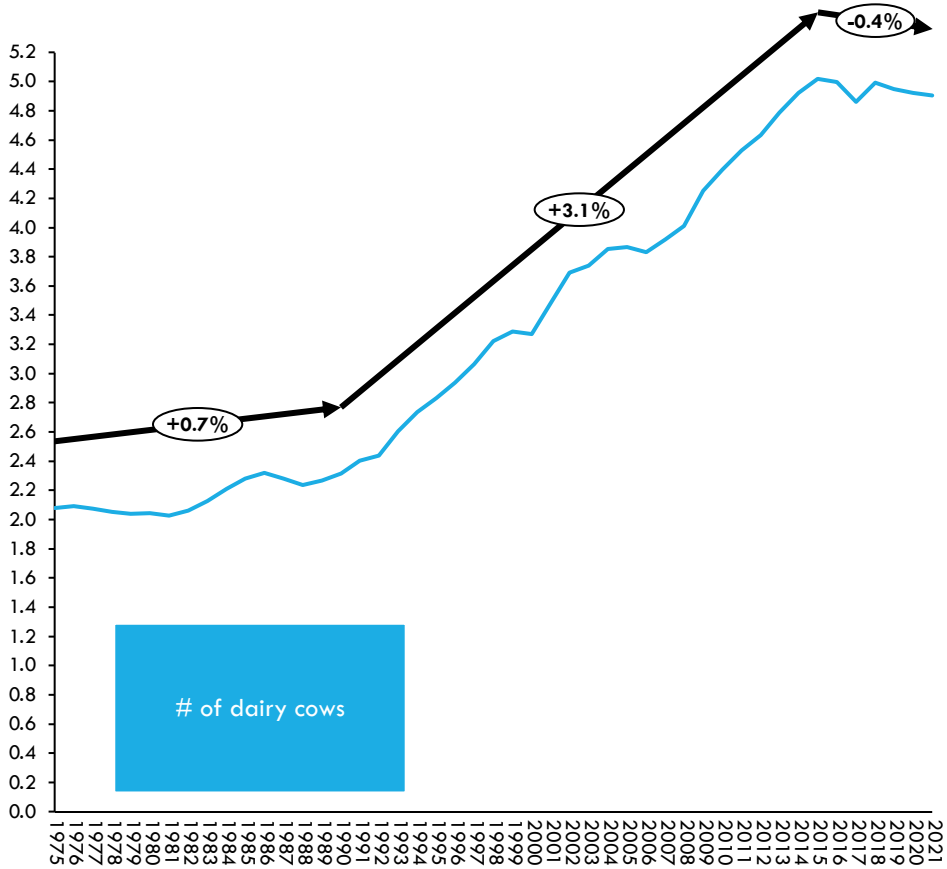


** Or not; the periods 1936+ (Great Depression) and 1973+ (Britain joining the EU) both show stalls followed by returns to growth; Note: Significant missing early data extrapolated; early data includes "house cows"; Source: StatisticsNZ (various publications); UN FAOStat; Coriolis modelling and analysis*

The dairy industry has stopped expanding cow numbers, however milk per cow continues to grow as a result of farm and feed strategies and genetics

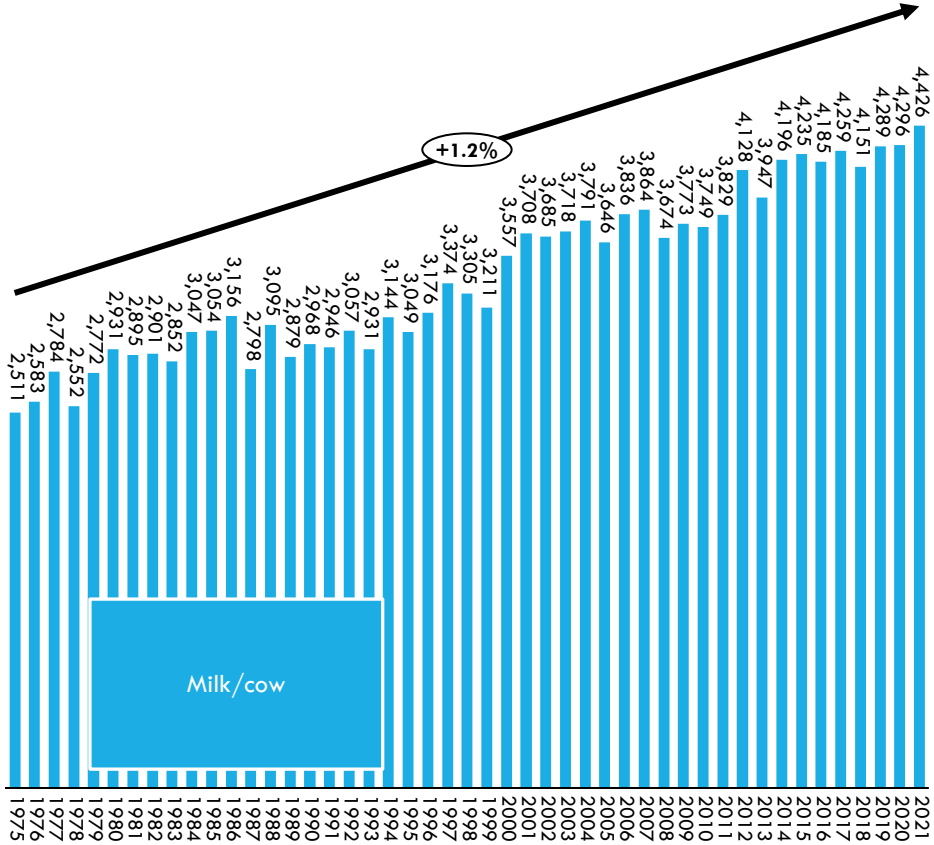
DAIRY COWS

Head; m; 1975-2021 (latest available)



AVERAGE MILK/COW

Litres/head; 1975-2021 (latest available)

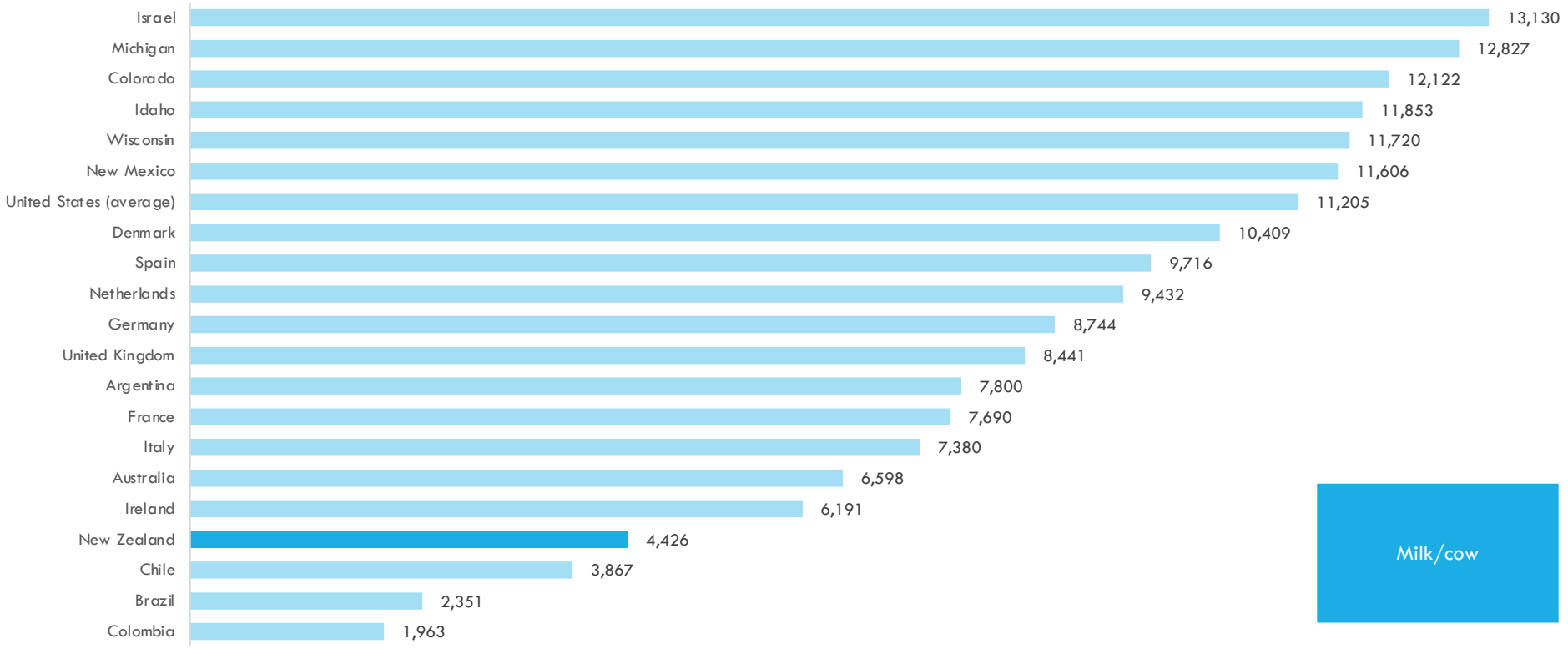


Source: DairyNZ (Dairy Statistics); Coriolis analysis

The current New Zealand dairy farming system produces very low milk per cow relative to other countries

AVERAGE MILK PER DAIRY COW

Litres/cow; 2021 or 2022

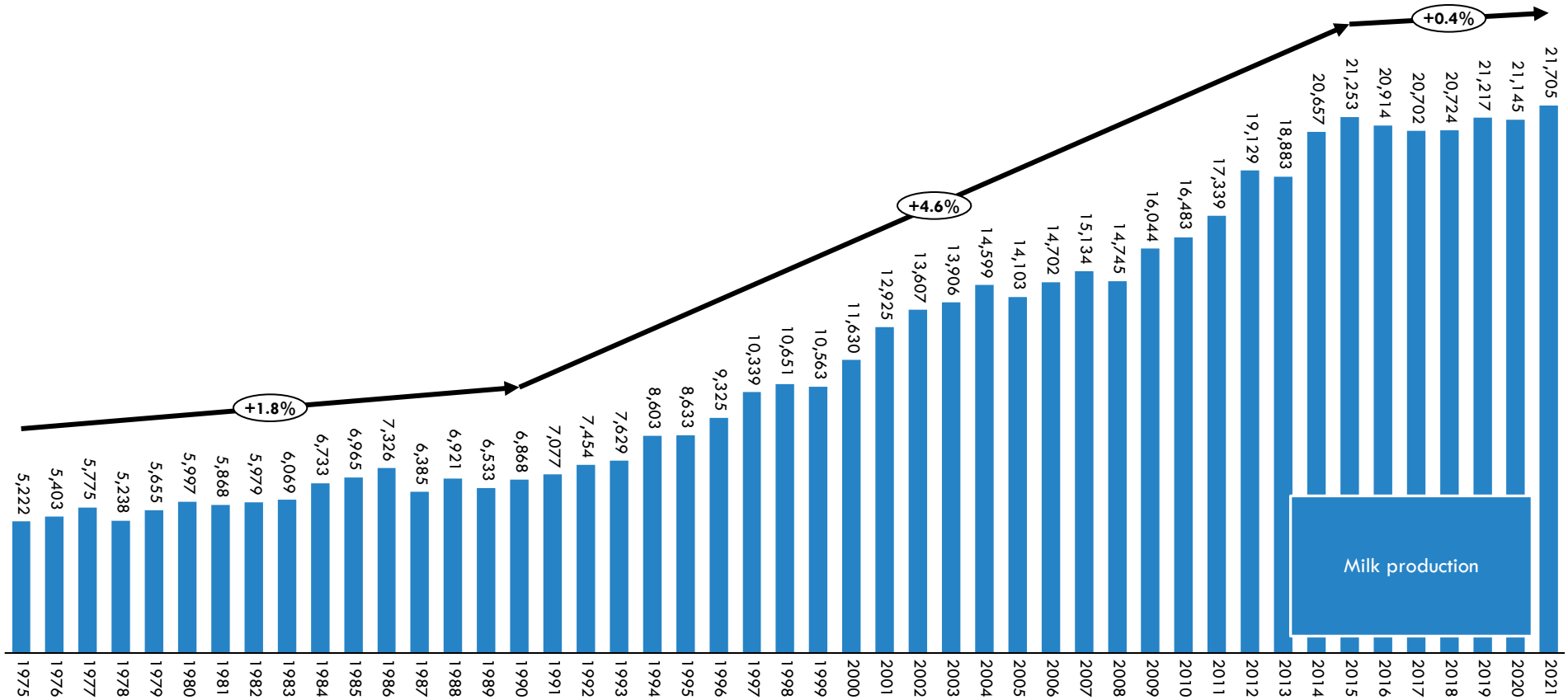


Note: Converts milk at 0.97kg=1l and 1lg = 0.453592kg; Source: DairyNZ; UN FAOStat (database); USDA NASS (database); Coriolis analysis

Total New Zealand milk production growth stalled around 2015

DAIRY COW MILK PRODUCTION

Litres; m; 1975-2021 (latest available)

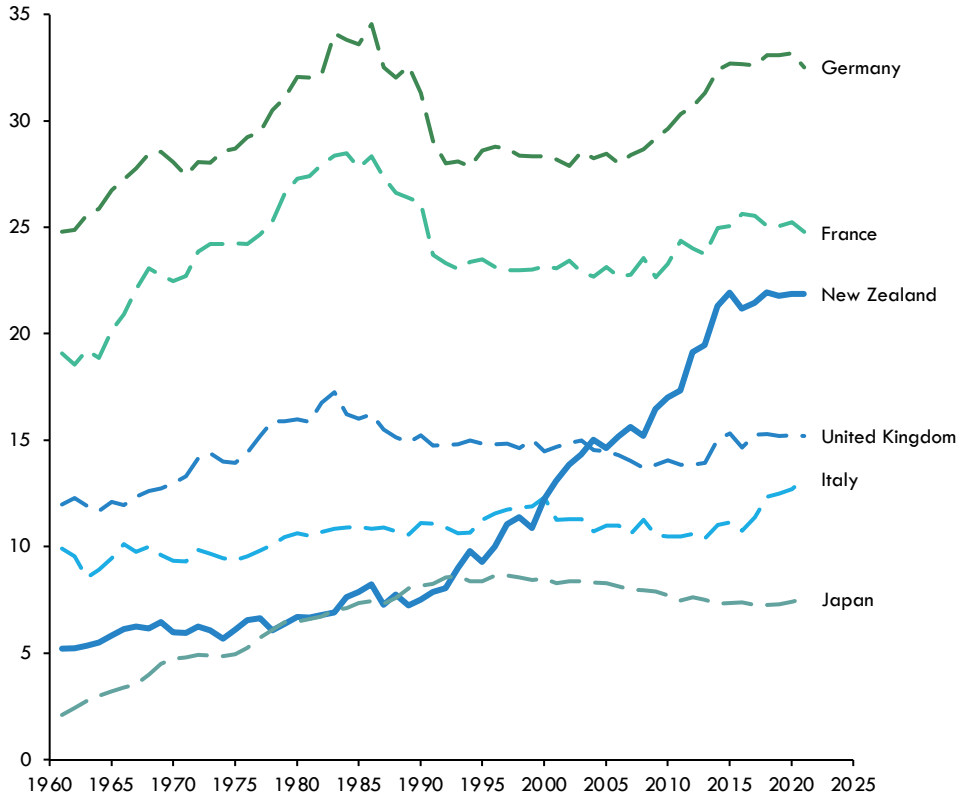


Source: DairyNZ (Dairy Statistics); Coriolis analysis

Between 1990 and 2015, NZ went from Japanese levels of total milk production to almost producing as much milk as France today

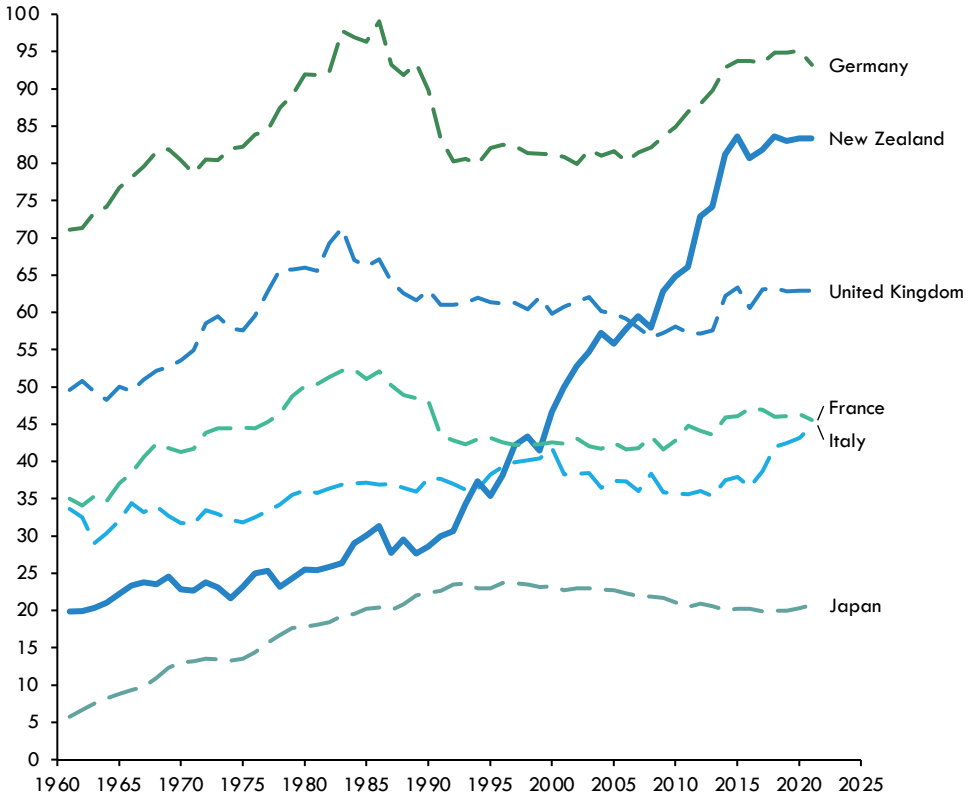
TOTAL DAIRY (COW) MILK PRODUCTION

Tonnes; m; 1961-2021 (latest available)



DAIRY (COW) MILK PROD. PER SQUARE KM

Tonnes/km^2; 1961-2021 (latest available)

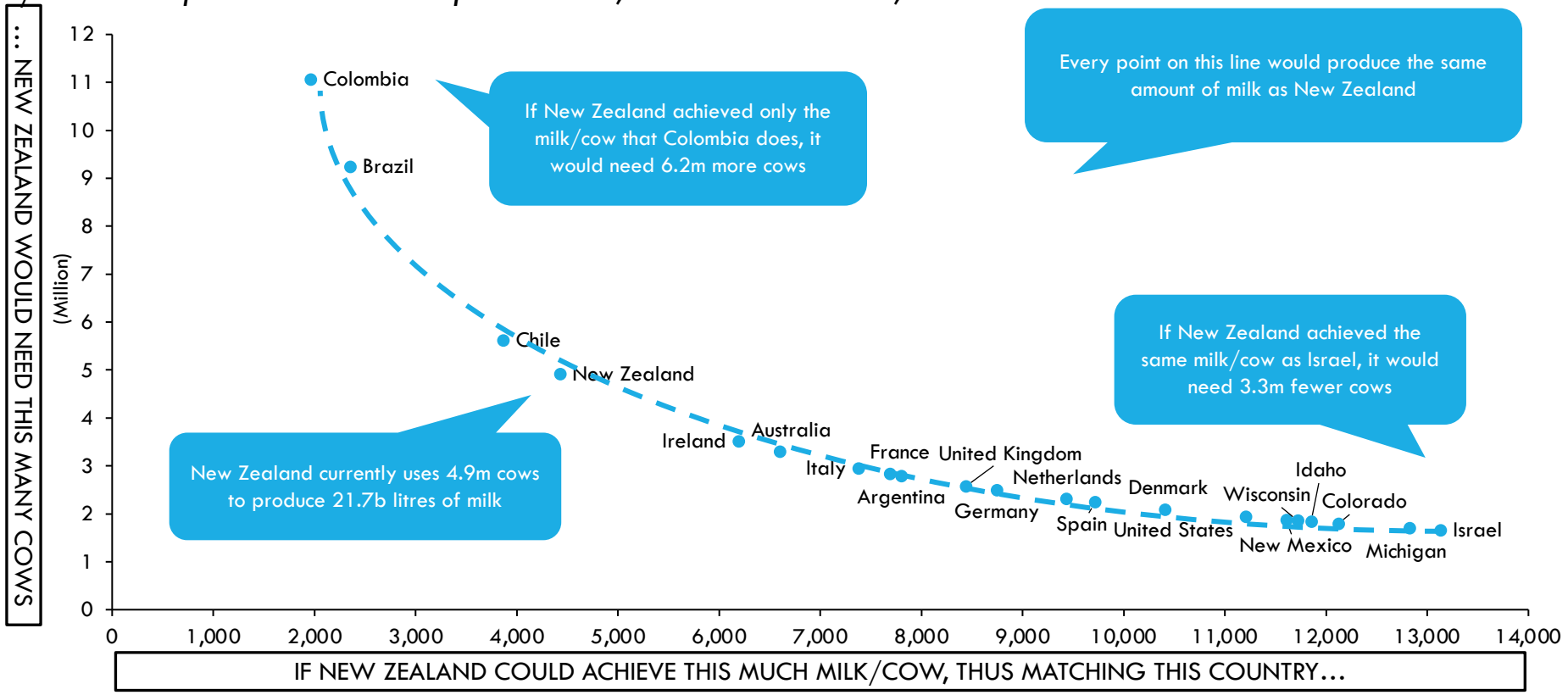


Source: DairyNZ; UN FAOStat (database); Coriolis analysis

Holding New Zealand milk production constant, different yields would lead to different cow numbers

HOW MANY COWS WOULD NEW ZEALAND NEED TO PRODUCE THE SAME AMOUNT OF MILK AS TODAY IF IT ACHIEVED A DIFFERENT YIELD PER COW?

Milk/cow vs. required cows needed produce 21,705m litres of milk; model

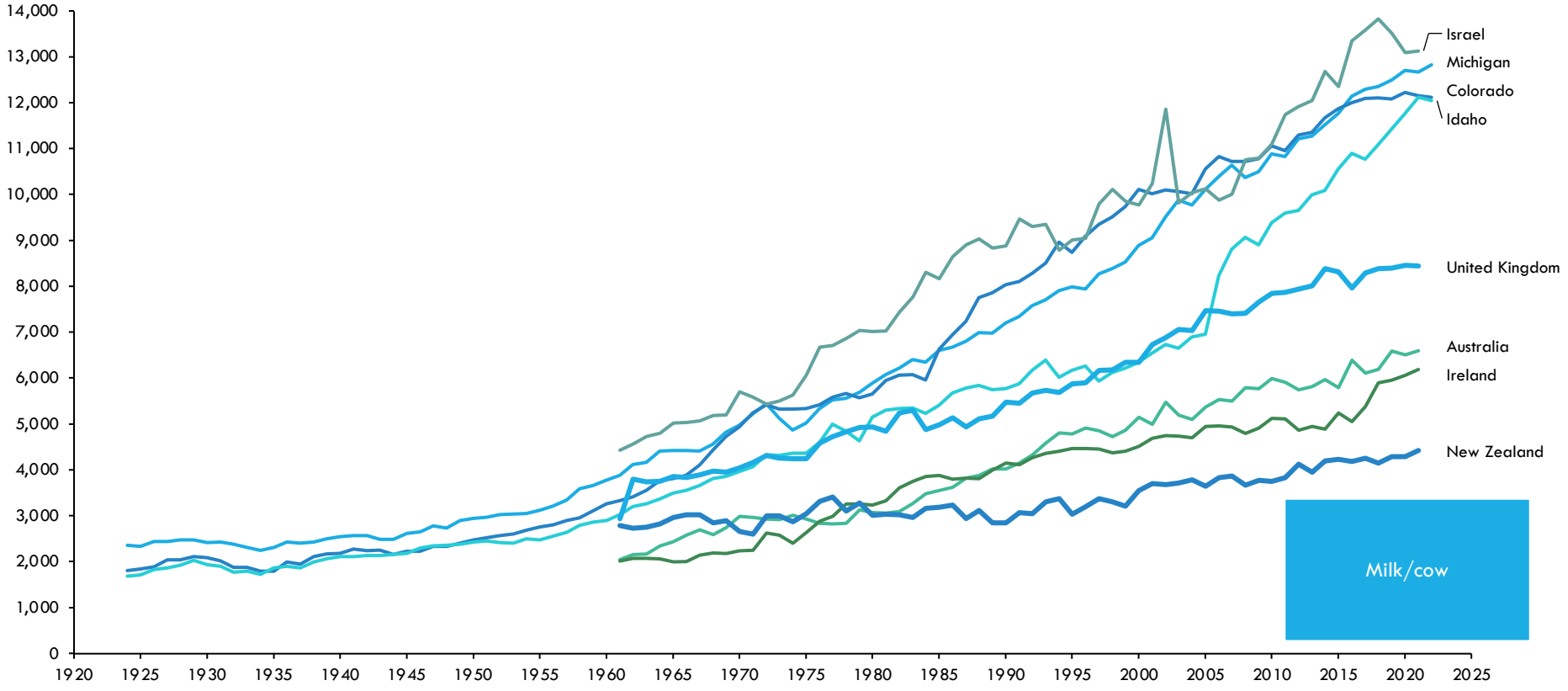


Note: Converts milk at 0.97kg=1l and 1lg = 0.453592kg; Source: DairyNZ; UN FAOStat (database); USDA NASS (database); Coriolis analysis

In terms of milk per cow, New Zealand is today where many peer group countries and regions were in the 1950's or 60's

AVERAGE MILK PER DAIRY COW

Litres/cow; 1925/1961- 2022

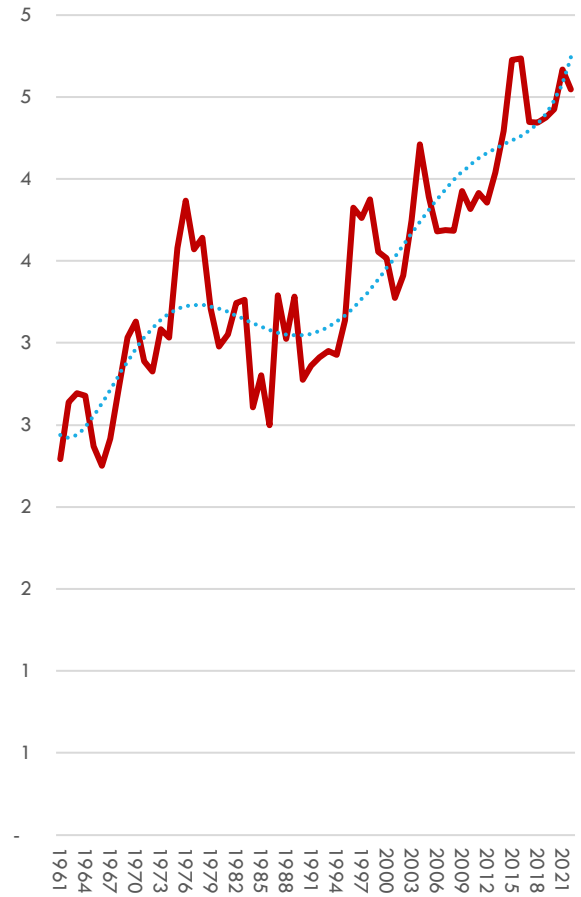


Note: Converts milk at 0.97kg=1l and 1lg = 0.453592kg; Source: DairyNZ (NZ 1997-2021); UN FAOStat (database) (NZ 1961-1996); USDA NASS (database); Coriolis analysis

New Zealand has growing numbers of cattle processed across shifting cattle meat yields leading to growing production

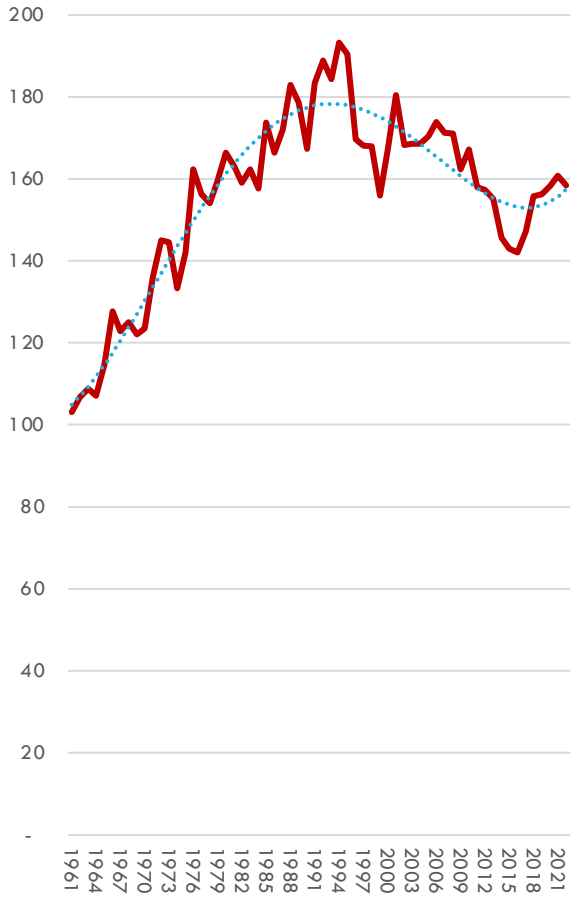
NZ CATTLE PROCESSED

Head; annual; 000; 1961-2021



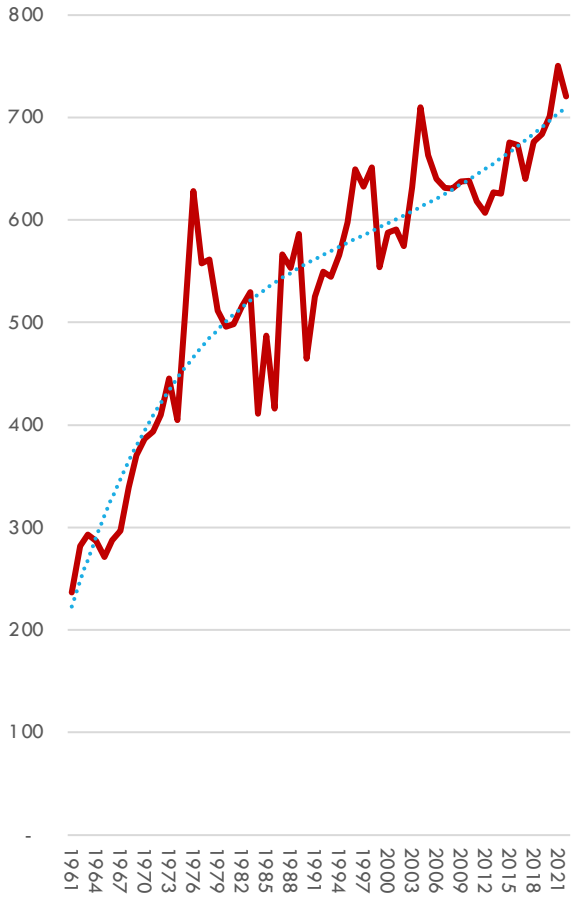
NZ CATTLE MEAT YIELD

Kg/head; 1961-2021



NZ CATTLE MEAT TONNES

Tonnes; 000; 1961-2021

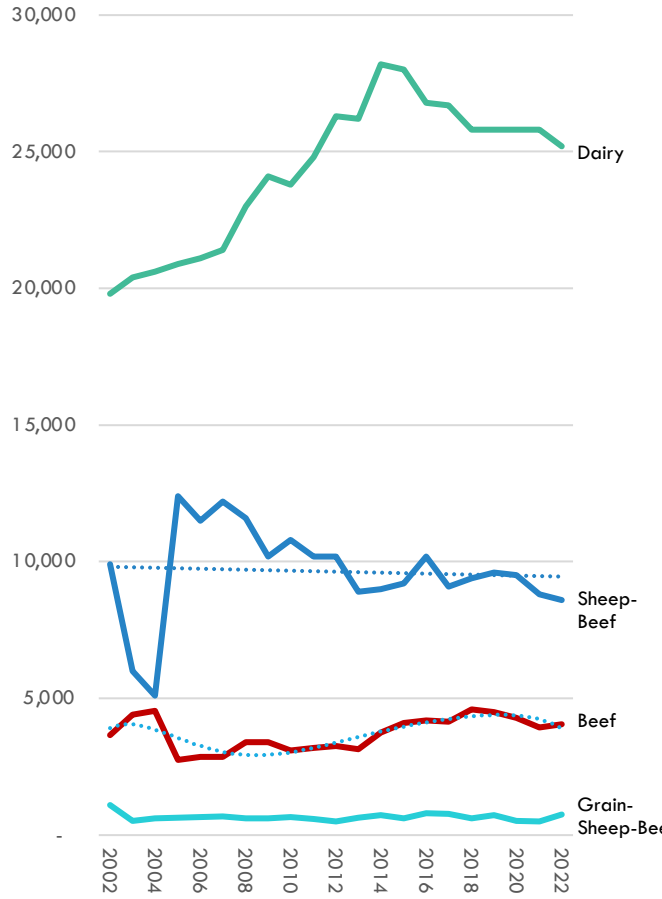


Source: StatsNZ Infoshare; UN FAOStat; Coriolis analysis

New Zealand still has a large number of small cattle producing farms; unlike other sectors (e.g. vegetables), structural changes occur slowly

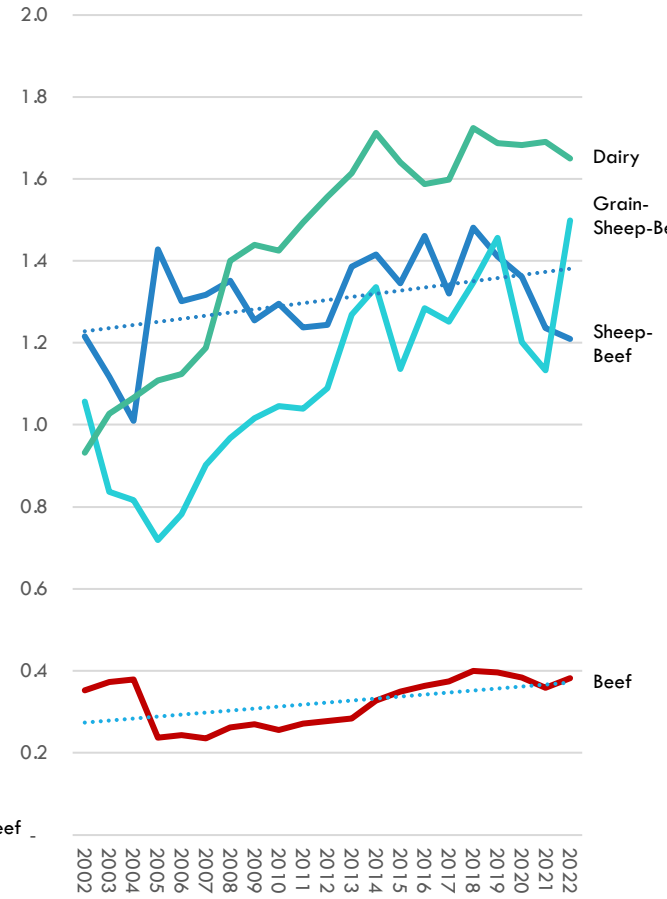
OF FARM UNITS

Geo units; 2002-2022



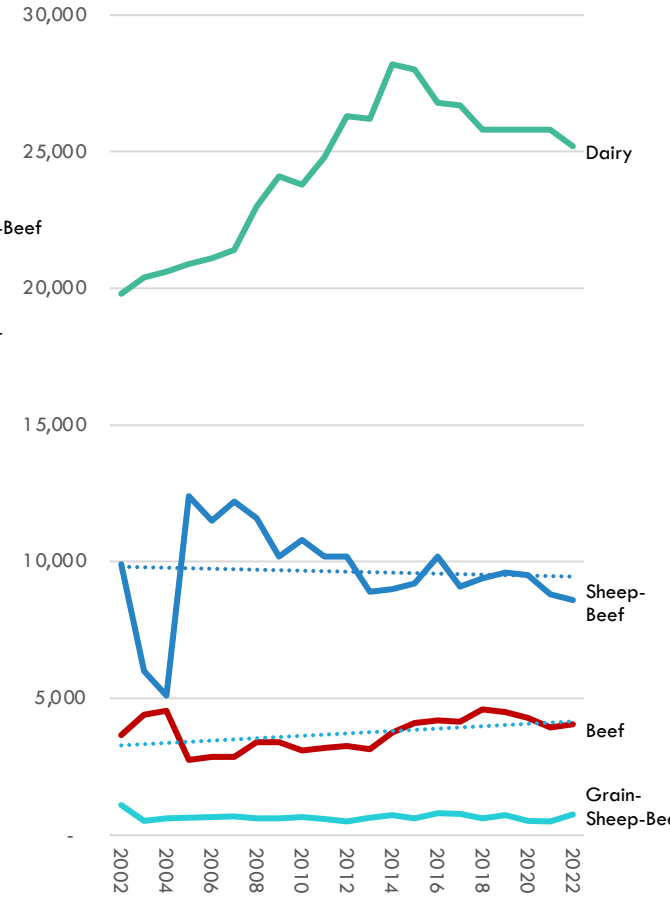
EMPLOYEES/FARM UNIT

Headcount/geo unit; 2002-2022



OF ON-FARM EMPLOYEES

Headcount; 2002-2022

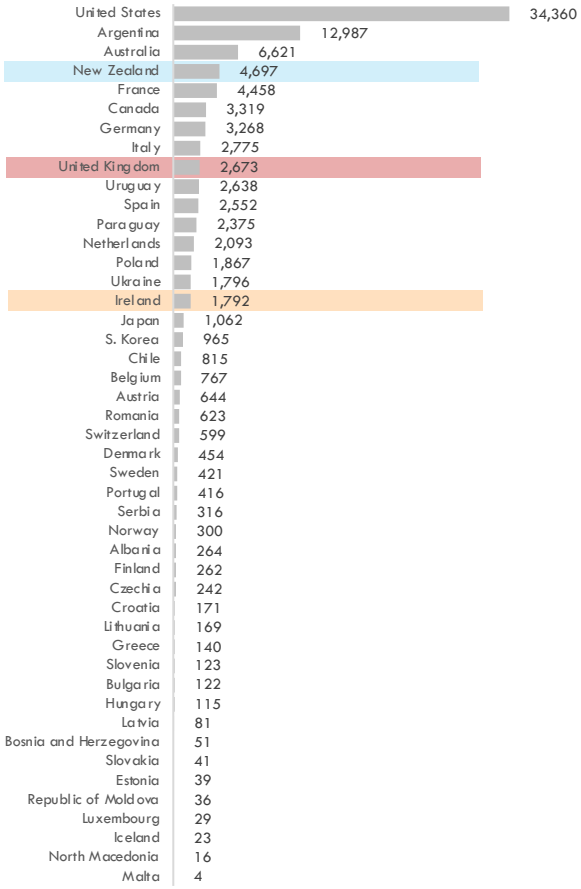


Note: Data is PAYE employees; does not include "owner operator" farmers; many farms have no "employees" and owner-operators are not measured, leading to a dramatic underestimation of farm jobs (if you are not careful); Source: StatsNZ (business demographics); Coriolis analysis

Relative to a wide climatic peer group, New Zealand produces a large number of small cattle

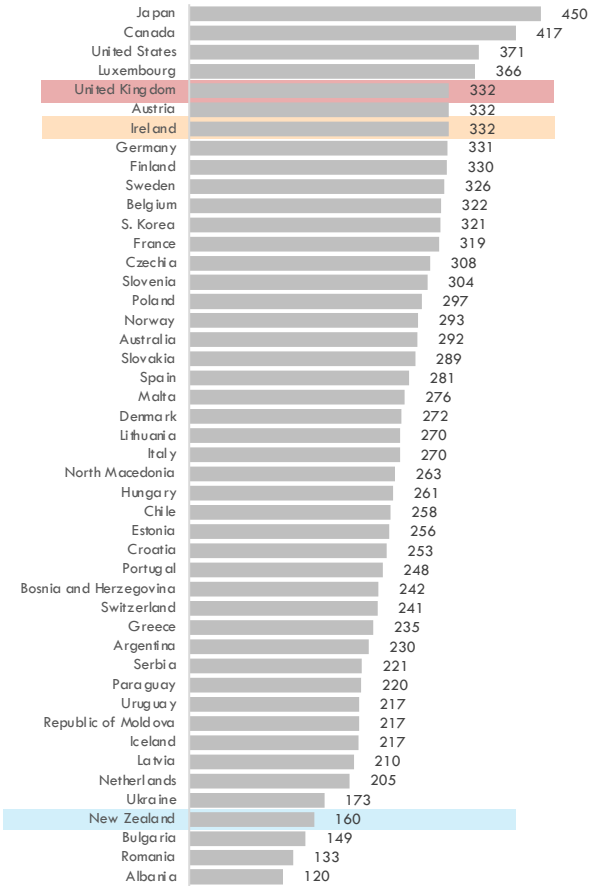
CATTLE HEAD PROCESSED

Head; 000; 2021



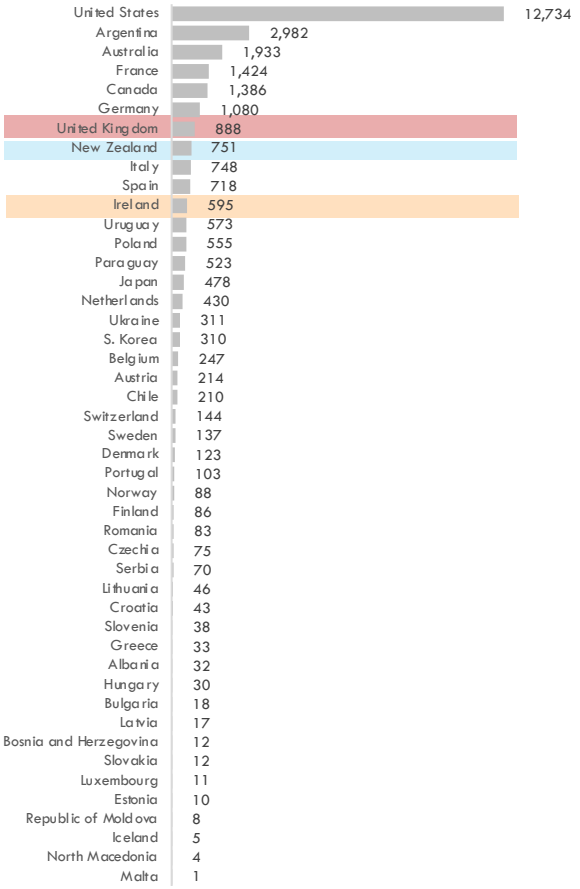
AVERAGE WEIGHT/HEAD

Kg/Head; 2021



CATTLE MEAT PRODUCED

T; 000; bone-in; 2021



Source: UN FAOStat; Coriolis analysis

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PAGES 172-205

3. DEVELOPING NEW PLATFORMS

WHY IS IT SO HARD TO DEVELOP NEW PLATFORMS IN THE BIOECONOMY?

PAGES 206-241

The New Zealand sheep industry has been in long term decline and there is no clear turnaround in sight; a new approach and new thinking is needed…

New Zealand has been poor at adapting to a changing global market for sheep-based products

- The New Zealand sheep sector has a robust industry across the total supply chain, with numerous participants all with well developed capabilities
- New Zealand's sheep industry is a world leader in a disappearing market
- The New Zealand (and Australian) sheep industry faces a wide range of global structural issues with no simple solutions
- The core on-farm sheep production system is struggling and under pressure, while at the same time local value-added processing is in collapse
- New Zealand has declining domestic demand for wool and collapsing sheep meat consumption with available surpluses going to export markets
- Competitiveness is calculated at the border; New Zealand's declining volumes lead to high but declining global competitiveness

New Zealand farmers are reacting to price signals from falling demand by reducing animal production or exiting sheep

- New Zealand sheep numbers peaked in the mid-80's and have been in decline for forty years; sheep numbers are now back at 1920 levels
- Sheep farming is experiencing falling farm numbers and falling on-farm employment
- The number of sheep per farm appears relatively stable, indicating the driver of falling sheep numbers is farms being sold and the land exiting sheep
- Sheep numbers are declining across all regions

… *continued*

Gains in average slaughter weight have been unable to offset declining animal numbers, leading to ongoing declines in total New Zealand sheep meat production

- New Zealand has falling sheep head processed across growing yields and falling sheep meat production
- Relative to a wide climatic peer group, New Zealand is a major sheep/lamb producer, though with animals 20% smaller than Australia

New Zealand wool production has fallen by two thirds with no signs of either slowing or a turnaround

- Wool productivity is not growing; realised wool per sheep plateaued in the late 50's and gone nowhere since; sheep breeding has focused on more lambs
- New Zealand wool production is declining as a result of fewer sheep and no wool productivity gains
- Wool primary handling and processing has more shearing units but fewer shearers overall
- Scouring and wholesaling are both experiencing declining unit numbers and declining employment

The New Zealand sheep sector has a robust industry across the total supply chain, with numerous participants all with well developed capabilities

NEW ZEALAND CAPABILITIES DRIVEN SUPPLY CHAIN: SHEEP

SELECT FIRMS

SHEEP GENETICS

HEAD WATERS, EARNSCLEUGH

Numerous others

Industry association has 561 members

VEHICLES/MACHINERY

JOHN DEERE, MASSEY FERGUSON, YAMAHA, TOYOTA, Hauer Machinery, GASCON, FENDT, moreni, POTTINGER, ALPEGO

FARM SUPPLIES

NEW ZEALAND FARM SOURCE, PGG Wrightson, Farmlands

FERTILISER

Ballance, ravensdown

ANIMAL FEED

GLENCORE VITERRA, NRM FEED TO SUCCEED, Weston Milling STOCKFEED, TAKAMINI FEEDS, Sharpes FARM FEEDS, Agrifeeds, nutrinza, GOLDEN GRAIN, GASCON

FUEL & LUBRICANTS

Gulf, Allied Petroleum never run out, npd, RD petroleum, McFALL FUEL, SMF

ANIMAL HEALTH

zoetis, Boehringer Ingelheim, Elanco, MERCK Animal Health, BAYER

SHEARING EQUIPMENT

Heiniger, Lister, Ace, BEIYUAN

LAND IN SHEEP/CATTLE

~5.6m hectares+

PEOPLE IN SHEEP FARMING*

~12,000 farmers

~14,000 employees

WOOL AUCTIONS

PGG Wrightson, WRIGHT WOOL, New Zealand merino, WOOL ONLINE, East Coast Wools Limited, Natural Fibre Exchange

WOOL TESTING

NZWTA, SGS

WOOL HANDLING

Primary WOOL COOPERATIVE LTD, CP Wool, PWC, WOOLS OF NEW ZEALAND, PGG Wrightson, WRIGHT WOOL, SEGARD MASUREL, ELCODIRECT WOOL BUYERS, Curtis Wool Direct, THE SCHNEIDER GROUP

VALUE-ADDED WOOL PRODUCTS

NZ Yarn, Bremworth WOOL CARPETS RUGS, Godfrey Hirst

WOOL SCOURING

WOOLWORKS

FELLMONGERING

Progressive LEATHERS EXPORT New Zealand

MEAT PROCESSING

SILVER FERN FARMS, ALLIANCE FARMERS' PRODUCE, ANZCO FOODS, Talley's, Greenlea, WILSON HELLABY New Zealand, UNIVERSAL BEEF PACKERS, TAYLOR PRESTON LIMITED, BXFOODS

SHIPPING

MAERSK LINE, HAMBURG SÜD, msc, CMA CGM, Hapag-Lloyd, EVERGREEN, COSCO SHIPPING, YANG MING

LOGISTICS

CODA, KOTAHI, MAINFREIGHT

INDUSTRY ORGS.

FEDERATED FARMERS OF NEW ZEALAND, beef+lamb new zealand, mia Meat Industry Association, NZ WOOL CLASSERS ASSOCIATION, The National Council of New Zealand Wool Growers Incorporated, NEW ZEALAND SHEARING CONTRACTORS, NEW ZEALAND SHEEPSKIN EXPORTERS ASSOCIATION

* *Includes "sheep", "sheep-beef" and "grain-sheep-beef" farmers but not "beef cattle" farmers; Source: Coriolis*

New Zealand's sheep industry is a world leader in a disappearing market

SWOT ANALYSIS: NEW ZEALAND SHEEP

STRENGTHS	WEAKNESSES
- World's largest exporter of sheep meat by value and #2 wool exporter - Extremely strong position in global markets alongside neighbouring Australia - Dual purpose animal with two main income streams (meat and wool) - Natural environment favourable to pastoral agriculture - Low cost, grass fed sheep production systems - Strong biosecurity rules and systems leading to low presence of some diseases - High standards of food safety and animal welfare - International recognition of high quality of New Zealand meat industry regulations - 135+ years experience exporting meat long distances - Strong position in global lamb trade in counter-seasonal window to Northern Hemisphere - Preferential access into Europe for some products for historical reasons - NZ reputation for quality products and trusted supplier - Proven capabilities and scale in bovine dairy that can support emergence of sheep dairy	- Industry has has shrinking animal numbers for over forty years; cascading series of challenges from this, particularly around excess capacity in all stages of the chain - Low and falling global consumption of both main products (now effectively niche markets) - High tariff barriers into key markets limits access to Europe and parts of Asia - 19th Century breeding processes in a 21st Century world (compare with Hyline or Aviagen) - Limited experience with branded and high value processed meats or meal solutions - Limited in-market knowledge, few firms close to customer/consumer, especially in growth markets of Asia - Lack of in-market co-ordination - High labour costs; labour shortages both on farm and in processing - Still exporting too much as whole and half carcass, rather than further processing in New Zealand - Cumulative impact of numerous free trade agreements, particularly China, on local manufacturing; ongoing collapse of almost every value added wool processing sector in New Zealand - 40+ year inability of industry to develop and implement a coherent strategy - Local animal welfare expectations in conflict with certain interpretations of a specific religion, leading to market share losses in Middle East to Sub-Saharan producers
OPPORTUNITIES	**THREATS/ISSUES/CHALLENGES/RISKS**
- Recent free trade agreement (FTA) with UK and EU; further negotiation of high quality FTA with key markets - Scientific research showing superior health properties of free range, grass-fed animals - Genomics research to optimise output quality, animal productivity, growth rates etc. - High and growing levels of foodservice penetration across most key markets - Religious-based food restrictions (e.g. Sikh, Muslim, Jewish, Hindu) [also a risk] - Ability to extend shelf life of chilled product (extend season window) - Increased demand for protein globally - Move from frozen product to chilled; position/develop brands and case-ready, convenience foods products for retail and hospitality/foodservice - Removal of EU/UK farm subsidies in the medium term - Extension/expansion of livestock traceability and specific-animal identification - Encourage innovative on-farm practices to minimise green house gases	- Continued conversion of beef and sheep land into dairy, forestry or lifestyle blocks - Market access reduced due to import restrictions - Continued decline in consumption of lamb and wool products in developed markets - Perfect storm of COVID-19, work-from-home, casual business attire, allergies, carpet-free homes, productivity gains in synthetics, and technological disruption (e.g. electric blankets) permanently driving down wool demand - Religious-based food restrictions (e.g. Sikh, Muslim, Jewish, Hindu) [also an opportunity] - Disease outbreak affecting stock numbers and or trade access - ETS, climate change legislation affecting cost of business (or land use) - Southern South America (e.g. Argentina, Uruguay, S. Brazil) improving their pasture system and "catching-up" with New Zealand - EU quota reallocation in post-Brexit negotiations (particularly lamb and mutton) - Animal welfare and extension of "rights revolution" to animals

The New Zealand (and Australian) sheep industry faces a wide range of global structural issues with no simple solutions

FORCES AT WORK IN THE GLOBAL SHEEP PRODUCTS TRADE

SUPPLY

NEW ZEALAND AND OTHER DEVELOPED	- Ongoing fall in sheep numbers - Relatively slow growing, inefficient animals - Failing to increase productivity - Involved and time consuming to farm - Low net profitability overall and per hectare - A distraction rather than a focus for many farmers - Pushed into more and more marginal lands - Labour intensive to process (time per kg yield) - Constant overcapacity in processing - Live export channel removed due to pressure from activists on animal welfare grounds - Non-ultrafine wool being outcompeted by rapidly improving synthetics with falling prices
AFRICA & MIDDLE EAST	- Northern Africa growing animal numbers long term (+160m animals over past 45 years) - Growing production across Middle East - Global warming/climate change may be driving increased production in sub-Sahara
ASIA	- North west regions of China rapidly increasing their flock (1970=80m; current 180m) - Growing production in India and Pakistan - Ex-Soviet "Stans" increasing animal numbers - Ethiopia now has more sheep than New Zealand

PRICE

DEMAND

- Falling consumption of meat and wool-based products in New Zealand, Australia and traditional Western markets - Highly consolidated retail markets - Increasing chain costs and cost-to-serve - Lamb is a minor specialty meat in most markets being pushed to case-ready	**ANGLO-EUROPEAN MARKETS**
- Five oil rich gulf states (~50m people) primarily want live animals for religious reasons - Demand for premium, imported meat dependent on local economy, itself driven by oil price - Live animals from Northern Africa taking share (shorter shipping/lower cost/no protests) - Civil war & unrest releasing stocks	**MIDDLE EAST**
- Japan and other rich East Asian demand small and flat - China a large and growing market only willing to pay low prices for meat or wool - China primarily taking secondary cuts, offal and whole carcass	**ASIA**

The core on-farm sheep production system is struggling and under pressure, while at the same time local value-added processing is in collapse

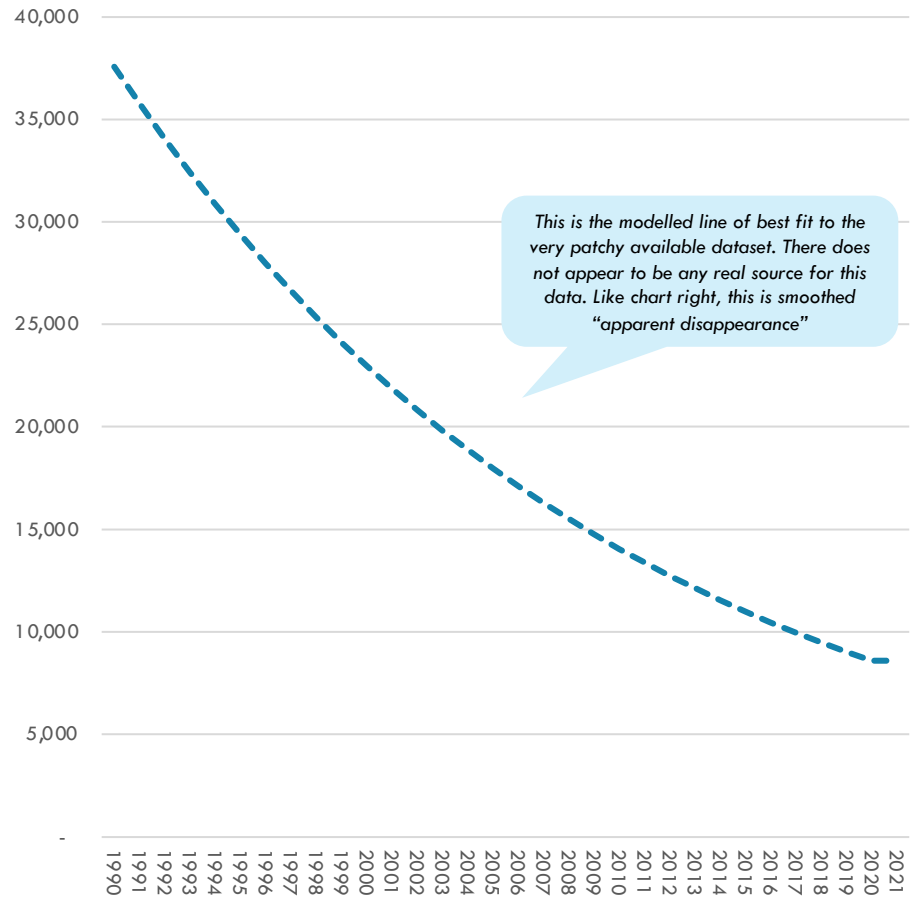
DRIVERS OF AN INTERNATIONALLY COMPETITIVE BIOECONOMY: SHEEP

Source: Coriolis

New Zealand has declining domestic demand for wool and collapsing sheep meat consumption with available surpluses going to export markets

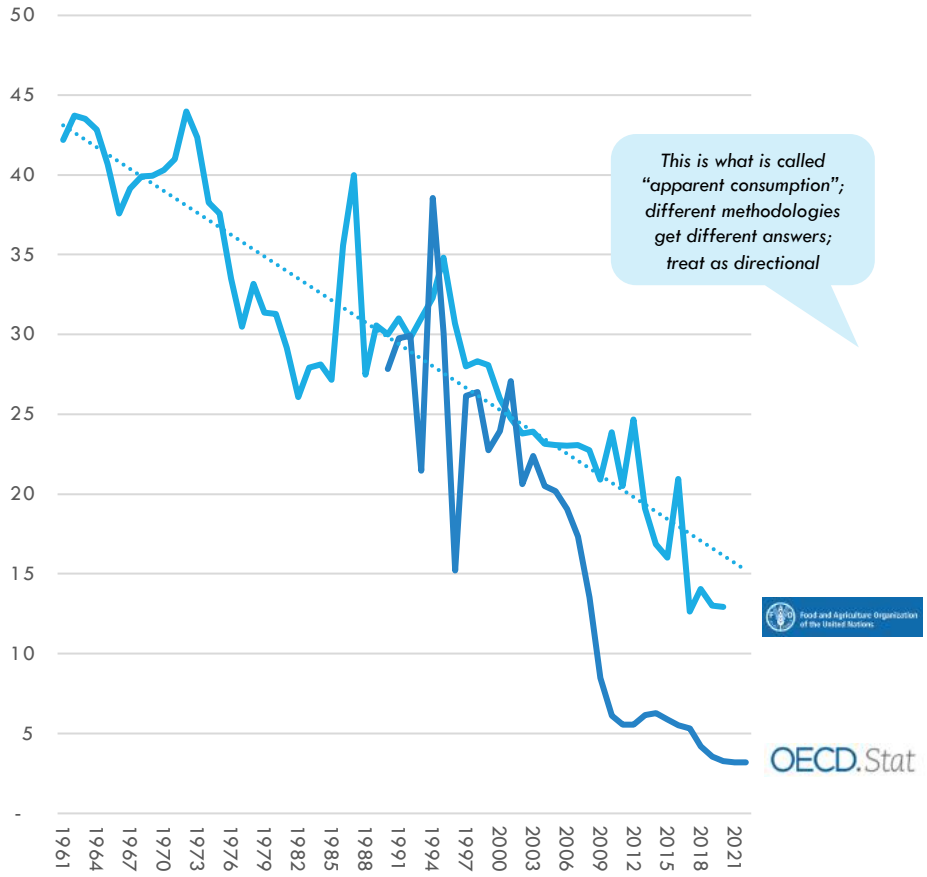
ESTIMATED NZ DOMESTIC WOOL UTILISATION

Tonnes; 1990-2021



NZ DOMESTIC SHEEP MEAT/CAPITA

Kg/person; 1961-2021

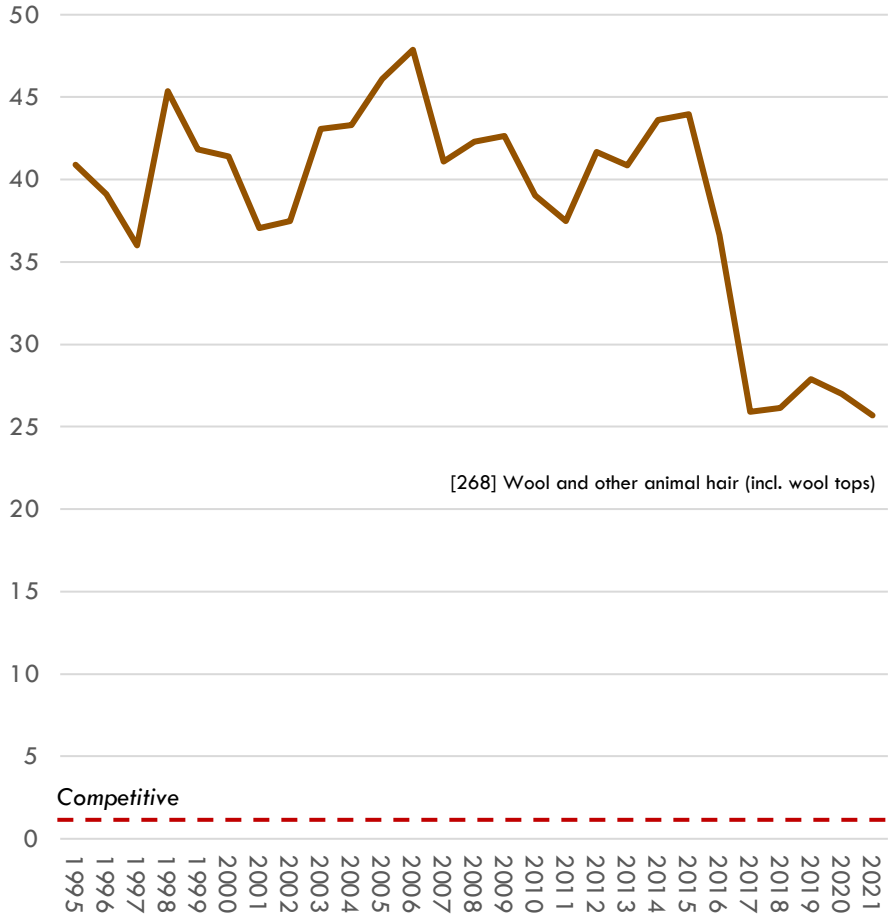


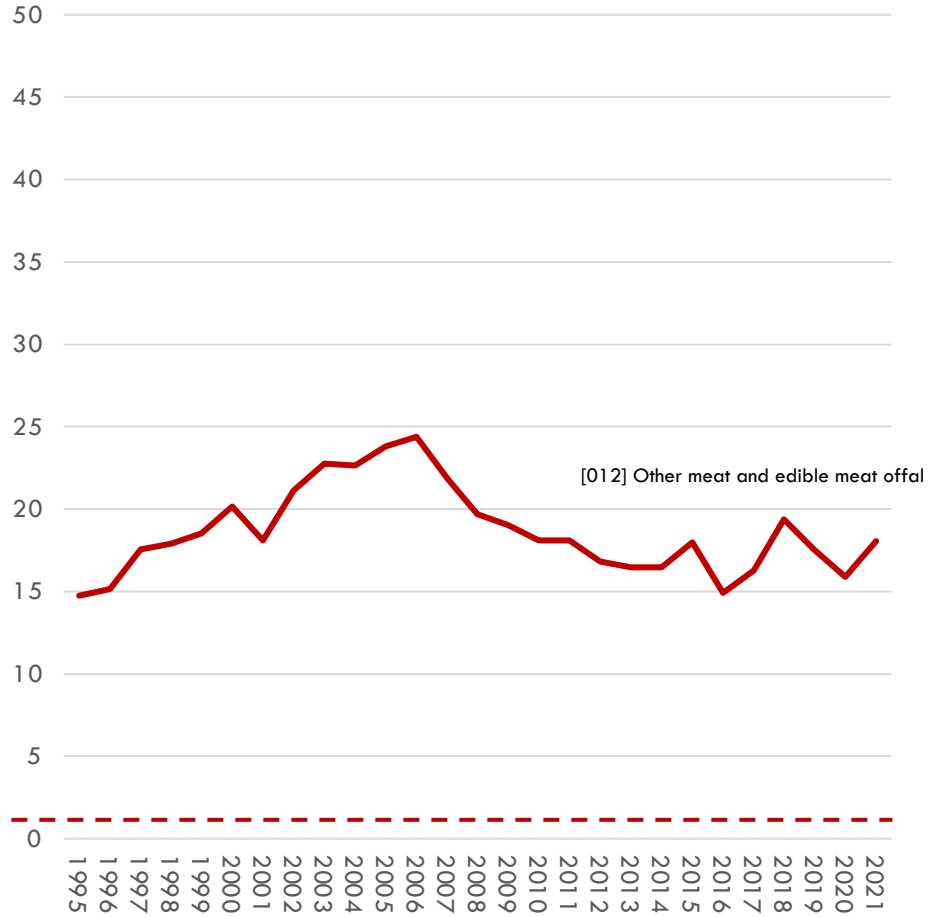
Source: United Nations FAO; United Nations Comtrade; Customs NZ; B+L New Zealand; Coriolis interviews, modelling, estimates and analysis

Competitiveness is calculated at the border; New Zealand's declining volumes lead to high but declining global competitiveness

ANNUAL REVEALED COMPARATIVE ADVANTAGE INDEX: NEW ZEALAND BY SELECT SITC3

1=Average of New Zealand across all exports; 1996-2022



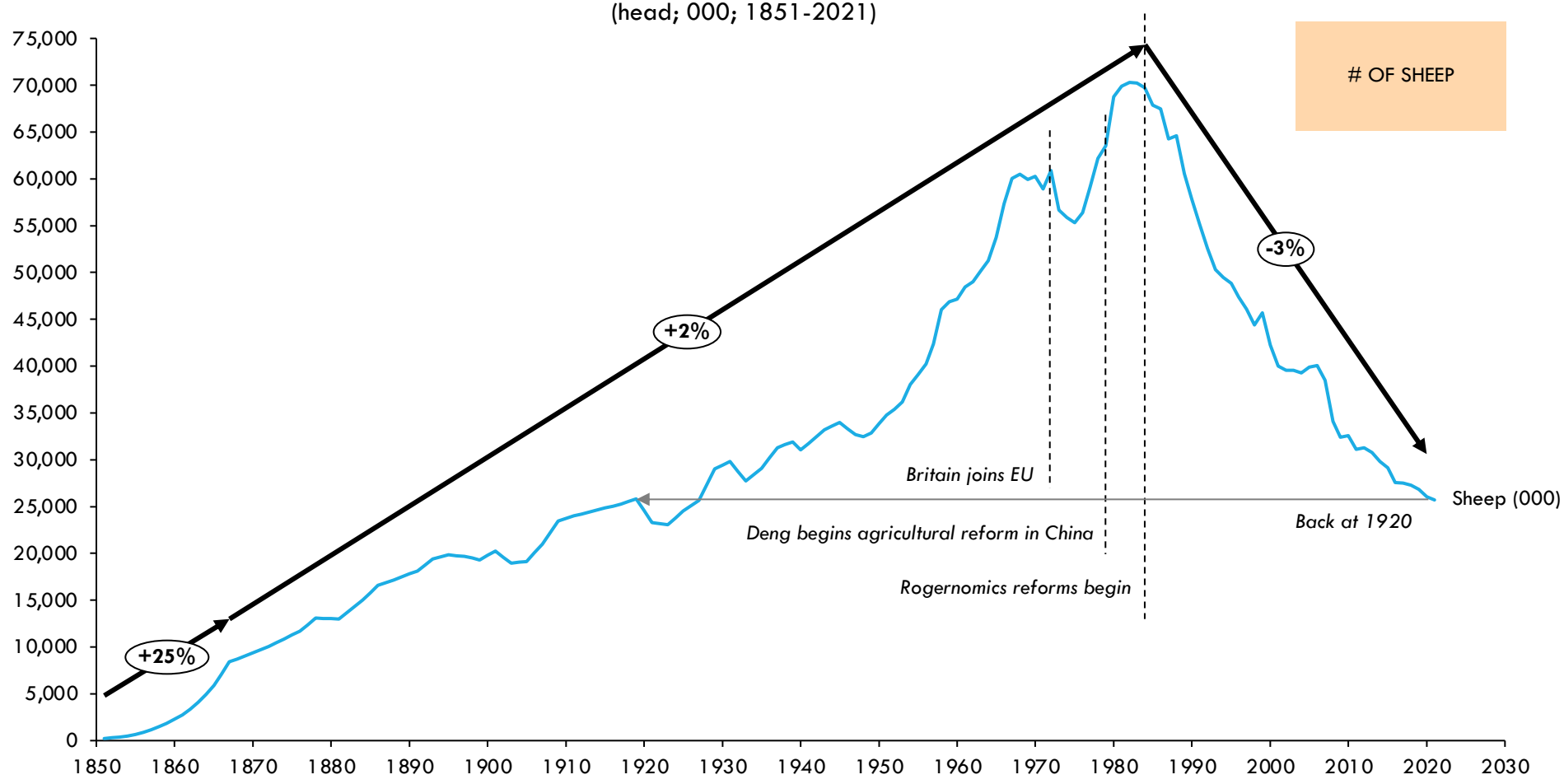


Source: UNCTAD STAT; Coriolis analysis

New Zealand sheep numbers peaked in the mid-80's and have been in decline for forty years; sheep numbers are now back at 1920 levels

NUMBER OF SHEEP IN NEW ZEALAND

(head; 000; 1851-2021)

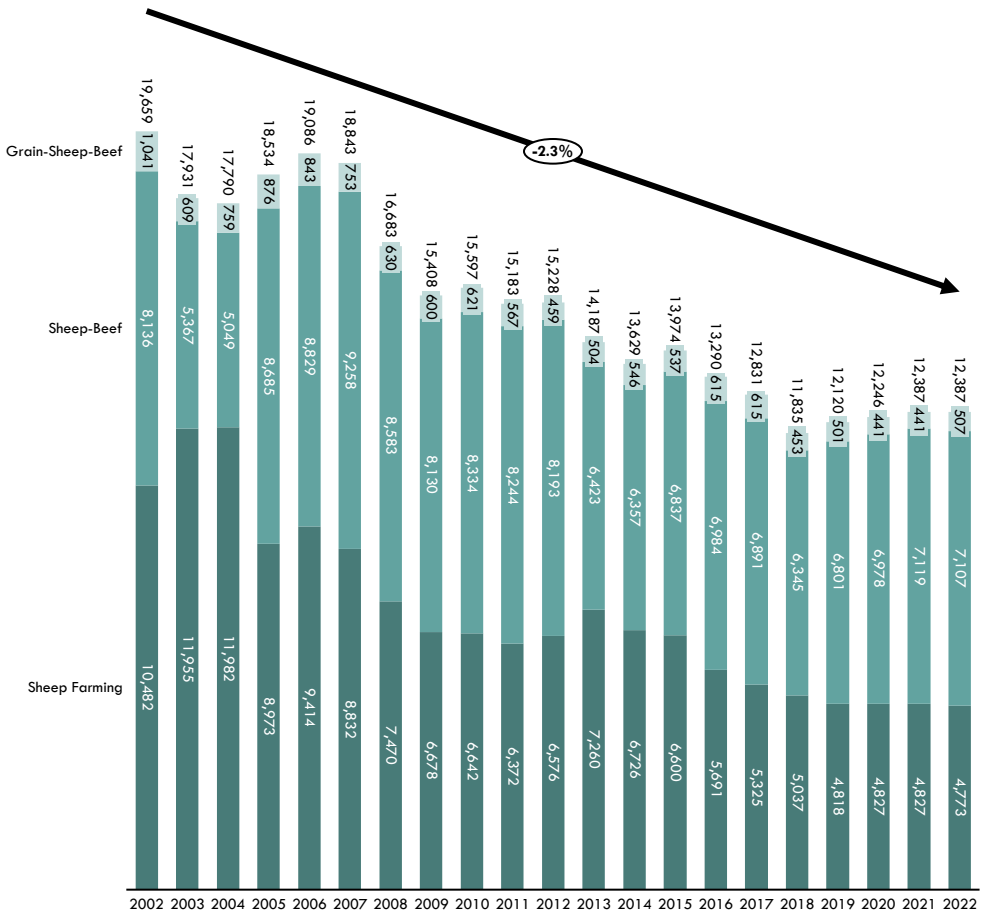


Note: Some missing historical data extrapolated; Source: United Nations FAO; New Zealand Department of Agriculture; Ministry for Primary Industries; Statistics New Zealand; Coriolis interviews, modelling, estimates and analysis

Sheep farming is experiencing falling farm numbers and falling on-farm employment

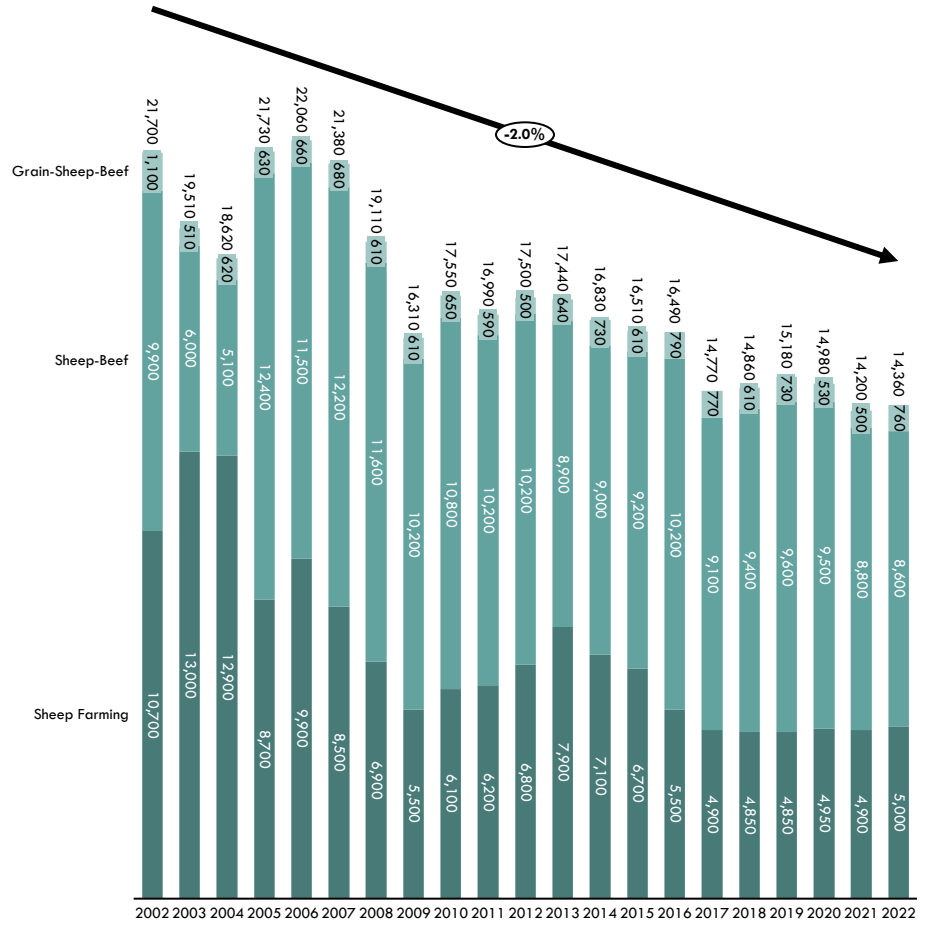
OF GEOGRAPHIC UNITS

(Activity units ("front doors"); 2002-2022)



OF EMPLOYEES

(Headcount; 2002-2022)

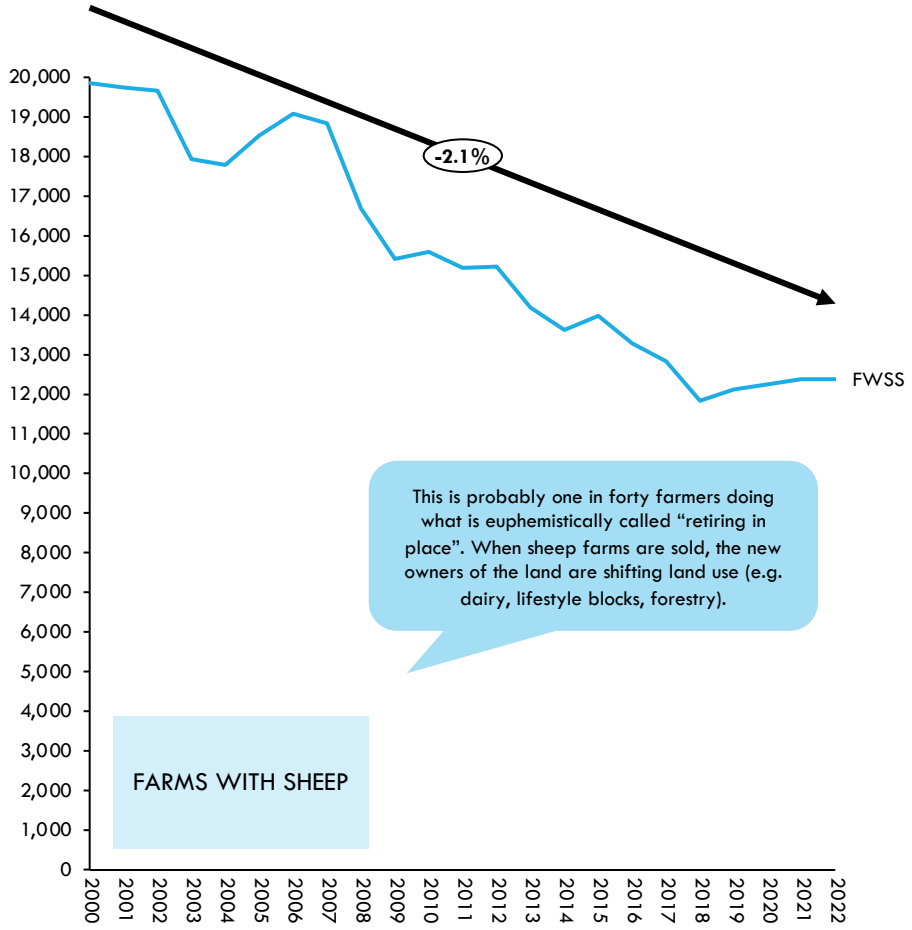


Source: Statistics NZ (Business Demographics); Coriolis classification and analysis

The number of sheep per farm appears relatively stable, indicating the driver of falling sheep numbers is farms being sold and the land exiting sheep

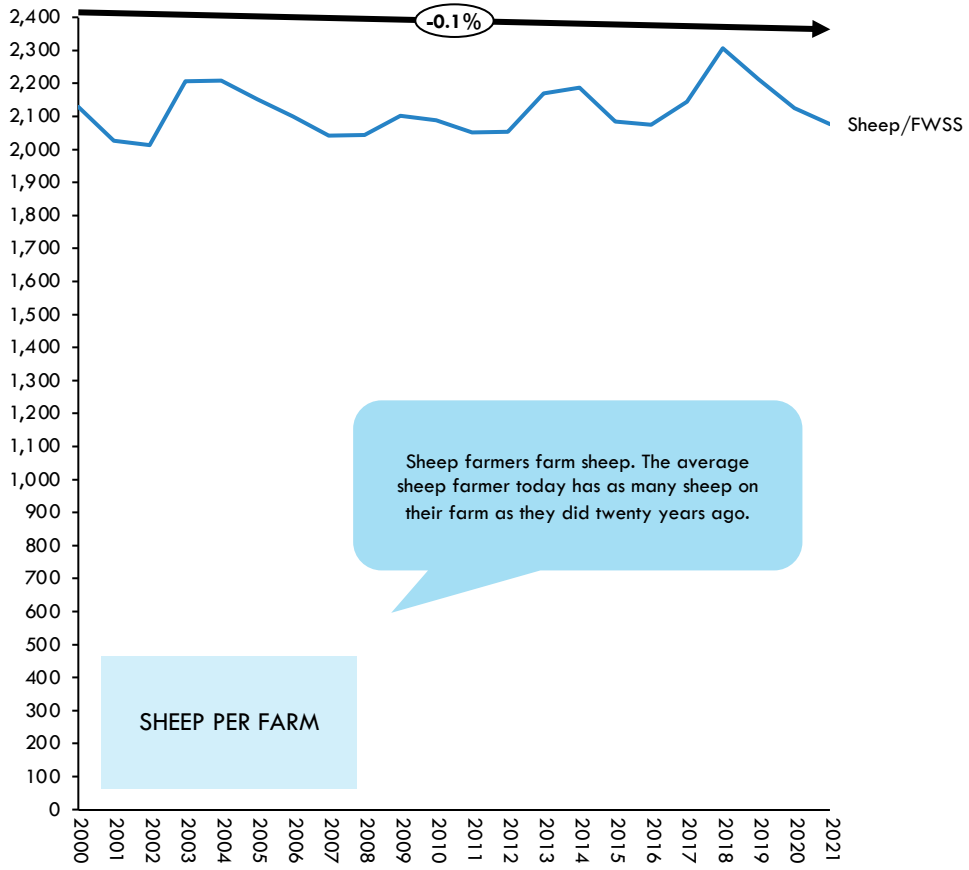
OF FARMS WITH SIGNIFICANT SHEEP

(Units; 2000-2022)



SHEEP/FARMS WITH SIGNIFICANT SHEEP

(Sheep/Units; 2000-2021)

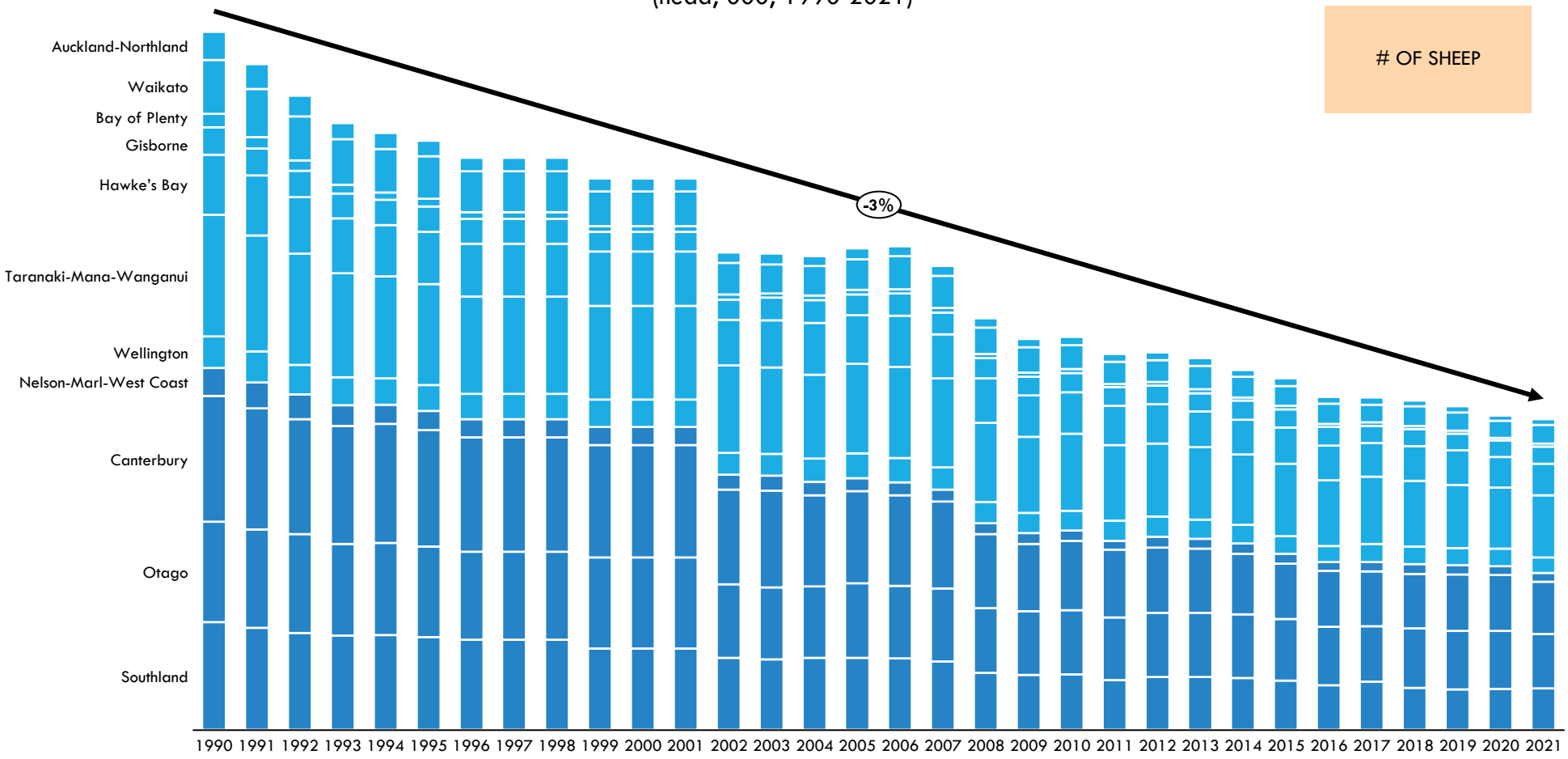


FWSS = Farms with Significant Sheep; Source: Statistics NZ (Business Demographics); UN FAO Stat; Coriolis classification and analysis

Sheep numbers are declining across all regions

NUMBER OF SHEEP IN NEW ZEALAND BY REGION

(head; 000; 1990-2021)

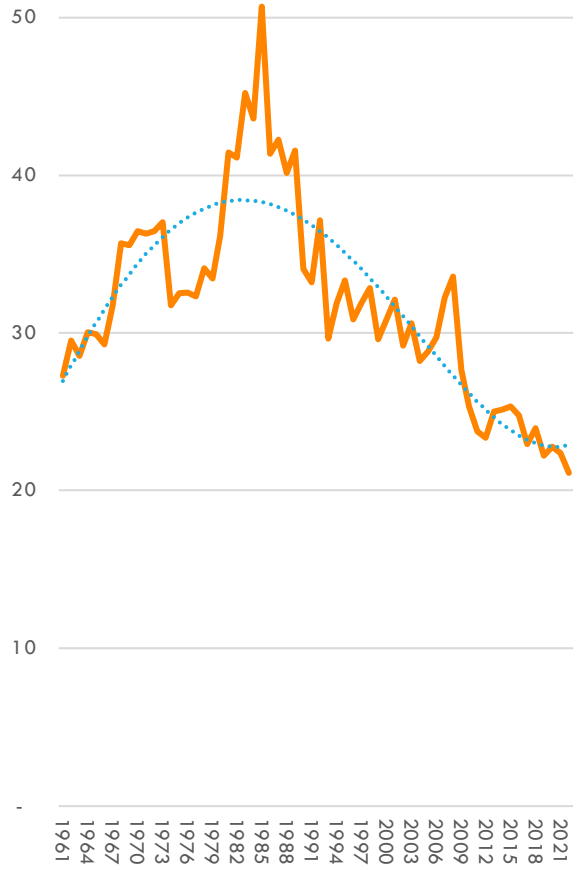


Source: Statistics New Zealand; Coriolis analysis

New Zealand has falling sheep head processed across growing yields and falling sheep meat production

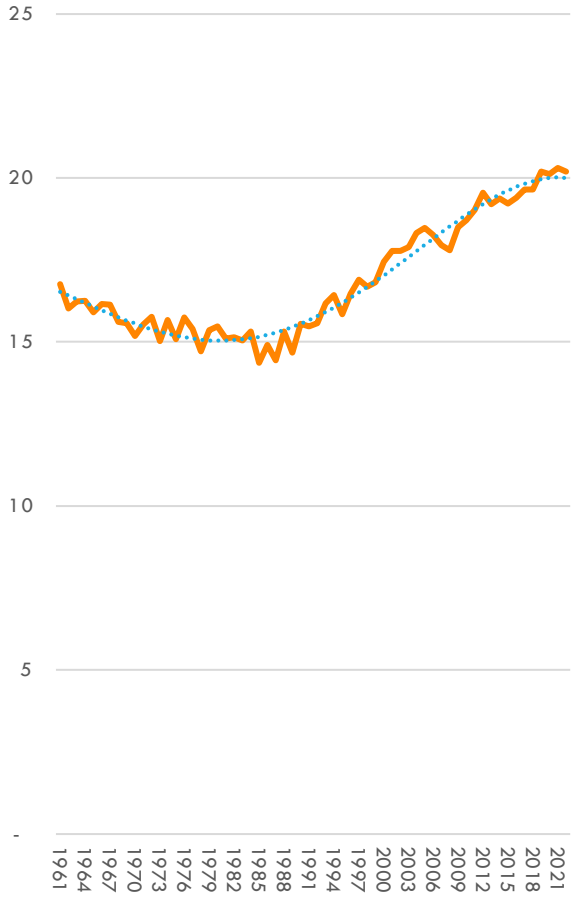
NZ SHEEP PROCESSED

Head; annual; m; 1961-2022



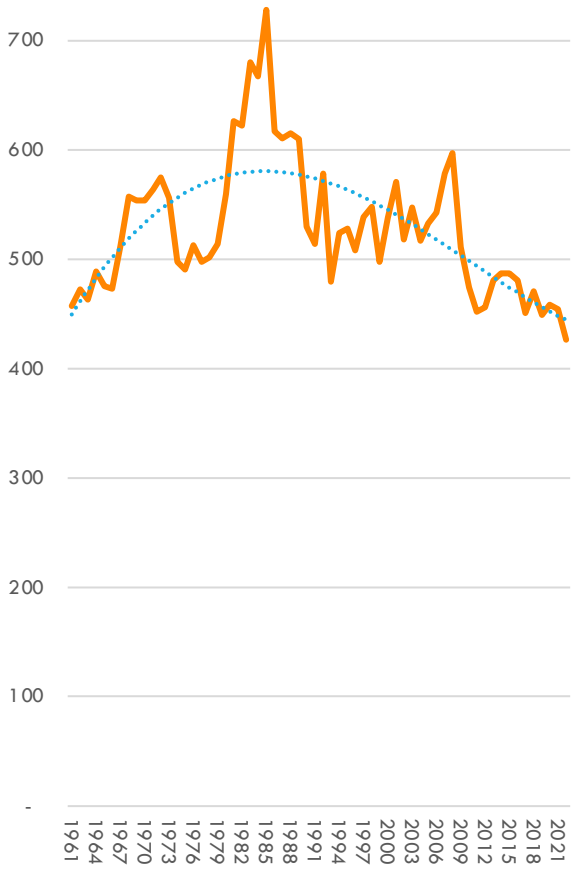
NZ SHEEP MEAT YIELD

Kg/head; 1961-2021



NZ SHEEP MEAT TONNES

Tonnes; 000; 1961-2021

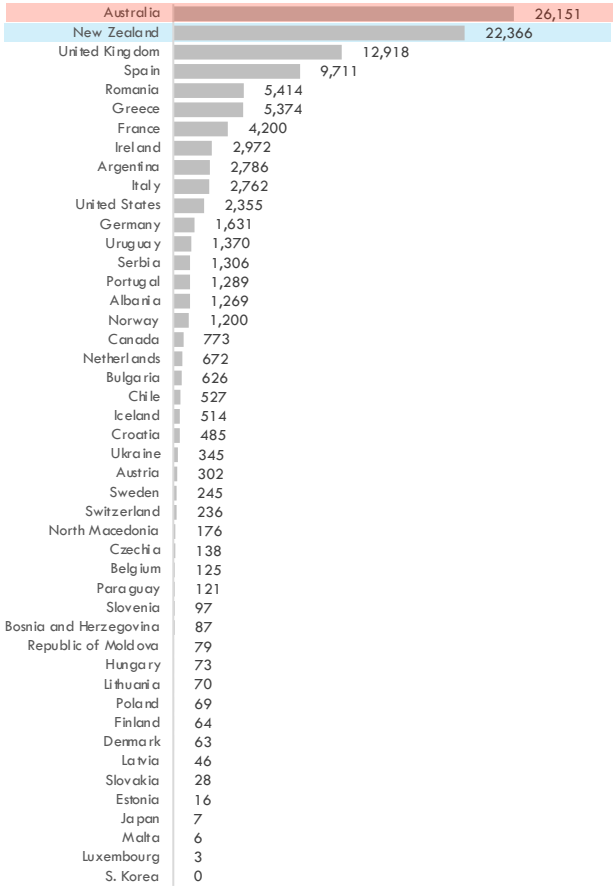


Source: UN FAOStat; StatsNZ Infoshare; Coriolis analysis

Relative to a wide climatic peer group, New Zealand is a major sheep/lamb producer, though with animals 20% smaller than Australia

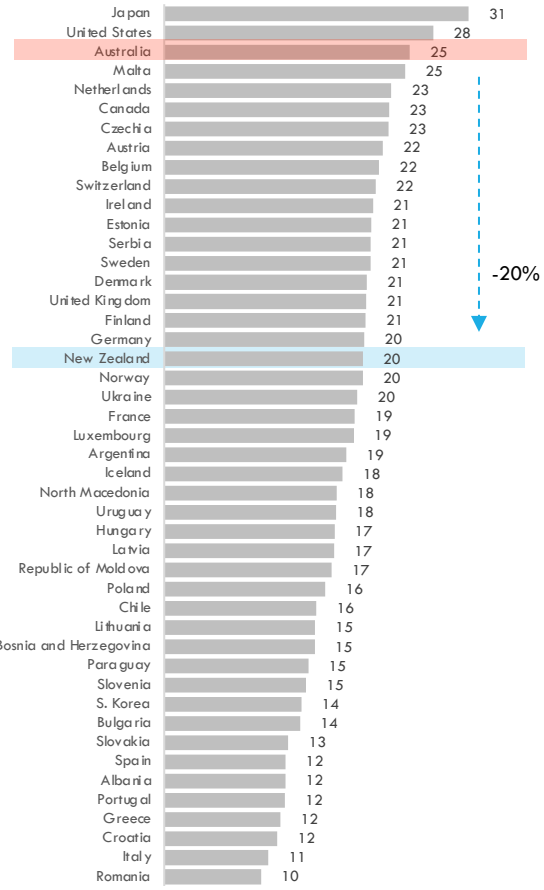
SHEEP HEAD PROCESSED

Head; 000; 2021



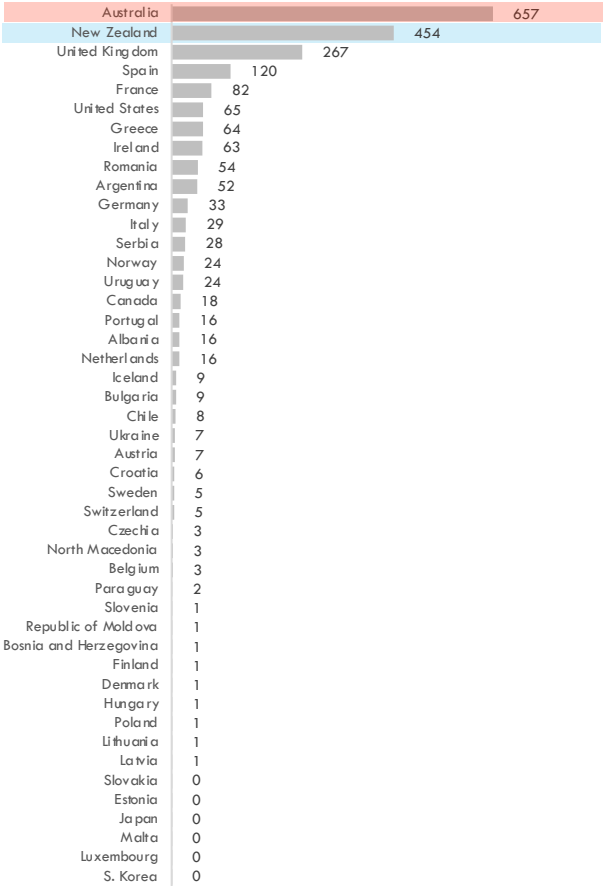
AVERAGE WEIGHT/HEAD

Kg/Head; 2021



SHEEP MEAT PRODUCED

T; 000; bone-in; 2021

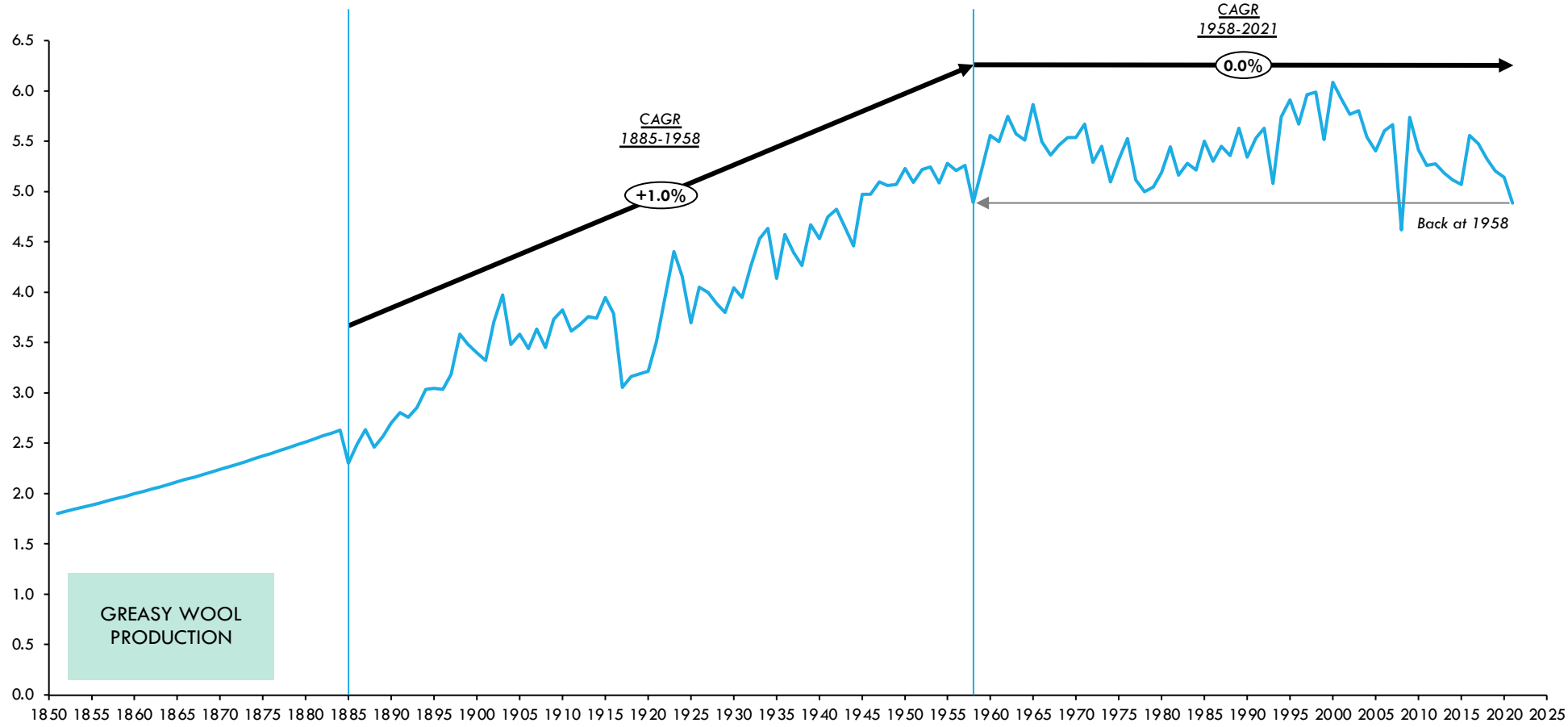


Note: China is the largest sheep/lamb producer in the world; Source: UN FAOStat; Coriolis analysis

Wool productivity is not growing; realised wool per sheep plateaued in the late 50's and gone nowhere since; sheep breeding has focused on more lambs

TOTAL GREASY WOOL PRODUCED PER ADULT SHEEP AT START OF YEAR

(kg/head; 1851-2021)

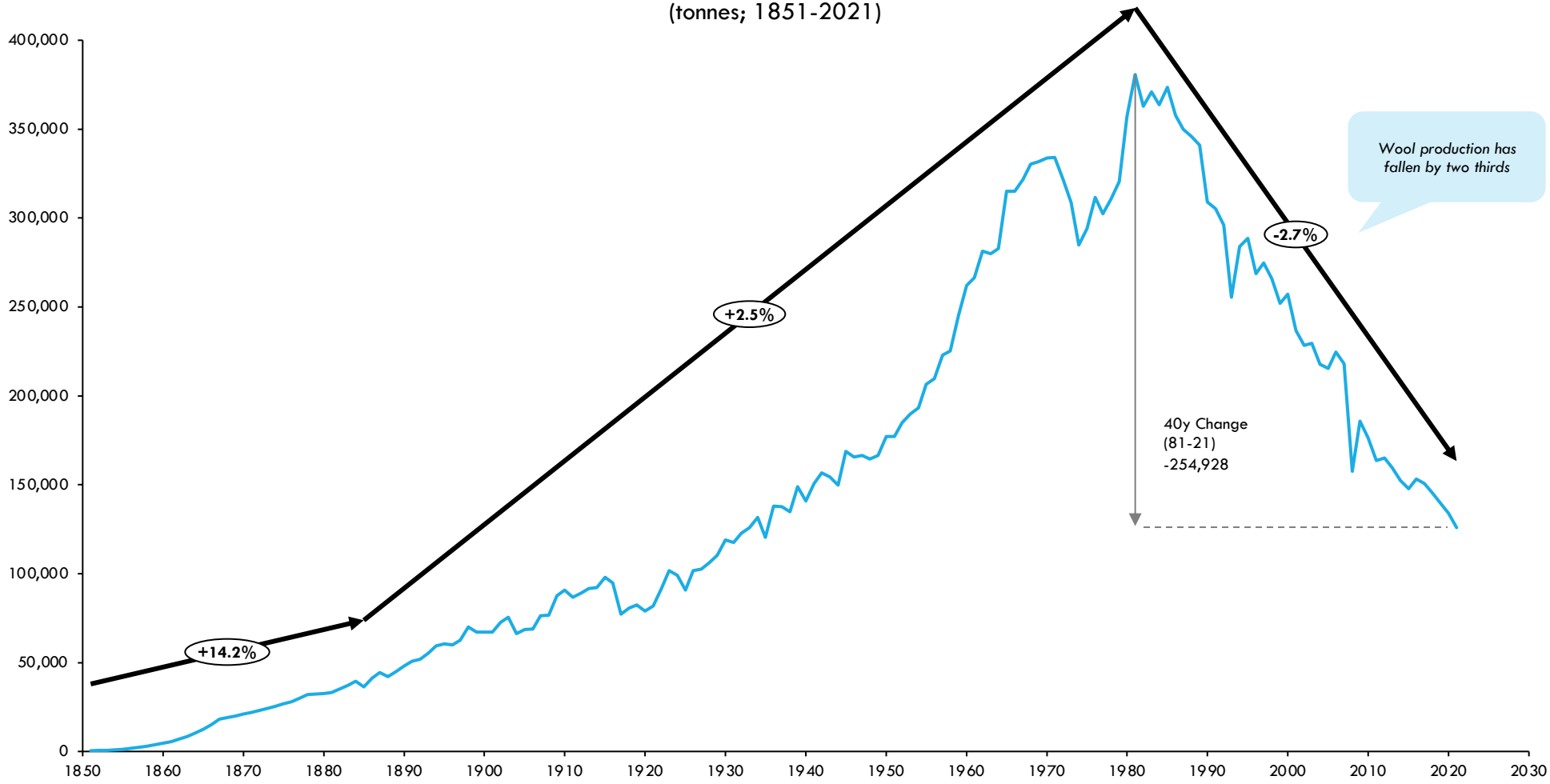


Note: Some missing historical data extrapolated across patchy dataset; Source: United Nations FAO; New Zealand Department of Agriculture; Ministry for Primary Industries; Statistics New Zealand; Coriolis interviews, modelling, estimates and analysis

New Zealand wool production is declining as a result of fewer sheep and no wool productivity gains

TOTAL NEW ZEALAND GREASY WOOL PRODUCTION

(tonnes; 1851-2021)

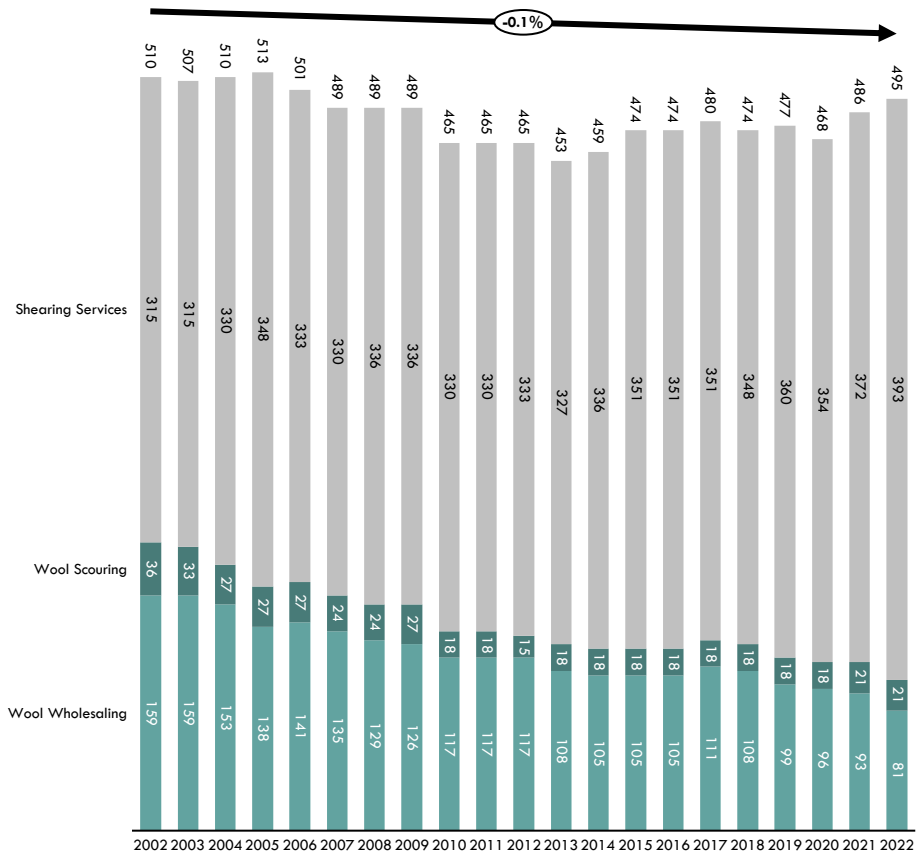


Note: Some missing historical data extrapolated across patchy dataset; Source: United Nations FAO; New Zealand Department of Agriculture; Ministry for Primary Industries; Statistics New Zealand; Coriolis interviews, modelling, estimates and analysis

Wool primary handling and processing has more shearing units but fewer shearers overall, while scouring and wholesaling are both declining

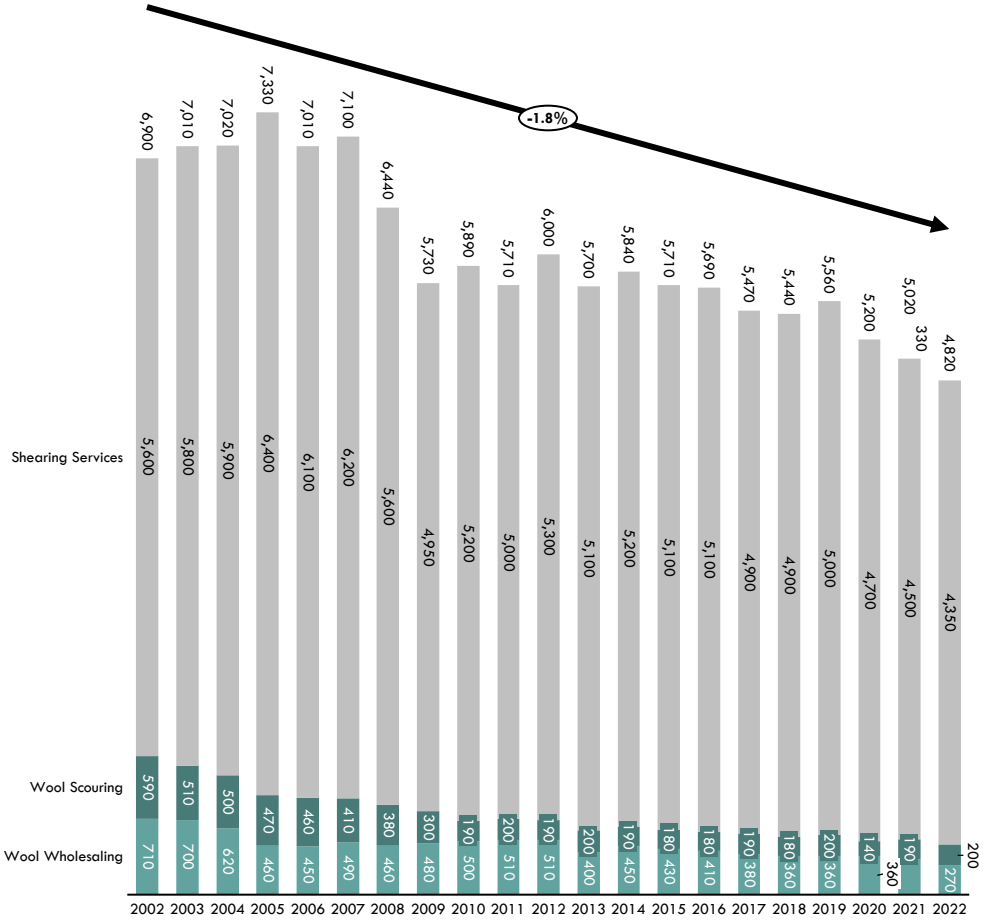
OF GEOGRAPHIC UNITS

(Activity units ("front doors"); 2002-2022)



OF EMPLOYEES

(Headcount; 2002-2022)



Source: Statistics NZ (Business Demographics); Coriolis classification and analysis

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WHAT DO WE HAVE TO WORK WITH?

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2. WIDER PAN-SECTOR SUPPORTING CAPABILITIES

WHAT ARE WE GOOD AT?

PAGES 172-205

3. DEVELOPING NEW PLATFORMS

WHY IS IT SO HARD TO DEVELOP NEW PLATFORMS IN THE BIOECONOMY?

PAGES 206-241

New Zealand has a growing chicken meat and egg industry, both protected by biosecurity and both currently primarily targeting the domestic market

New Zealand has a modern, growing poultry industry that is – in many ways – going from success-to-success inside a high priced biosecurity bubble; maybe one day it will become an export story

- The New Zealand poultry industry has a relatively streamlined supply chain with most required capabilities controlled by the major processors
- New Zealand's poultry meat and egg industry is successful and growing; in an ideal world, it would mature and become export competitive
- Competitiveness is calculated at the border; NZ is competitive in in-shell eggs, almost competitive in poultry meat and not competitive in processed eggs

Looking across the longer term, poultry meat is growing but eggs are basically flat

- New Zealand has growing broiler chicken numbers and consumption, but flatter layer numbers and consumption
- New Zealand has growing head processed, growing chicken meat yields and growing meat production
- New Zealand has recovering layer numbers, growing egg yields and growing egg production
- New Zealand has growing poultry meat farming and consolidating (and growing) egg farming

New Zealand performs well, but without the threat of imports, there will always be opportunities to improve

- New Zealand is a mid size chicken meat producer relative to a wide climatic peer group, with the animal numbers of Sweden and the yields of Poland
- New Zealand has strict biosecurity around birds; only extremely processed products can enter and volumes are close to immaterial currently

The New Zealand poultry industry has a relatively streamlined supply chain with most required capabilities controlled by the major processors

NEW ZEALAND CAPABILITIES DRIVEN SUPPLY CHAIN: CHICKEN

SELECT FIRMS

CHICKEN SHEDS

Numerous regional suppliers

VEHICLES/MACHINERY

John Deere, Massey Ferguson, Yamaha, Toyota, Kubota, Gascon, Fendt, Merlo, Pottinger, Alpego

FARM SUPPLIES

New Zealand Farm Source, PGG Wrightson, Farmlands

ANIMAL FEED

Tegel, Inghams, MainFeeds, NRM Feed to Succeed, Sharpes Farm Feeds, SF Supa Feeds

FUEL & LUBRICANTS

Gulf, Allied Petroleum never run out, npd, RD Petroleum, McFall Fuel, SHF

ANIMAL HEALTH

Zoetis, Boehringer Ingelheim, Elanco, Merck Animal Health, Bayer

FARMS

144 poultry meat farms
144 egg farms

PEOPLE IN POULTRY FARMING

~2,500 employees

GLOBAL CHICKEN GENETICS

Aviagen, Cobb-Vantress, Hy-Line, Hendrix Genetics

CHICKEN PROCESSING

Bounty, Tegel, Inghams, Brinks, Turks

EGG HANDLING

ZEAGOLD Nutrition, Otaika Valley Free Range Eggs, Henergy

Numerous others

LOGISTICS

Tegel, Inghams, Brinks

Numerous regional suppliers

INDUSTRY ORGS.

PIANZ, Egg Producers Federation of New Zealand, FG:C New Zealand Food & Grocery Council, Federated Farmers, iLove eggs

Source: Coriolis

New Zealand's poultry meat and egg industry is successful and growing; in an ideal world, it would mature and become export competitive

SWOT ANALYSIS: NEW ZEALAND POULTRY

STRENGTHS	WEAKNESSES
- Growing yields (average weight/head); further upside available - Growing domestic consumption - Highly profitable processors at scale and protected by biosecurity - Free from many major global poultry diseases leading to faster growth and lower medical costs - Natural environment favourable to agriculture - Strong biosecurity rules and systems leading to low presence of key diseases - High standards of food safety and animal welfare - Highly consolidated industry with a small number of both farmers and only 3-4 major processors - International recognition of high quality of New Zealand meat industry regulations - 135+ years experience exporting meat long distances - Strong position in global beef and lamb trade in counter-seasonal window to Northern Hemisphere - NZ reputation as a trusted supplier of quality meat products - Access to modern broiler and layer genetics from global breeding pools - Low emissions per kilogram of protein relative to cattle or sheep	- Local prices far above world price encouraging firms to remain inside biosecurity bubble - Declining arable crop competitiveness; industry dependent on imported feed - 50 years of "rear guard action" by industry focused on preventing imports (rather than becoming competitive); in the unlikely case that imports were permitted, the experience of pork could repeat - Vocal segment of consumers driving imposition of higher cost regulations driving up prices; most consumers appear unable to make the link between regulation and prices - Labour shortages both on farm and in processing - Animal welfare issues - Domestic and imported grain prices higher than competitors, which restricts competitiveness of pork, poultry, and other feed-dependent production systems
OPPORTUNITIES	**THREATS/ISSUES/CHALLENGES/RISKS**
- Continuous improvement in farm management and production systems - Adopting European (or other) standards (rather than local bureaucrats reinvesting the wheel) - Increased demand for protein globally - Both broiler meat and poultry appear to have the potential to grow exports further with focus and a clear plan with support from the total industry	- Constant background threat of disease arrival - Attitudes and opinions of local producers; lack of current export vision - Animal welfare and extension of "rights revolution" to animals - Further government regulation

New Zealand's capabilities in the poultry chain are solid, but the country is uncompetitive at the biosecure border

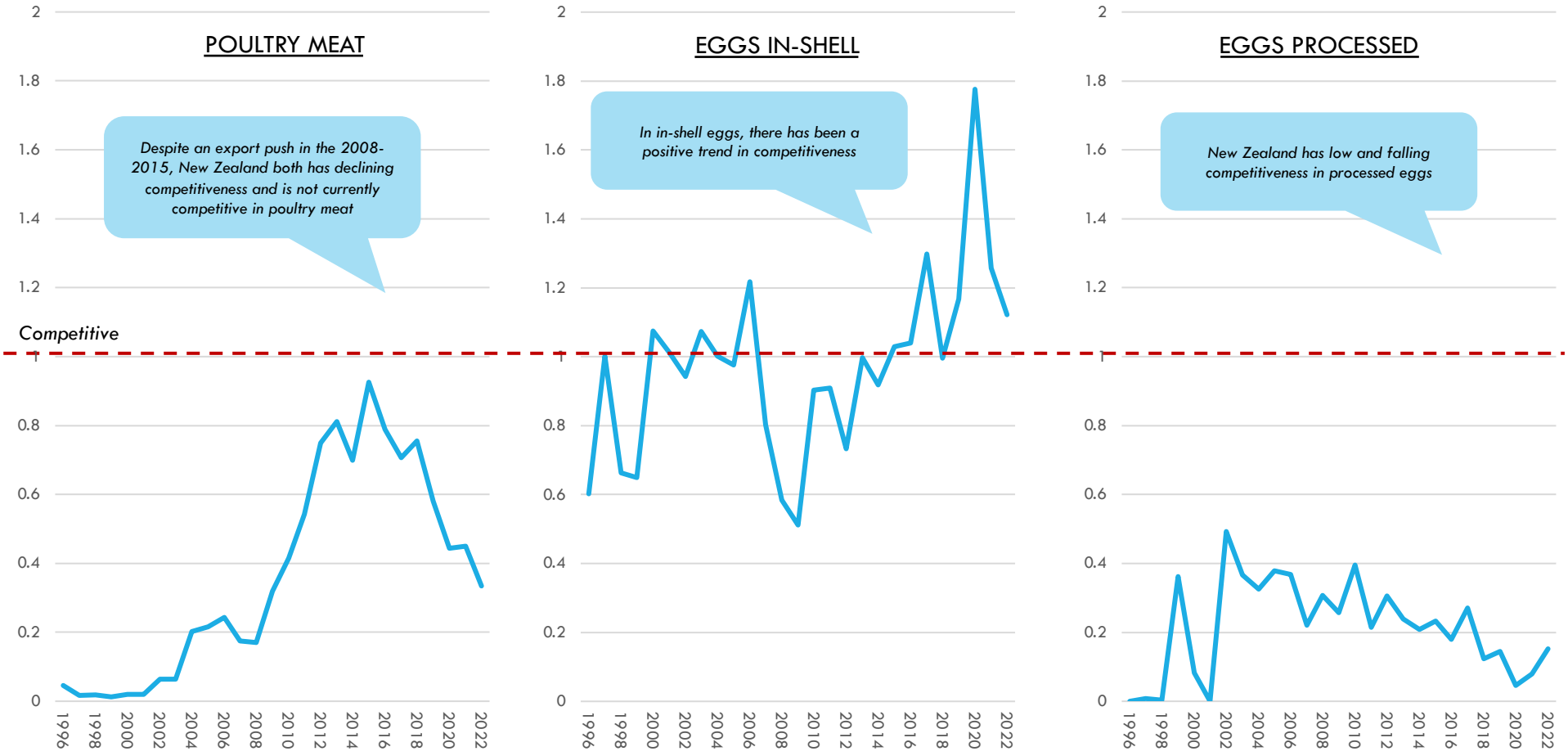
DRIVERS OF AN INTERNATIONALLY COMPETITIVE BIOECONOMY: CHICKEN

Source: Coriolis

Competitiveness is calculated at the border; NZ is competitive in in-shell eggs, almost competitive in poultry meat and not competitive in processed eggs

ANNUAL REVEALED COMPARATIVE ADVANTAGE INDEX: NEW ZEALAND IN POULTRY (HS0207)

1=Average of New Zealand across all exports; 1996-2022

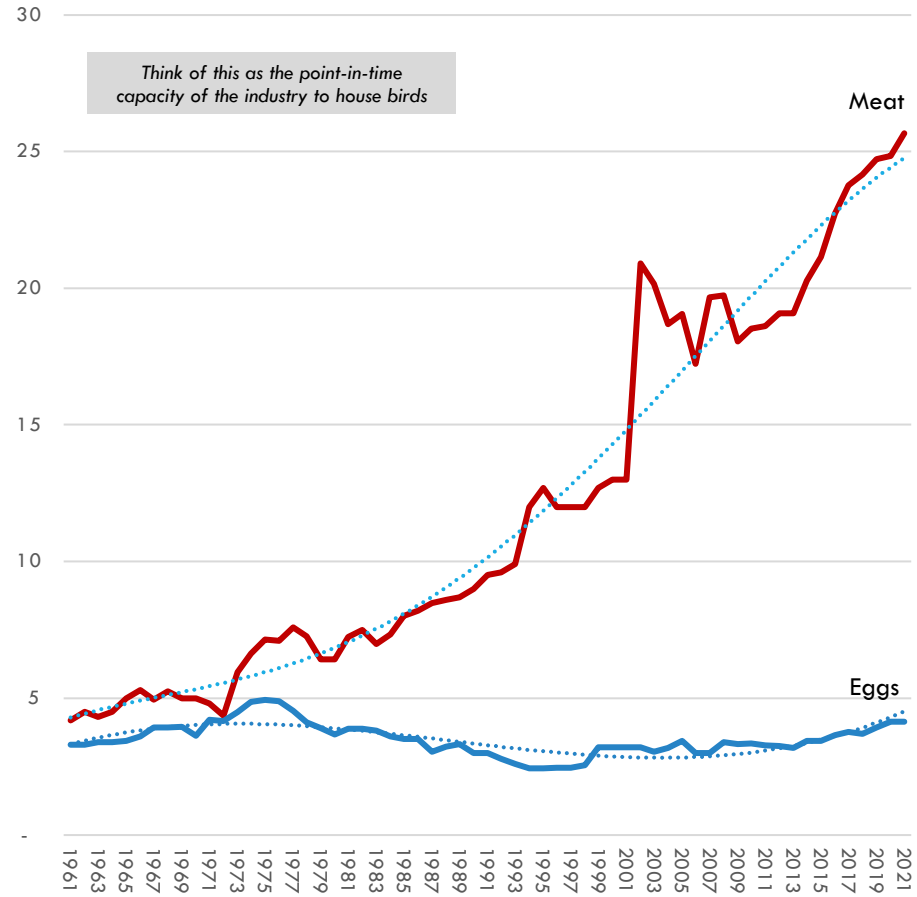


Source: World Bank WITS; UNCTAD STAT; Coriolis analysis

New Zealand has growing broiler chicken numbers and meat consumption, but flatter layer numbers and egg consumption

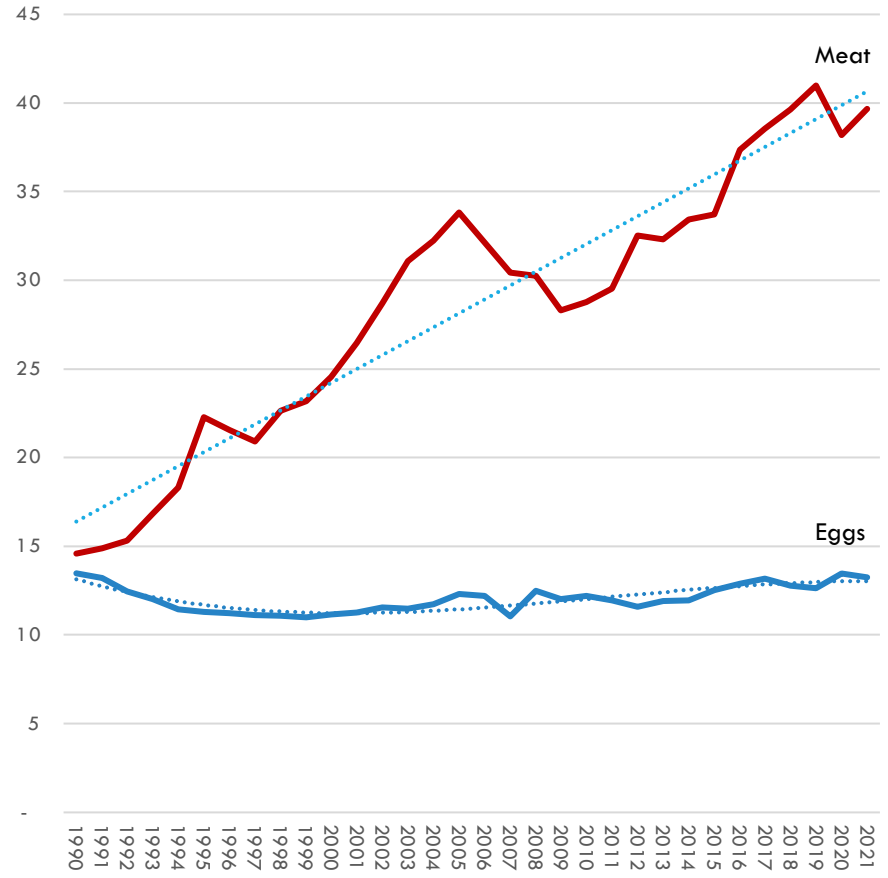
NZ BROILER/LAYER INVENTORY

Head; point-in-time; m; 1961-2021



NZ MEAT/EGGS CONSUMPTION

Kg/person; 1990-2021

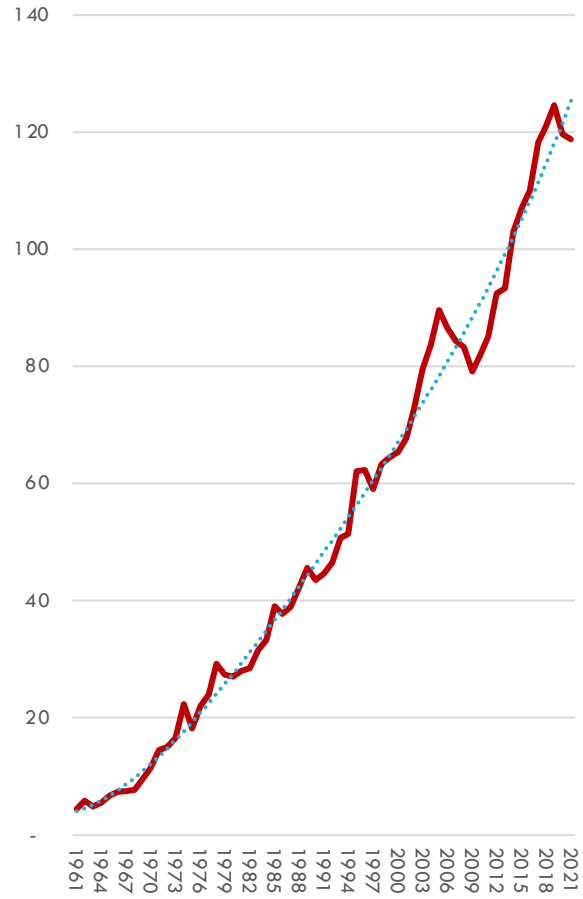


Source: UN FAOStat; Coriolis analysis

New Zealand has growing birds processed, growing chicken meat yields and growing meat production

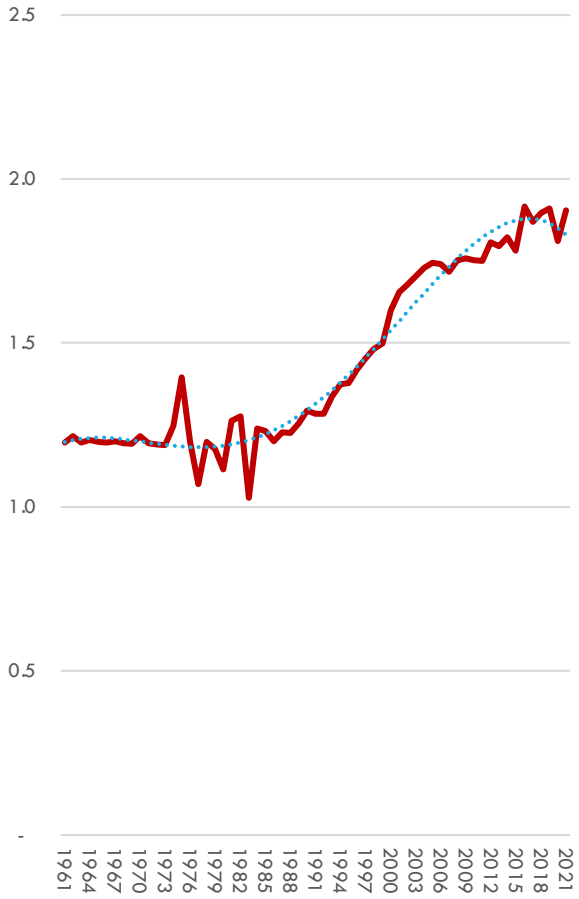
NZ BIRDS PROCESSED

Head; m; annual; 1961-2021



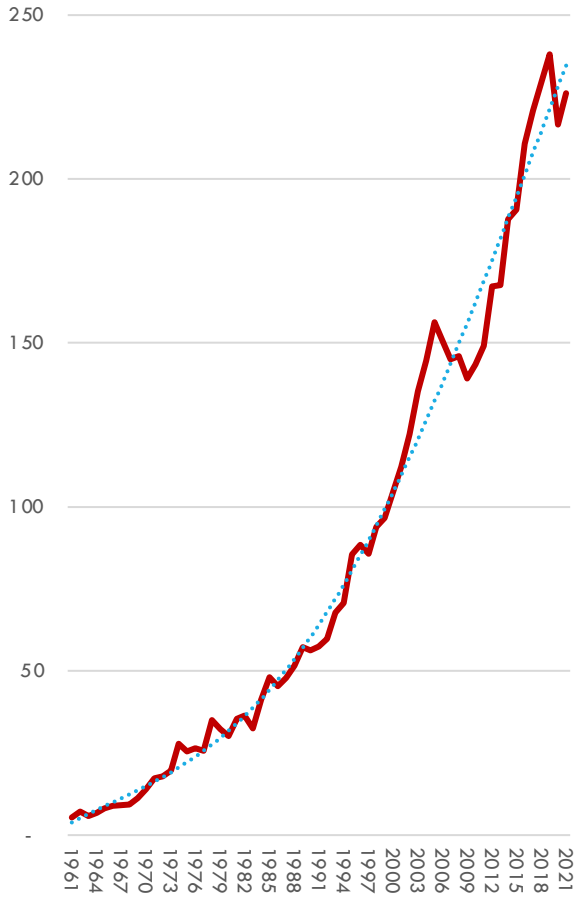
NZ CHICKEN MEAT YIELD

Kg/head; 1961-2021



NZ MEAT TONNES

Tonnes; 000; 1961-2021

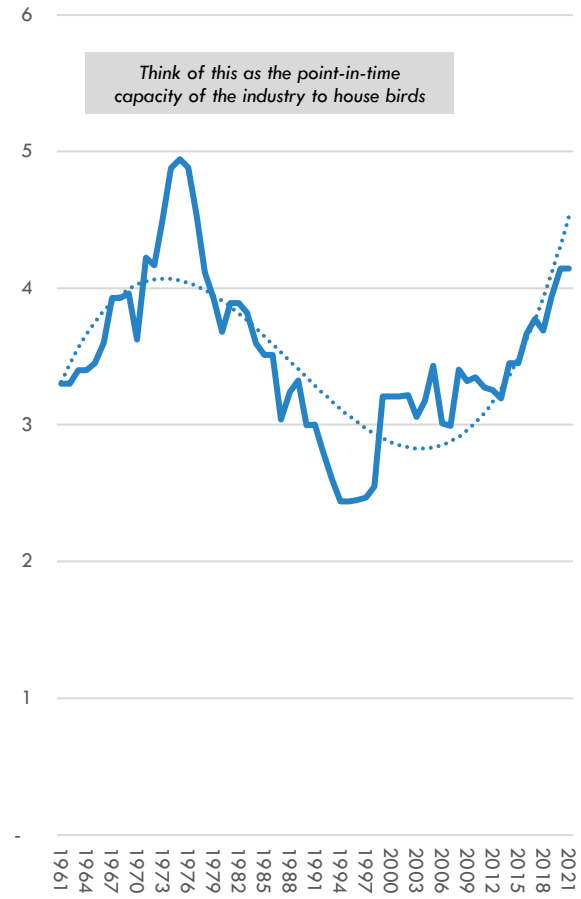


Source: UN FAOStat; Coriolis analysis

New Zealand has recovering layer numbers, growing egg yields and growing egg production

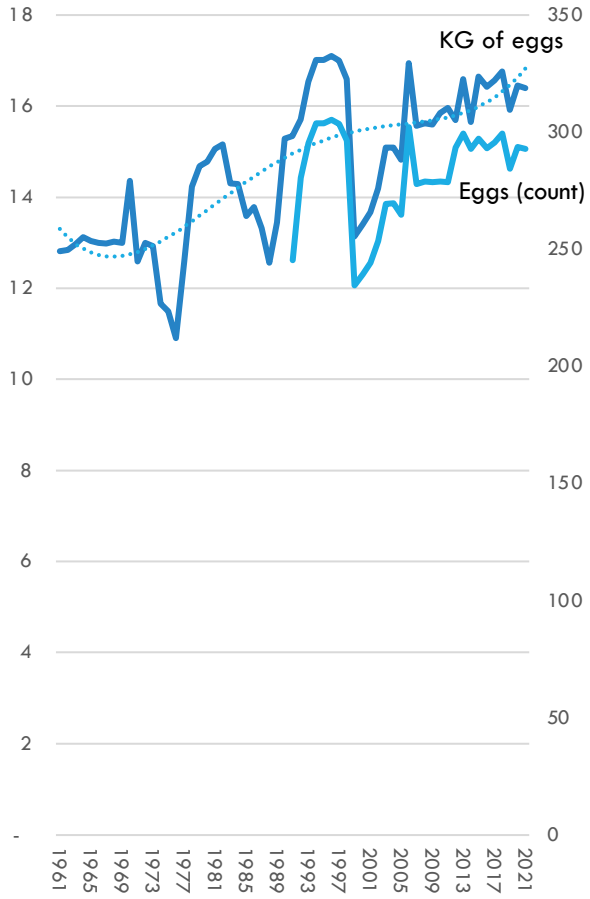
NZ LAYER INVENTORY

Head; m; point-in-time; 1961-2021



NZ EGG YIELD/LAYER

Kg or eggs/layer space/year; 61-21



NZ EGGS TONNES

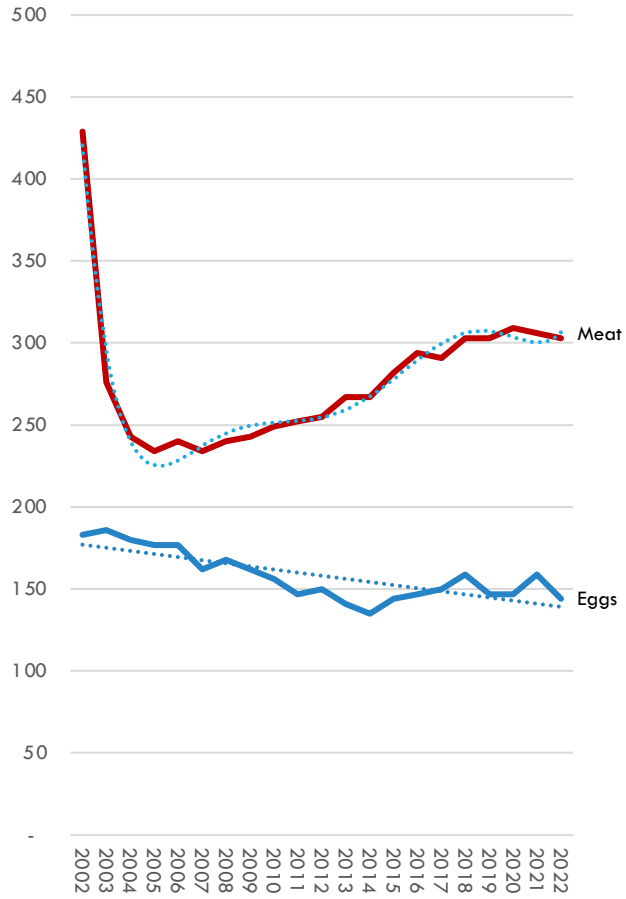
Tonnes; 000; 1961-2021

Source: UN FAOStat; Coriolis analysis

New Zealand has growing poultry meat farming and consolidating (and growing) egg farming

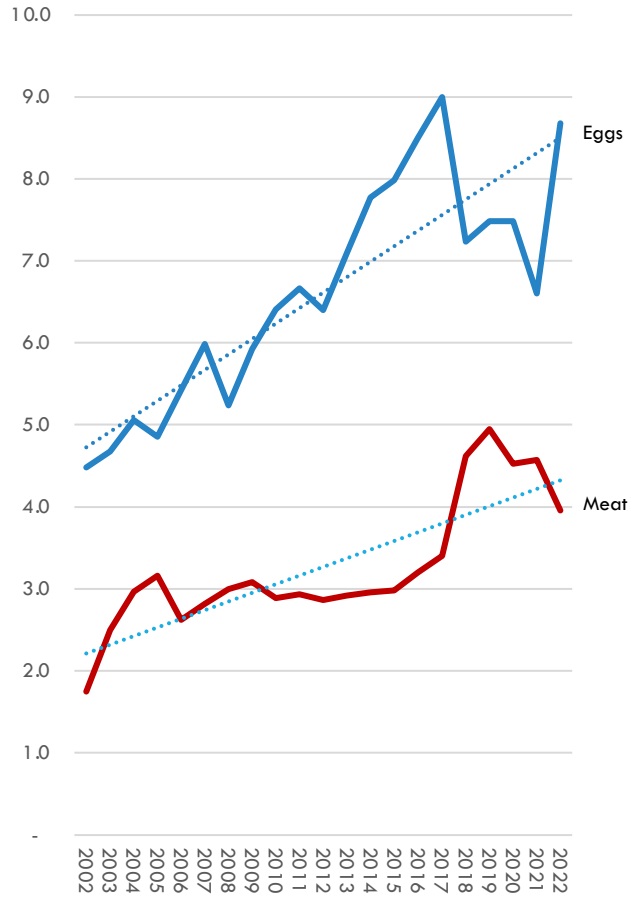
OF FARM UNITS

Geo units; 2002-2022



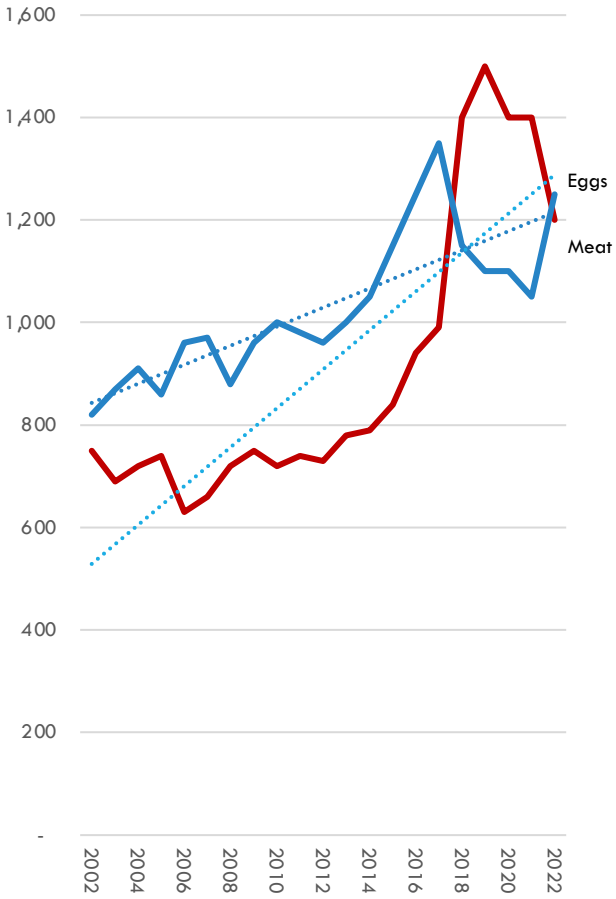
EMPLOYEES/FARM UNIT

Headcount/geo unit; 2002-2022



OF ON-FARM EMPLOYEES

Headcount; 2002-2022

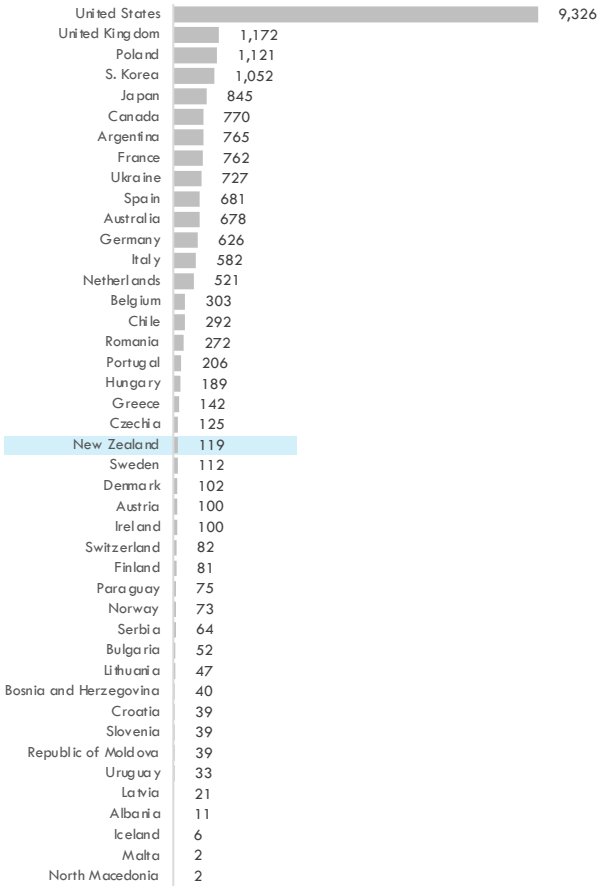


Note: Data is PAYE employees; does not include "owner operator" farmers; Source: StatsNZ (business demographics); Coriolis analysis

New Zealand is a mid-size chicken meat producer relative to a wide climatic peer group, with the animal numbers of Sweden and the yields of Poland

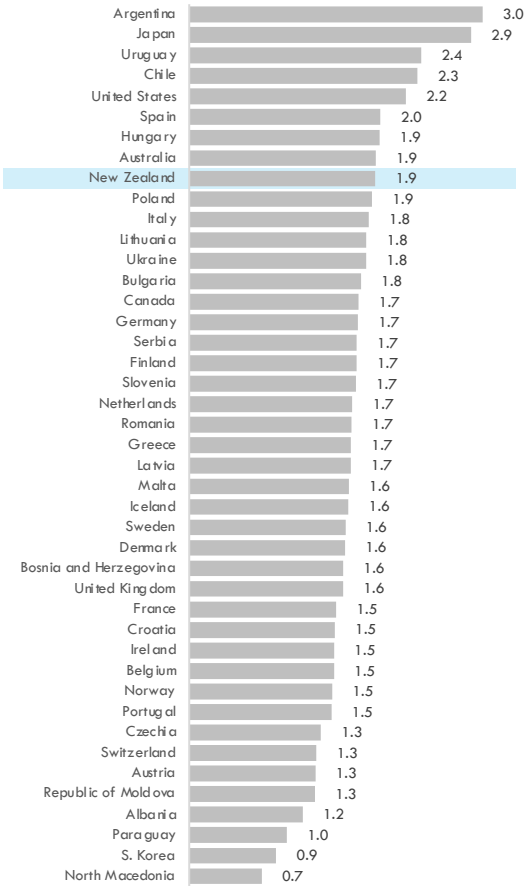
CHICKENS PROCESSED

Head; m; 2021



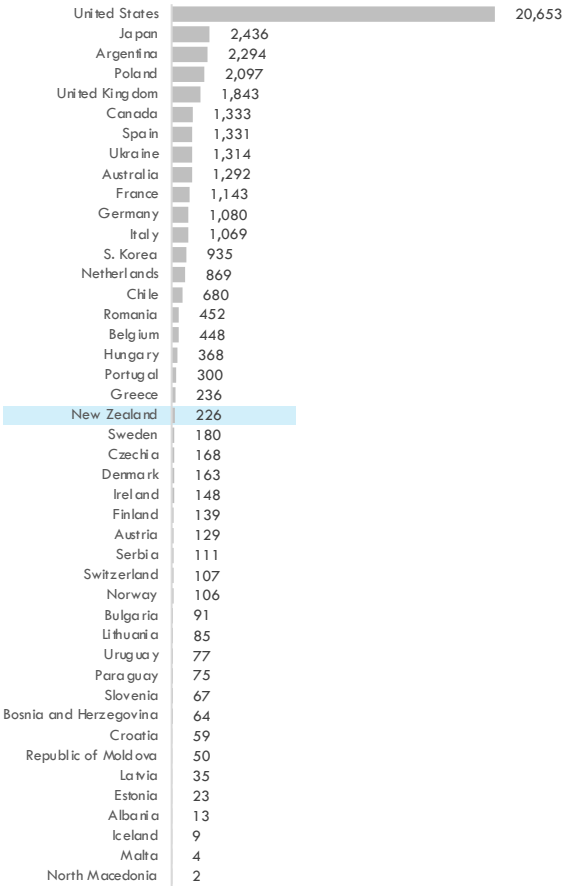
AVERAGE WEIGHT/HEAD

Kg/Head; 2021



CHICKEN MEAT PRODUCED

T; 000; 2021

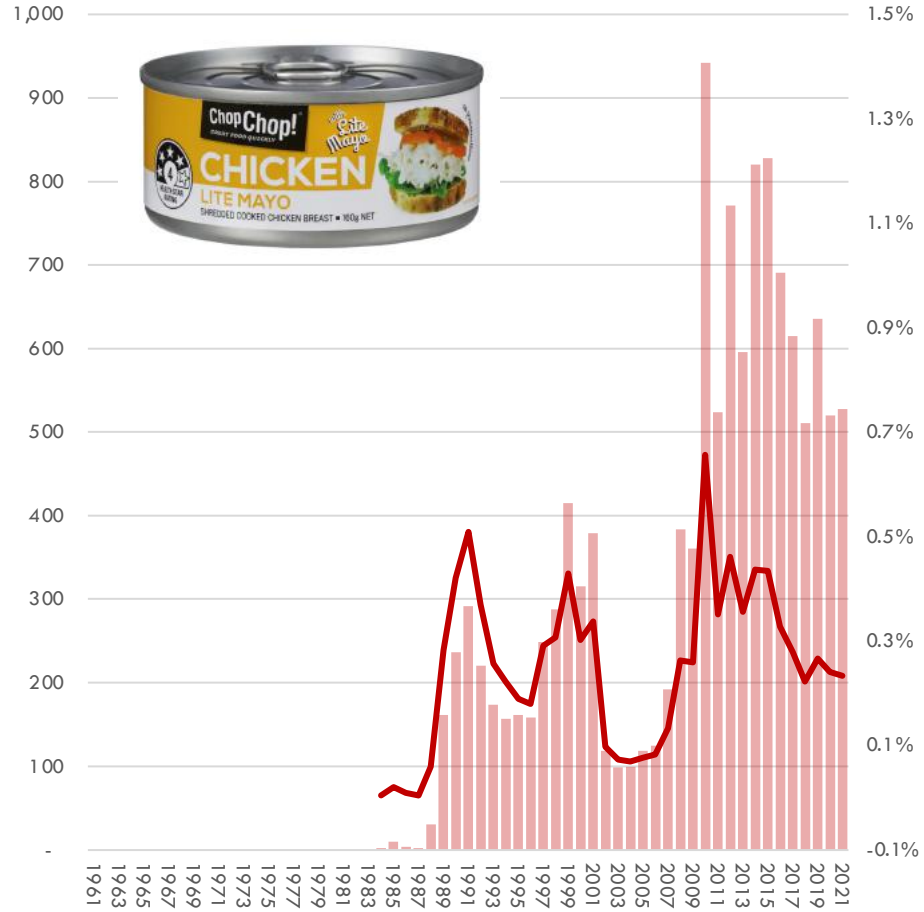


Source: UN FAOStat; Coriolis analysis

New Zealand has strict biosecurity around birds; only extremely processed products can enter and volumes are close to immaterial currently

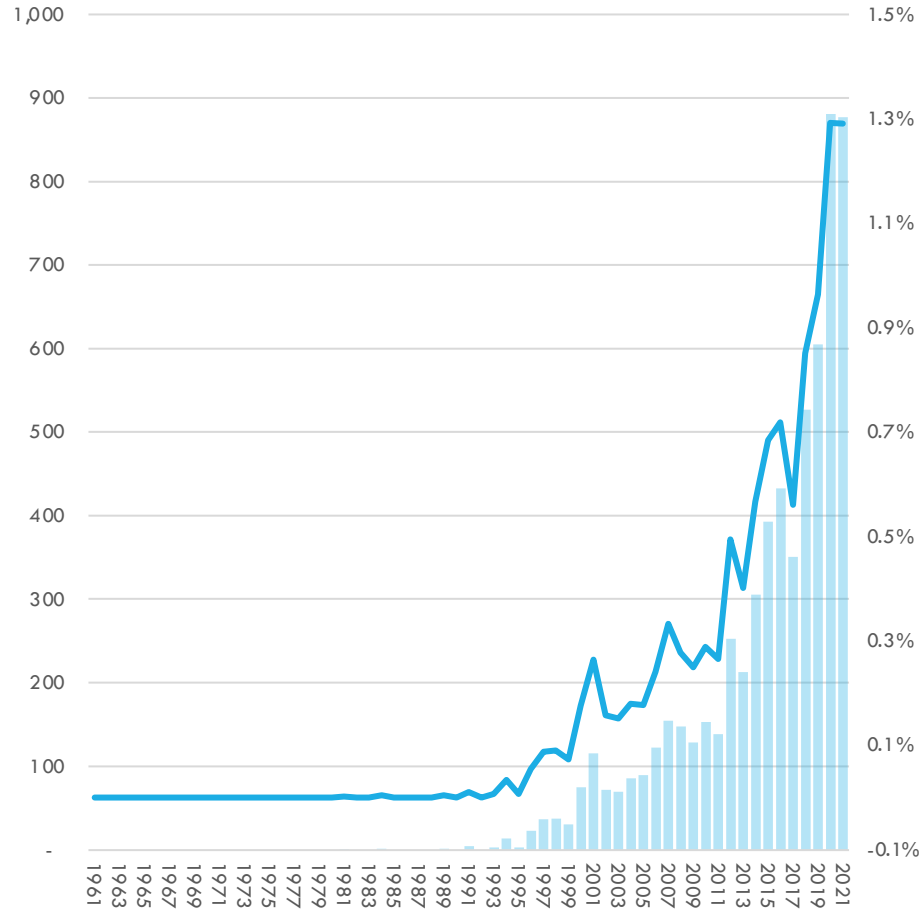
NZ CHICKEN MEAT IMPORTS

Tonnes; % of NZ prod; 1961-2021
(bar) (line)



NZ EGG PRODUCTS IMPORTS

Tonnes; % of NZ prod; 1961-2021
(bar) (line)



Source: UN FAOStat; Coriolis analysis

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PAGES 206-241

The New Zealand pig industry has been struggling against imports from more efficient producers (e.g. Germany) as biosecurity has been removed

The removal of biosecurity has put strong pressure on the domestic pig industry to improve and move towards global best practice

- The New Zealand pig industry has a relatively streamlined supply chain with most required capabilities
- New Zealand's pig industry is struggling and unable to articulate a plan to dramatically change the situation
- New Zealand has limited capabilities in the pig chain and technology adoption is stymied by government; the industry is struggling against imports

While New Zealand is a globally competitive producer of cattle and sheep meat, this is not the case in pork

- Competitiveness is calculated at the border; New Zealand is not currently competitive in pork

New Zealand produces a falling number of relatively small pigs; however yields are improving and the country is no longer the worst performer in its peer group

- New Zealand has falling pig animal numbers, but growing pork consumption, with the gap being filled by imports as biosecurity restrictions have come off
- New Zealand has stable-to-growing pig meat yields and falling production
- New Zealand has rapidly falling pig farm numbers and falling on-farm employment, but the surviving units are getting larger
- New Zealand is a small pig producer relative to a wide climatic peer group, with the pig numbers of Moldova and the yields of Bulgaria

Imports are surging from high productivity, high regulation, high wage countries

- New Zealand has rapidly growing pig meat imports driven by (1) biosecurity rules changes and (2) more countries completed "their paperwork"

The New Zealand pig industry has a relatively streamlined supply chain with most required capabilities

NEW ZEALAND CAPABILITIES DRIVEN SUPPLY CHAIN: PIGS

SELECT FIRMS

PIG SHEDS

Numerous regional suppliers

VEHICLES/MACHINERY

John Deere · Massey Ferguson · Yamaha · Toyota · Hamaguchi · Gascon · Fendt · Moreni · Pottinger · Alpego

FARM SUPPLIES

New Zealand Farm Source · PGG Wrightson · Farmlands

ANIMAL FEED

MainFeeds · NRM Feed to Succeed · Glencore Viterra · Weston Milling Stockfeed · Taranaki Feeds · Sharpes Farm Feeds · Agrifeeds · Golden Grain · Advanced Feed · Nutrinza

FUEL & LUBRICANTS

Gulf · Allied Petroleum · npd · RD Petroleum · McFall Fuel · SMF

ANIMAL HEALTH

Zoetis · Boehringer Ingelheim · Elanco · MERCK Animal Health · Bayer

FARMS

SNZ 96 pig farms
Pork NZ ~80 commercial

PEOPLE IN PIG FARMING

~96 farmers
380 employees

PIG GENETICS

Genus · PIC

Numerous smaller breeders

PRIMARY PROCESSING

freshPork nz NZ's Pork Specialist · Wilson Hellaby New Zealand · Five Star Pork · Cabernet Foods

VALUE ADDED PROCESSING

Verkerks · Hellers NZ's Butcher · Colonial Bacon & Ham · Source and Supply Food Co. · Beehive · Leonard's

LOGISTICS

Numerous regional suppliers

INDUSTRY ORGS.

NZ Pork · FG:C New Zealand Food & Grocery Council · Federated Farmers of New Zealand

Source: Coriolis

New Zealand's pig industry is struggling and unable to articulate a plan to dramatically change the situation

SWOT ANALYSIS: NEW ZEALAND PIGS/PORK INDUSTRY

STRENGTHS	WEAKNESSES
- Growing yields (average weight/head); no longer the worst in our peer group - Natural environment favourable to agriculture - Strong biosecurity rules and systems leading to low presence of key diseases - High standards of food safety and animal welfare - Highly consolidated industry with a small number of both farmers and processors - International recognition of high quality of New Zealand meat industry regulations - 135+ years experience exporting meat long distances - Strong position in global beef and lamb trade in counter-seasonal window to Northern Hemisphere - NZ reputation as a trusted supplier of quality meat products - Access to modern genetics from global breeding pools (unlike Australian industry) - Low emissions per kilogram of meat relative to cattle or sheep - Somewhat unique 'theatrical' free-range pasture system (with supplementary feed obviously)	- Small animals relative to almost every peer (at least NZ beat Bulgaria and Serbia) - Falling number of animals throughput impacting processing return on capital and retarding incentives for investment - Inefficient, low productivity industry relative to developed country leaders (e.g. Netherlands) - Low scale across all stages of the chain - Declining arable crop competitiveness; industry dependent on imported feed - 50 years of "rear guard action" by industry focused on preventing imports (rather than becoming competitive) - No obvious industry strategy or plan to address growing imports head on by becoming competitive with European producers - Vocal segment of consumers driving imposition of uncompetitive regulations (vs. Denmark or Germany) - Limited experience with branded and high value processed meats or meal solutions - Labour shortages both on farm and in processing - Animal welfare issues - Domestic and imported grain prices higher than competitors, which restricts competitiveness of pork, poultry, and other feed-dependent production systems
OPPORTUNITIES	**THREATS/ISSUES/CHALLENGES/RISKS**
- Better farm management and production systems - Encouraging immigrants from countries with world-class skills and capabilities (e.g. Denmark) - Adopting European standards (rather than re-inventing the wheel) - Increased demand for protein globally - Convincing someone, somewhere, in some export market, to pay some premium for 'free-range' (but supplementary fed) NZ pork	- Attitudes and opinions of local producers; lack of vision - Surging imports; growing market share of imports; imports spreading beyond processed products - Animal welfare and extension of "rights revolution" to animals - Further government regulation further decreasing competitiveness - Religious-based food restrictions (e.g. Sikh, Muslim, Jewish, Hindu)

New Zealand has limited capabilities in the pig chain and modern farming systems are almost impossible; the industry is struggling against imports*

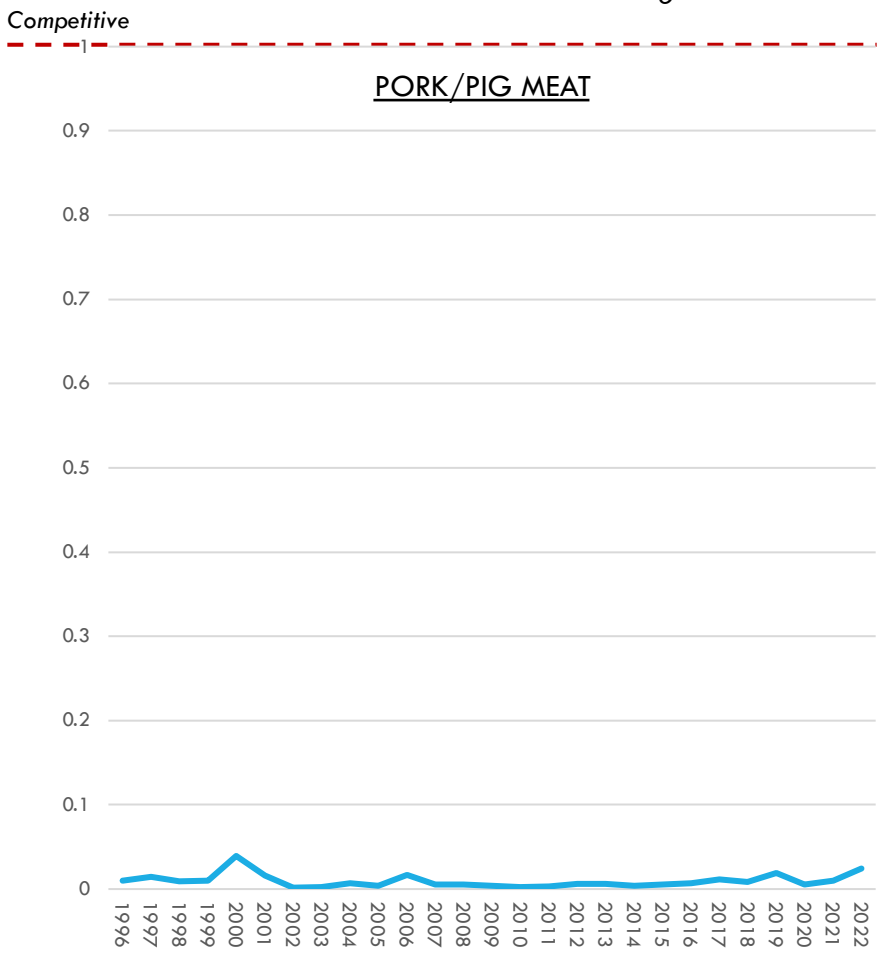
DRIVERS OF AN INTERNATIONALLY COMPETITIVE BIOECONOMY: PIGS

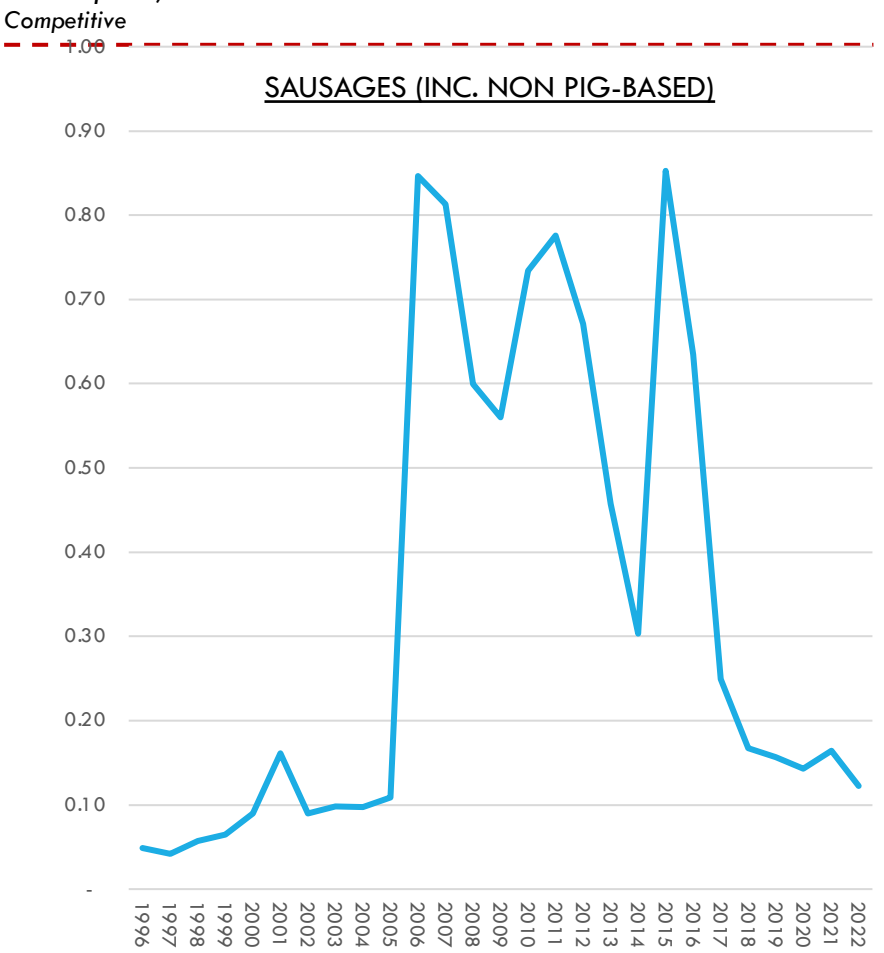
** In this instance simply defined as those that are taking production share globally, but particularly in major EU suppliers to NZ; Source:Coriolis*

Competitiveness is calculated at the border; New Zealand is not currently competitive in pork

ANNUAL REVEALED COMPARATIVE ADVANTAGE INDEX: NEW ZEALAND BY SELECT SITC3

1=Average of New Zealand across all exports; 1996-2022



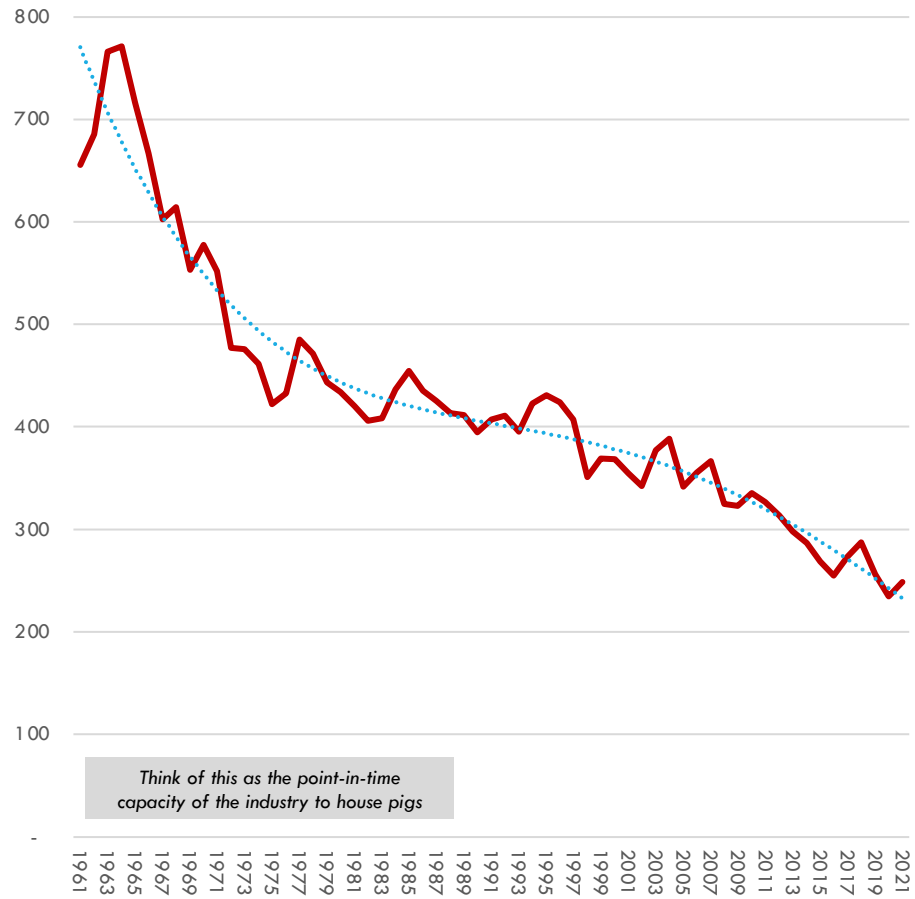


Source: World Bank WITS; UNCTAD STAT; Coriolis analysis

New Zealand has falling pig animal numbers but growing pork consumption with the gap being filled by imports as biosecurity restrictions have come off

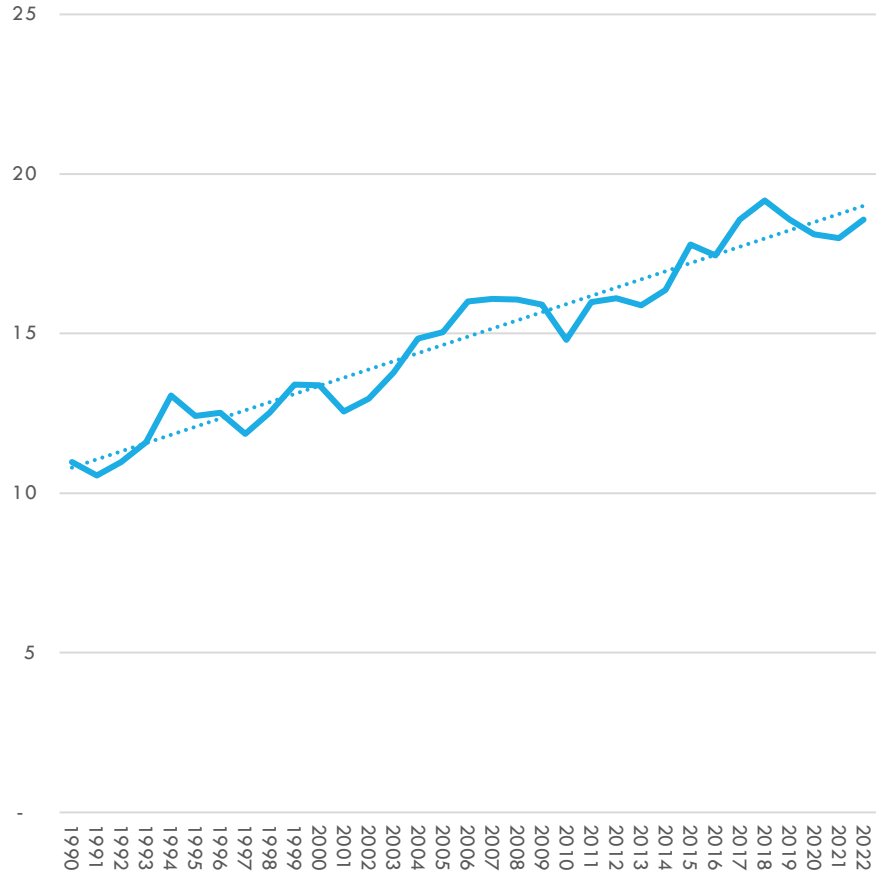
NZ PIG INVENTORY

Head; point-in-time; 000; 1961-2021



NZ PIG MEAT/CAPITA

Kg/person; 1990-2021

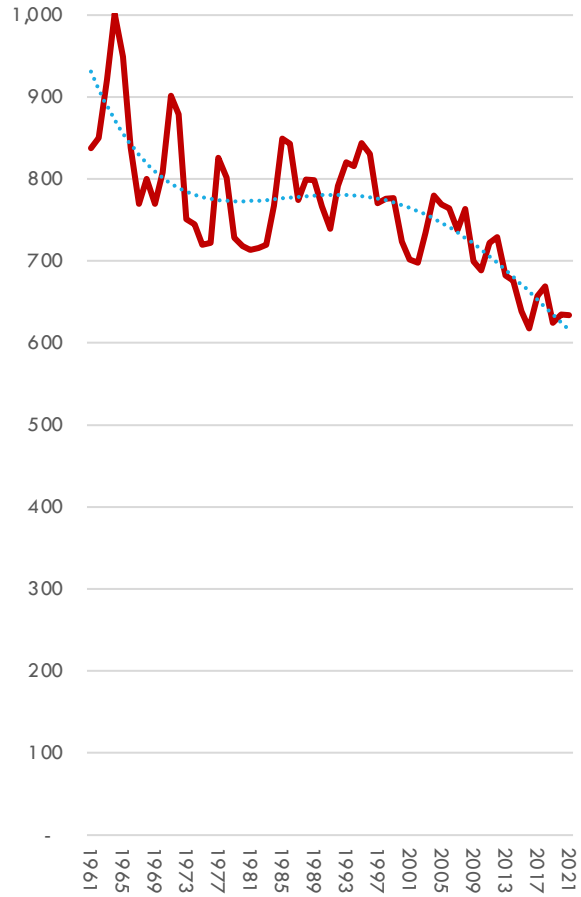


Source: UN FAOStat; Coriolis analysis

New Zealand has stable-to-growing pig meat yields and falling production

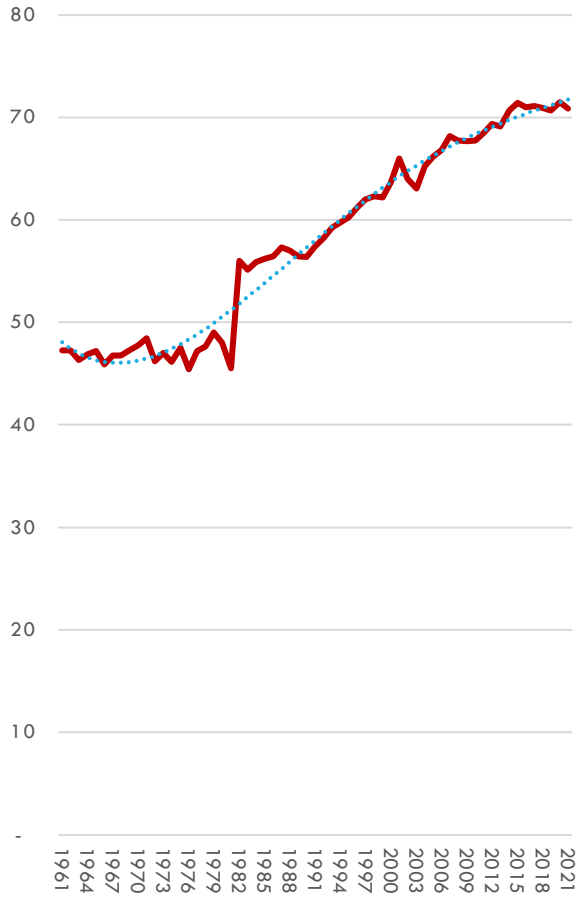
NZ PIGS PROCESSED

Head; annual; 000; 1961-2021



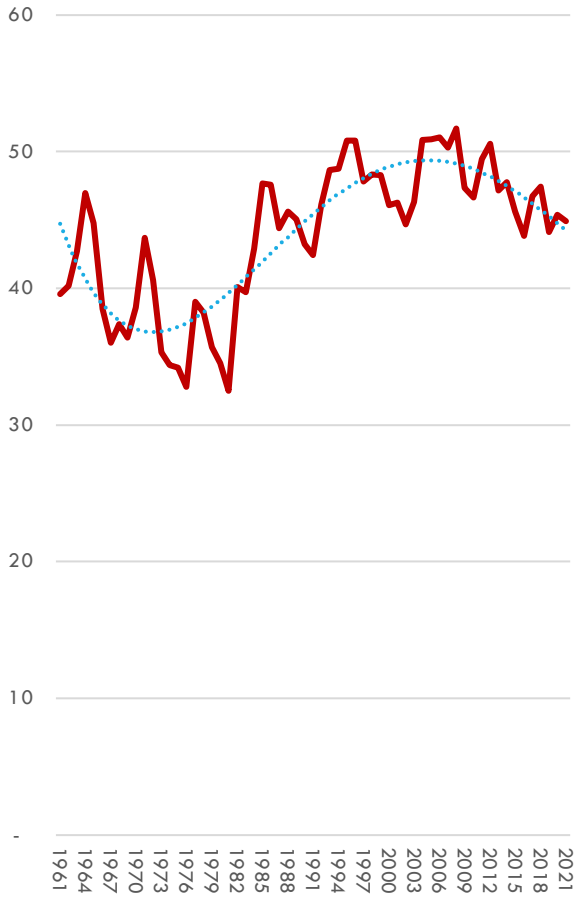
NZ PIG MEAT YIELD

Kg/head; 1961-2021



NZ PIG MEAT TONNES

Tonnes; 000; 1961-2021

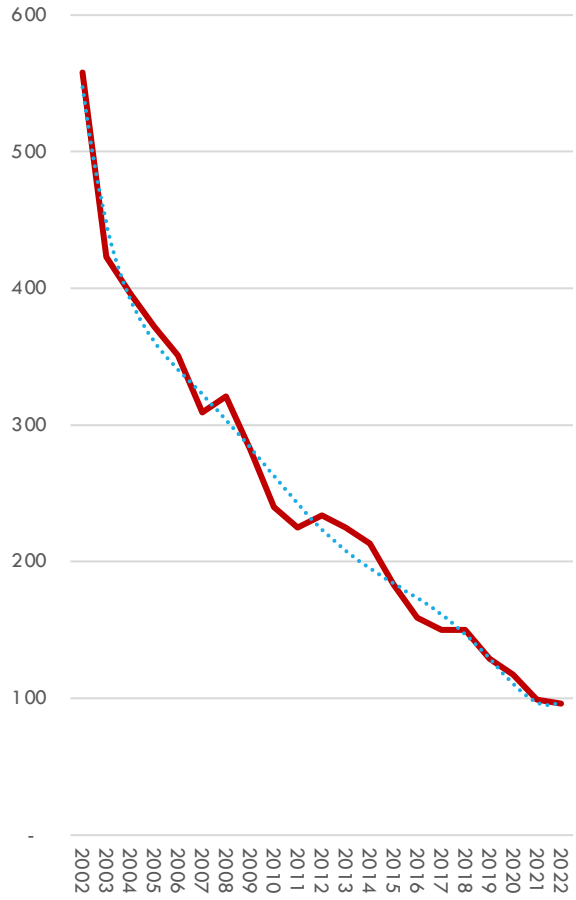


Source: UN FAOStat; Coriolis analysis

New Zealand has rapidly falling pig farm numbers and falling on-farm employment, but the surviving units are getting larger

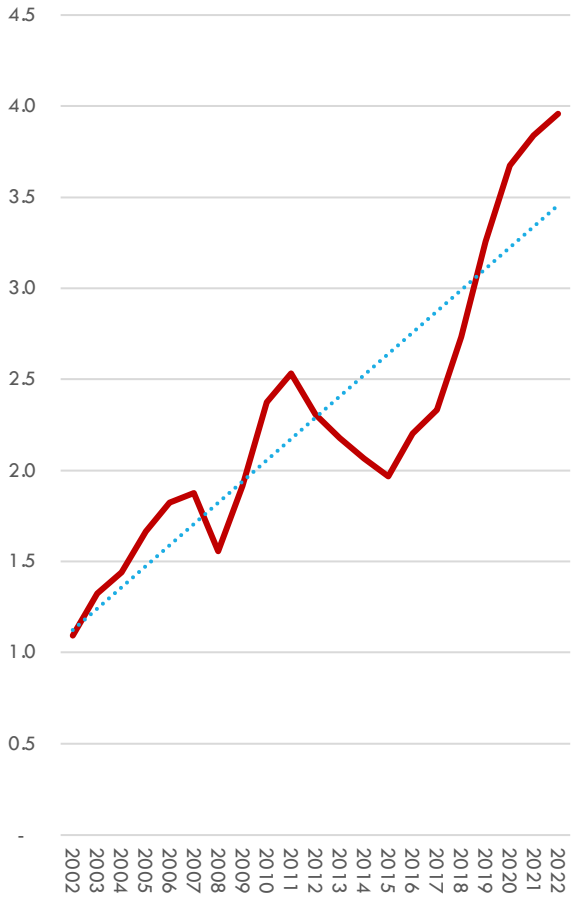
OF FARM UNITS

Geo units; 2002-2022



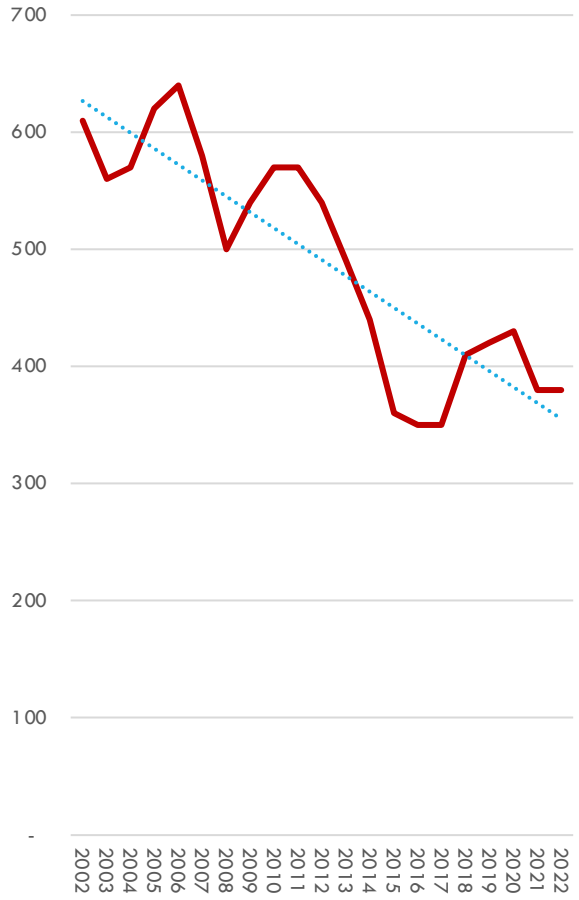
EMPLOYEES/FARM UNIT

Headcount/geo unit; 2002-2022



OF ON-FARM EMPLOYEES

Headcount; 2002-2022

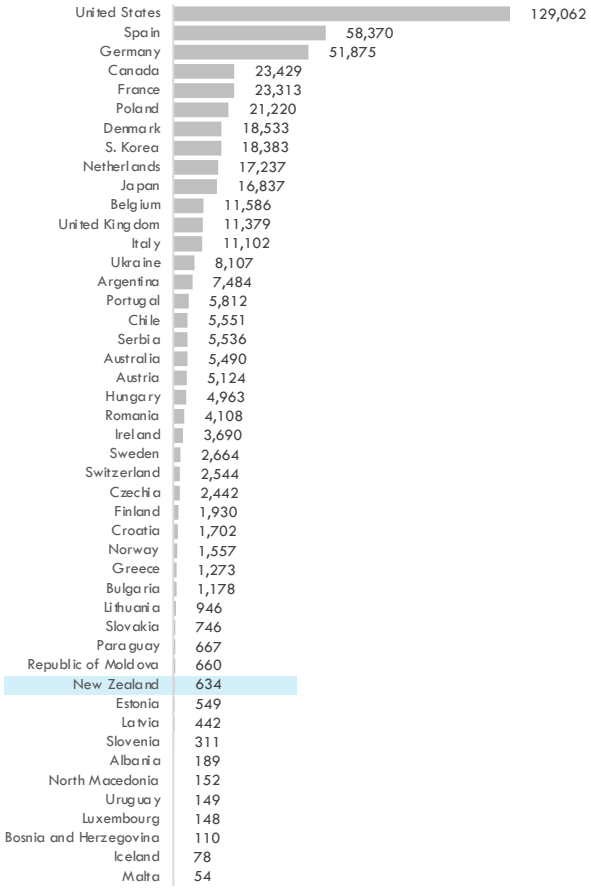


Note: Data is PAYE employees; does not include "owner operator" farmers; Source: StatsNZ (business demographics); Coriolis analysis

New Zealand is a small pig producer relative to a wide climatic peer group, with the pig numbers of Moldova and the yields of Bulgaria

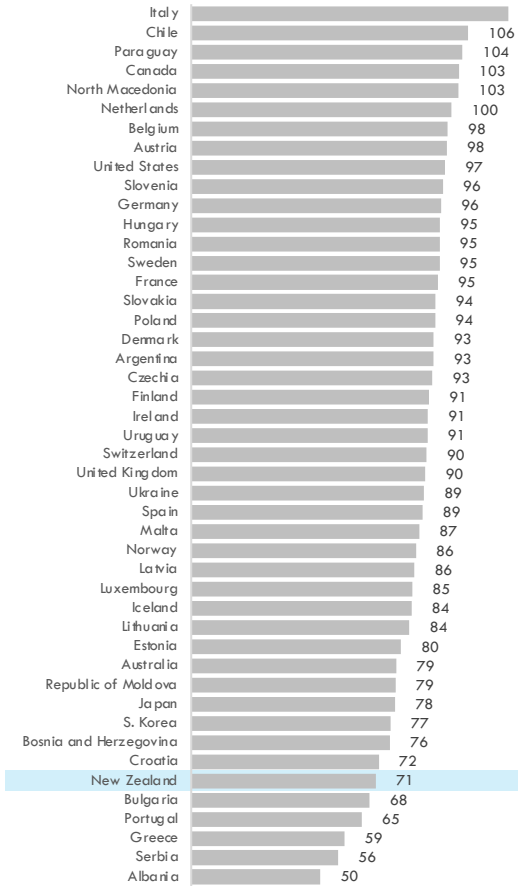
PIG HEAD PROCESSED

Head; 000; 2021



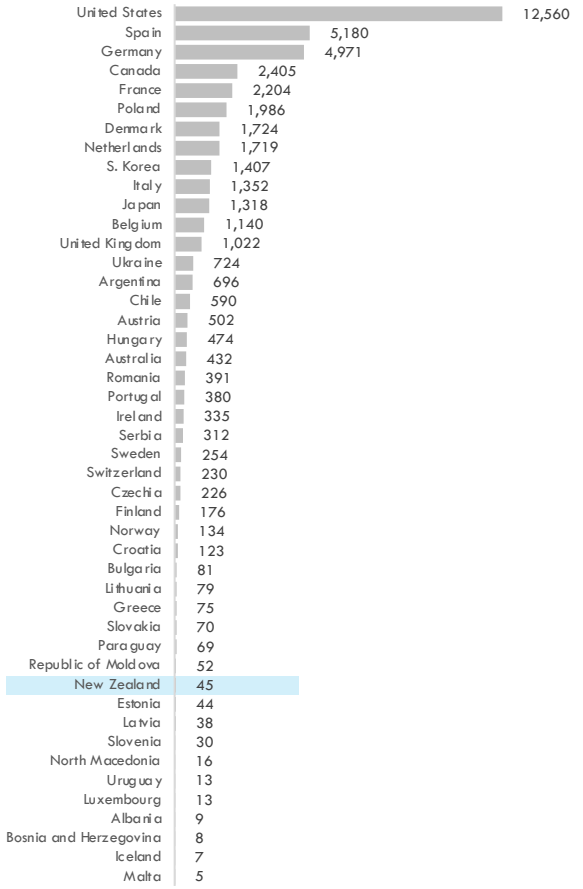
AVERAGE WEIGHT/HEAD

Kg/Head; 2021



PIG MEAT PRODUCED

T; 000; bone-in; 2021

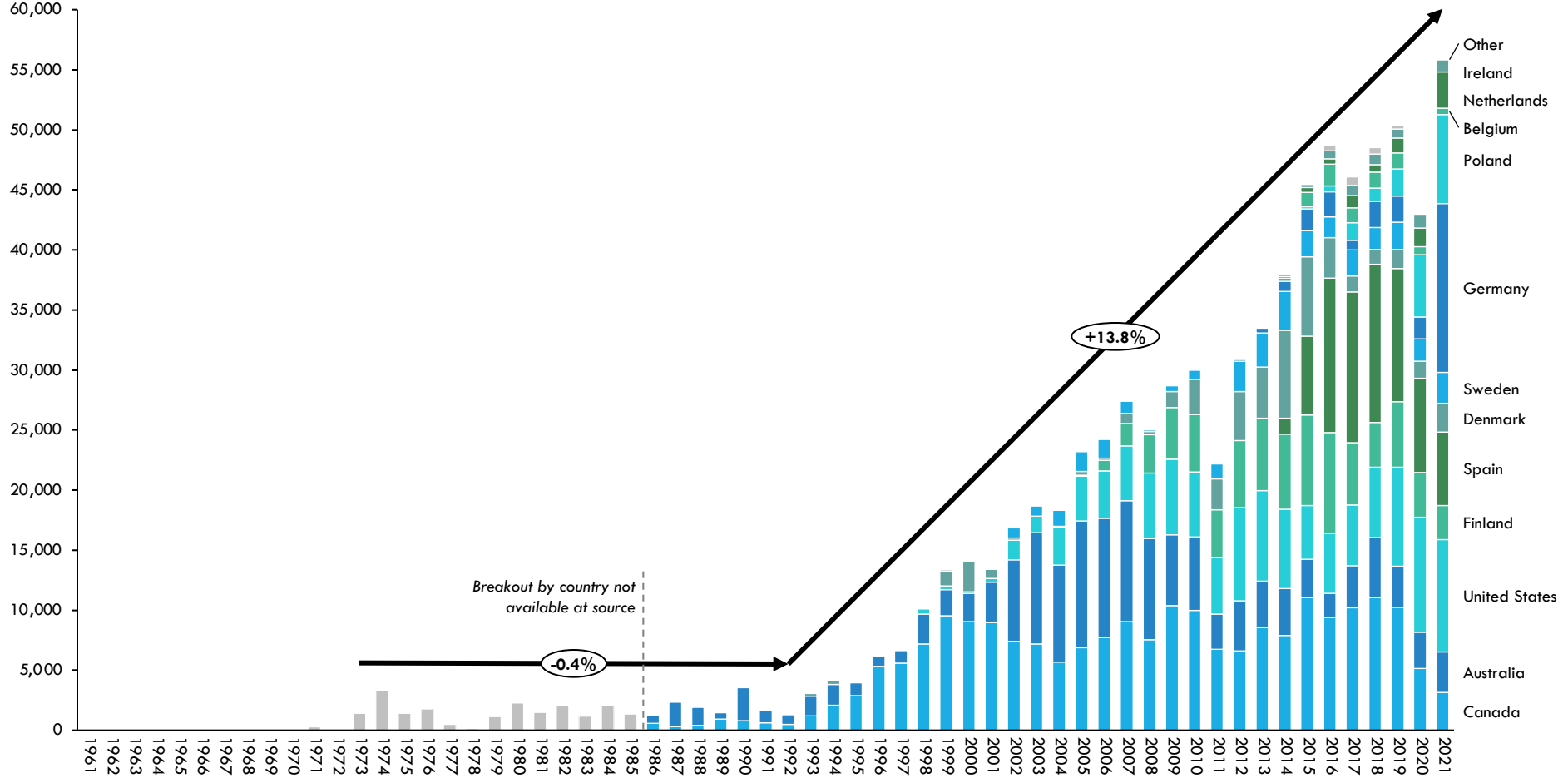


Source: UN FAOStat; Coriolis analysis

New Zealand has rapidly growing pig meat imports driven by (1) biosecurity rules changes and (2) more countries completed "their paperwork"

NZ PIG MEAT IMPORTS

Tonnes; bone-in and boneless; 1961-2021



Source: UN FAOStat; Coriolis analysis

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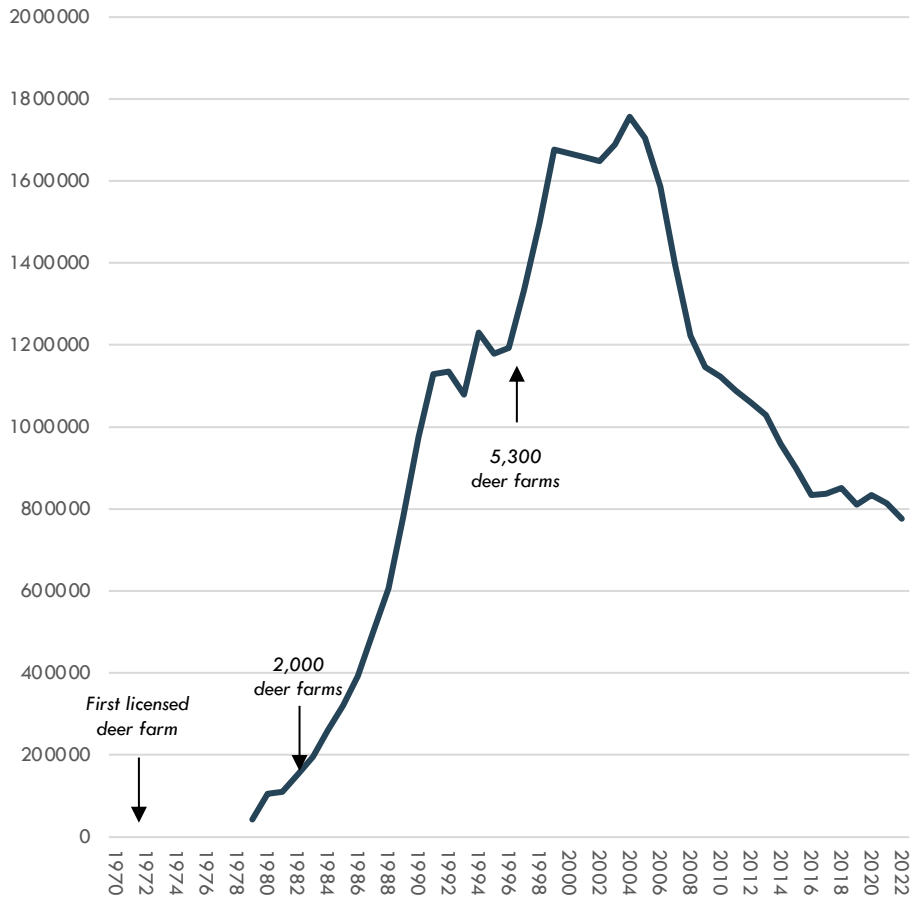
New Zealand seems to have a habit of inflating farming bubbles around new species

- The New Zealand **deer industry** inflated a farming bubble; after a period of sharp decline, the situation has stabilised more recently
- The New Zealand **goat industry** inflated a farming bubble; after a period of sharp decline, the situation has stabilised more recently
- The New Zealand **llama and alpaca industry** inflated a farming bubble; after a period of sharp decline, the situation has stabilised more recently
- While there isn't any data, the ostrich and emu industries did the same thing
- New Zealand has seen collapsing farm numbers in deer and other livestock
- A wide range of other species are being, have been or have been proposed for farming

The New Zealand deer industry inflated a farming bubble; after a period of sharp decline, the situation has stabilised more recently

NZ DEER STOCKS/ INVENTORY

Head; point-in-time; 1970-2021



VELVET HARVESTED

Tonnes; 1979-2021

"GAME MEAT" PRODUCED

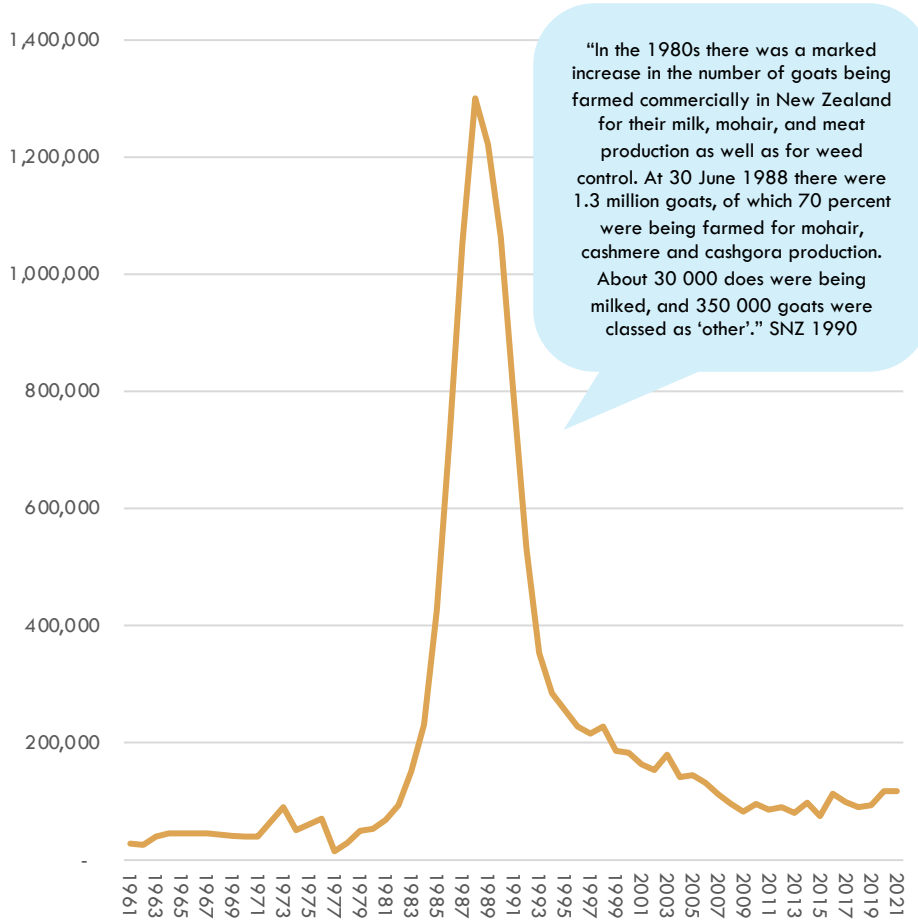
Tonnes; 1979-2021

Source: StatisticsNZ; UN FAOStat; Coriolis analysis

The New Zealand goat industry inflated a farming bubble; after a period of sharp decline, the situation has stabilised more recently

NZ GOAT STOCKS/ INVENTORY

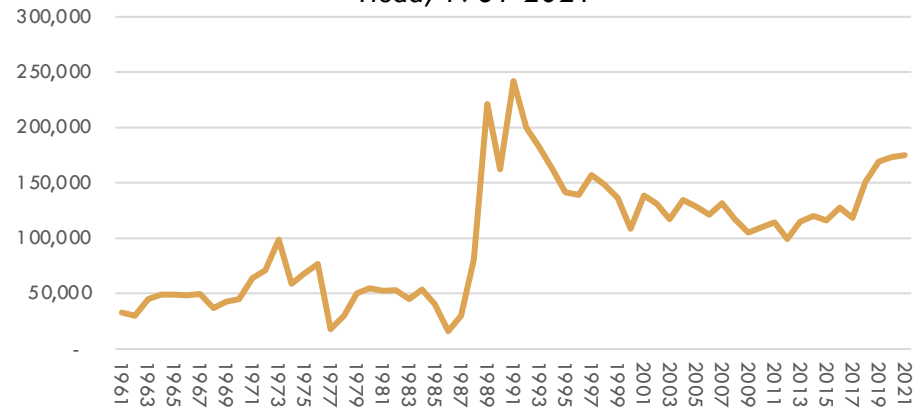
Head; point-in-time; 1961-2021



"In the 1980s there was a marked increase in the number of goats being farmed commercially in New Zealand for their milk, mohair, and meat production as well as for weed control. At 30 June 1988 there were 1.3 million goats, of which 70 percent were being farmed for mohair, cashmere and cashgora production. About 30 000 does were being milked, and 350 000 goats were classed as 'other'." SNZ 1990

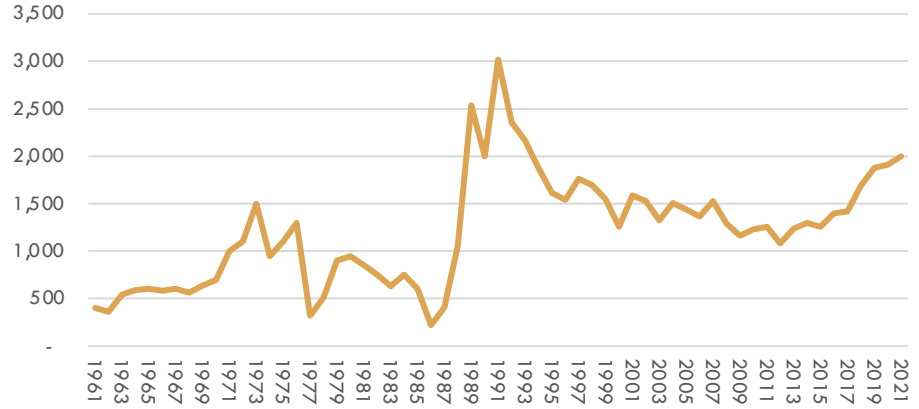
GOAT KILL AT LICENSED ABATTOIRS

Head; 1961-2021



GOAT MEAT PRODUCED

Tonnes; 1961-2021

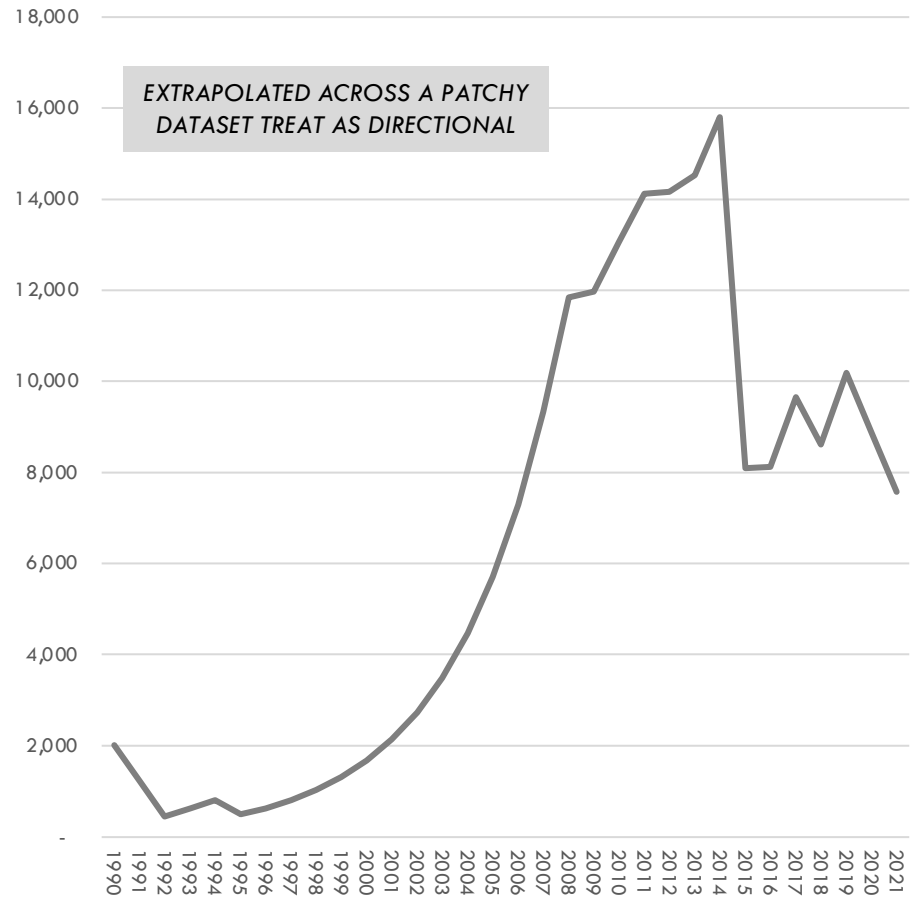


Source: StatisticsNZ; UN FAOStat; Coriolis analysis

The New Zealand llama and alpaca industry inflated a farming bubble; after a period of sharp decline, the situation has stabilised more recently

NZ LLAMA/ALPACA STOCKS/ INVENTORY

Head; point-in-time; 1990-2021



OTHER SPECIES WITH LIMITED DATA

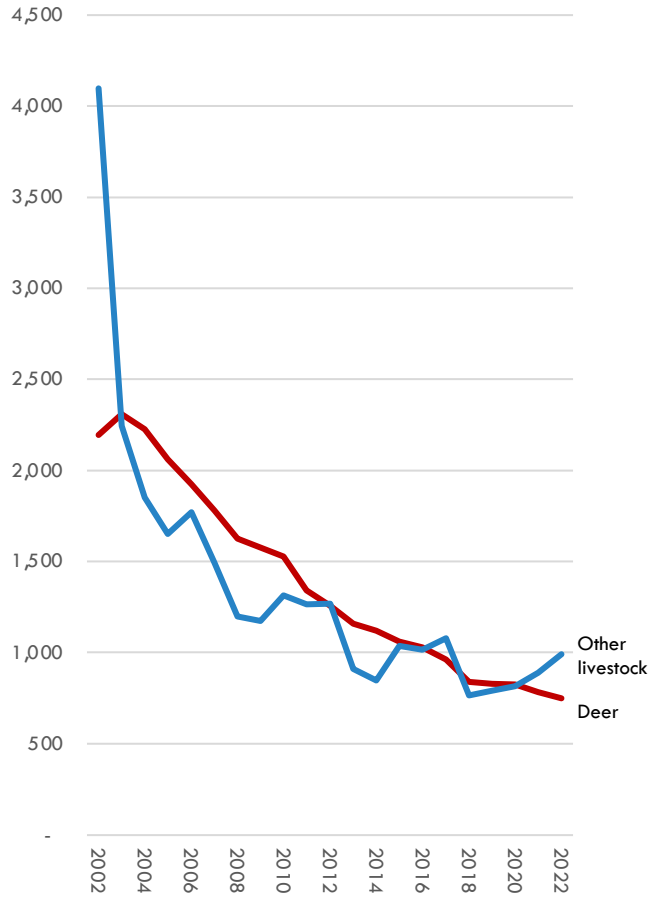
POSSUM FARMING 53 farms in 1982	QUAIL
FERRET FARMING	PEAFOWL/PEACOCKS
RABBITS	GUINEA FOWL
EMU/OSTRICH	HEDGEHOGS*
CHINCHILLA	CRICKETS
EMU/OSTRICH	MEALWORMS
GUINEA PIGS	LOCUSTS
SILKWORM	SNAILS
PHEASANTS	FROGS
EMU/OSTRICH	OTHERS…

** We wish we were making that up ("yuppie puppies, the hot new designer pet of the '90s; exports to US, particularly Florida"); Source: StatisticsNZ; UN FAOStat; Coriolis modelling and analysis*

New Zealand has seen collapsing farm numbers in deer and other livestock

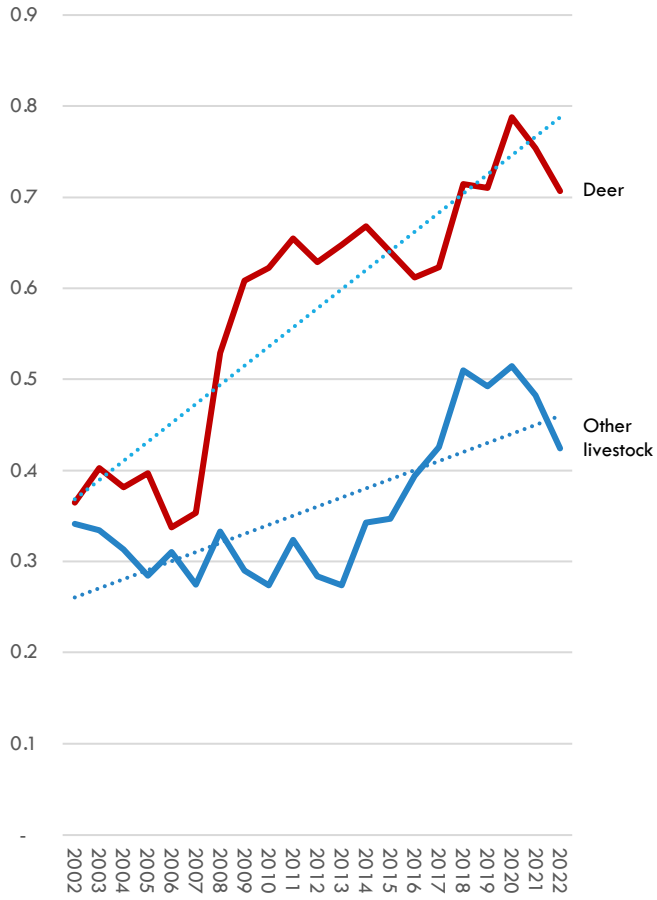
OF FARM UNITS

Geo units; 2002-2022



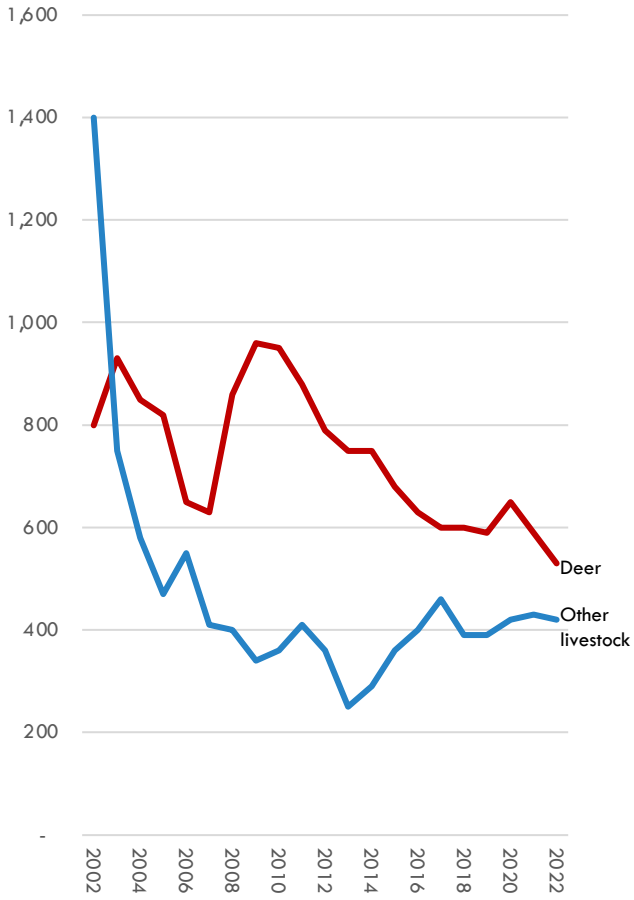
EMPLOYEES/FARM UNIT

Headcount/geo unit; 2002-2022



OF ON-FARM EMPLOYEES

Headcount; 2002-2022



Note: Data is PAYE employees; does not include "owner operator" farmers; Source: StatsNZ (business demographics); Coriolis analysis

DOCUMENT STRUCTURE/TABLE OF CONTENTS

1. AVAILABLE BIO-RESOURCES & IN-SECTOR CAPABILITIES

WHAT DO WE HAVE TO WORK WITH?

PAGES 8-171

2. WIDER PAN-SECTOR SUPPORTING CAPABILITIES

WHAT ARE WE GOOD AT?

PAGES 172-205

3. DEVELOPING NEW PLATFORMS

WHY IS IT SO HARD TO DEVELOP NEW PLATFORMS IN THE BIOECONOMY?

PAGES 206-241

We need to move beyond descriptive and narrative driven discussions of capabilities; New Zealand needs improvement in multiple areas to deliver on the bioeconomy of the future

New Zealanders need to ensure they do not engage in groupthink regarding the country's capabilities

- New Zealand believes it has world leading capabilities in all agriculture and wider bioeconomy disciplines
- In particular, New Zealand regularly highlights that it is 'world-class'; it is difficult to find a capability where New Zealand does not claim to be 'world-class'

A capability is not a descriptive or narrative story or marketing pitch, rather it is the ability to execute

- The military has a clear definition of 'capabilities'; it is the ability to execute
- Like the military, business also defines capabilities as the ability to execute
- 'Capabilities' do not exist in isolation; the concept is a relative one; a peer group of similar countries to New Zealand was developed for comparisons

Beyond the in-sector capabilities discussed earlier in this report, three broad capabilities are required to support the functioning market bioeconomy of the future

1. SMART PEOPLE

New Zealand has increased the number of university graduates

- A large and growing percent of New Zealanders now have a degree
- Relative to peers, New Zealand both produces a lot of graduates and has a large percent of students that are from abroad

New Zealand has a large number of universities, none of which are top tier

- New Zealand has eight universities, a comprehensive polytechnic and training system, and a range of other tertiary education providers
- However, identified peers have more, better Universities;
- A similar message comes from all global rankings; New Zealand universities are not top tier (except maybe Auckland)

The current tertiary education system is not optimally configured for competition with peers in the bioeconomy of the future

- New Zealand universities have pockets of capability in some bio-economy-related areas
- About a quarter (25%) of New Zealand university graduates are likely to be useful or highly useful for constructing the bioeconomy of the future

2. GOOD IDEAS

New Zealand underperforms in R&D relative to peers

- New Zealand has a growing number of researchers and other R&D personnel, however personnel numbers are low relative to peers
- Relative to peers, New Zealand has a lot of university researchers, but relatively few business researchers
- New Zealand does not spend a lot on R&D relative to peers
- This creates a situation where New Zealand has a large number of underfunded researchers primarily working in Universities

New Zealand underperforms in scientific papers relative to peers

- New Zealand's scientists (1) produce fewer scientific papers, (2) which produce less 'impact', and (3) are less often in the best journals
- New Zealand is strong in medicine, agriculture and a range of fields related to the bioeconomy

New Zealand has low but growing business R&D, with relatively little of this workforce pointed at the bioeconomy

- About 45% of New Zealand's total R&D workforce works in business and the number of business R&D workers is growing
- About 11% of New Zealand's business R&D personnel are pointed at the bioeconomy or sectors that may be able to support it in the future
- Relative to peers, New Zealand has a lot of R&D personnel in ag/forestry/fishing and food & beverage; lack of large pharma stands out

New Zealand underperforms in patents relative to peers

- New Zealand patent applications appear to be trending down; climate change and biotechnology both among the major domains for NZ
- New Zealand does not produce a lot of patents relative to peers; New Zealand trending down while many peers trending up
- Relative to peers, New Zealand is not a leader in patent production in any major field

3. USEFUL CAPITAL

Relative to peers, New Zealand is strong in venture capital but has a small stock market

- New Zealand is doing well in terms of amount of venture capital (VC) funding attracted
- Relative to peers, New Zealand has a small stock market and relatively few listed companies

New Zealanders need to ensure they do not engage in groupthink regarding the country's capabilities

What is groupthink?

Groupthink is a phenomenon that occurs when a group of individuals prioritises consensus and harmony over critical thinking and rational decision-making. In groupthink, members of the group tend to conform to the group's views and ideas, often disregarding their own opinions and ignoring conflicting information.

Groupthink can occur in any setting where a group of individuals is making a decision or working towards a common goal. It is often seen in workplaces, government, and social settings. Symptoms of groupthink may include a lack of diversity of opinions, self-censorship, an illusion of unanimity, and pressure to conform to the group's views.

Groupthink can have negative consequences, including flawed decision-making and a lack of creativity and innovation. It can also lead to a false sense of confidence in the group's decisions and can result in decisions that are not in the best interest of the group or society as a whole.

To avoid groupthink, it is important to encourage diverse perspectives and opinions, promote open and honest communication, and foster an environment where dissenting views are welcomed and considered. It is also important to have a process for evaluating decisions and ideas objectively, with a focus on evidence-based reasoning and critical thinking.

Are countries with small populations more susceptible to groupthink?

Countries with small populations may be more susceptible to groupthink, but this is not necessarily always the case.

On the one hand, smaller populations may result in more homogeneity in terms of culture, values, and experiences, which can lead to a greater likelihood of groupthink. In smaller communities, individuals may be more likely to conform to the views and opinions of the group, and there may be less diversity of opinions and perspectives.

However, on the other hand, smaller populations can also foster a stronger sense of community and shared values, which can promote open communication and the exchange of diverse perspectives. In smaller communities, individuals may be more likely to know and trust one another, which can create a more supportive and inclusive environment where individuals feel comfortable expressing their own opinions and ideas.

Ultimately, whether or not a country with a small population is more susceptible to groupthink will depend on a variety of factors, including the cultural norms, the level of diversity of the population, and the degree of openness to new ideas and perspectives.

ChatGPT

In the age of AI, you need to make sure you are not just having your own propaganda fed back to you (aka. "believing your own hype" or "getting high on your own supply").

Source: ChatGPT (GPT-3.5; Mar 23 version)

New Zealand believes it has world leading capabilities in all agriculture and wider bioeconomy disciplines

"New Zealand is one of the most efficient agricultural economies in the world, with a reputation for producing cutting edge research and technology, robust and safe agricultural practices and delicious and high quality products."

H.E. Wendy Matthews, New Zealand Ambassador to Viet Nam, April 2018

"A comprehensive international fisheries science assessment has rated New Zealand the world's top performing country for managing its marine and fishery resources… We can all take credit for being regarded internationally as leading the world in many aspects of marine resource management."

Phil Heatley, New Zealand Fisheries Minister, Nov 2009

"New Zealand has a global reputation for farming expertise, innovative agricultural related research and technology and quality food-production… New Zealand's expertise in the horticulture sector is world-leading, including in relation to fruit genetics, horticulture commercialisation, pest management and post-harvest handling. New Zealand [has] world class agriculture expertise."

NEW ZEALAND FOREIGN AFFAIRS & TRADE
MANATŪ AORERE

"New Zealand has strengths and specialisations in research in agriculture and biological sciences, and in products related to agriculture, partly reflecting a climate conducive to agriculture."

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI

"New Zealand's reputation for producing high-quality food and fibre that is safe, free of pests and diseases and produced sustainably… New Zealand has a well-earned reputation for producing high-quality food and fibre"

Ministry for Primary Industries
Manatū Ahu Matua

https://www.mfat.govt.nz/en/media-and-resources/viet-nam-gets-rambutan-import-license/

In particular, New Zealand regularly highlights that it is 'world-class'…

"Our **world-class** technology, meticulous production values, the highest levels of ethical production and our adherence to environmental sustainability, all contribute to our reputation for food excellence."

ALLIANCE FARMERS' PRODUCE

"Broadly our kiwifruit and apple research programmes are **world class**. Certainly, the cultivar development parts of them but also the production systems too – pest and disease system controls, sustainable production and post-harvest and all the consumer work. All of that sweeter stuff for those two industries is **world class**."

Plant & Food™ Research
Rangahau Ahumāra Kai

"Growing and producing fresh, healthy food is one of the most essential staple industries across the globe. It's also a major cornerstone of New Zealand's economy… At Lincoln, we're constantly expanding our **world-class** academic instruction."

LINCOLN UNIVERSITY
TE WHARE WĀNAKA O AORAKI

"We are **world class** in animal- based food production systems… ruminant genomics and breeding… fibre science, micro-analysis of keratin materials… protein modification chemistry of bio-based products… food safety… integrity of animal production and processing systems."

agresearch
āta mātai, mātai whetū

"Pāmu: New Zealand's **World Class** Agricultural Leader… Pāmu is a recognised leader not only in New Zealand's agricultural sector, but around the world where our farming practices are studied and emulated."

PĀMU

"We… deliver **world class** New Zealand Argri-products to customers around the world."

WILKINS FARMING CO

https://www.mfat.govt.nz/en/media-and-resources/viet-nam-gets-rambutan-import-license/

…it is difficult to find a capability where New Zealand does not claim to be 'world-class'

"New Zealand has a **world-class** agricultural industry, with a reputation for its leading edge technological and scientific practices."

Agri Training

"NMIT offers **world-class** aquaculture programmes"

nmit
Nelson Marlborough Institute of Technology

"We will ensure New Zealand's **world class** food safety system remains robust."

Ministry for Primary Industries
Manatū Ahu Matua

"New Zealand has several **world-class** cheese companies."

100% PURE NEW ZEALAND

"Cawthron Institute's **world-leading** advanced shellfish and finfish breeding programmes and technologies now underpin a significant portion of New Zealand's aquaculture production"

CAWTHRON

"New Zealand offers a **world-class** education. All eight universities are ranked within the top 3% in the world."

Te Pōkai Tara
Universities New Zealand

"New Zealand's… innovative, **world-class** [wine] industry."

New Zealand Wine
Altogether Unique.

"Our **world-class** agritech innovations."

NEW ZEALAND TRADE & ENTERPRISE
Te Taurapa Tūhono

https://www.mfat.govt.nz/en/media-and-resources/viet-nam-gets-rambutan-import-license/

The military has a clear definition of 'capabilities'; it is the ability to execute

"The ability to execute a specified course of action. (A capability may or may not be accompanied by an intention.)"
Dictionary of Military and Associated Terms. US Department of Defense 2005.

"The capacity or ability to achieve an operational effect. An operational effect may be defined or described in terms of the nature of the effect and or how, when, where and for how long it is produced."
Australian Department of Defence

"The enduring ability to generate a desired operational outcome or effect, [which] is relative to the threat, physical environment and the contributions of coalition partners."
United Kingdom Ministry of Defence

"A country's military capability is its ability to fight in a war."
Collins Dictionary

"Capability: 'military potential expressed in quantitative and qualitative terms'; 'the ability to create an effect."
NATOTerm

https://www.mfat.govt.nz/en/media-and-resources/viet-nam-gets-rambutan-import-license/

Like the military, business also defines capabilities as the ability to execute

"A business capability represents the ability for a business to do something."

THE Open GROUP

"[T]here's no minimizing the importance of understanding how your organization creates value—its capabilities."

HARVARD BUSINESS SCHOOL

"A business capability defines "what" a business does at its core. This differs from "how" things are done or where they are done."
William Ulrich, President, TSG Inc.

"An organisation's strategic capabilities are what bridges the gap between "great on paper" and great in reality... Organisational capabilities are the abilities of an enterprise to operate its day-to-day business as well as to grow, adapt, and seek competitive advantage in the marketplace. In other words, capabilities are how the business does what it does – and does what it wants to do."

Monitor Deloitte.

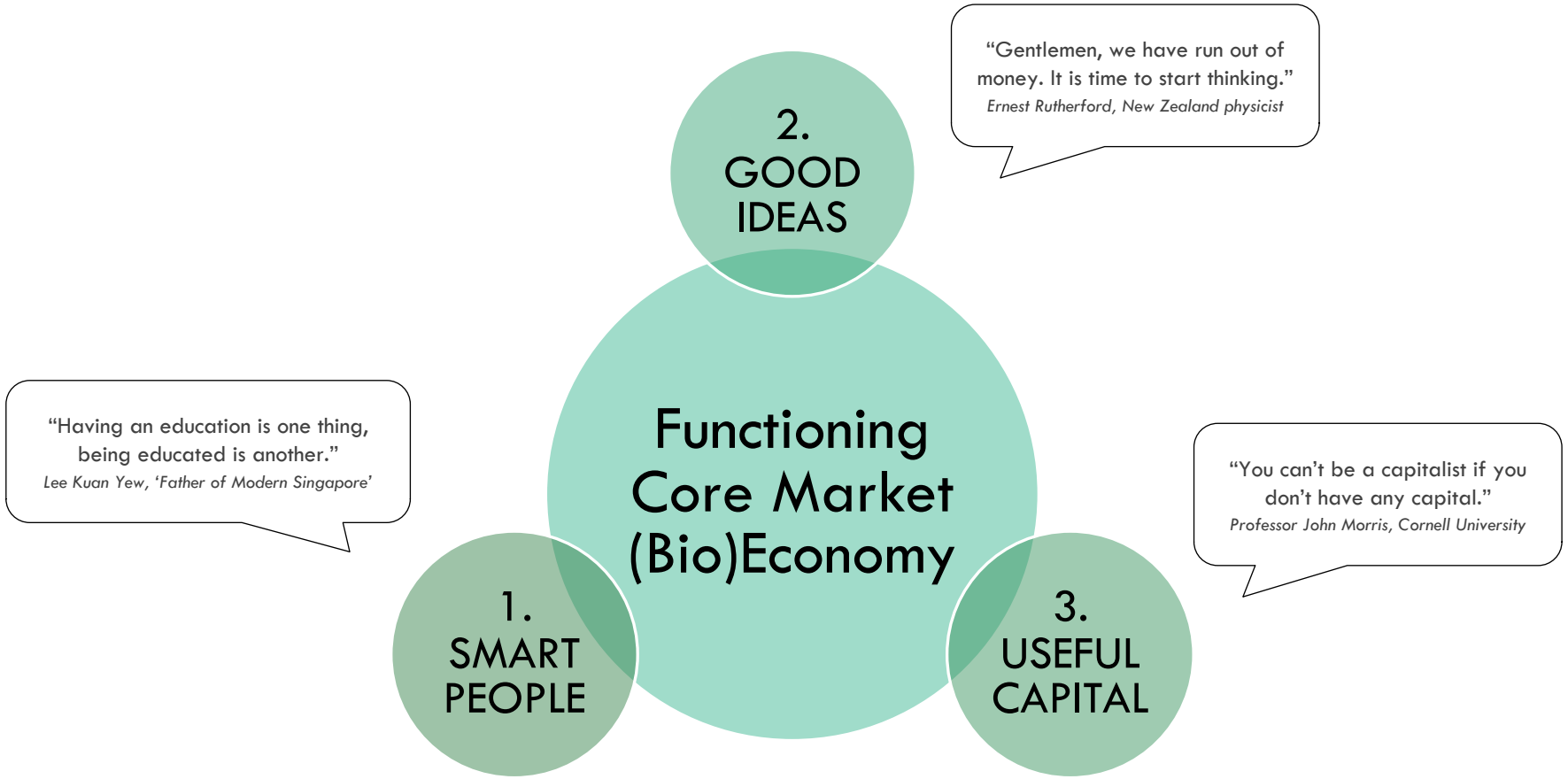
"Business capability is the expression or the articulation of the capacity, materials and expertise an organization needs in order to perform core functions."

TechTarget

"Organizational capabilities enable companies to maximize their performance and achieve their goals."
Academy to Innovate HR (AIHR) website

https://www.mfat.govt.nz/en/media-and-resources/viet-nam-gets-rambutan-import-license/

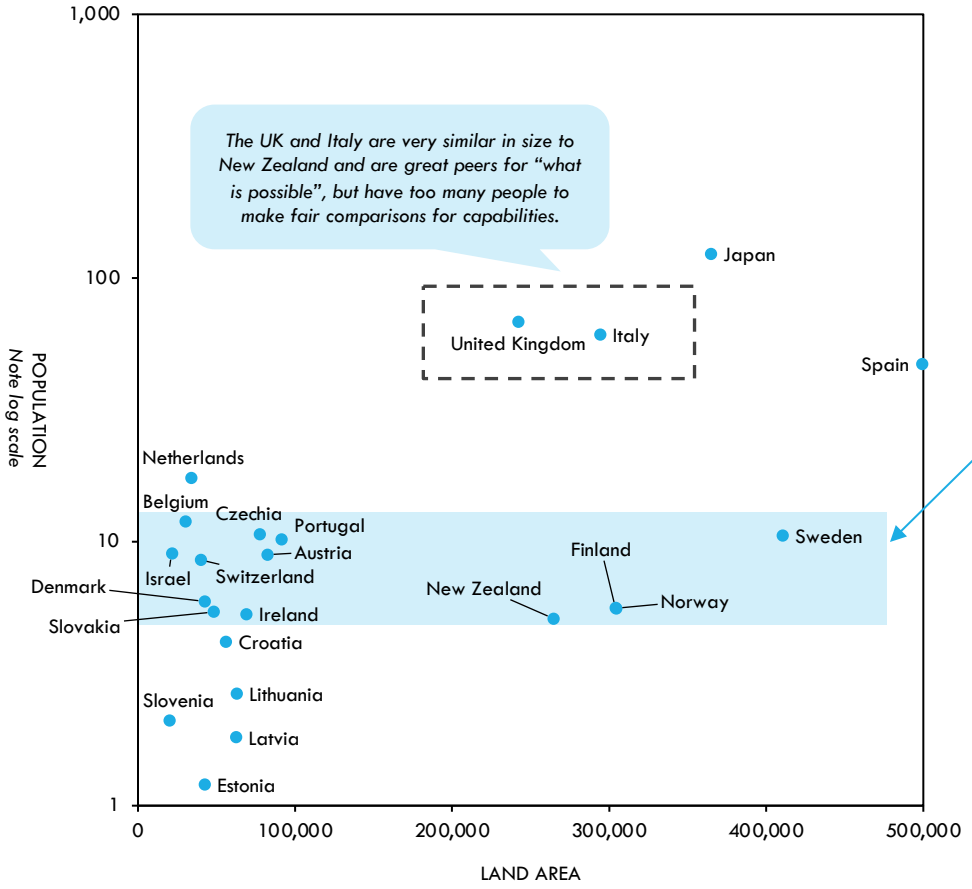
Three broad capabilities are required to support the functioning market bioeconomy of the future



'Capabilities' do not exist in isolation; the concept is a relative one; a peer group of similar countries to New Zealand was developed for comparisons

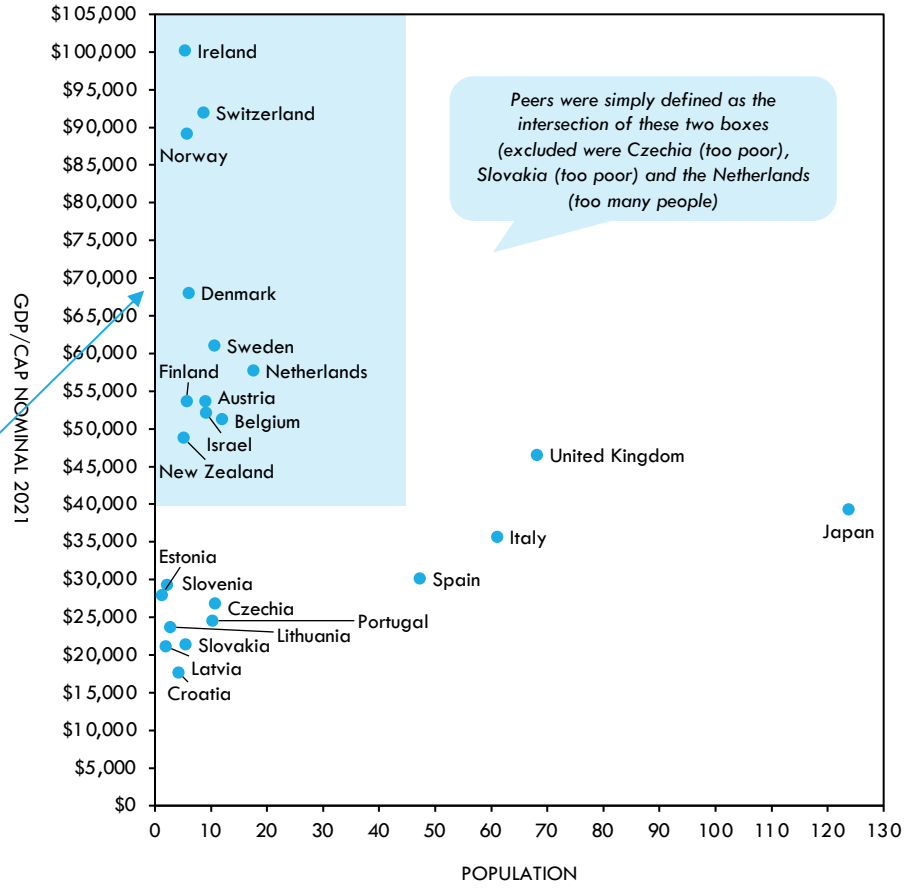
LAND AREA VS. POPULATION

Km^2; population; 2023 (or as available)



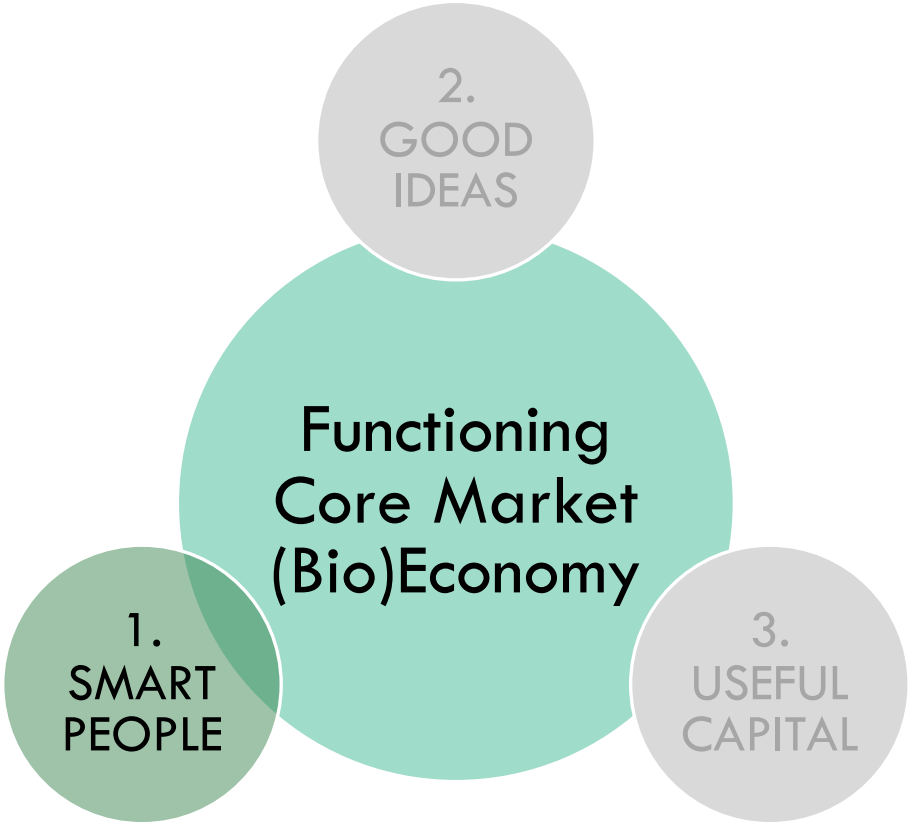
POPULATION VS. GDP/CAPITA

Population; nominal GDP/capita; 2023 (or as avail.)



Source: CIA World Fact Book; World Bank; Coriolis analysis

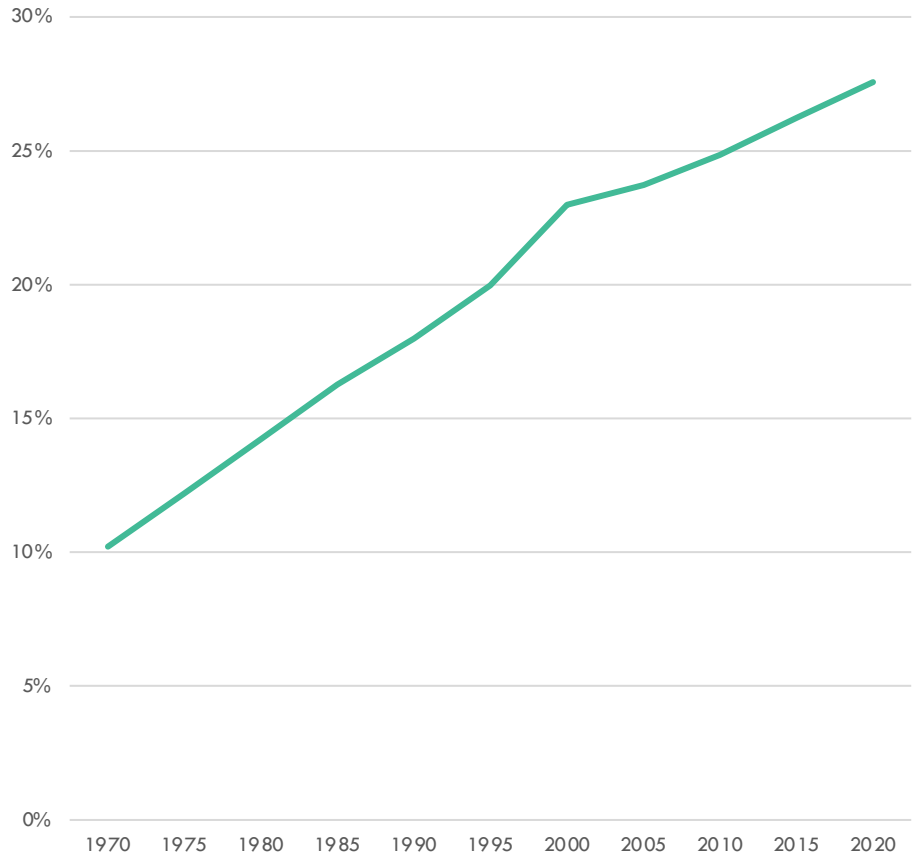
1. Smart people



A large and growing percent of New Zealanders now have a degree

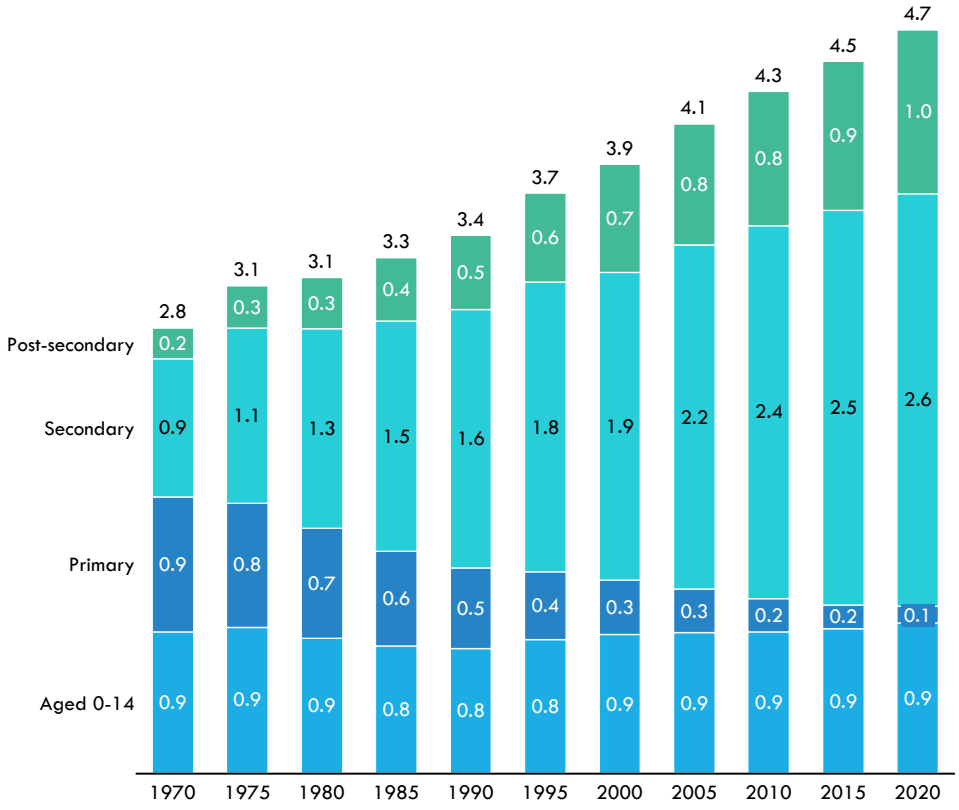
% OF NZ ADULTS EDU. TO DEGREE LEVEL

% of population 15+; 1970-2020



NZ POP. BY EDUCATION ACHIEVED

% of population; 1970-2020

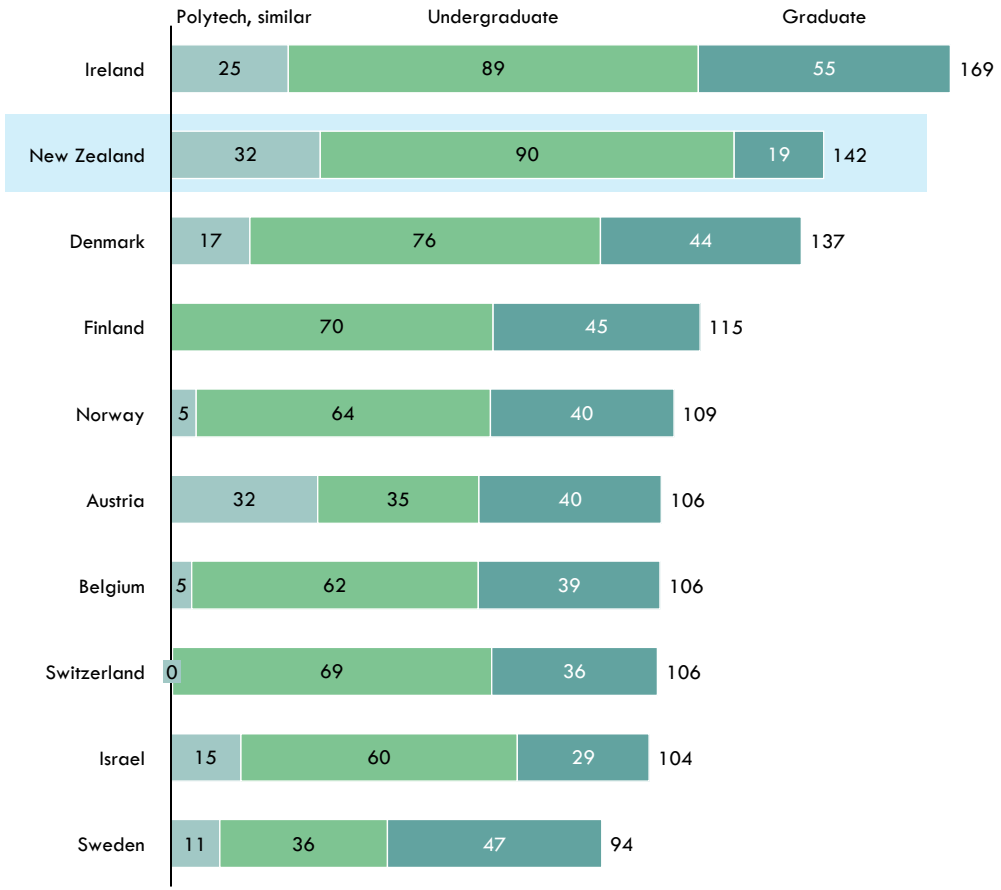


Source: International Institute for Applied Systems Analysis (IIASA): World Population and Human Capital in the Twenty-First Century (2015); OurWorldInData.org/tertiary-education • CC BY

Relative to peers, New Zealand both produces a lot of graduates and has a large percent of students that are from abroad

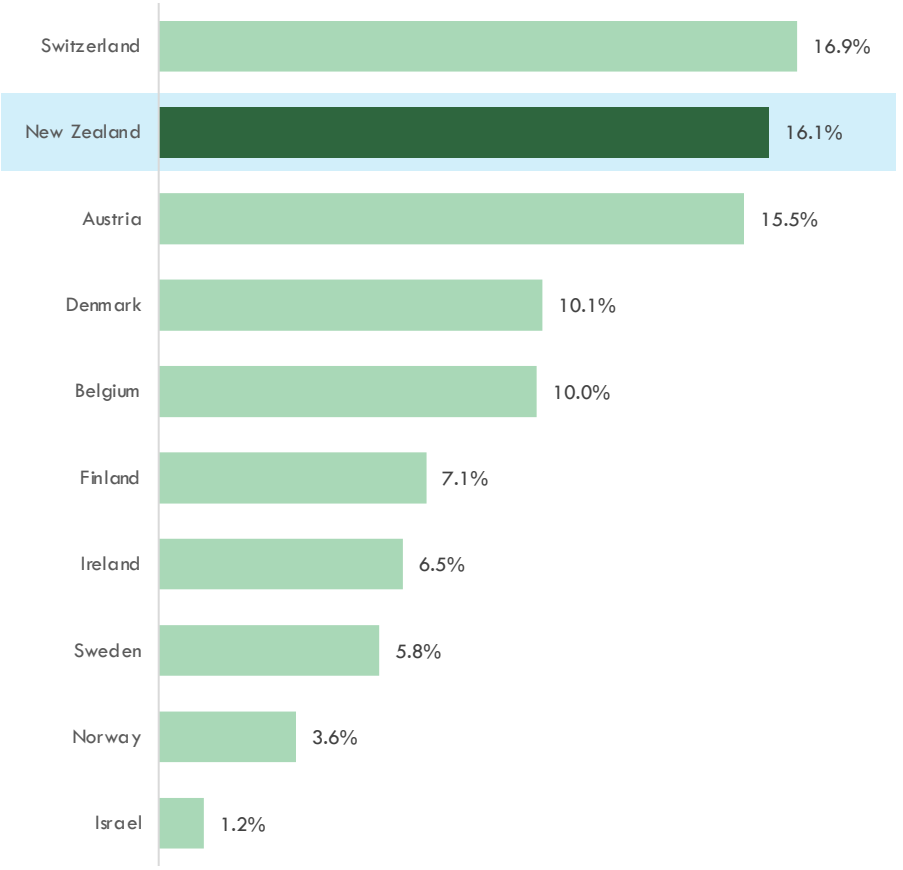
TERTIARY GRADS/YEAR PER 10,000 POP

# of graduates/10,000 pop; 2020



% UNI STUDENTS FROM ABROAD

% of total tertiary enrolment; 2015



Source: OECD Education at a Glance 2020 (https://www.oecd-ilibrary.org/education/education-at-a-glance-2020_69096873-en); CIA World Factbook (https://www.cia.gov/the-world-factbook/countries/); Coriolis analysis

New Zealand has eight universities, a comprehensive polytechnic and training system, and a range of other tertiary education providers

NEW ZEALAND UNIVERSITIES & SIMILAR

Te Wānanga o Aotearoa

National

Source: https://en.wikipedia.org/wiki/List_of_public_sector_organisations_in_New_Zealand#Institutes_of_Technology_and_Polytechnics

However, identified peers have more, better Universities

ACADEMIC RANKING OF WORLD UNIVERSITIES 2022

	1-100	101-200	201-300	301-400	401-500
Switzerland	ETH Zurich (20) University of Zurich (59) University of Geneva (62) University of Basil (83)	Swiss Fed. Inst. of Tech. Lausanne (101-150) University of Bern (101-150) University of Lausanne (101-150)			Chalmers University of Technology Stockholm School of Economics
Sweden	Karolinska Institute (41) Uppsala University (89) Stockholm University (90)	University of Gothenburg (101-150) Lund University (151-200)	KTH Royal Inst. Of Tech. (201-300)	Linkoping University Swedish U. of Agricultural Sci.	
Denmark	University of Copenhagen (39) Arhaus University (69)	Technical University of Denmark (151-200)	University of Southern Denmark (201-300)	Aalborg University	
Israel	Hebrew University of Jerusalem (77) Technion Israel Institute of Tech. (83) Weizmann Institute of Science (83)	Tel Aviv University (151-200)		Bar-Ilan University	Ben-Gurion University of the Negev
Finland	University of Helsinki (92)			Aalto University	University of Oulu University of Turku
Belgium	Ghent University (74) University of Leuven (95)	University Libre Bruxelles (101-150)	Catholic University of Louvain University of Antwerp	University of Liege Vrije Universiteit Brussel	
Austria		University of Vienna (151-200)	Medical University of Vienna	University of Innsbruck Vienna Uni. of Technology	Medical University of Innsbruck University of Natural Resources and Life Sciences, Vienna
Norway	University of Oslo (67)	Norwegian Uni. of Science and Technology (101-150)		University of Bergen	
Ireland		Trinity College Dublin (151-200)		University College Cork University College Dublin	
New Zealand			University of Auckland	University of Otago	University of Canterbury Victoria Uni. of Wellington

Source: https://www.shanghairanking.com/rankings/arwu/2022

A similar message comes from all global rankings; New Zealand universities are not top tier (except maybe Auckland)

NZ GLOBAL UNIVERSITIES ACROSS MAJOR RANKINGS

	SHANGHAI RANKING	QS WORLD UNIVERSITY RANKINGS	THE WORLD UNIVERSITY RANKINGS
University of Auckland	201-300	87	139
University of Otago	301-400	217	301-350
University of Canterbury	401-500	284	601-800
Victoria University of Wellington	401-500	275	401-500
Massey University	601-700	292	601-800
AUT University	701-800	486	251-300
Lincoln University	701-800	368	401-500
The University of Waikato	701-800	331	401-500

Source: https://www.shanghairanking.com/rankings/arwu/2022; https://www.topuniversities.com/university-rankings/world-university-rankings/2023?qs_qp=topnav; https://www.timeshighereducation.com/world-university-rankings/2023/world-ranking;

New Zealand universities have pockets of capability in some bio-economy-related areas

NZ GLOBAL UNIVERSITIES ACROSS MAJOR RANKINGS

SHANGHAI RANKING

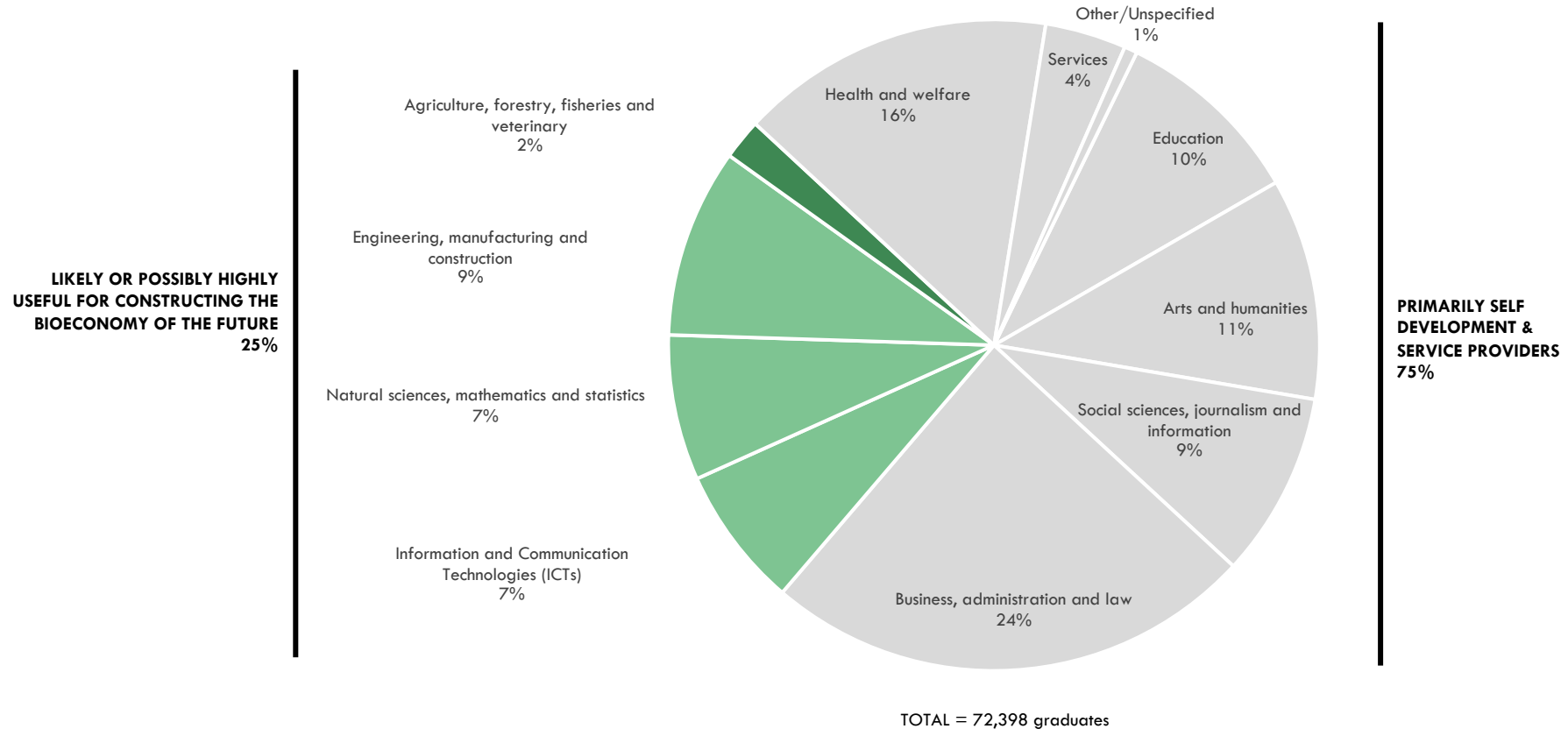
	Food Science & Technology	Biomedical Engineering	Biotechnology	Agricultural Science	Biological Science	Veterinary Science	Chemistry	Oceanography
University of Auckland	31	201-300	201-300	201-300	201-300		201-300	151-200
University of Otago	76-100	201-300	301-400		301-400	201-300		101-150
University of Canterbury								
Victoria University of Wellington								
Massey University	51-75		301-400	151-200		42	401-500	
AUT University								
Lincoln University	151-200			301-400				
The University of Waikato								

Source: https://www.shanghairanking.com/rankings/gras/2022

About a quarter (25%) of New Zealand university graduates are likely-or-possibly highly useful for constructing the bioeconomy of the future

NEW ZEALAND TERTIARY EDUCATION GRADUATES BY TYPE

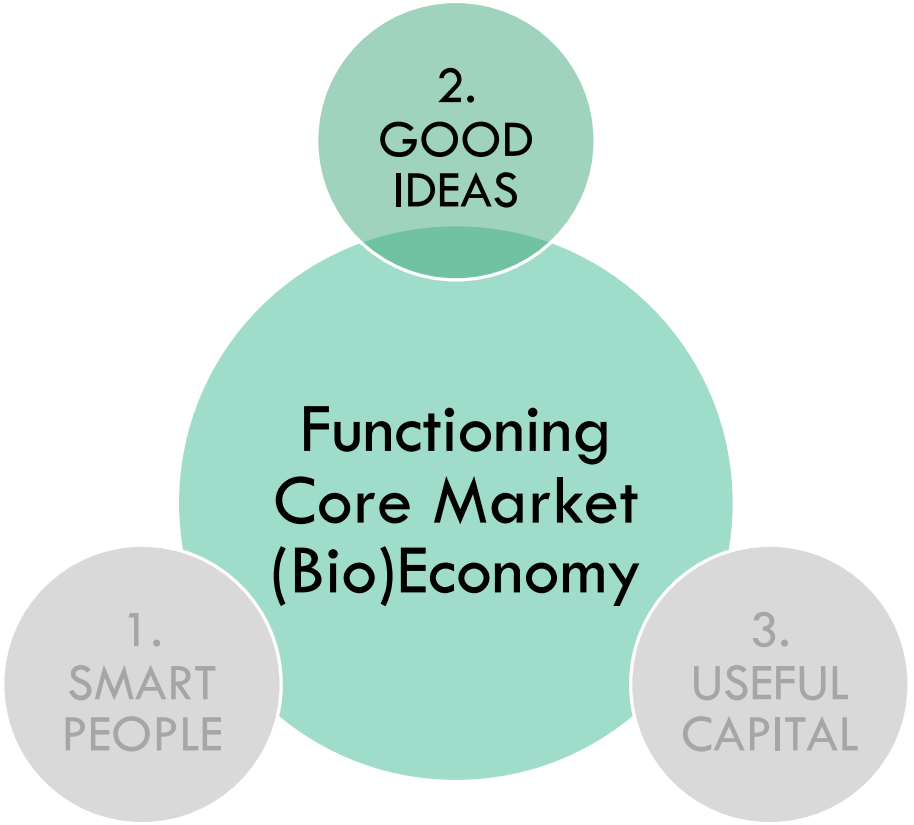
% of total; 2020



TOTAL = 72,398 graduates

Source: OECD Education Statistics (https://www.oecd-ilibrary.org/education/data/oecd-education-statistics_edu-data-en)

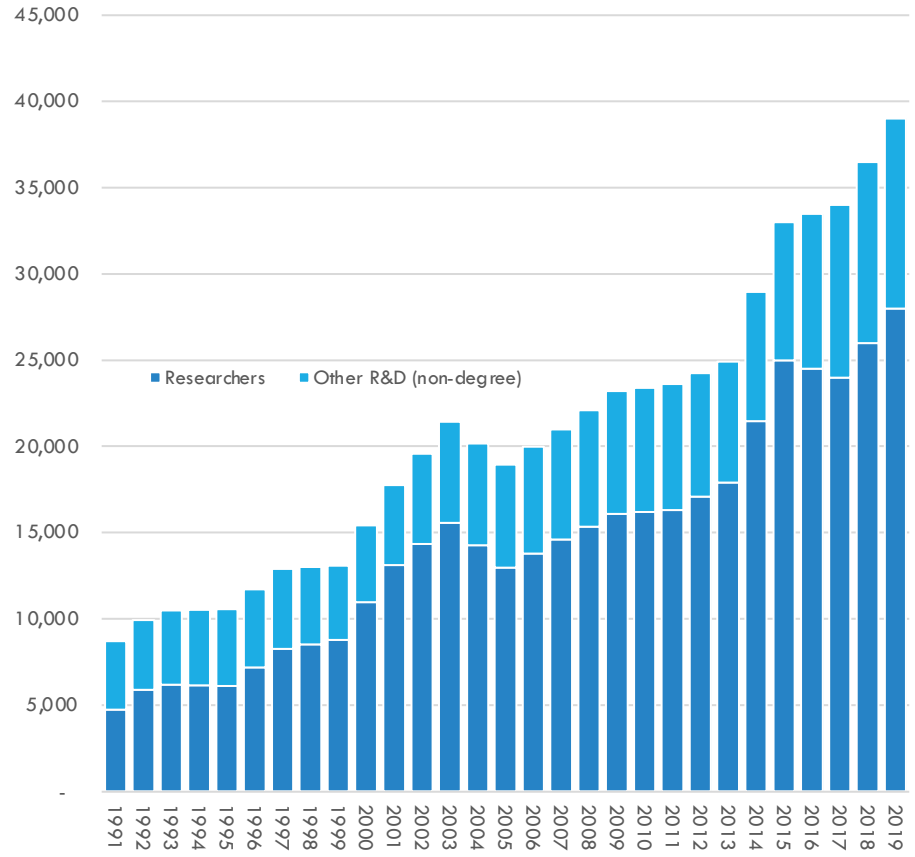
2. Good ideas


2.
GOOD
IDEAS
Functioning
Core Market
(Bio)Economy
1.
SMART
PEOPLE
3.
USEFUL
CAPITAL

New Zealand has a growing number of researchers and other R&D personnel, however personnel numbers are low relative to peers

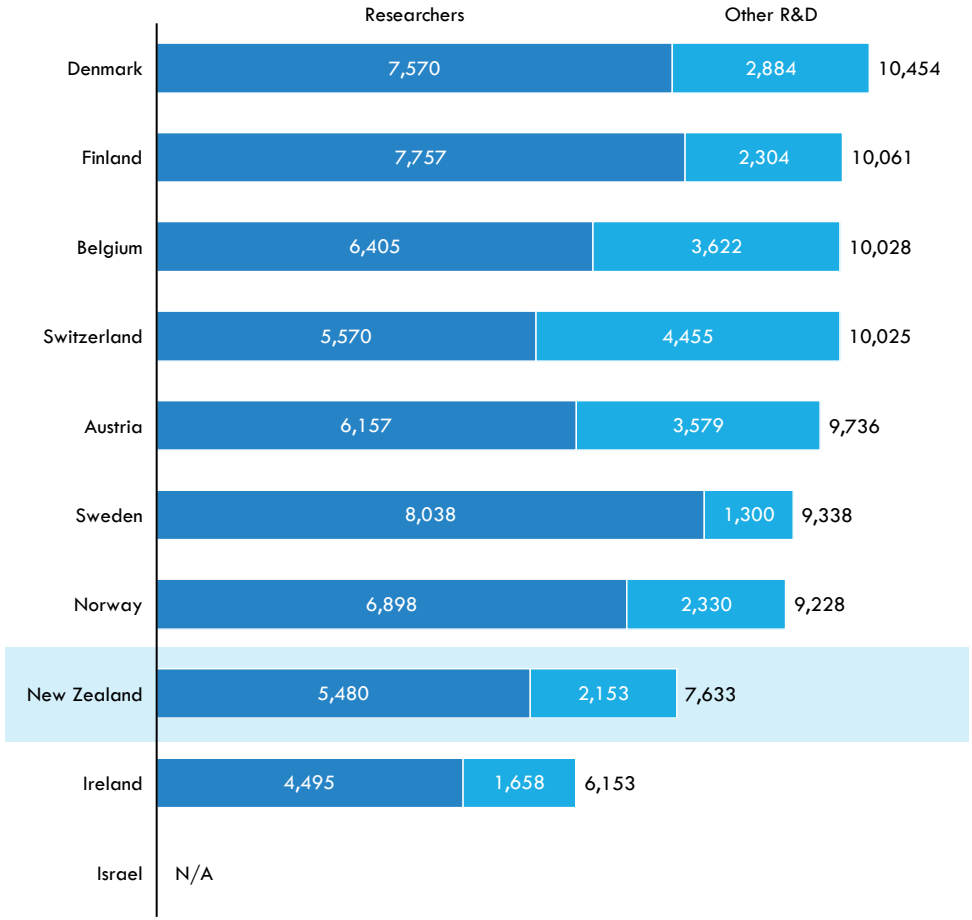
OF R&D PERSONNEL IN NZ

FTE; 1991-2019 (latest available)



R&D PERSONNEL PER MIL PEOPLE

*FTE R&D personnel per million people; 2021**

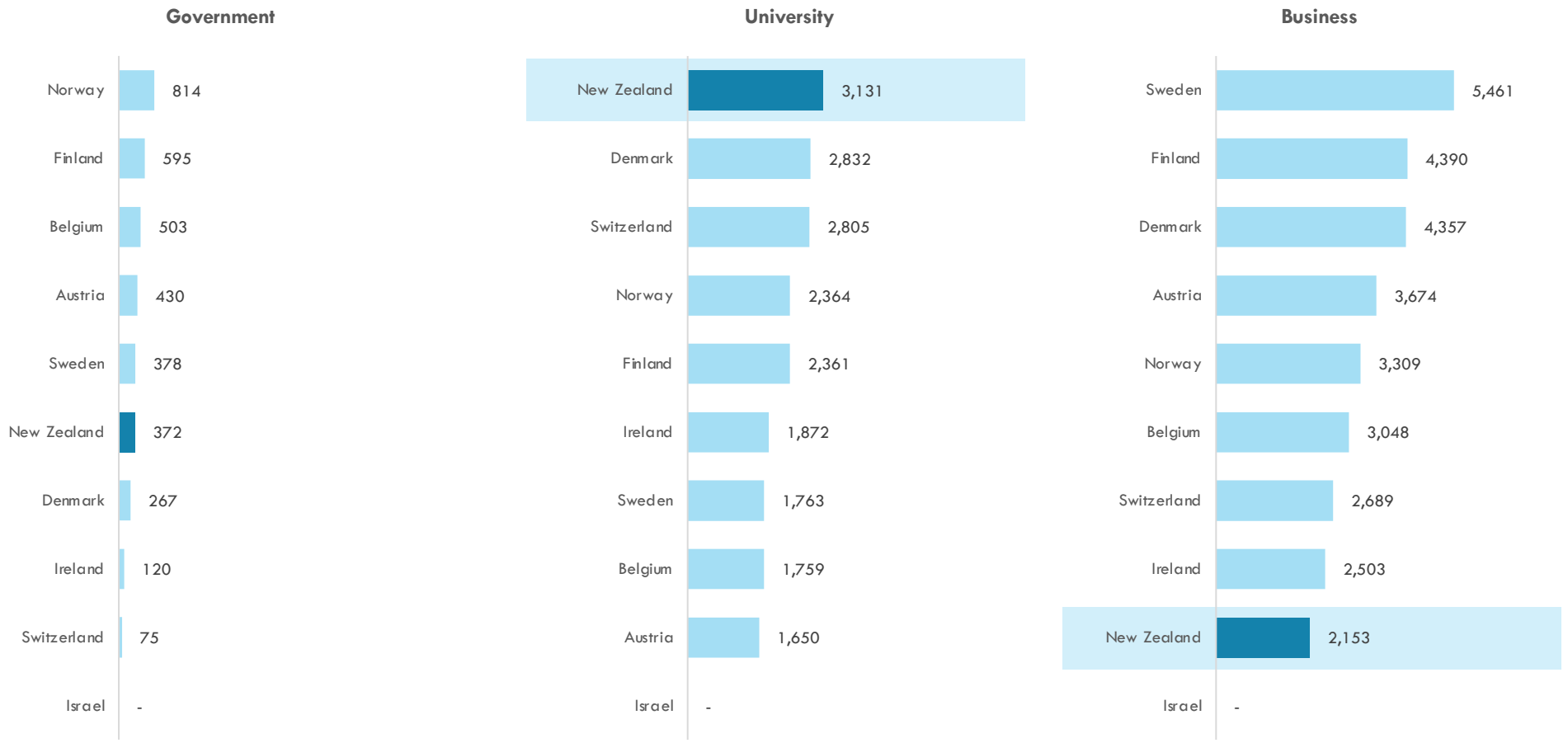


** or as available; NZ is 2019; Note: Some missing years extrapolated; "researchers" are defined as R&D personnel with a degree; Source: OECD Main Science and Technology Indicators (https://www.oecd-ilibrary.org/science-and-technology/main-science-and-technology-indicators_2304277x); CIA World Factbook (https://www.cia.gov/the-world-factbook/countries/); Coriolis analysis*

Relative to peers, New Zealand has a lot of university researchers, but relatively few business researchers

R&D RESEARCHERS PER MIL PEOPLE BY SECTOR

*FTE R&D personnel w/degree per million people; 2021**

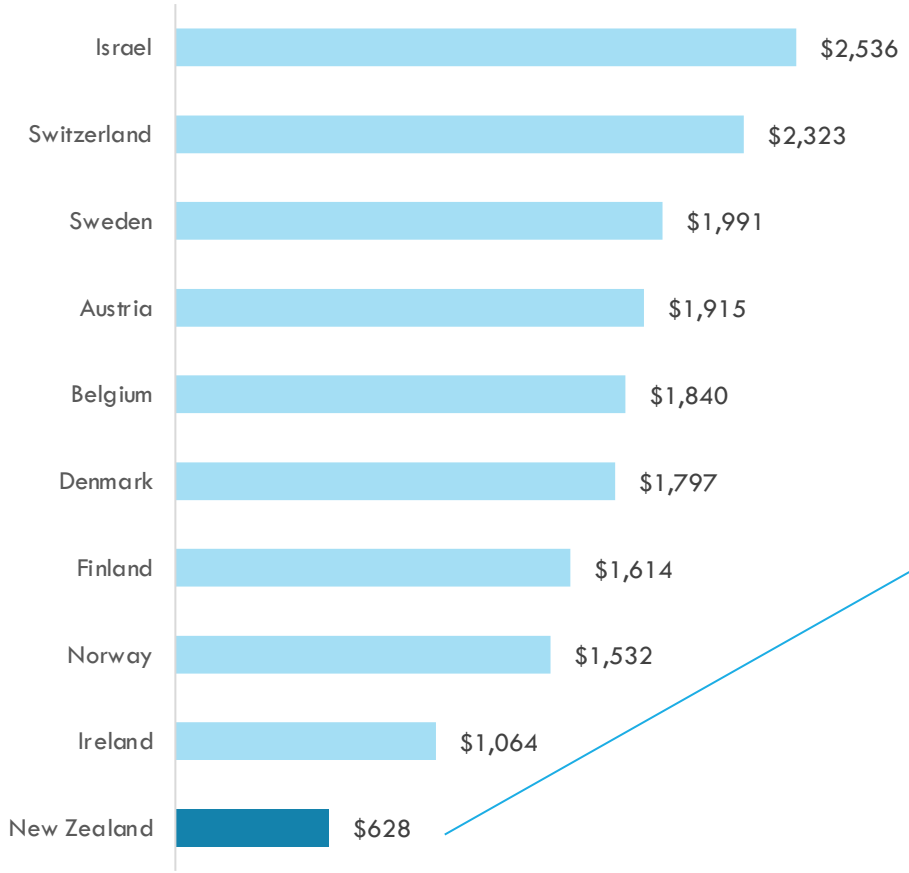


** or as available; NZ is 2019; Note: "researchers" are defined as R&D personnel with a degree; Source: OECD Main Science and Technology Indicators (https://www.oecd-ilibrary.org/science-and-technology/main-science-and-technology-indicators_2304277x); CIA World Factbook (https://www.cia.gov/the-world-factbook/countries/); Coriolis analysis*

New Zealand does not spend a lot on R&D relative to peers

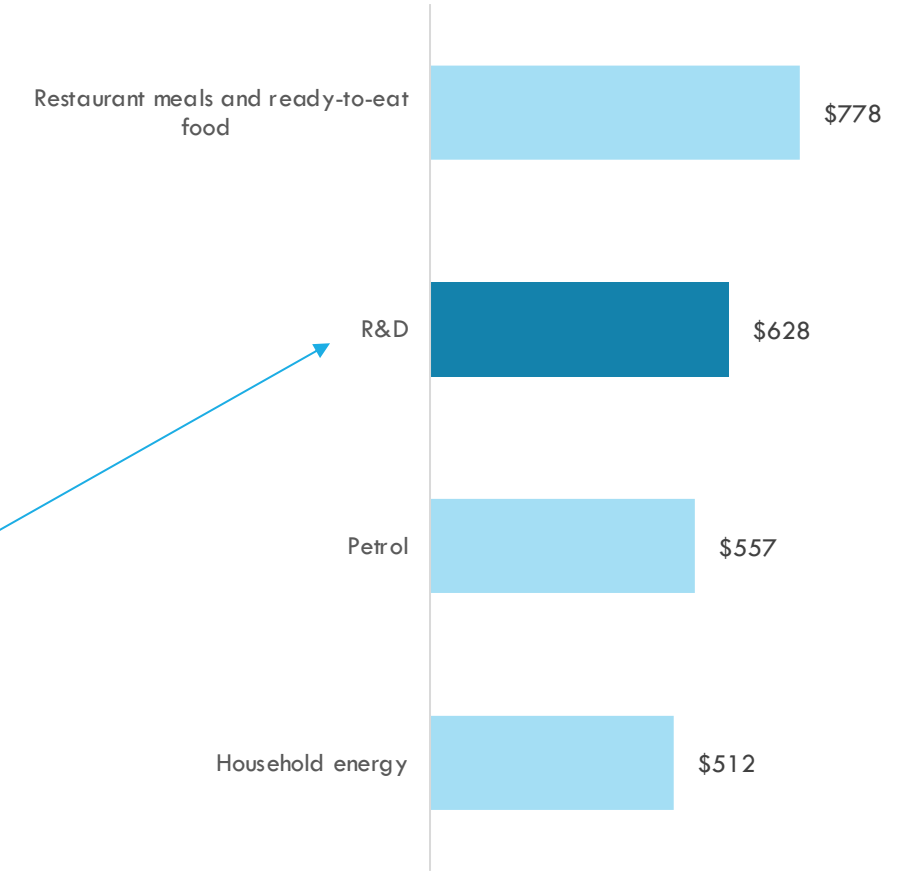
EXPENDITURE ON R&D PER PERSON

US$/capita; 2021 (or as available)



NZ PERSONAL EXPENDITURE VS NZ NATIONAL R&D PER PERSON

US$/capita; 2019 (latest available)



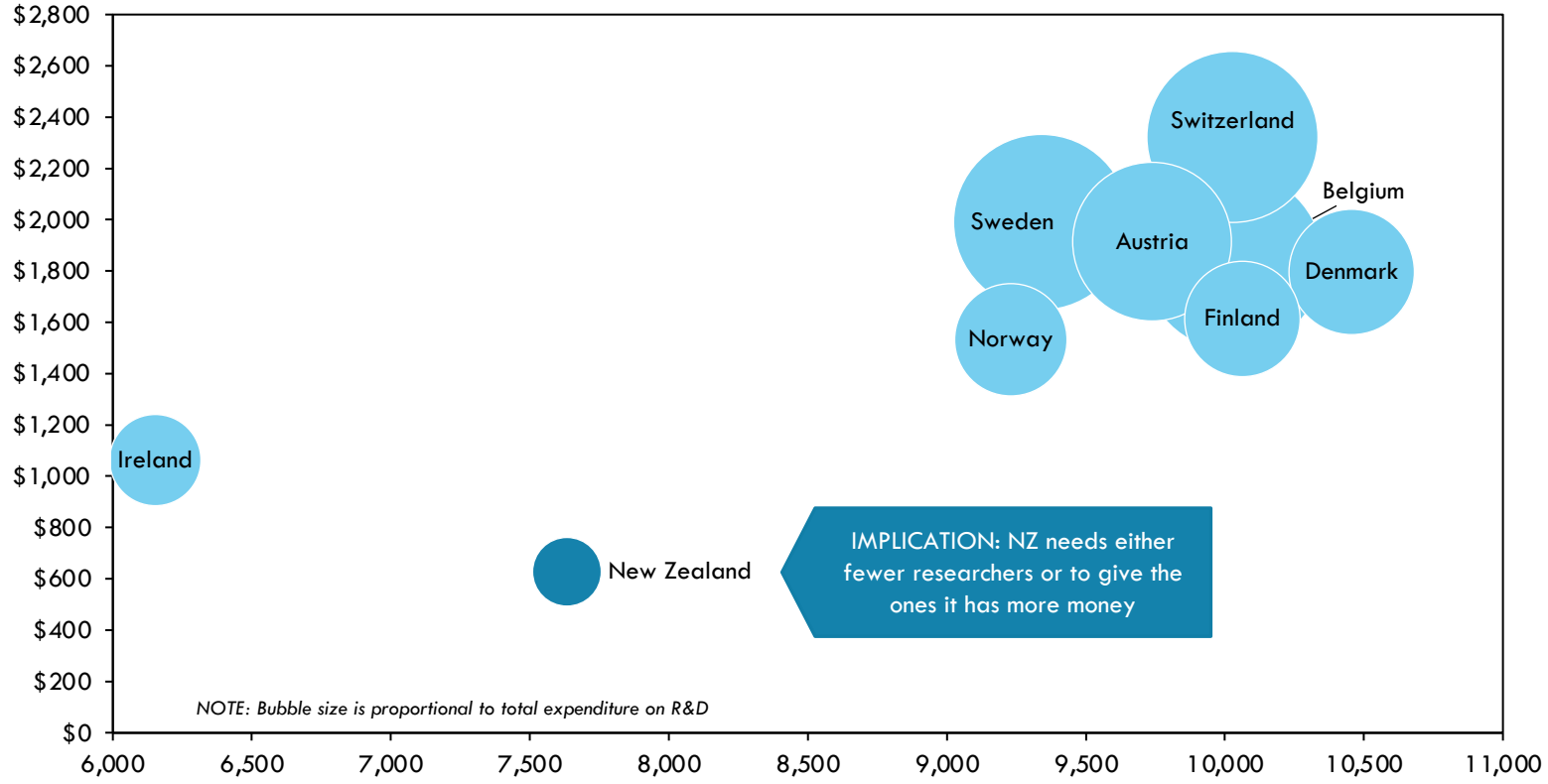
Note: Data is household expenditure and so excludes business or government expenditure; Source: OECD Main Science and Technology Indicators (https://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB); CIA World Factbook (https://www.cia.gov/the-world-factbook/countries/);StatsNZ (https://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE7552); Oanda (https://www.oanda.com/currency-converter/en/?from=NZD&to=USD&amount=1); Coriolis analysis

This creates a situation where New Zealand has a large number of underfunded researchers primarily working in Universities

R&D RESEARCHERS PER MIL PEOPLE BY SECTOR

*FTE R&D personnel per million people; 2021**

EXPENDITURE ON R&D PER PERSON
US$/capita; 2021 (or as available)



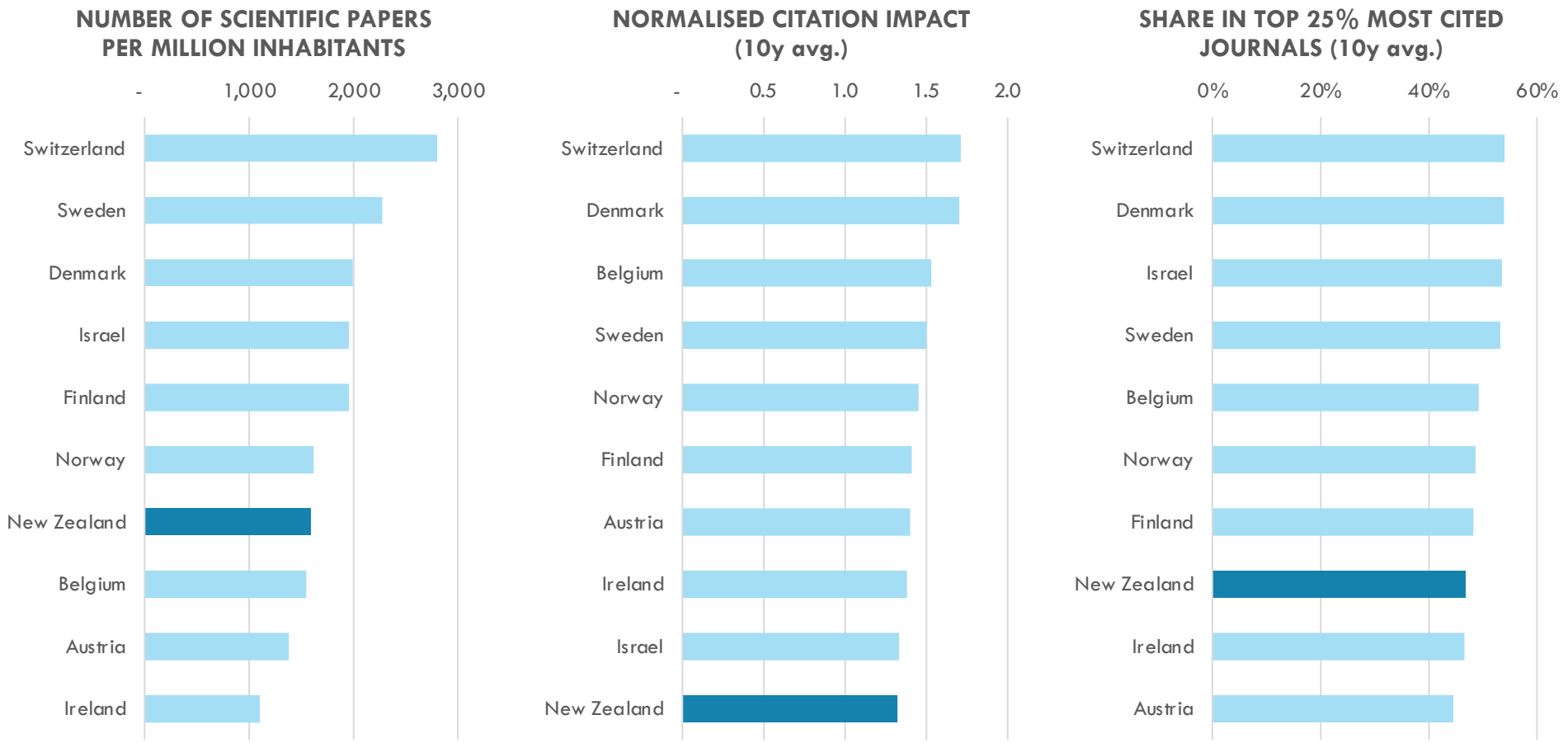
R&D PERSONNEL PER MIL PEOPLE
*FTE R&D personnel per million people; 2021**

Source: OECD Main Science and Technology Indicators (https://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB); CIA World Factbook (https://www.cia.gov/the-world-factbook/countries/); Coriolis analysis

New Zealand's scientists (1) produce fewer scientific papers, (2) which produce less 'impact', and (3) are less often in the best journals

THE NZ SCIENCE SYSTEM: OUTPUT AND QUALITY OF OUTPUT

Various measures; various time periods (latest OECD; as available)

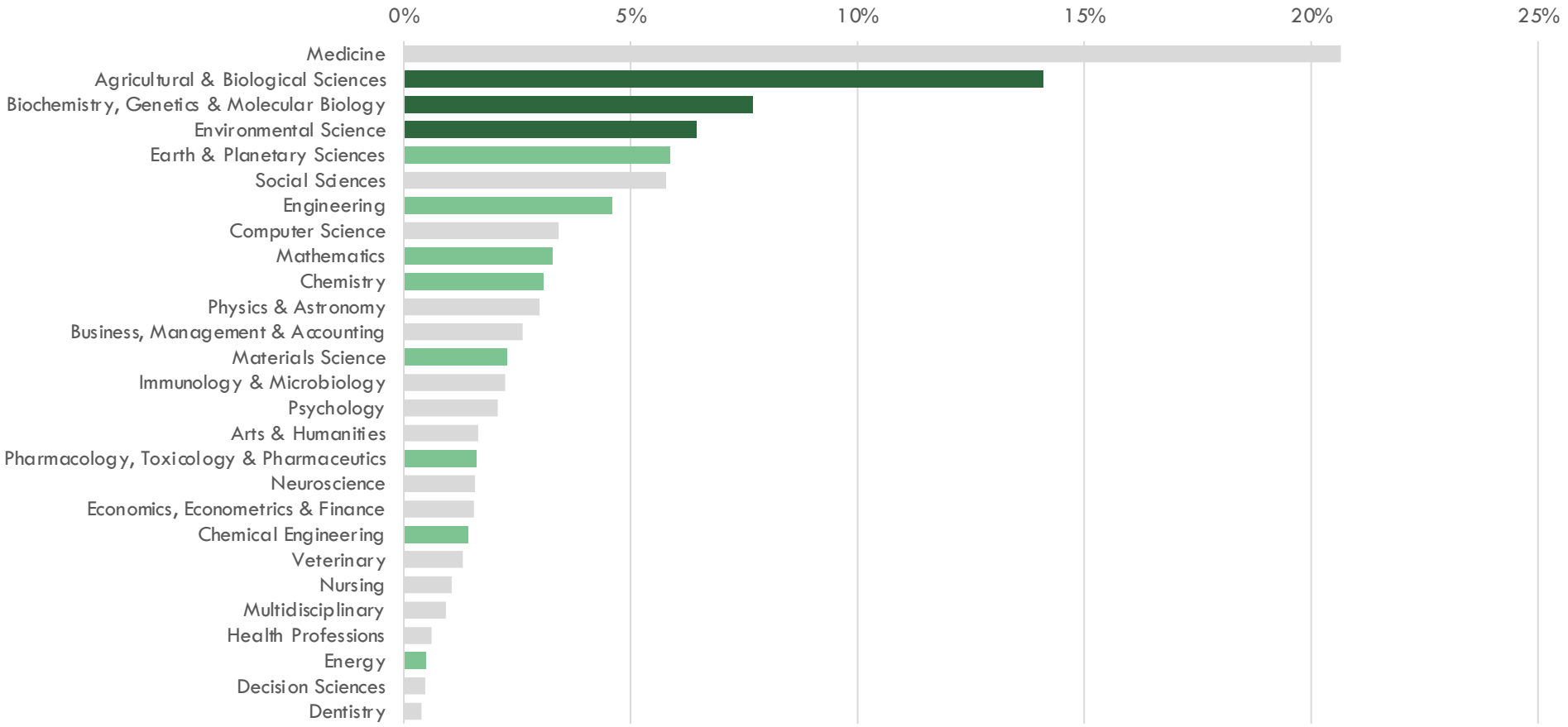


Source: OECD (Normalised citation impact(http://www.oecd.org/sti/CBSI-Ch1-F14.xls); number of papers (http://www.oecd.org/sti/CBSI-Ch1-F5.xls); shore in most cited (http://www.oecd.org/sti/CBSI-Ch1-F15.xls)); Coriolis analysis

New Zealand is strong in medicine, agriculture and a range of fields related to the bioeconomy

SHARE OF FIELD OVER TOTAL OUTPUT WITHIN COUNTRY: NEW ZEALAND

% of NZ documents indexed in SCOPUS by type for 10 year period 2003-2012 (latest OECD available)

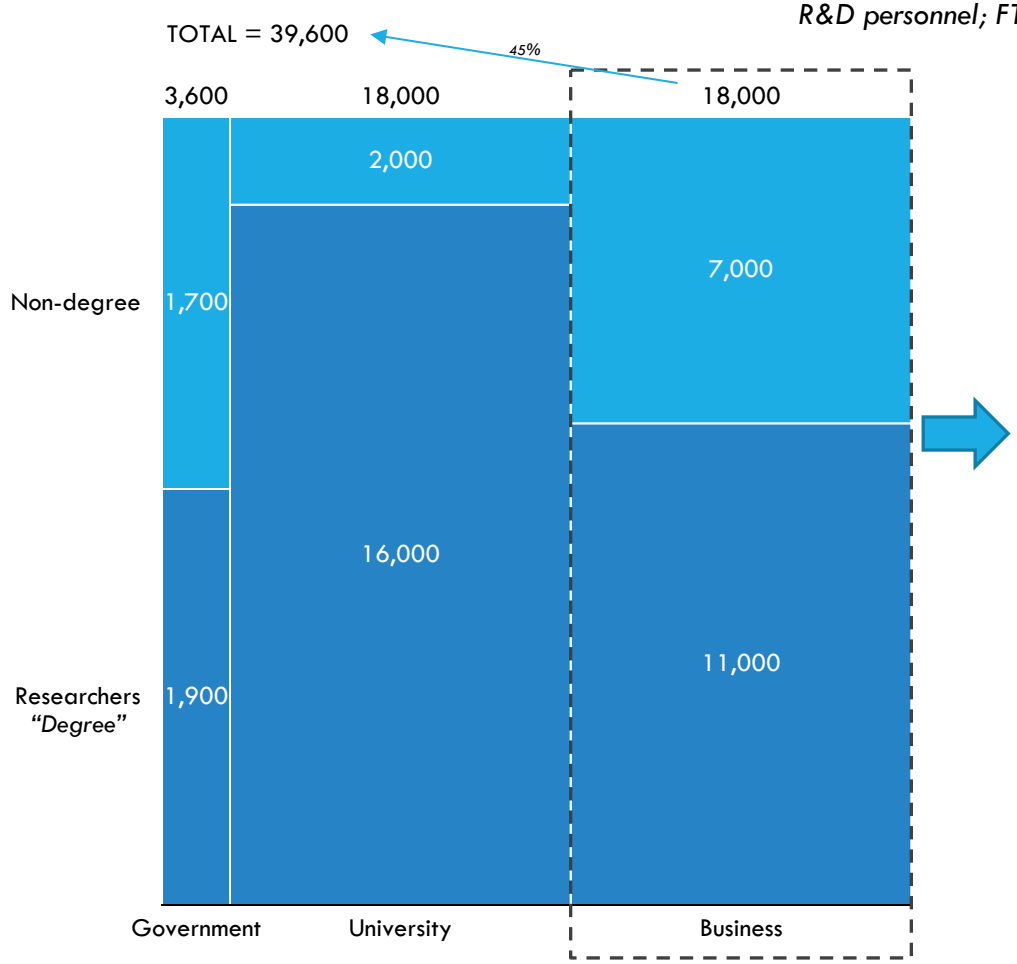


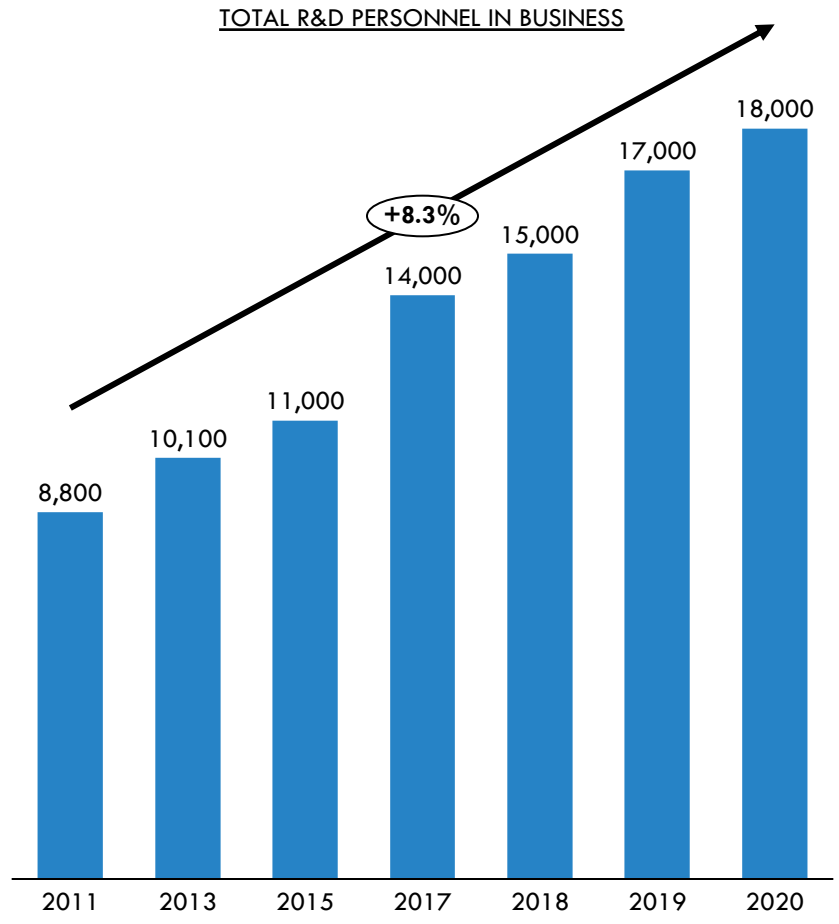
Source: OECD (https://www.oecd.org/sti/inno/Bibliometrics-Compendium.pdf)); Coriolis analysis

*About 45% of New Zealand's total R&D workforce works in business and the number of business R&D workers is growing**

TOTAL R&D PERSONNEL IN NEW ZEALAND BY SECTOR

R&D personnel; FTE; 2020



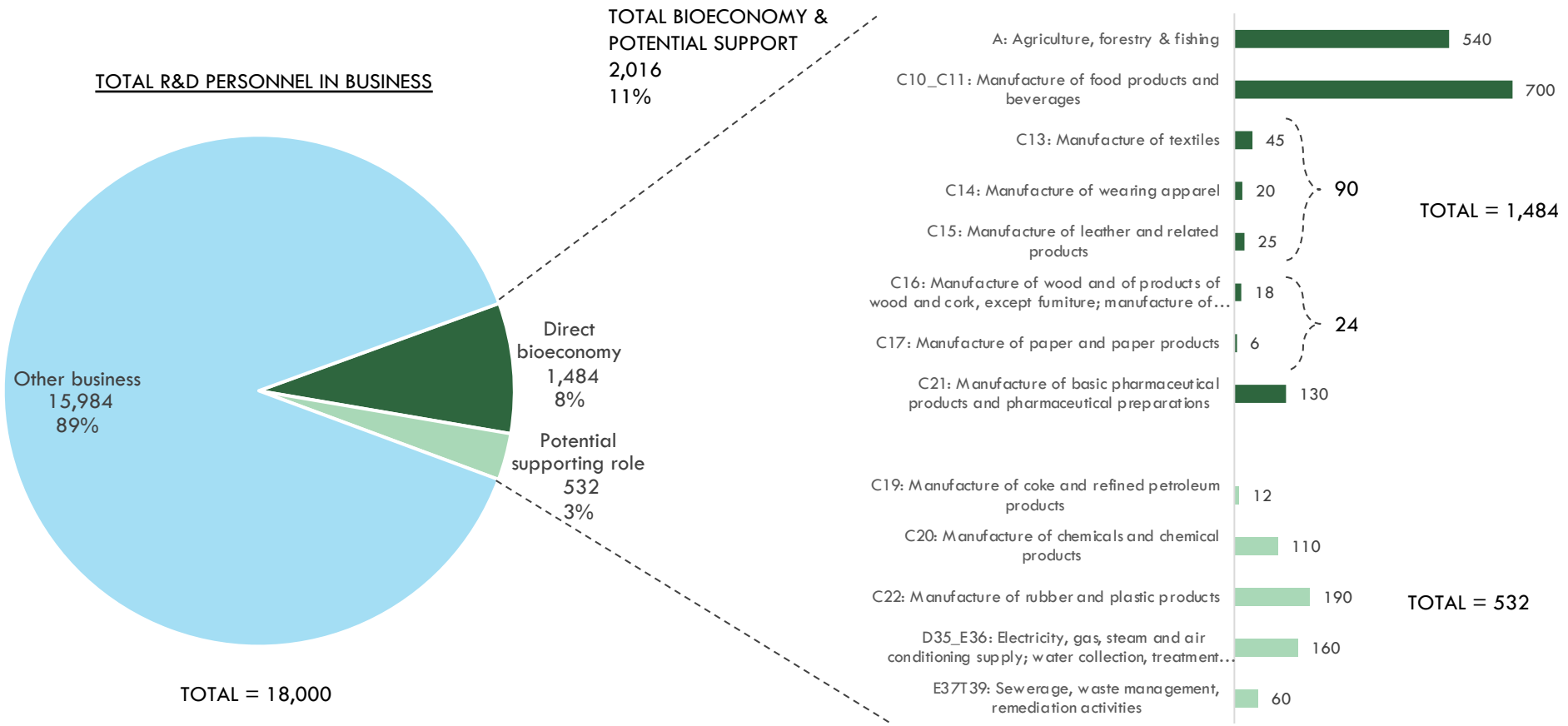


** Alternatively, some of this growth may be StatsNZ improving their sampling; Note: "researchers" are defined as R&D personnel with a degree; Source: OECD Main Science and Technology Indicators (https://www.oecd-ilibrary.org/science-and-technology/main-science-and-technology-indicators_2304277x); (https://stats.oecd.org/Index.aspx?DataSetCode=PERS_INDU); Coriolis analysis*

About 11% of New Zealand's business R&D personnel are pointed at the bioeconomy or sectors that may be able to support it in the future

TOTAL BUSINESS R&D PERSONNEL IN NEW ZEALAND BY SECTOR

R&D personnel; FTE; 2020



** Alternatively, some of this growth may be StatsNZ improving their sampling; Note: "researchers" are defined as R&D personnel with a degree; Source: OECD Main Science and Technology Indicators (https://www.oecd-ilibrary.org/science-and-technology/main-science-and-technology-indicators_2304277x); (https://stats.oecd.org/Index.aspx?DataSetCode=PERS_INDU); Coriolis analysis*

Relative to peers, New Zealand has a lot of R&D personnel in ag/forestry/fishing and food & beverage; lack of large pharma stands out

TOTAL BUSINESS R&D^ PERSONNEL BY CORE BIOECONOMY SECTORS: NZ VS. PEERS

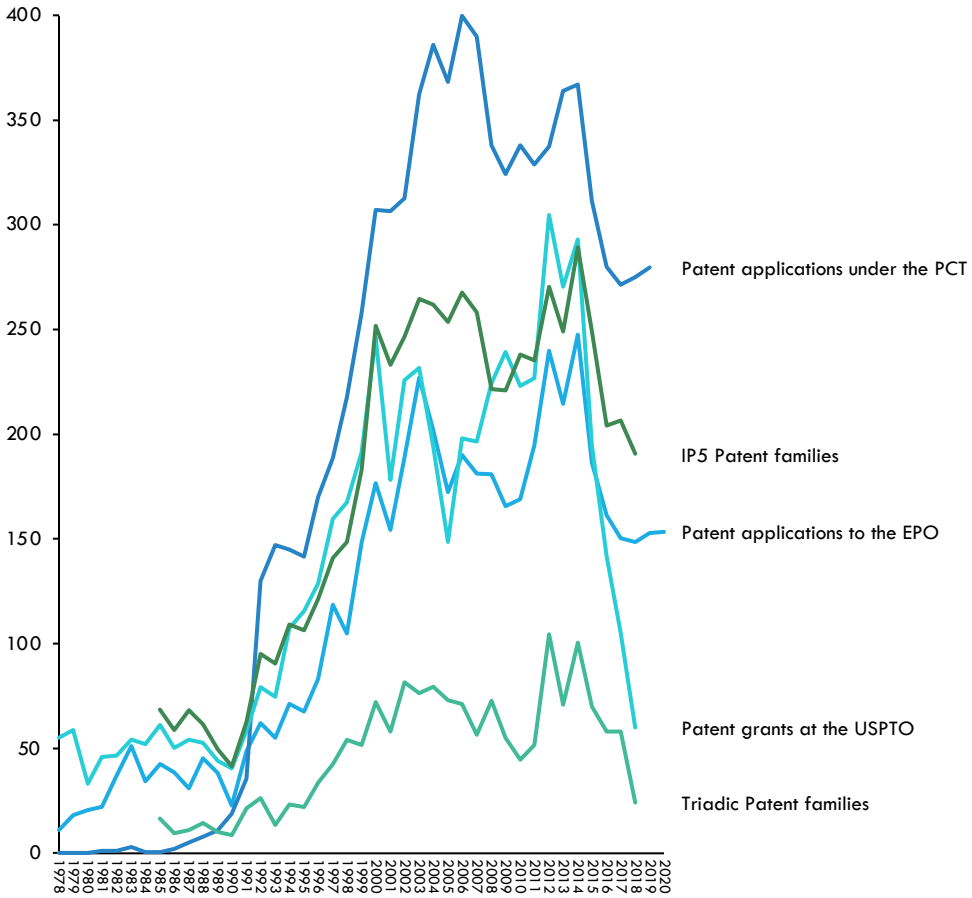
R&D personnel; FTE; 2020

*^ Excludes Universities and CRI's; * Alternatively, some of this growth may be StatsNZ improving their sampling; Note: "researchers" are defined as R&D personnel with a degree; Source: OECD Main Science and Technology Indicators (https://www.oecd-ilibrary.org/science-and-technology/main-science-and-technology-indicators_2304277x); (https://stats.oecd.org/Index.aspx?DataSetCode=PERS_INDU); Coriolis analysis*

New Zealand patent applications appear to be trending down; climate change and biotechnology both among the major domains for NZ

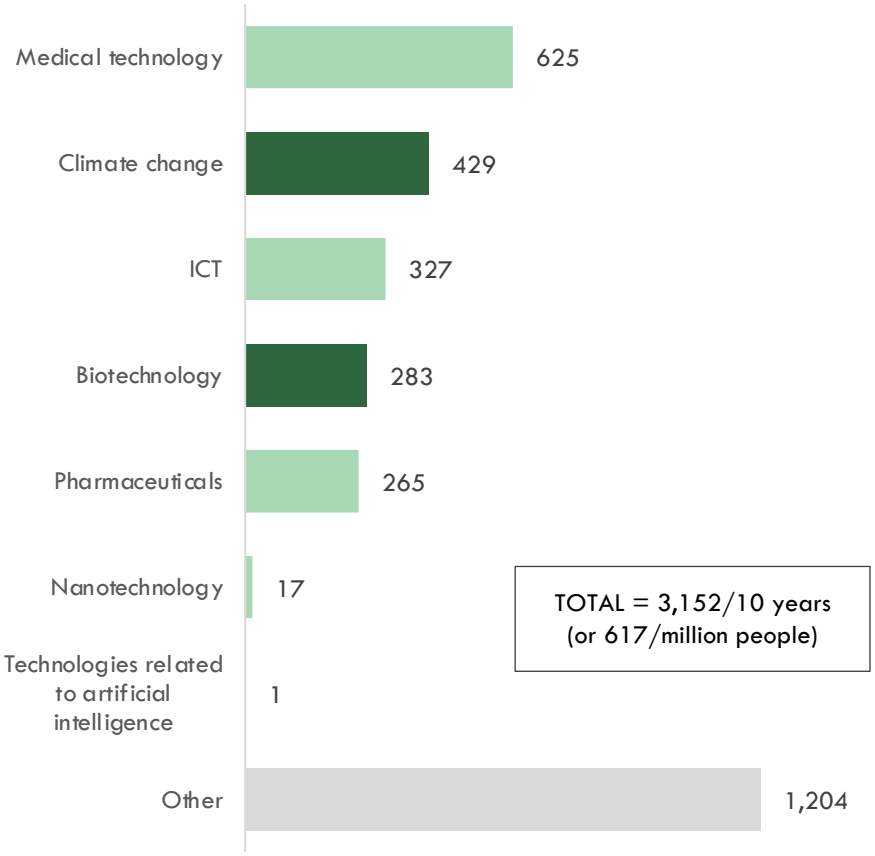
NEW ZEALAND PATENTS

Total patents; 1978-2020 (or latest available)



10Y TOTAL NZ PATENTS APPLICATIONS

Total patents applications; 2010-2019 (latest 10y available)

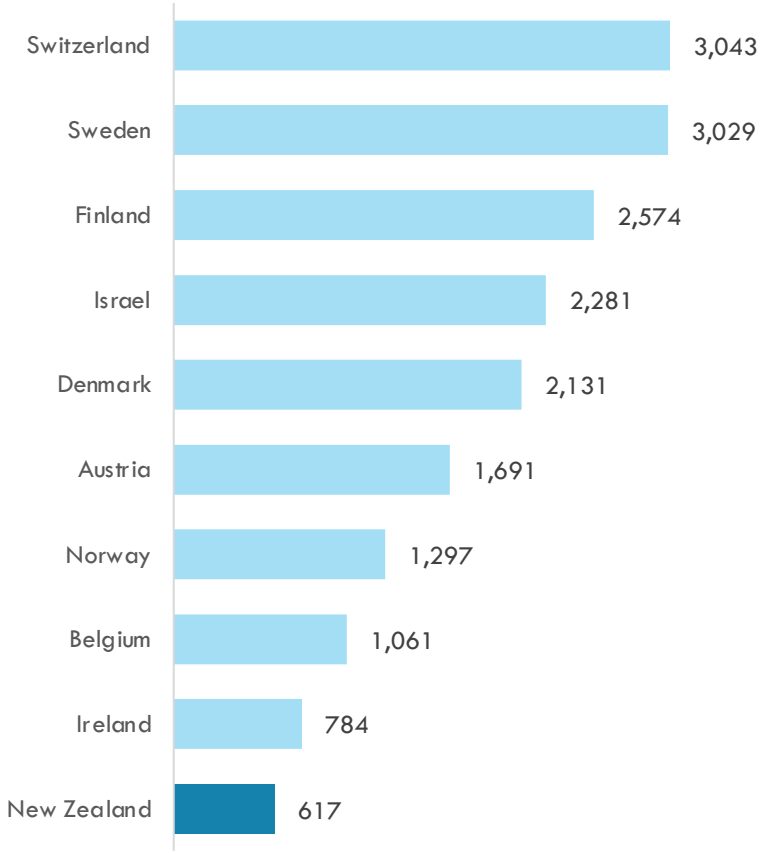


Source: OECD Science, Technology and Industry Outlook (Patents by technology: Patents - total and specific technology domains (OECD) https://stats.oecd.org); Coriolis analysis

New Zealand does not produce a lot of patents relative to peers; New Zealand trending down while many peers trending up

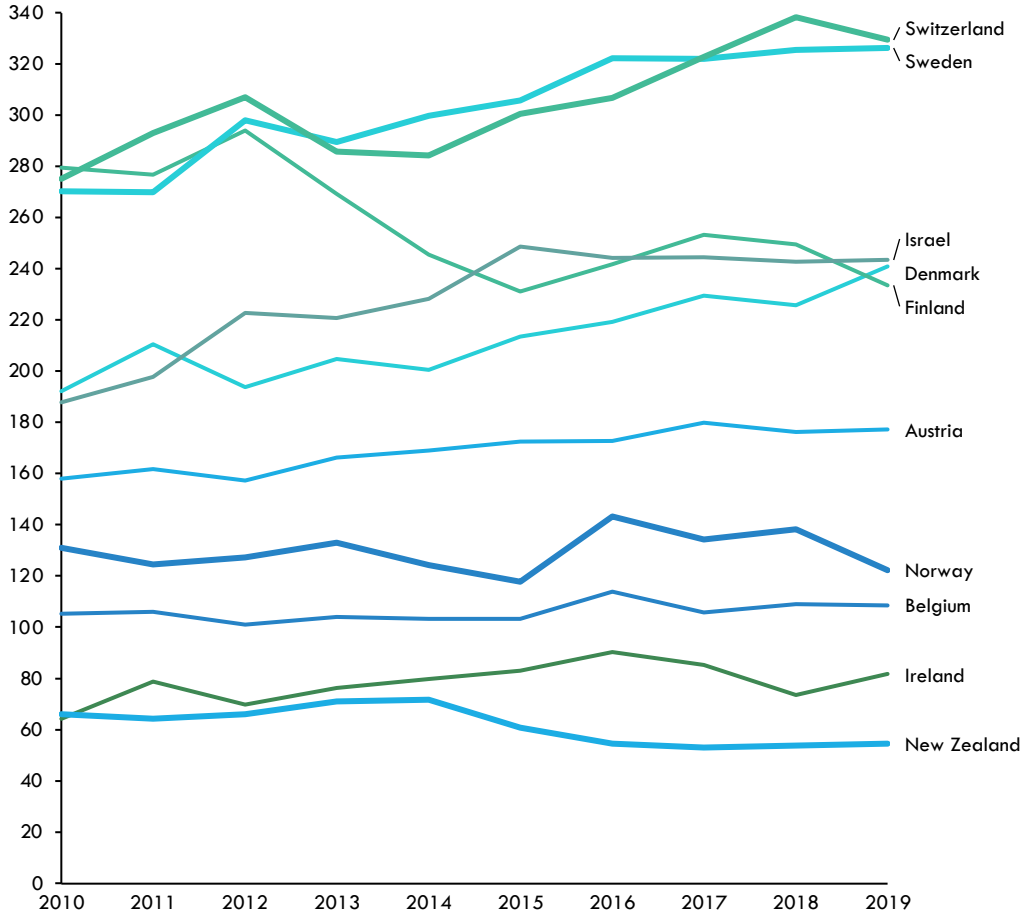
10Y TOTAL PATENTS APPS PER MIL POP

PTO applications/mil pop; 2010-2019 (latest 10y avail.)*



PATENTS APPLICATIONS PER MIL POP

PTO applications/mil pop; 2010-2019 (latest 10y avail.)

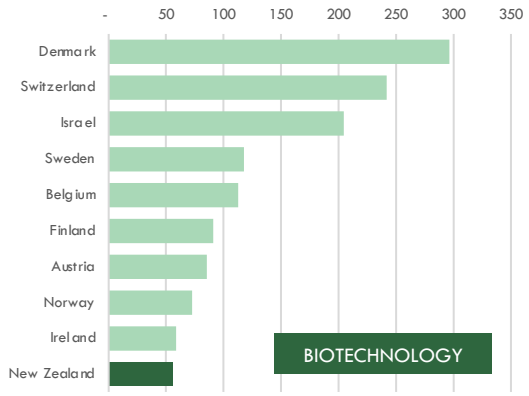


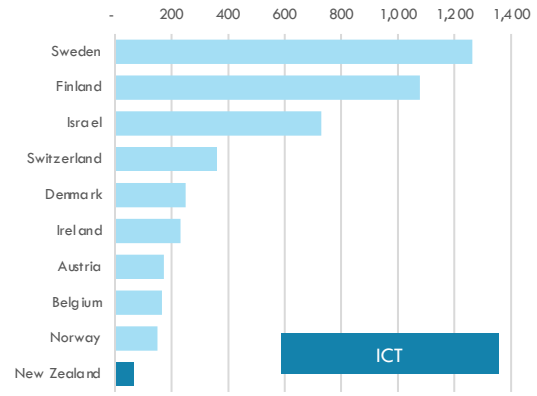
** PTO Patent and Trademark Office; Note: Uses constant population; Source: OECD Science, Technology and Industry Outlook (Patents by technology: Patents - total and specific technology domains (OECD) https://stats.oecd.org); Coriolis analysis*

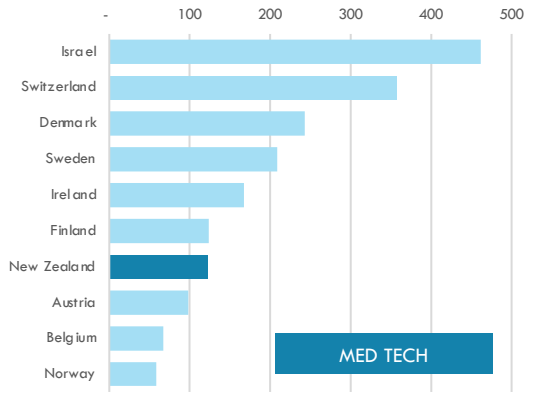
Relative to peers, New Zealand is not a leader in patent production in any major field

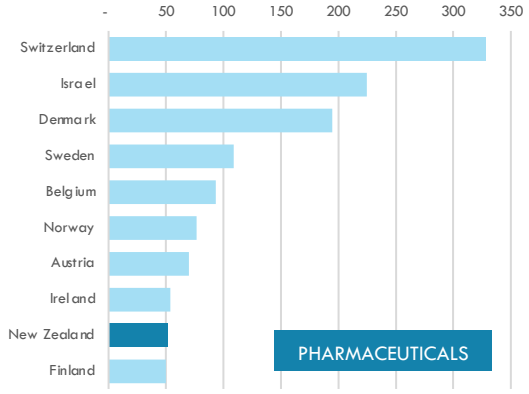
10Y TOTAL PATENTS APPS PER MIL POP: BY DOMAIN

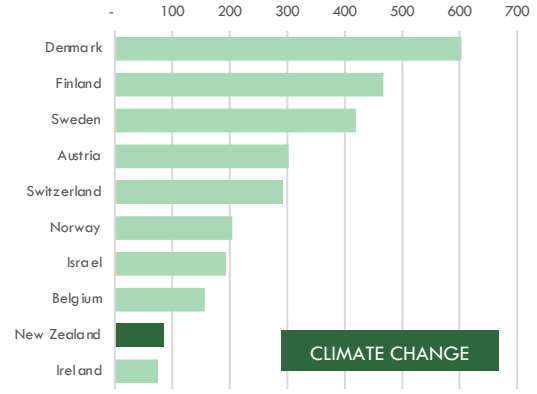
10y PTO applications/mil pop; 2010-2019 (latest 10y avail.)

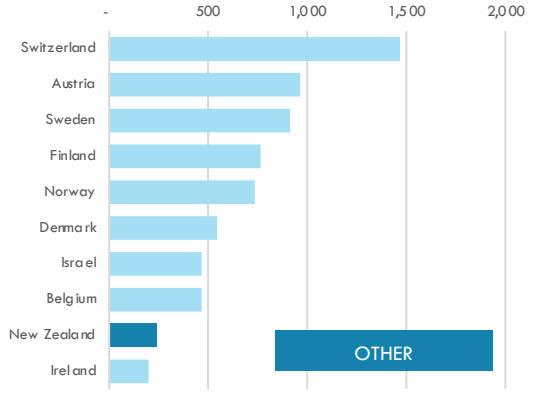






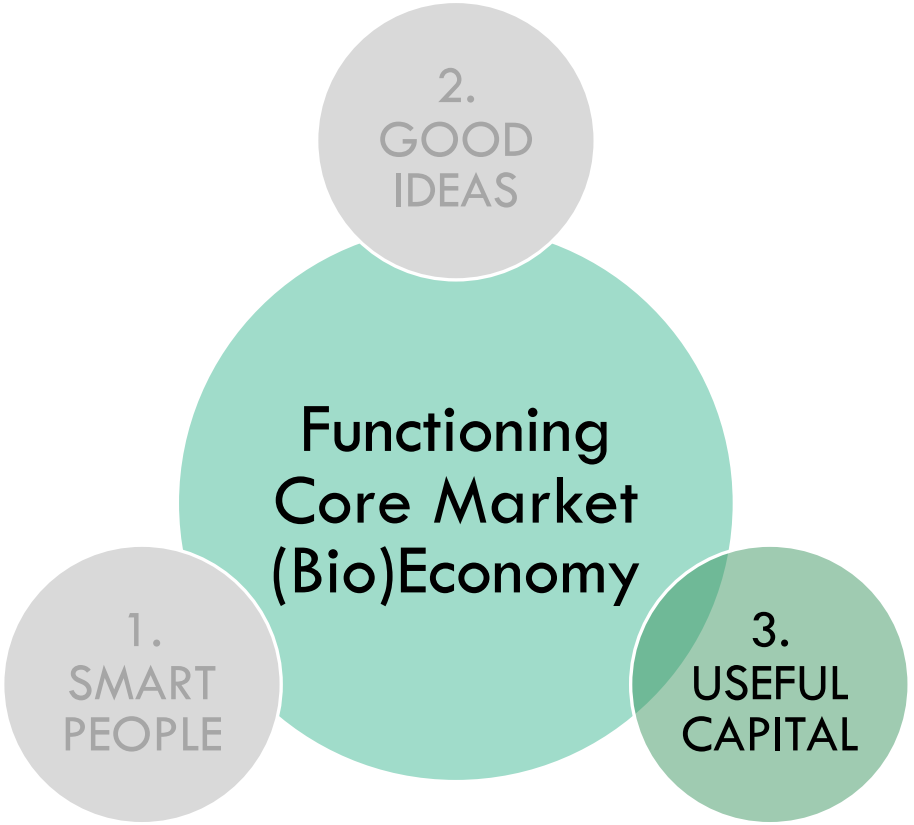






Note: Uses constant population; Source: OECD Science, Technology and Industry Outlook (Patents by technology: Patents - total and specific technology domains (OECD) https://stats.oecd.org); Coriolis analysis

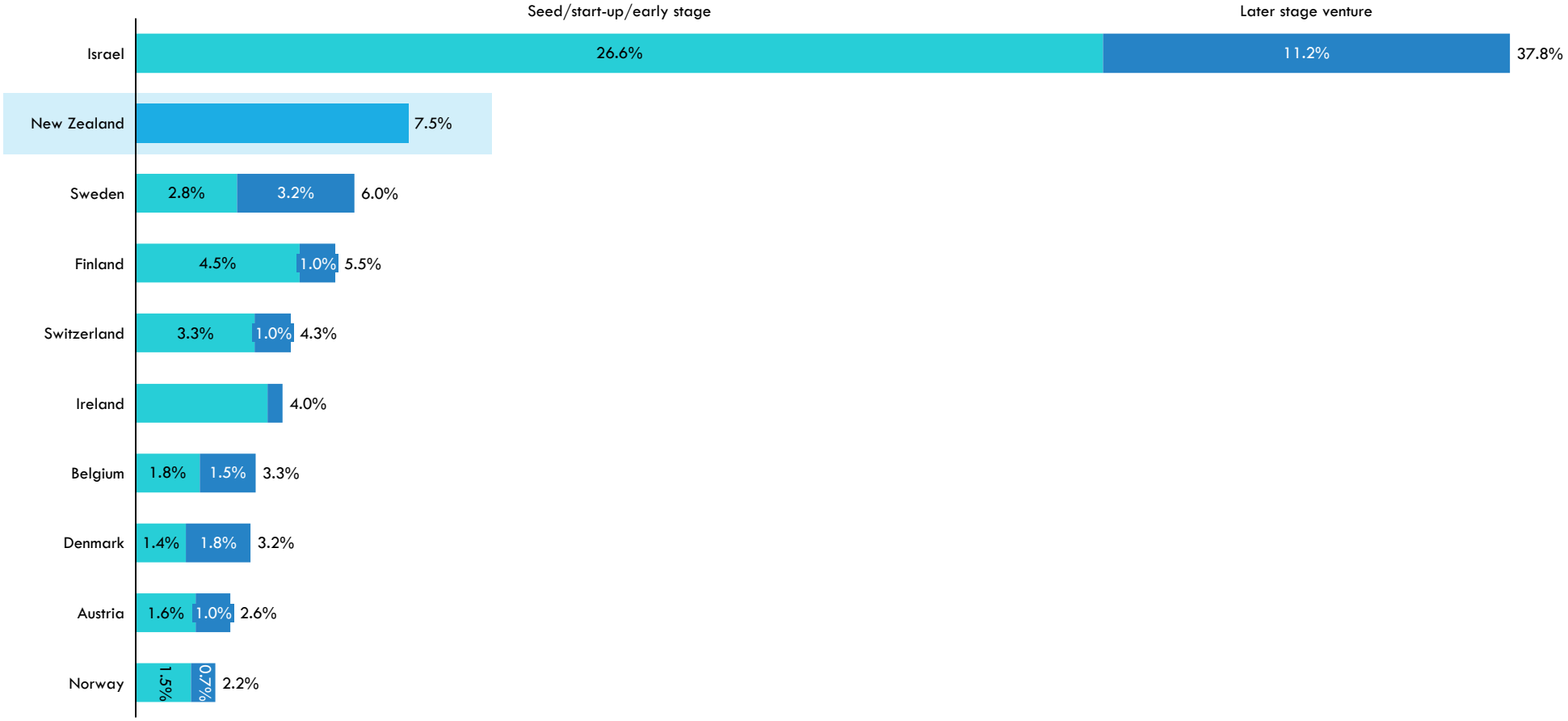
3. *Useful capital*



New Zealand is doing well in terms of amount of venture capital (VC) funding attracted

VENTURE CAPITAL INVESTMENTS AS A PERCENTAGE OF GDP

% of GDP; 2017 (latest available)

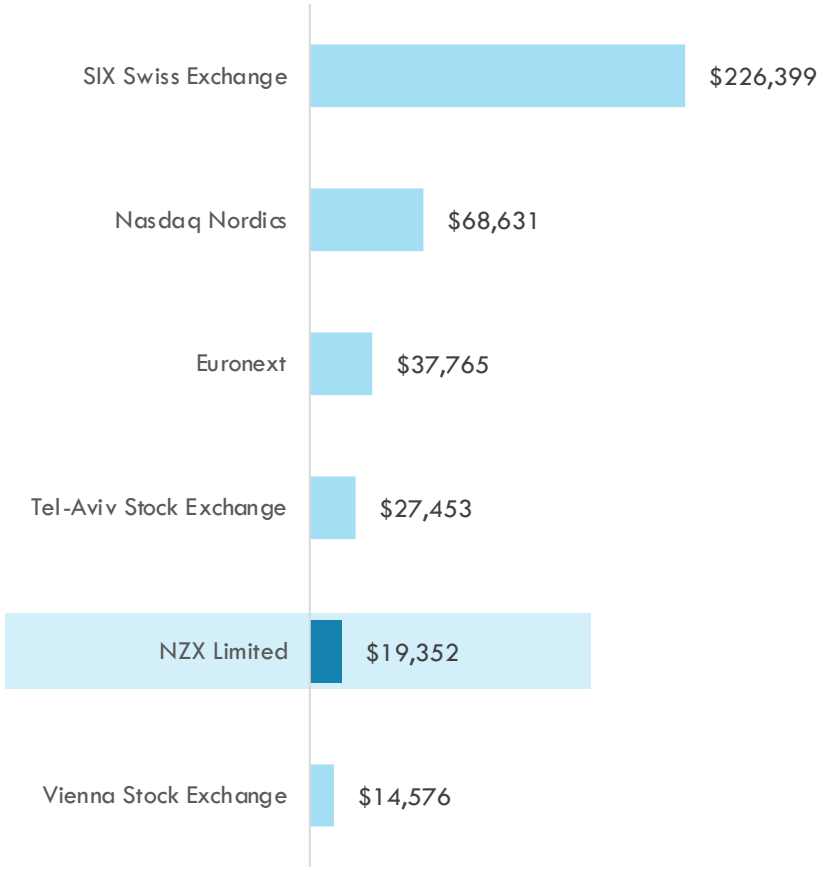


Source: OECD Entrepreneurship at a Glance Highlights 2018 [discontinued; last edition] (https://stat.link/n1p7da; https://www.oecd-ilibrary.org/employment/entrepreneurship-at-a-glance-2017/venture-capital-investments_entrepreneur_aag-2017-25-en); Coriolis analysis

Relative to peers, New Zealand has a small stock market and relatively few listed companies

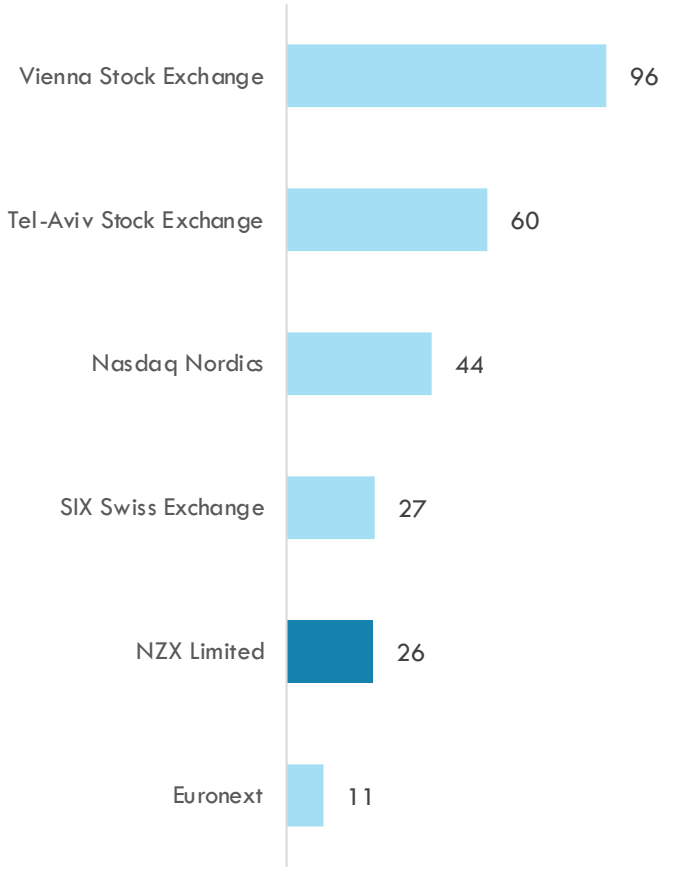
MARKET CAP OF LISTED COMPANIES

US$/capita; Mar 2023 (latest available)



LISTED CO PER MILLION POP

# of listed companies/mil capita; Mar 2023



Note: Euronext includes Belgium, Ireland and Norway; NASDAQ Norway includes Denmark, Finland and Sweden; both use regional total (i.e. all country averages)Source: World Federation of Exchanges (https://focus.world-exchanges.org/issue/may-2023/market-statistics and https://www.world-exchanges.org/our-work/statistics); CIA World Factbook (https://www.cia.gov/the-world-factbook/countries/); Coriolis analysis

DOCUMENT STRUCTURE/TABLE OF CONTENTS

1. AVAILABLE BIO-RESOURCES & IN-SECTOR CAPABILITIES

WHAT DO WE HAVE TO WORK WITH?

PAGES 8-171

2. WIDER PAN-SECTOR SUPPORTING CAPABILITIES

WHAT ARE WE GOOD AT?

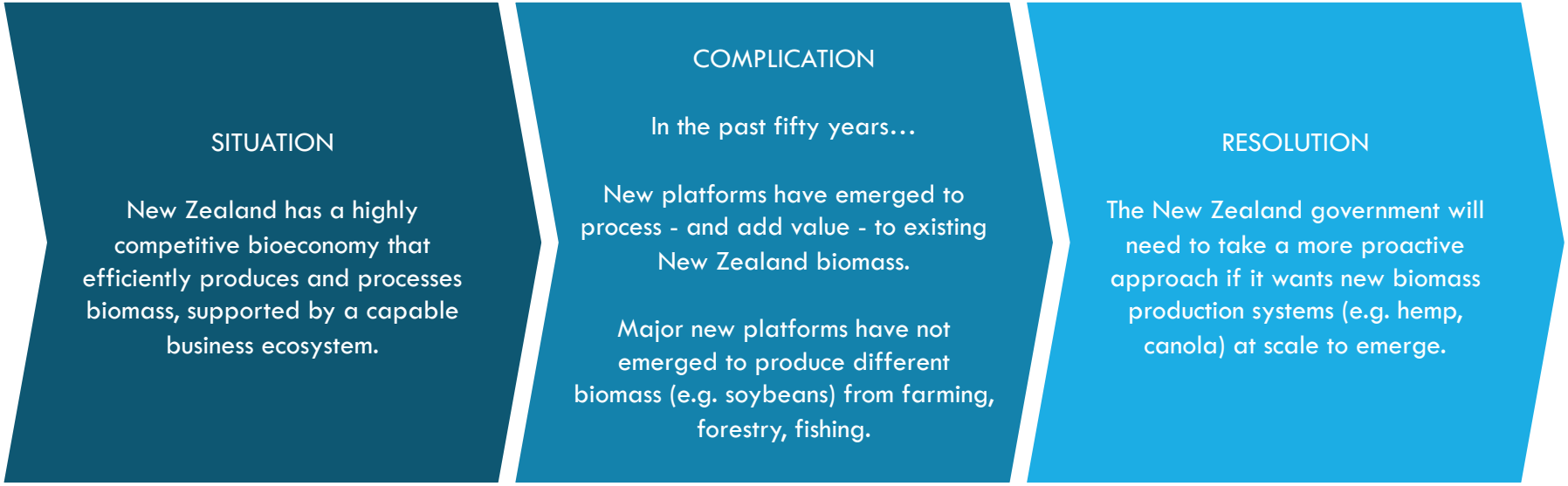
PAGES 172-205

3. DEVELOPING NEW PLATFORMS

WHY IS IT SO HARD TO DEVELOP NEW PLATFORMS IN THE BIOECONOMY?

PAGES 206-241

While the New Zealand bioeconomy has some world class capabilities, more needs to be done to nurture and support new and emerging platforms



This section looks at the key economic drivers of internationally competitive bioeconomy systems. It does not assess related issues such as sustainability, land-use change, alternative production systems (e.g. regenerative), or market or customer imposed requirements or regulations that might impact competitiveness (e.g. recycled packaging requirements, Carbon Border Adjustment Mechanisms (CBAM))

New Zealand has a highly competitive bioeconomy that efficiently produces and processes biomass that is supported by a world class business ecosystem

SITUATION

New Zealand has a highly competitive bioeconomy that efficiently produces and processes biomass, supported by a capable business ecosystem.

What is agricultural (and forestry and fishing) competitiveness?

WHAT IS A COMPETITIVE AGRICULTURAL SECTOR?

"Competitiveness is essentially about advantage in selling products in markets. This requires… farmers to be relatively more efficient producers than their many competitors, and for them to be backed up by efficient supply chains. Producing efficiently, in turn, involves Australian producers being exposed to international competition to spur innovation and productivity gains both to reduce costs and to develop products that consumers are prepared to pay for. It also depends upon the capacity to be flexible and to adapt swiftly to changing market conditions.

An internationally competitive agricultural sector (as for other sectors of the economy) requires policies and institutional frameworks that facilitate innovation, least-cost production, efficient risk management and the allocation (and reallocation) of resources such as land, water and management skills to areas of production and investment with the highest expected net returns. Generally speaking, appropriate incentives will be provided by open, competitive markets and efficient (non-distorted) price signals."

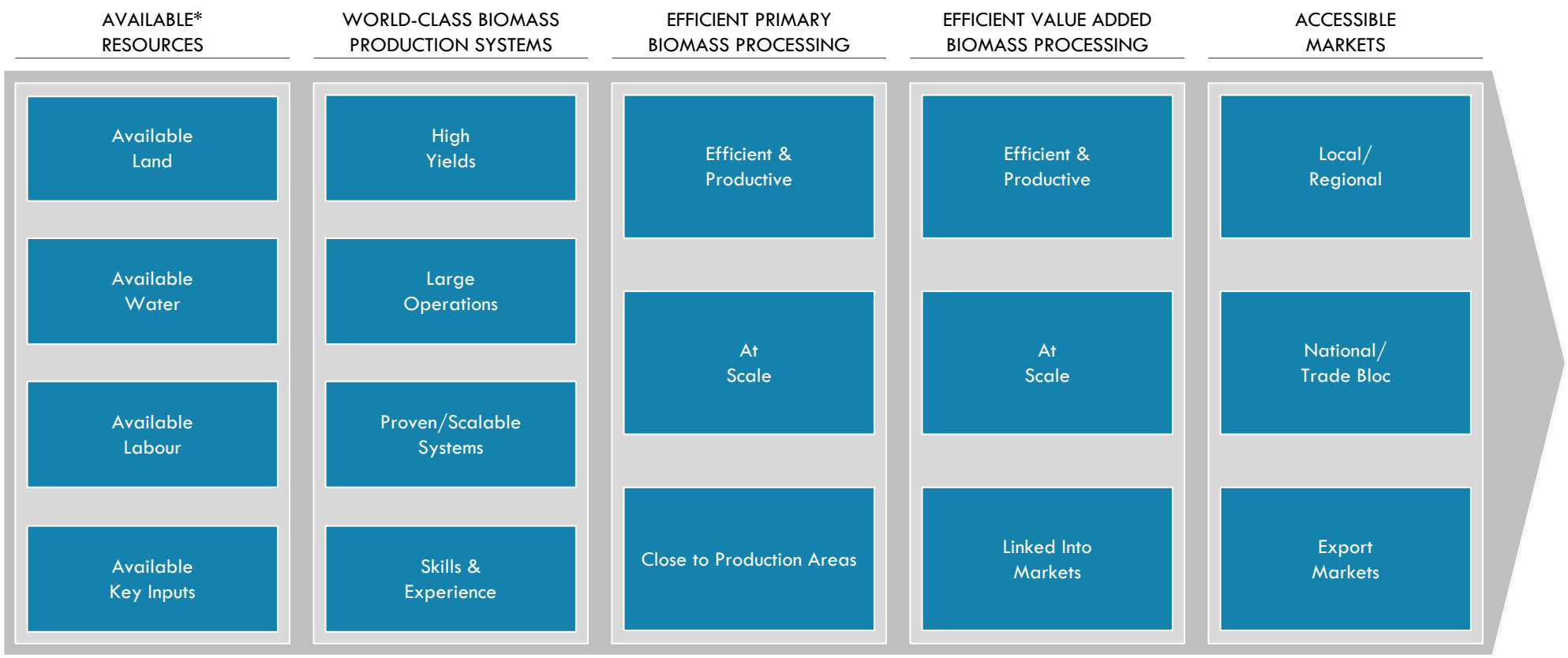
Submission to the Agricultural Competitiveness Taskforce, Australian Government Productivity Commission, April 2014

Australian Government
Productivity Commission

Source: https://www.pc.gov.au/research/supporting/agricultural-competitiveness-taskforce

An internationally competitive bioeconomy is created by a range of key drivers

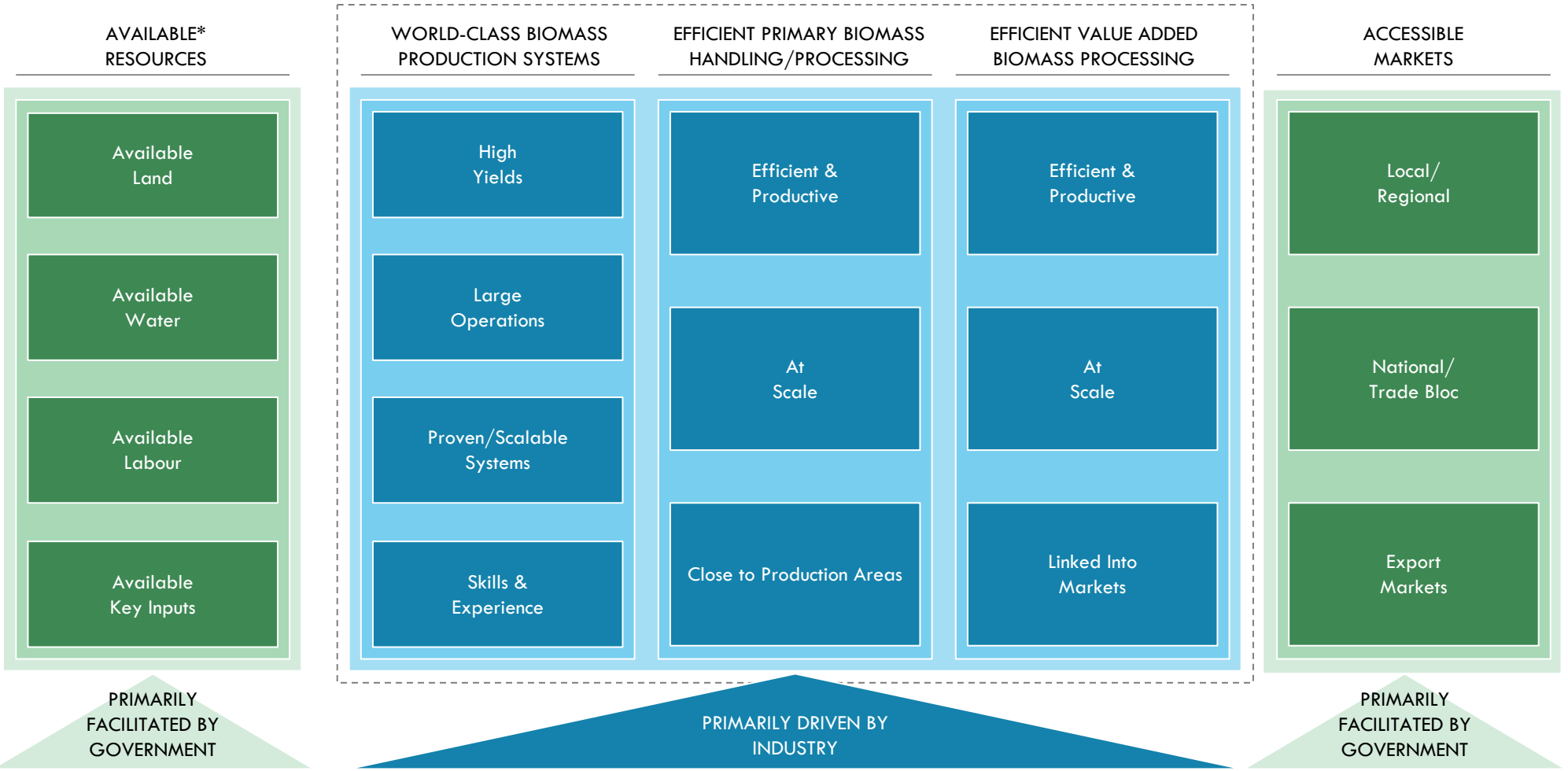
DRIVERS OF AN INTERNATIONALLY COMPETITIVE BIOECONOMY



** Efficiently allocated*

Industry and government can influence the drivers of an internationally competitive bioeconomy

DRIVERS OF AN INTERNATIONALLY COMPETITIVE BIOECONOMY



* *Efficiently allocated*

Internationally competitive regions globally have readily available resources to produce biomass

DRIVERS 01: AVAILABLE RESOURCES

AVAILABLE RESOURCES | WORLD-CLASS PRODUCTION SYSTEMS | EFFICIENT PRIMARY HANDLING/PROCESSING | EFFICIENT VALUE-ADDED PROCESSING | ACCESSIBLE MARKETS

	What?	Why?	Challenges
Available Land	- Climatic and environmental conditions suited to genetics and production system being used - Clear, stable, easily complied with environmental regulations - Freehold property - Property rights; rule-of-law - New resources available to bring into production	- Able to increase production - Incentivised to invest - Certainty of ownership	- NIMBY (not in my backyard) attitudes - Conflicting land use - Climate change impacting production - Multiple, conflicting, uncoordinated government agencies with multiple objectives and multiple regulations
Available Water	- Readily available water in sufficient quantities - Consistent, stable rainfall or seasonally recharged irrigation - Competitively priced water relative to peer group competition - Effective and efficient water allocation mechanisms	- Minimises risk - Stability/certainty of supply (e.g. for processor) - Able to increase production	- Climate change impacting water supplies - Non-rational water allocation systems - Illiquid water markets - Multiple, conflicting, uncoordinated government agencies with multiple objectives and multiple regulations
Available Labour	- People willing to work in physically demanding agriculture, forestry, fishing and processing roles - Labour pay relative to labour productivity - Competitively priced labour relative to peer group competitors	- Cost control - Price competitiveness	- Low population in rural regions - Transient, unskilled labour unaccustomed to hard work (e.g. backpackers) - Immigration laws - Cost of labour
Available Key Inputs	- Ready supply of key inputs produced or available in region - Competitively priced	- Cost control	- Lack of scale in inputs - Key inputs not approved or authorised - High prices on key inputs relative to key competitors

Internationally competitive regions globally have world-class production systems

DRIVERS 02: WORLD CLASS PRODUCTION SYSTEMS

AVAILABLE RESOURCES | **WORLD-CLASS PRODUCTION SYSTEMS** | EFFICIENT PRIMARY HANDLING/PROCESSING | EFFICIENT VALUE-ADDED PROCESSING | ACCESSIBLE MARKETS

	What?	Why?	Challenges
High Yields	- Best practice operation management around yield - Genetics most suited to production system and climate - Access to highest performance genetics available from largest/deepest breeding pool	- Efficient conversion of inputs to outputs - Not disadvantaged against competition - Time is money	- Biosecurity (e.g. no access to non-New Zealand genetics) - Poor/weak global pool not improving at rate of competing products (e.g. lamb vs. chicken) - No access to IP-controlled genetics
Large Operations	- Large, modern operations - Large operations at or above key competitors scale - Small number of large operations (not vice versa) - Specifically designed and focused on single product	- Lower production costs per unit - Higher yields - Better processes, systems and management (on average)	- Barriers to operation consolidation - Anti-agribusiness sentiment - Rate of farm sales and farm exits - Attitudes and opinions
Proven/Scalable Systems	- Proven, reproducible models in place delivering strong real-world results - World-class systems available - Easy access to latest specialised equipment & technology - Systems operating at minimum required scale	- De-risk operations - Higher productivity - Global best practice - Not disadvantaged	- Lack of minimum local scale to implement - Lack of required skills - Lack of required equipment or technology - No proven model exists (e.g. native botanicals) - Multiple, conflicting, uncoordinated layers of government with multiple objectives
Skills & Experience	- Deep pool of local skilled operators - Strong industry training programs and systems - Regular uptake of new global best practice	- Readily available labour - Enable rapid growth and expansion	- Local pool cut-off from global best practice by distance, culture or attitudes - Local pool under some critical threshold and therefore not self-sustaining - Immigration laws preventing arrival of new skills suited to new products/systems

Internationally competitive regions globally have efficient primary handling and primary processing

DRIVERS 03: EFFICIENT PRIMARY PROCESSING/HANDLING

AVAILABLE RESOURCES | WORLD-CLASS PRODUCTION SYSTEMS | **EFFICIENT PRIMARY HANDLING/PROCESSING** | EFFICIENT VALUE-ADDED PROCESSING | ACCESSIBLE MARKETS

	What?	Why?	Challenges
Efficient & Productive	- Biomass wholesaling, bulk handling and primary processing activities are efficient and productive - Using latest modern equipment and efficient systems - Deep knowledge and capabilities	- Lower cost - Higher productivity	- Small scale operations - Undercapitalised operations unable to reinvest in improvements - Local operations cut off from global best practice by distance, culture or attitudes
At Scale	- Large scale wholesaling/bulk handling and/or primary processing activities - Large, high productivity facilities - Operations at or above key competitors scale	- Lower costs per unit	- Low local production volume restricting scale of local processing
Close to Production Areas	- Wholesaling/processing centrally located in production area (rather than a significant number widely distributed) - Primary production operations located within close distance to first point of handling/processing	- Logistics efficiency - Transport costs per unit	- Zoning - Land cost and availability - Location of ports vs. location of resources - Distorting effect of historic government interference in markets

Internationally competitive regions globally have efficient value-added processing

DRIVERS 04: EFFICIENT VALUE ADDED PROCESSING

AVAILABLE RESOURCES → WORLD-CLASS PRODUCTION SYSTEMS → EFFICIENT PRIMARY HANDLING/PROCESSING → **EFFICIENT VALUE-ADDED PROCESSING** → ACCESSIBLE MARKETS

	What?	Why?	Challenges
Efficient & Productive	- Value-added processing activities are efficient and productive - Using latest modern equipment and efficient systems - Deep knowledge and capabilities - Innovative new product development occurring in region - Access to innovation infrastructure (e.g. pilot facilities)	- Lower cost - Higher productivity	- Small scale operations - Undercapitalised operations unable to reinvest in improvements - Local operations cut off from global best practice by distance, culture or attitudes
At Scale	- Value-added processing activities occurring in region at minimum scale required to be competitive - Operations are large, high productivity facilities - Operations are at or above scale of key competitors that are gaining or driving share and market growth	- Lower costs per unit	- Low local production volume restricting scale of local processing - Limited number support services and input suppliers
Linked Into Markets	- Key value-added producers have solid, stable route-to-market and in-market sales force - Regular, on-going interface with in-market retailers and consumers - Presence of global leaders in the region	- Sales growth - Reduced transaction costs - Increased innovation	- Small scale local processors isolated from world markets - Lack of regular flow of global market information back to regional processors (e.g. trends; NPD*; new flavours) - Lack of connections into key global input or ingredient suppliers (e.g. flavour houses)

** New Product Development (NPD)*

Internationally competitive regions globally have access to markets

DRIVERS 05: ACCESSIBLE MARKETS

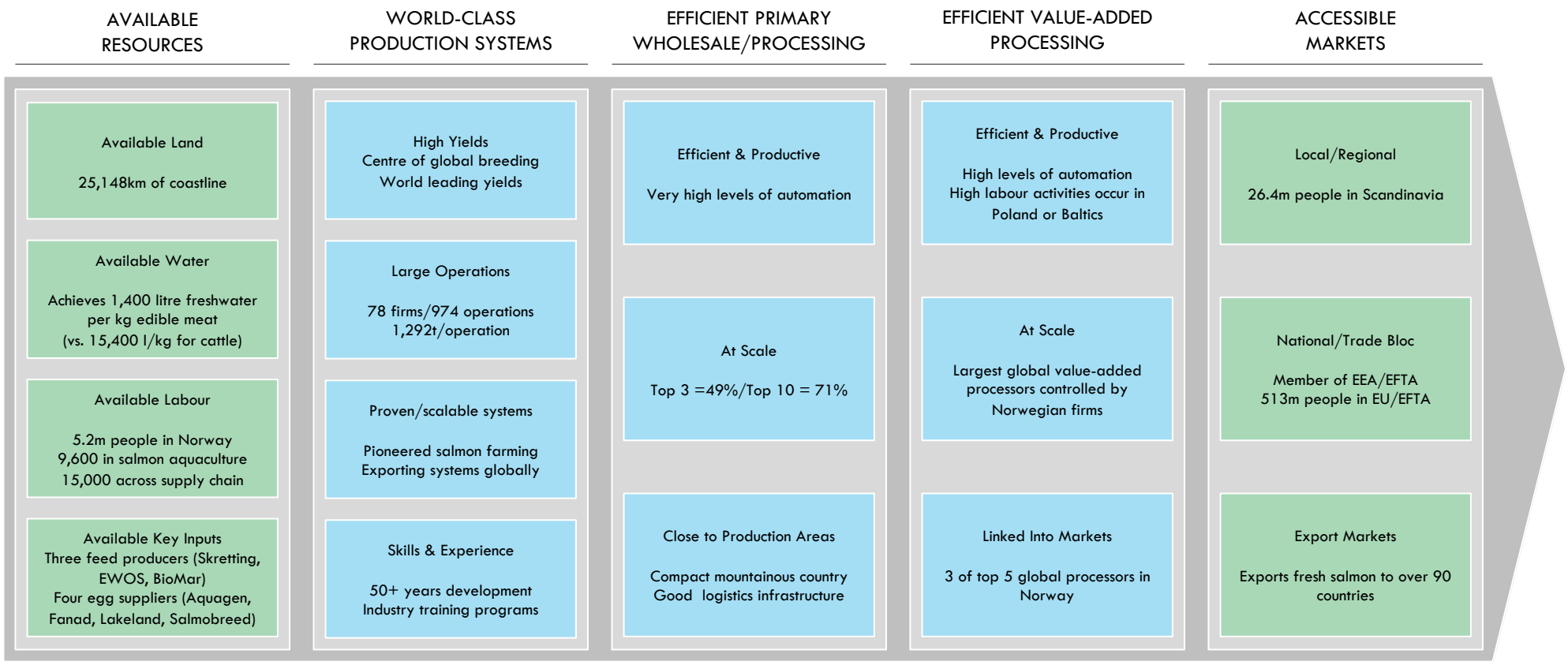
AVAILABLE RESOURCES | WORLD-CLASS PRODUCTION SYSTEMS | EFFICIENT PRIMARY HANDLING/PROCESSING | EFFICIENT VALUE-ADDED PROCESSING | **ACCESSIBLE MARKETS**

	What?	Why?	Challenges
Local/ Regional	- Competitive and robust local/regional market - Sophisticated and discerning customers - Multiple channels and retailers	- Test bed/nursery for new product development (NPD) - Guaranteed minimum volumes and sales	- Small local markets - Very limited local demand for product (e.g. not used in local cuisine)
National/ Trade Bloc	- Large pool of regional consumers - Ready access via regional trade agreement	- Drive volume - Available pool of customers - Easy, gradual expansion	- Internal barriers to trade such as transport distances or cost - Language or cultural barriers
Export Markets	- Low/reduced tariffs into key markets - Large number of high quality trade agreements - Regular and available transport and shipping solutions - Minimum scale required to export product in efficient quantities	- Enables export growth	- Restricted access in some key markets - Presence of significant non-tariff trade barriers - Currency risks

** New Product Development (NPD)*

As an example, the Norwegian salmon industry delivers on all key international competitiveness drivers

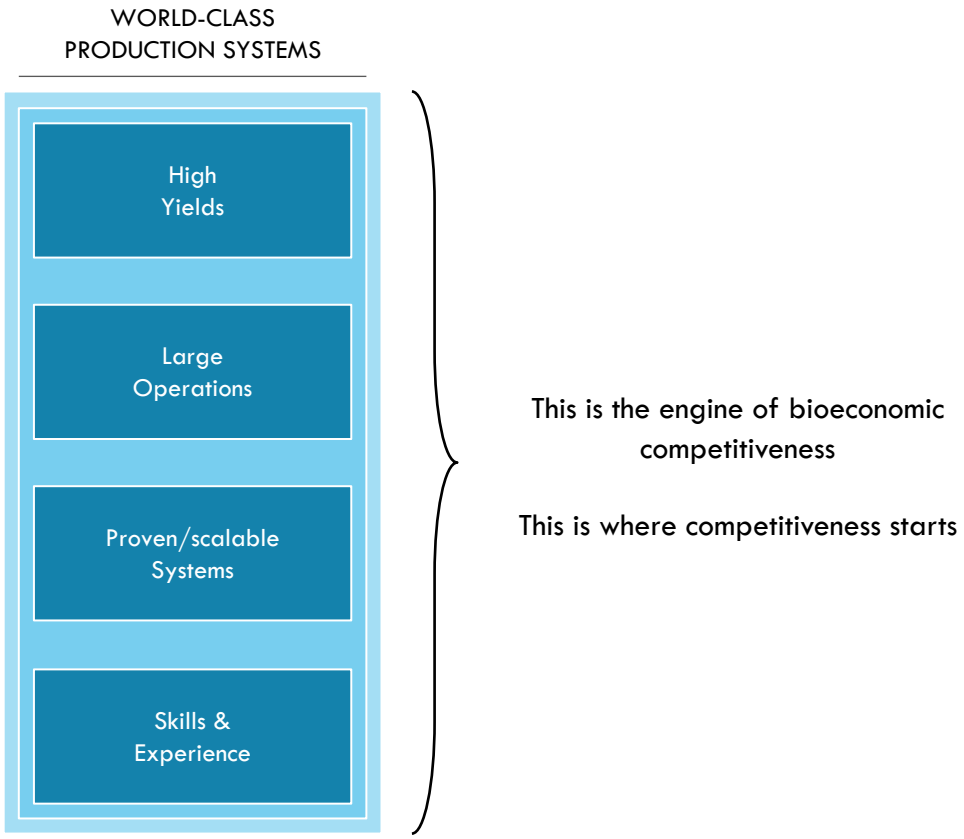
EXAMPLE: DRIVERS OF COMPETITIVENESS OF NORWEGIAN SALMON INDUSTRY



Source: Marine Harvest; UN Comtrade database; CIA World Factbook; Glitnir; Coriolis analysis and estimates

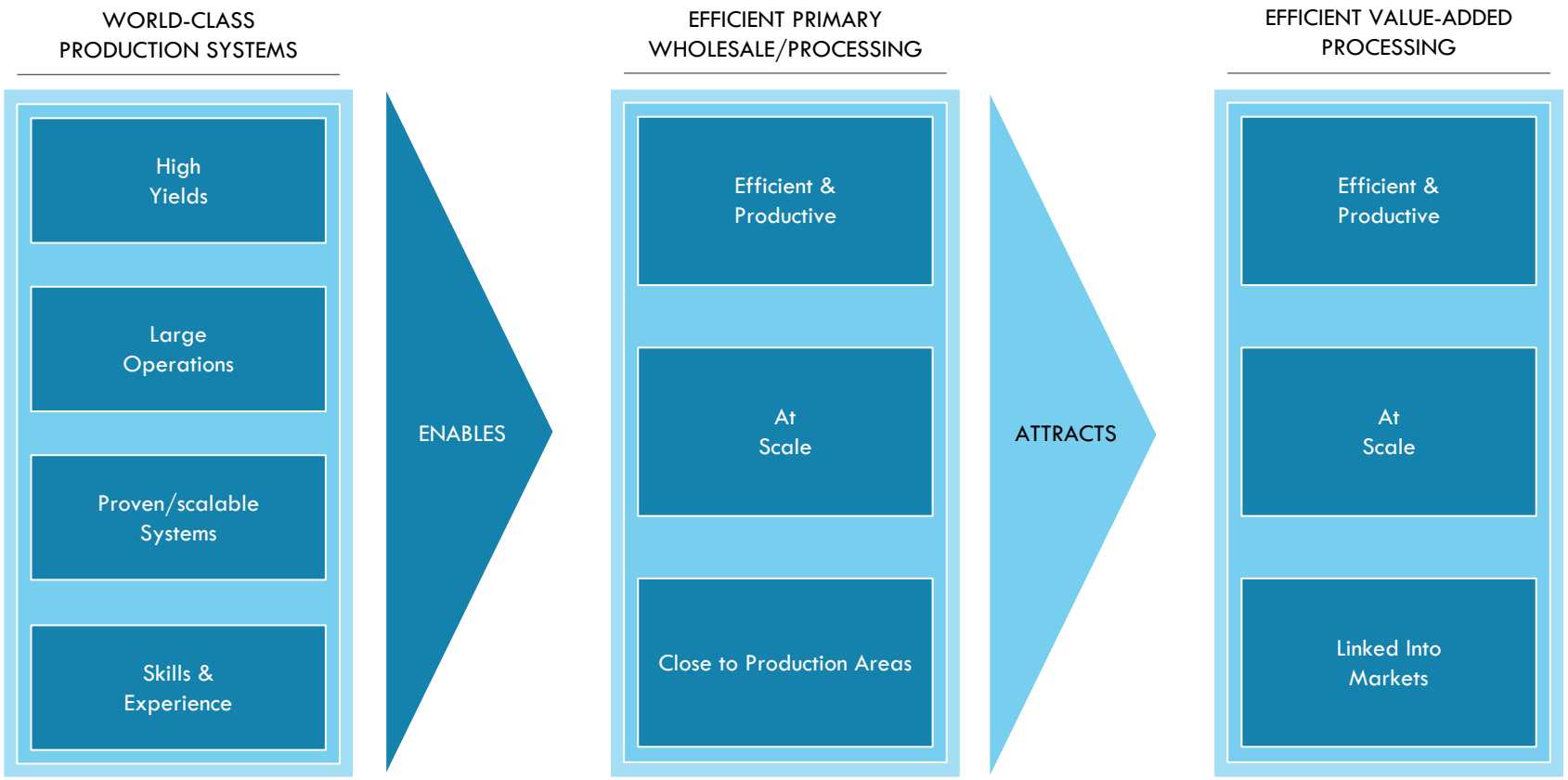
World-class production systems are the core engine of competitiveness; without this, all other parts of the chain will struggle to scale

WORLD-CLASS PRODUCTION SYSTEMS ARE THE ENGINE



World-class production systems enable efficient primary processing which attracts efficient value added processing

WORLD-CLASS PRODUCTION SYSTEMS ARE THE ENGINE



Major new platforms have emerged in 'post farmgate" biomass processing but not in primary biomass production (farming, forestry, fishing)

SITUATION

New Zealand has a highly competitive bioeconomy that efficiently produces and processes biomass, supported by a capable business ecosystem.

COMPLICATION

In the past fifty years…

New platforms have emerged to process and add value to existing New Zealand biomass.

Major new platforms have not emerged to produce different biomass (e.g. soybeans) from farming, forestry, fishing.

THE CHALLENGE: There is a 'chicken-and-the-egg' problem; how do you get experience with high costs?

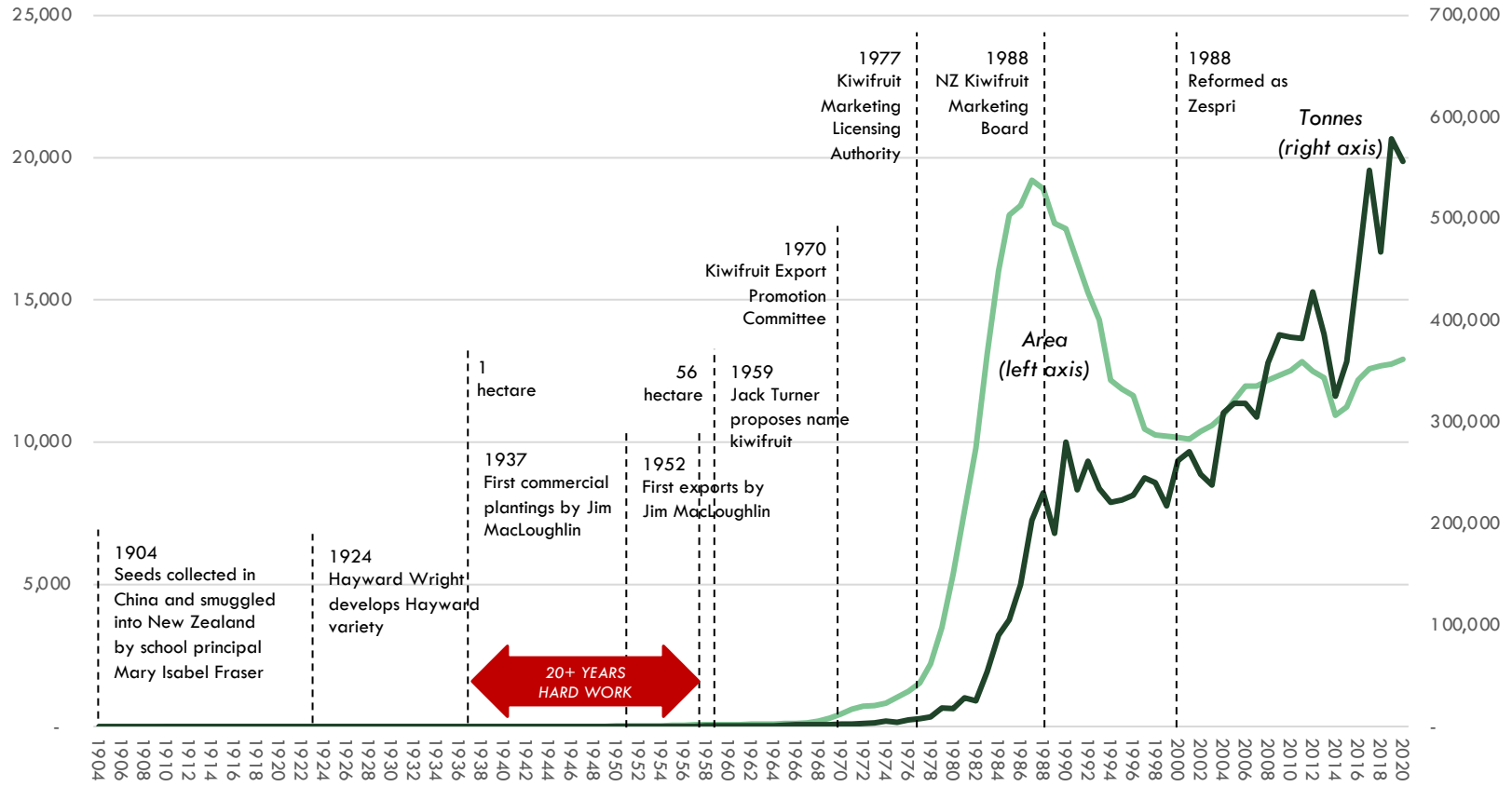
We have high costs because we haven't gone down the experience curve

HOW DO WE RESOLVE THIS ISSUE?

We can't get any experience because our prices are too high

The New Zealand kiwifruit industry took twenty years of hard work from the first commercial planting by Jim MacLaughlin to 'get much of anywhere'

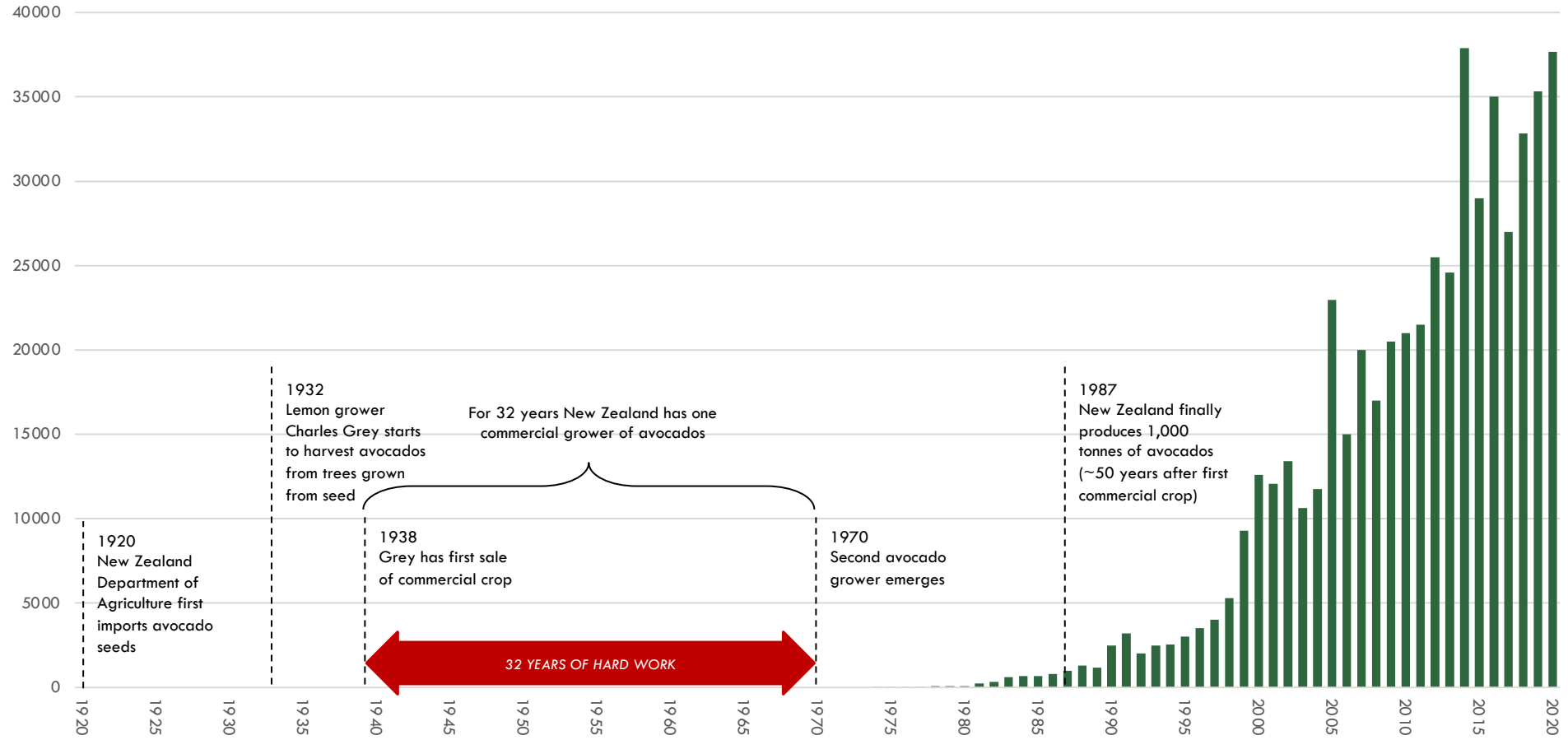
EXAMPLE: AREA & PRODUCTION IN THE NEW ZEALAND KIWIFRUIT INDUSTRY



Source: NZ Department of Statistics; NZ Ministry of Agriculture; UN FAO; UN Comtrade; Zespri Annual Reports (various years); past Coriolis work; Coriolis analysis and estimates

The New Zealand avocado industry took 32 years of hard work to move beyond a single champion

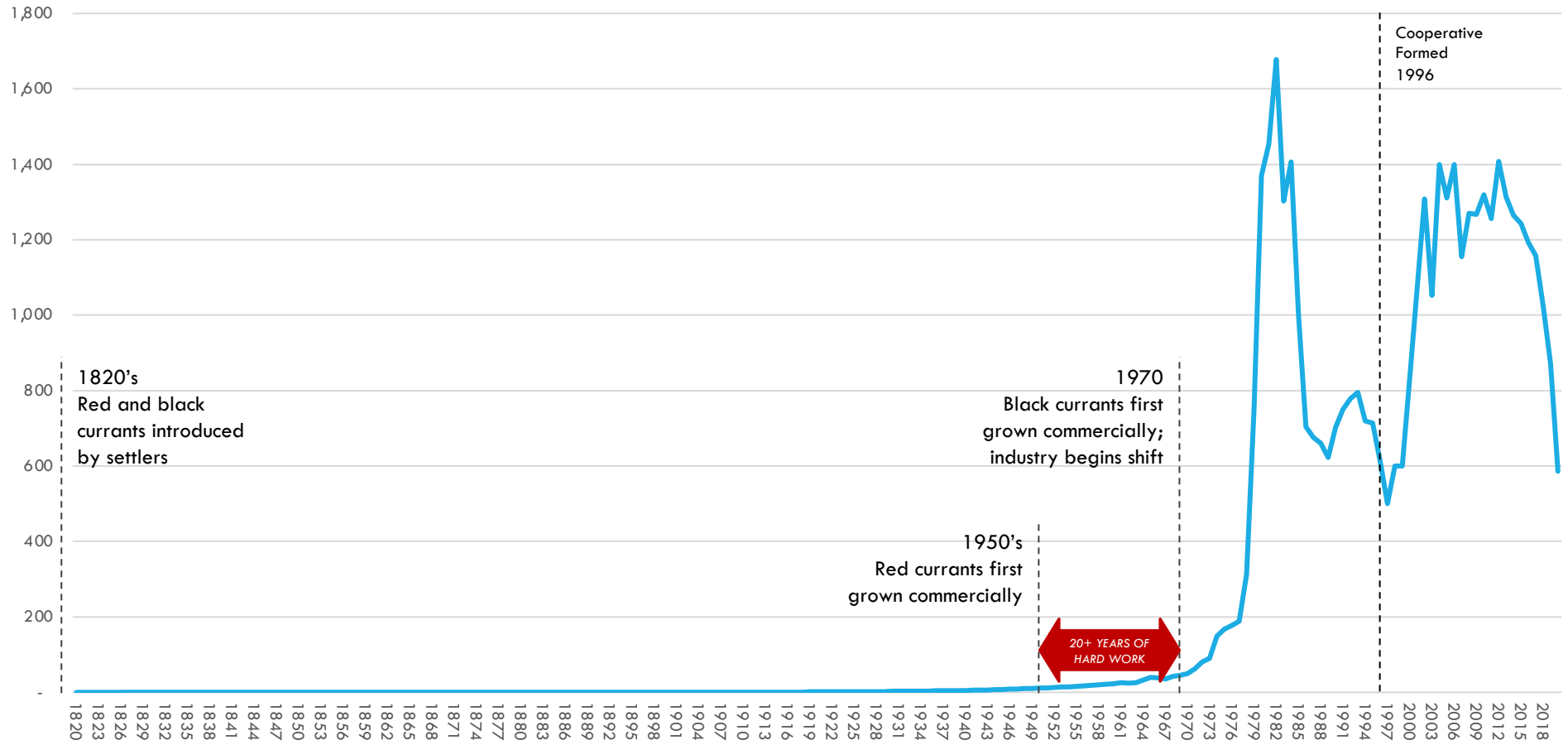
EXAMPLE: NEW ZEALAND AVOCADO INDUSTRY HISTORY AND PRODUCTION VOLUME



Source: https://industry.nzavocado.co.nz/avocado-history/; Sources: Statistics New Zealand; United Nation FAO (itself from MPI); Coriolis analysis

The New Zealand currant industry was around for 20+ years before it shifted across from red to black and started to achieve traction

CASE STUDY: NEW ZEALAND CURRANT AREA (ha)



Why is this happening? The experience curve proposes a constant relationship between the cumulative production quantity and the cost of production

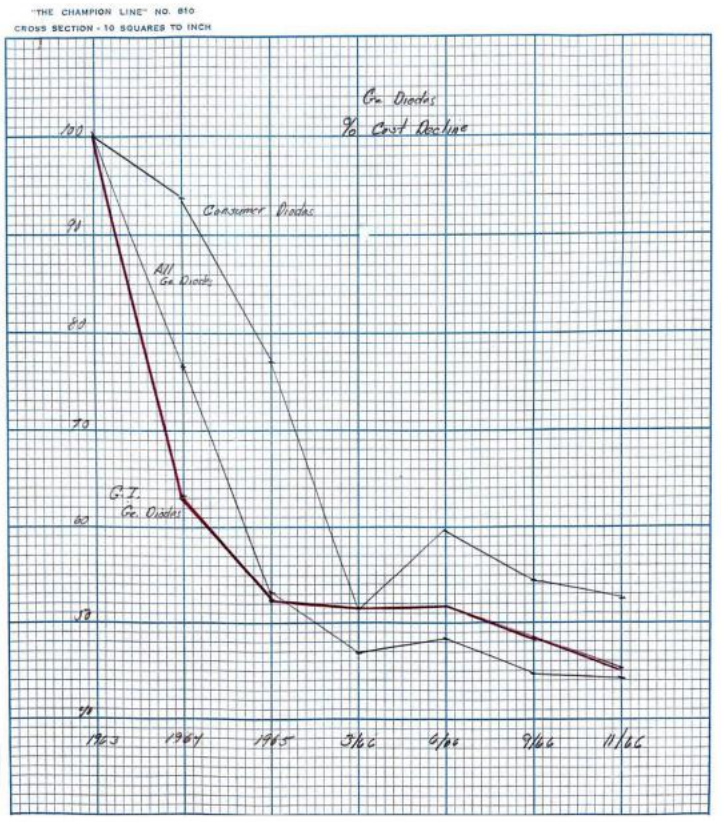
ORIGINAL EXPERIENCE CURVE DIAGRAM

"There is a hypothesis that costs follow a definite pattern which is a function of accumulated production experience… The characteristic decline is consistently 20-30% each time accumulated production is doubled… There is a large amount of empirical evidence that this relationship is so fundamental that any deviation should be explainable." Bruce Henderson, BCG, Jan 1968

BCG BOSTON CONSULTING GROUP

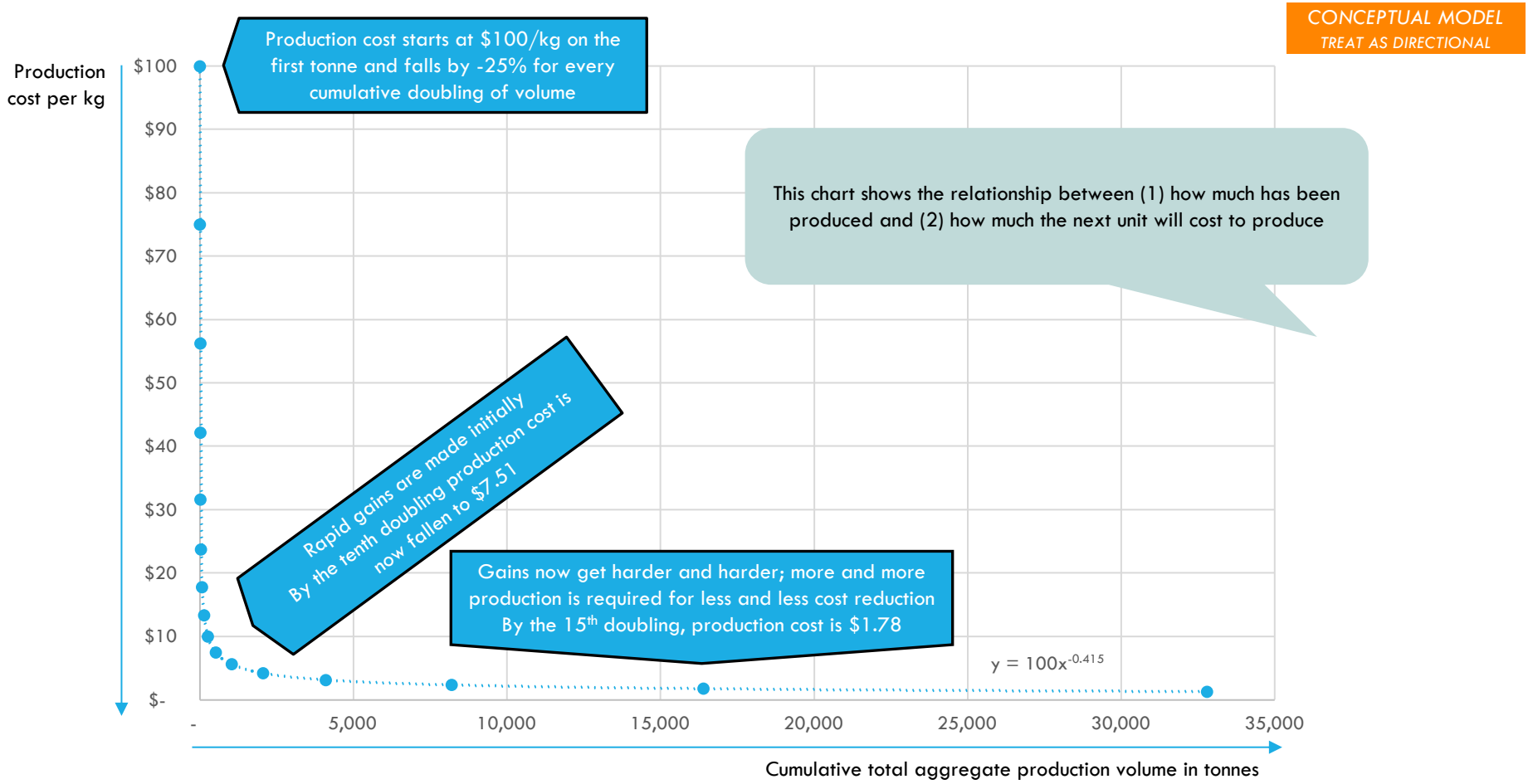
"Experience Curve is a concept that states that there is a consistent relationship between the cumulative production quantity… and the cost of production. The concept implies that the more experienced a company is in manufacturing a specific product, the lower its cost of production.."

CFI



As an example, say a product starts with a production cost of $100/kg and costs fall at -25% per each cumulative doubling

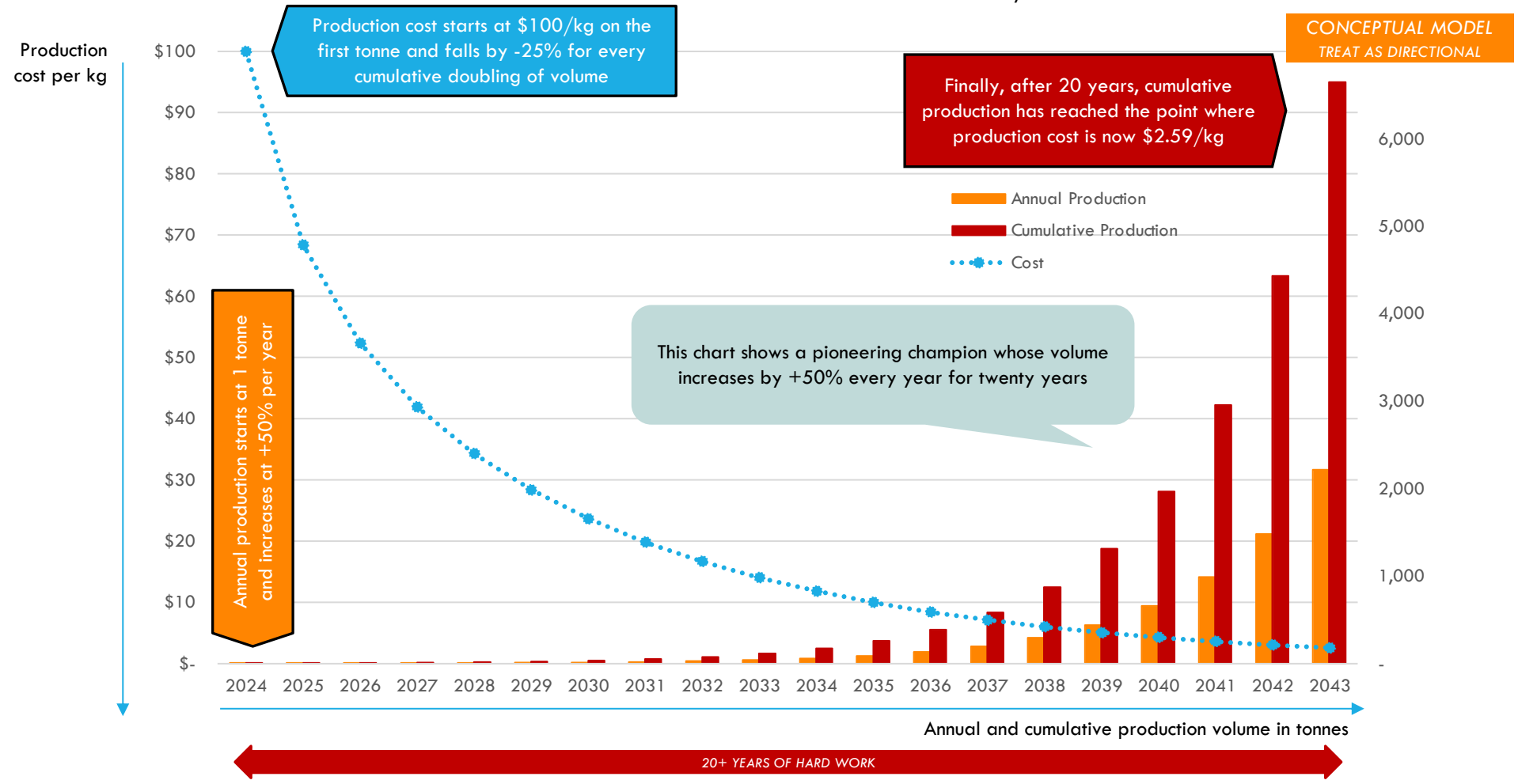
EXAMPLE: EXPERIENCE CURVE WITH $100 STARTING & -25% COST DECLINE PER DOUBLING



NOTE: Excludes inflation

So in this worked example, starting with 1t and with production increasing +50% per year, it takes 20 years to get production cost down to $2.59/kg

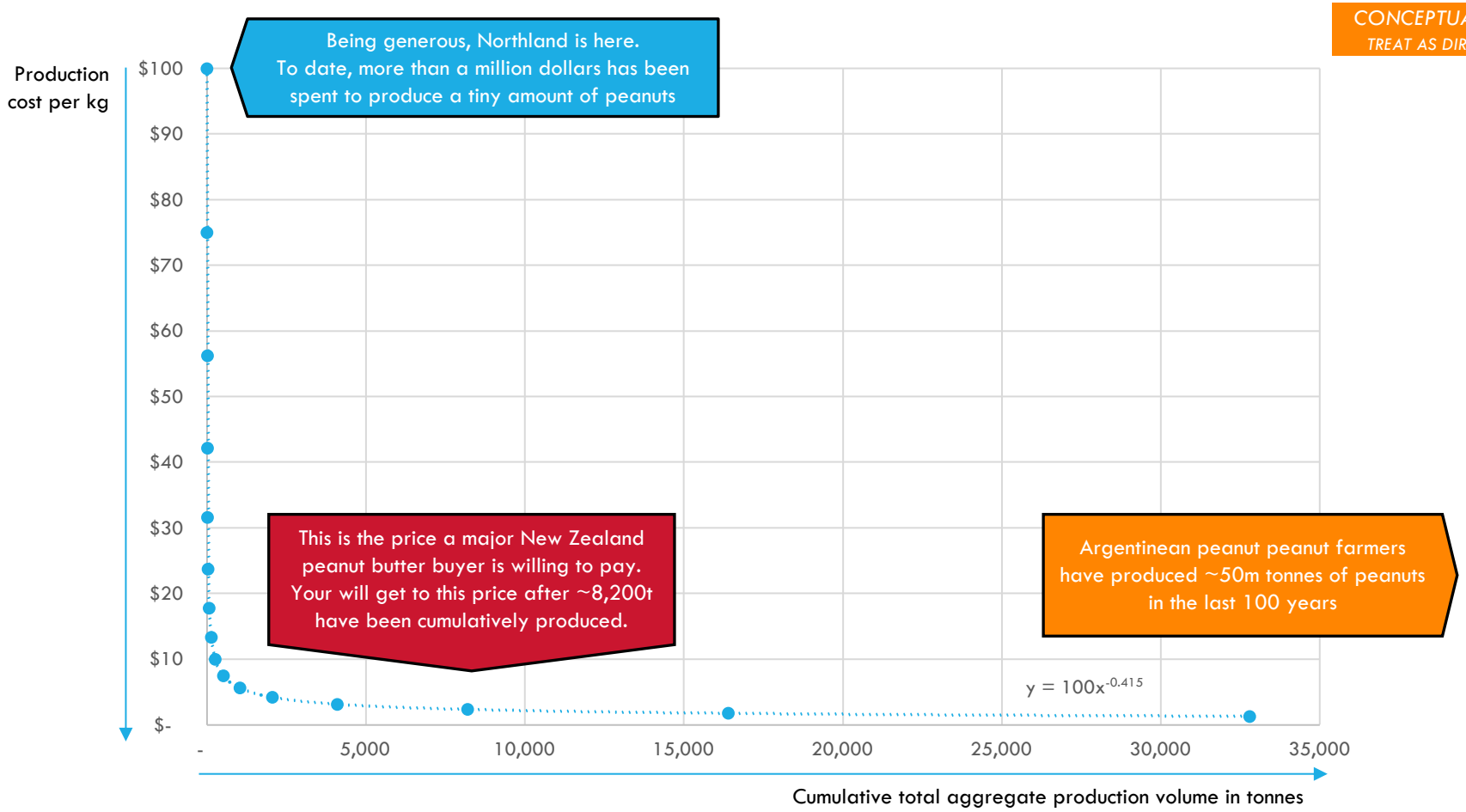
EXAMPLE: IMPLEMENTING THE EXPERIENCE CURVE PAGE PRIOR W/+50% GROWTH PER YEAR



NOTE: Excludes inflation

Any new product is at the start of the experience curve, while key competitors in the market are far along and down the curve

EXAMPLE: EXPERIENCE CURVE NORTHLAND VERSUS ARGENTINA IN PEANUTS



New Zealand has no track record of solving the problem of penetrating a highly competitive agricultural market 'late in the game'

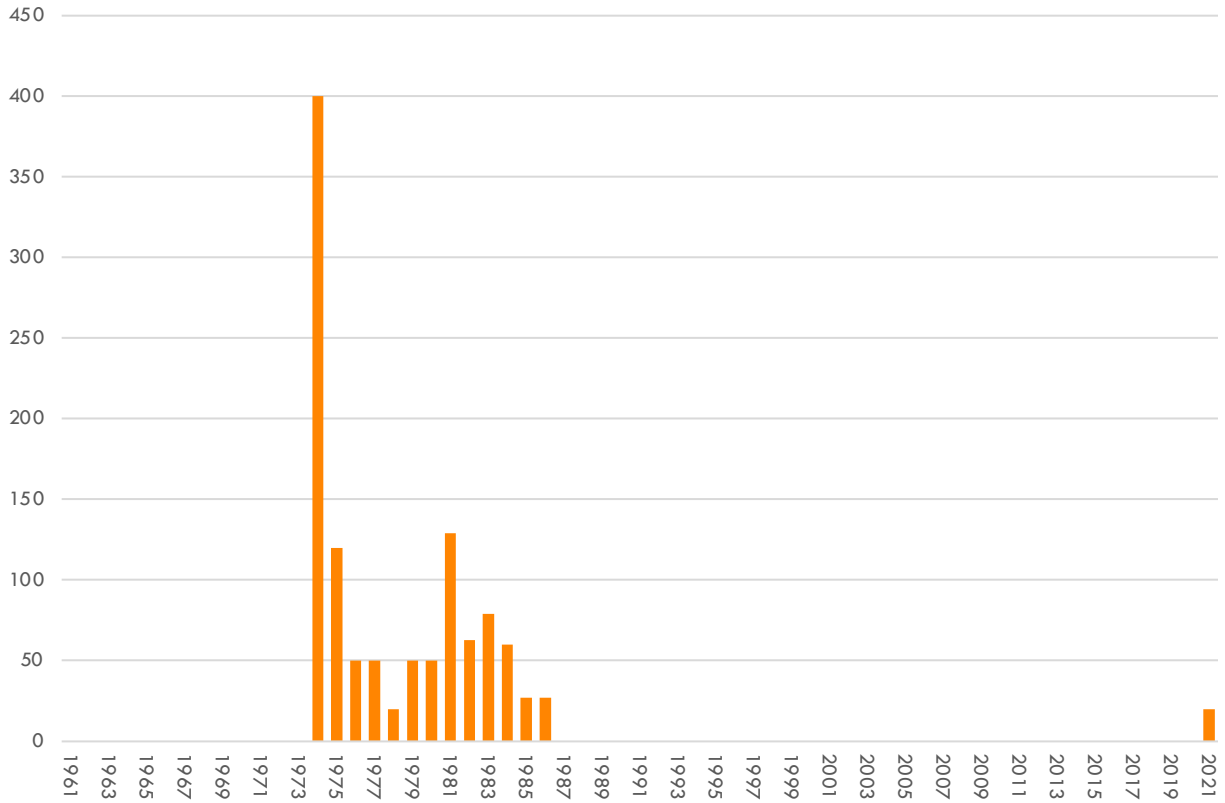
POSITION ON THE EXPERIENCE CURVE: NEW ZEALAND VS. WORLD

HAS NEW ZEALAND MOVED DOWN THE EXPERIENCE CURVE? / IS NEW ZEALAND AT SCALE	NO	YES
YES	Kiwifruit 1970's	Dairy 2022 Apples 2022 Beef 2022 Lamb 2022 Potatoes 2022 Onions 2022 Kiwifruit 2022 *NZ entered all these products prior to 1840*
NO	Kiwifruit 1937 Avocados 1938	Soybeans 1970 (failed) Quinoa or sunflower (currently trying) *There are no obvious examples of New Zealand achieving success starting from here in the last 100 year**

HAVE MAJOR COMPETITORS MOVED DOWN THE EXPERIENCE CURVE?
IS THE WORLD AT SCALE?

New Zealand tried a version of this "field of dreams" strategy in soybeans in the 1970's and 80's and it failed

AREA IN NEW ZEALAND IN SOYA BEANS (hectares)



COMMENTS/NOTES

- Soya beans cultivated in trial quantities in 1910 by Department of Agriculture at Tauranga Experimental Farm
- In late 1911 nine soybean varieties were received from the US Department of Agriculture and tested, but poor yields in 1912 and 1913 led officials to conclude that the climate was too uncertain and soy beans did not look promising.
- "Periodic waves of enthusiasm have swept New Zealand for soya beans and will doubtless continue to do so." New Zealand Journal Of Agriculture, 20 October 1938
- Further trials conducted in Canterbury from 1958-1966 using new varieties sourced from North America
- Commercially grown at a small scale in 1970's through mid-80's
- In Spring 2021 three growers have planted 20ha in another trial
- Soya beans are the second largest global oilcrop after palm; NZ has been unable to achieve the yields or production costs needed to succeed

Note: Dataset is accurate to sources but may be incomplete; Sources: Statistics New Zealand; United Nation FAO (itself from MPI); https://pureoil.nz/product-development/soyabean-processing/; Coriolis analysis

The New Zealand government will need to take a more proactive approach if it wants new biomass production systems (e.g. hemp) at scale to emerge

SITUATION

New Zealand has a highly competitive bioeconomy that efficiently produces and processes biomass, supported by a capable business ecosystem.

COMPLICATION

In the past fifty years…

New platforms have emerged to process and add value to existing New Zealand biomass.

Major new platforms have not emerged to produce different biomass (e.g. soybeans) from farming, forestry, fishing.

RESOLUTION

The New Zealand government will need to take a more proactive approach if it wants new biomass production systems (e.g. hemp, canola) at scale to emerge.

Some initial observations on farming systems (aka. biomass/biomaterials production systems) in New Zealand

New Zealand farming systems can be segmented into three broad categories

1. Large, globally competitive systems at scale and at the world price
   - No easy/obvious replacements for existing large, land intensive biomass production systems
   - Pinus radiata, cattle and sheep are ~57% of land vs. arable 1.4% & orchards/vineyards 0.4%
2. "Bio-securable" products, with low/no competition from imports (can host disease or pathogens) (e.g. kumara, lettuce, chicken meat)
   - NZ operators: inefficient, old technologies, uncompetitive globally, low competition
   - No clear case studies of these transitioning to competitiveness in the last 50 years
3. "Un-bio-securable" products (output is cooked, treated, processed) (e.g. canned chicken)
   - Mostly imported; any NZ operator is competitive, at quality-adjusted world price (+freight)
   - No clear case studies of NZ farmers significantly penetrating un-bio-securable systems in the last 50 years

Small number of large ("globally competitive") and a large number of small ("bio-secure") systems

- Systems are effectively binary (yes/no) in that it is either working (competitive) or not (hobby)

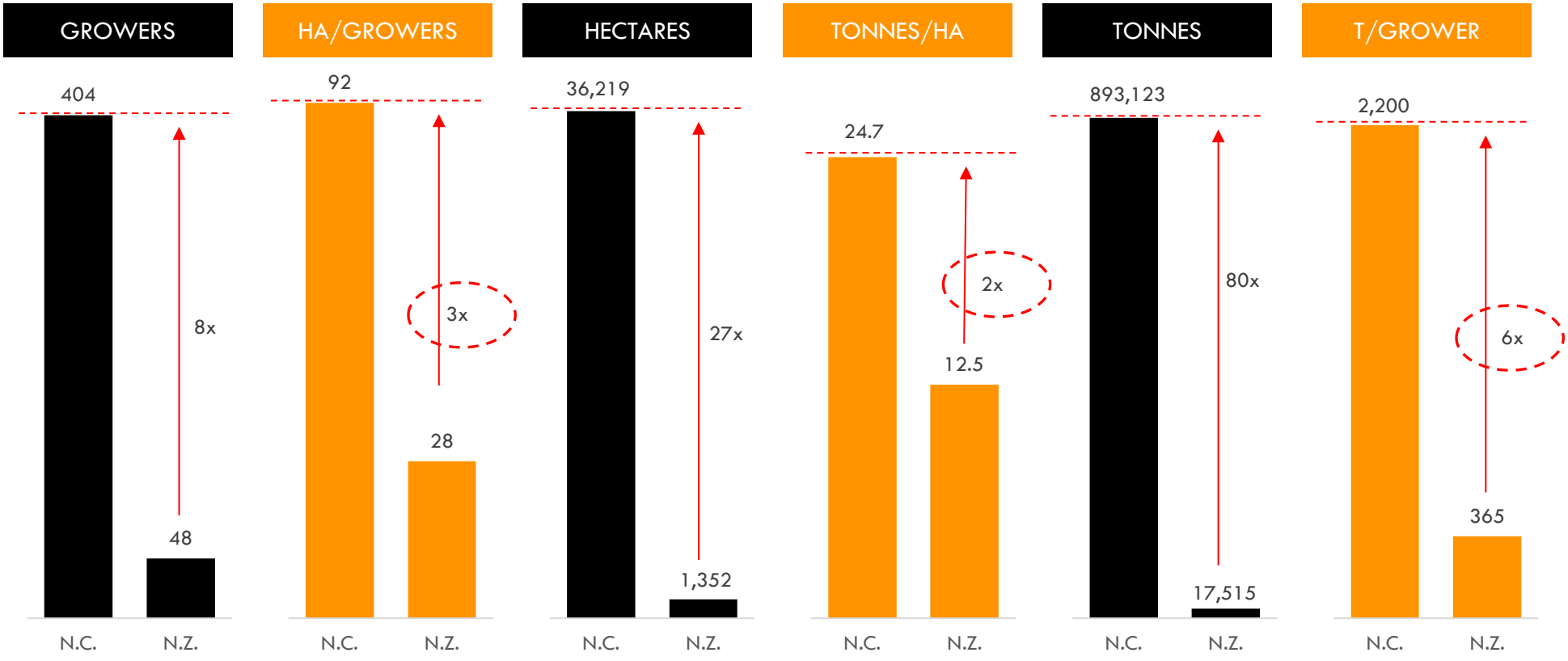
No obvious climatically suitable biomass production systems that have not been tried

- No obvious kiwifruit waiting to be commercialised

A comparison of sweet potato (kumara) growers in South Carolina and New Zealand provides a real-world case study of an insulated/inefficient industry

INDUSTRY SIZE AND PERFORMANCE METRICS: NORTH CAROLINA VS. NEW ZEALAND

Select variables as given; 2017 or as available

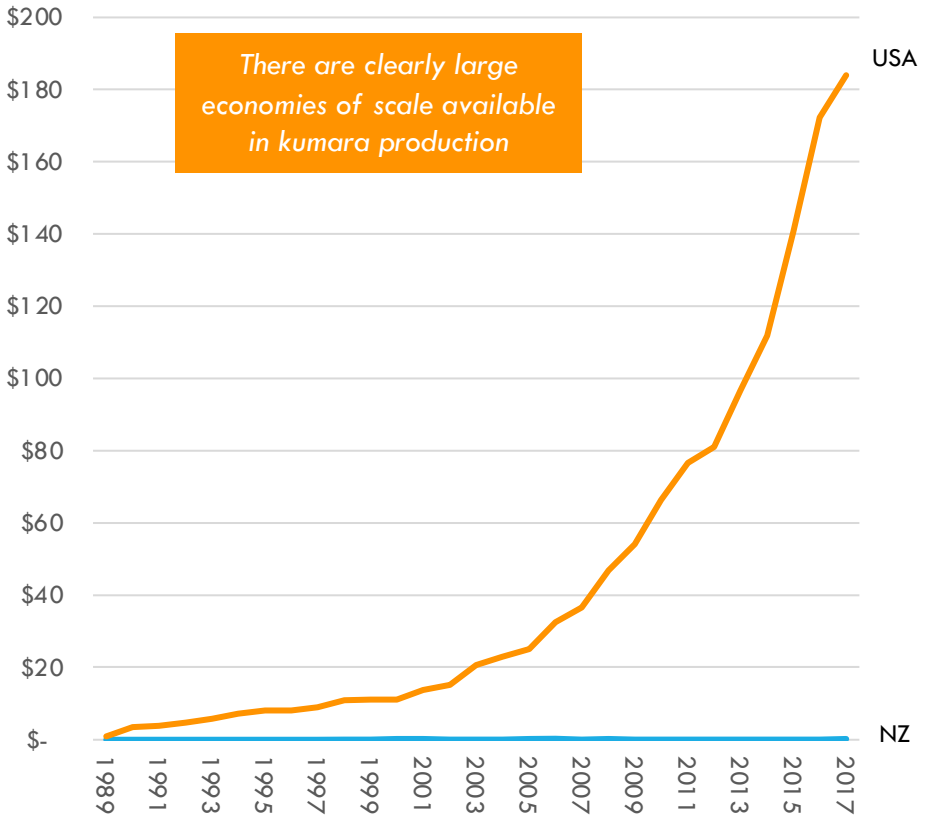


Note: (1) uses average of available sources; (2) NC data is growers 2ha+; Source: UN FAO (itself from MPI); USDA Census of Agriculture; USDA ERS; Plant & Food FreshFacts; Coriolis analysis

North Carolina's production growth is coming almost exclusively from large farms and these farms are achieving export success

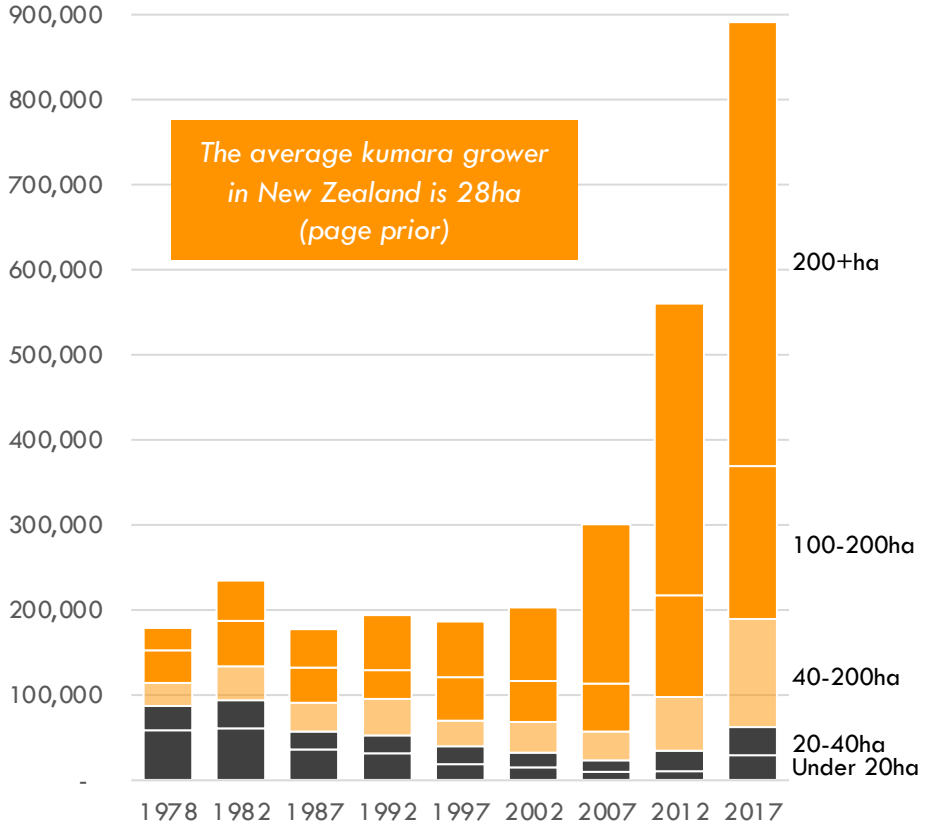
SWEET POTATO EXPORT VALUE: USA VS. NEW ZEALAND

US$m; 1961-2018



NORTH CAROLINA SWEET POTATO PRODUCTION BY FARM SIZE

Tonnes by size class, 1978-2017



Note: NC data is growers 2ha+; Source: UN FAO; USDA Census of Agriculture; USDA ERS; Plant & Food FreshFacts; Coriolis analysis

In farming systems, New Zealand went from intensive government involvement in driving growth to government as a "hands off rule maker"

PRE-1984

Intensive government involvement in driving industry
- Securing and importing genetics
- Focused, long term R&D funding
- Experimental farms
- Massive plantings on government land
- Marketing boards
- Priorities in trade negotiations
- Limited, relatively flexible biosecurity
- Supportive wider regulatory environment
- Strong and secure demand from one dominant market (pre-1973)

All of the large biomaterials production systems and post-farmgate primary processing systems emerged in this era

All have been the beneficiary of massive, long-term support activity when they were in H2 and H3

POST 1984+

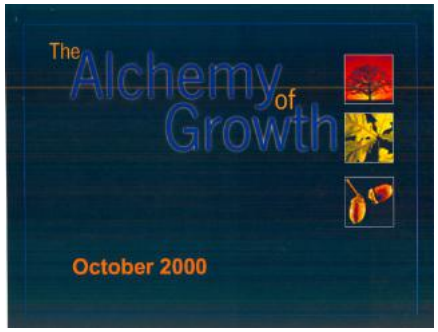
Intensive government involvement in driving industry
- Hazardous organisms act; very costly or impossible
- Scattershot, unfocused R&D funding
- Hands off rather than hands dirty
- Elimination of marketing boards
- Large, existing only priorities in trade negotiations (cf. feta vs. mānuka)
- Strict biosecurity
- Increasingly challenging regulatory environment
- Loss of industry development capabilities in government agencies relative to peers

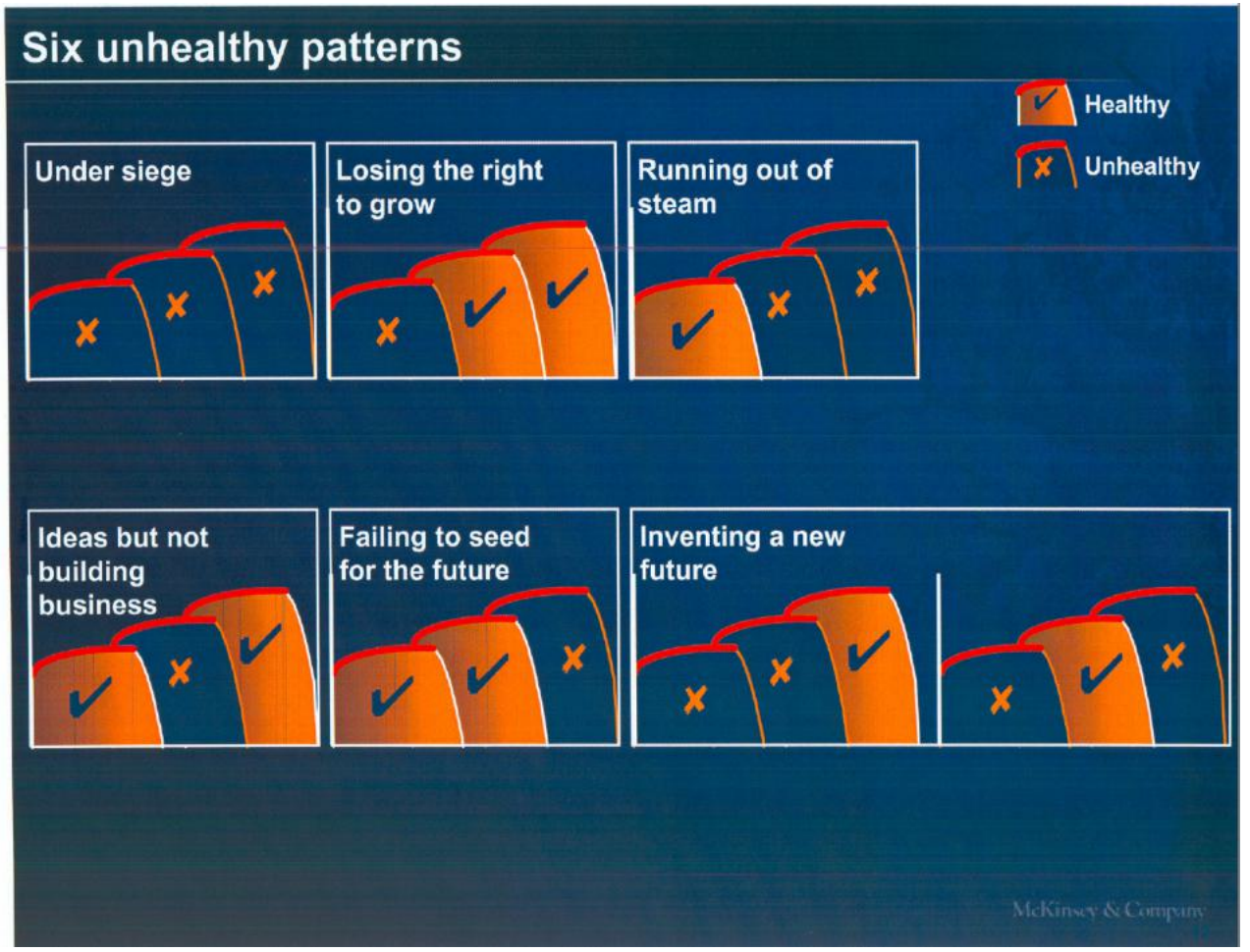
No new globally competitive farming systems/biomaterials production systems have emerged in the last 50 years

Introducing a new globally competitive biomass production system is almost impossible

It is unclear how change will occur without support?

In <u>farming systems</u>, New Zealand is stuck in McKinsey's unhealthy pattern called "ideas but not building businesses"





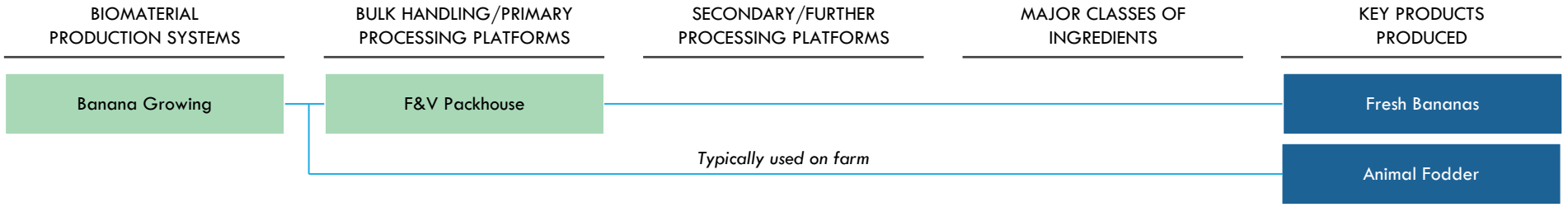
"Platforms" typically combine farming systems and post-farmgate processing, though this is not always the case as these examples demonstrate

Wool can be produced and processed to an export ready form on farm

Sugar is processed in New Zealand despite not producing the raw materials

Fresh bananas are an example of a relatively simple platform that delivers NZ grown fruit to domestic consumers (and animal fodder as a byproduct)

VALUE CHAIN AND LINKAGES: BANANAS

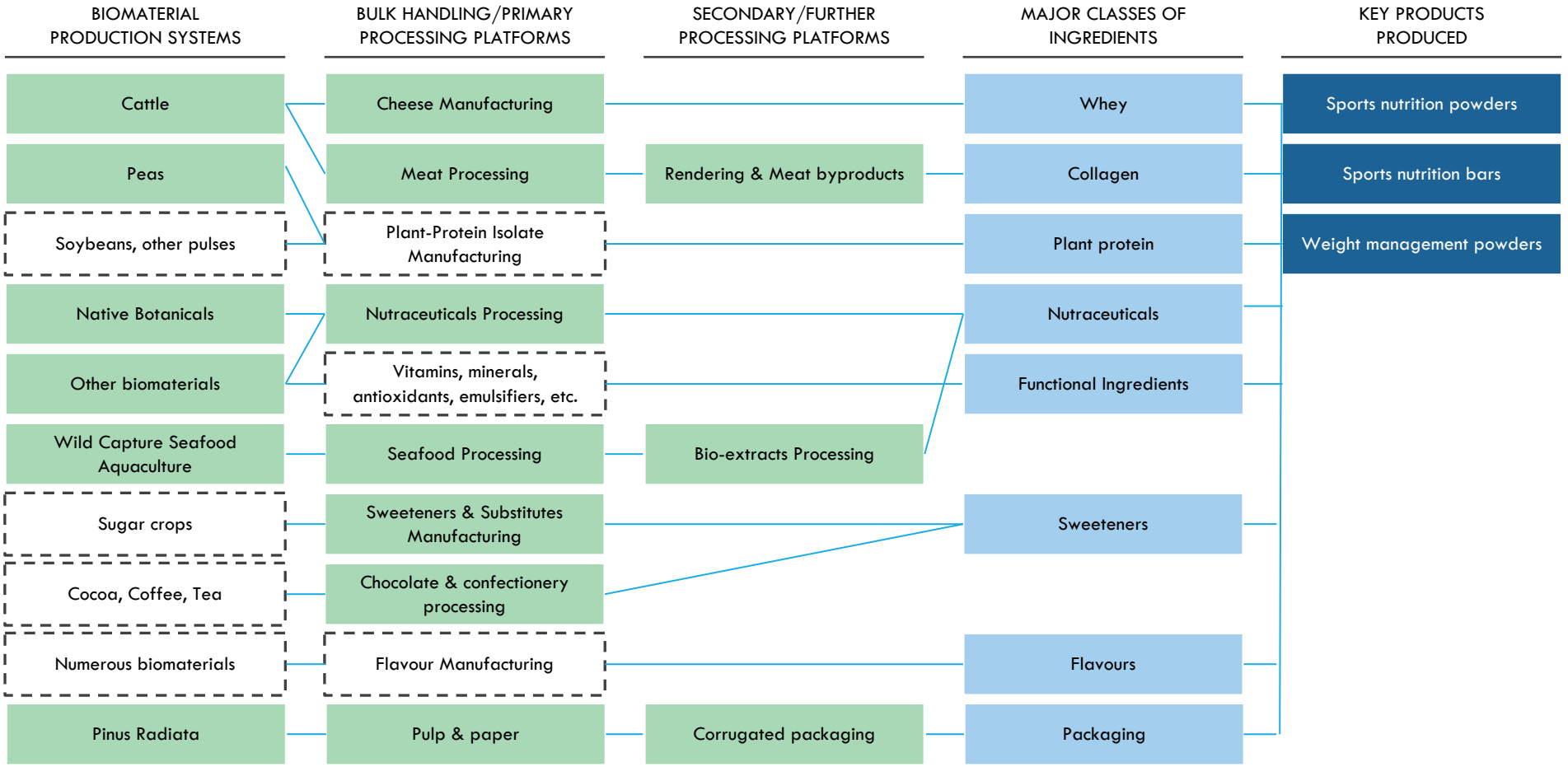


Additional processing would be possible once the industry was at scale

Current | Potential

Sports nutrition is a more complex platform that brings together a wide range of New Zealand and imported ingredients into value-added products

VALUE CHAIN AND LINKAGES: SPORTS NUTRITION/WEIGHT MANAGEMENT



Current | Potential

Some high level patterns emerge in post-farmgate processing systems

Multiple stages of post-farmgate processing exist

BULK HANDLING
PACKHOUSES
PRIMARY PROCESSING

SECONDARY
FURTHER PROCESSING

TERTIARY
"VALUE ADDED"
PROCESSING

Scale is extremely important in primary processing of raw material ingredients (e.g. milk powder)

Scale becomes less important as you move down the chain

As a broad generalisation, there have been three eras in New Zealand post-farmgate processing

PIONEER
(1200's-1930'S)

INDUSTRIAL
(1930'S-1990'S)

INNOVATION
(2000'S+)

Can we even produce it or do we need to trade with other for it?

Can we get to scale and compete globally?

Can we make a differentiated product and tell a compelling story

Some observations on New Zealand's post-farmgate processing systems

1. Secondary and tertiary post-farmgate processing is highly flexible, adaptable, adjustable and not directly tied to the land (e.g. imported pea-protein in NZ-made sports nutrition)

2. New Zealand is moving from simple to more complex value chains

3. Identified STAGE II Platforms that are emerging are not "islands"; they overlap into a network or web of capabilities

4. Most/all identified STAGE II Platforms have similar challenges/limitations
   - High costs and low volumes
   - Lack of scale in processing
   - Small, heterogeneous markets
   - Where NZ biomaterials are needed, returns/hectare are typically under dairy

5. Continued growth and emergence of smaller STAGE II Platforms will be slow and hazardous, with a high rate of failure under current settings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