NZIER
NEW ZEALAND INSTITUTE OF ECONOMIC RESEARCH

Workforce forecasts for 2032

Based on three future scenarios

NZIER report to the Ministry for Primary Industries

January 2023

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Authorship

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Key points

Introduction to food and fibre sectors workforce counts and composition

This report sets out alternative views of the food and fibre sectors workforce (in the form of "what if" scenarios) to understand:

- The size of the food and fibre workforce in 2032, both nationally and regionally.
- Food and fibre workforce composition nationally and regionally to show the types of skills that may be required in 2032.

By sketching out possible futures, this report provides one of the building blocks for assisting government and industry to work together to plan for workforce needs in the next decade.

As such, this work provides a variety of different futures for workforce planning purposes. It incorporates industry aspirations and government objectives. The scenarios are more akin to "what if" questions:

- What if sectors can reach growth aspirations by changing the composition of exports to higher value products valued by consumers and what it means for workforce requirements
- What if productivity grows faster or slower and what that means for workforces in different sectors.

We have deliberately not modelled other strategies or plans – such as the Industry Transformation plans, and He Waka Eke Noa. However, this paper provides an approach that illustrates how productivity improvements and changes in export demand impact on sector returns and workforce requirements.

The data set has been constructed in a way that puts the food and fibre sectors into the context of the whole economy and to allow comparison between sectors/industries on a consistent basis.

These results provide a good basis for a discussion on the workforce of the future and what actions are needed to ensure the sectors do have the capacity and capability needed to continue to succeed, whether this be in activities to attract and retain people, or investment in productivity enhancing activities, and how these actions along with other actions can help lift demand for New Zealand's food and fibre. These actions will also influence what labour and skills will ultimately be needed.

Like all modelling, it is more important to understand the "direction of travel" and the factors that drive this, rather than focusing on the exact numbers. It is also important to recognise that the modelling provides an indication of "demand", that is, how the workforce may grow over time, and which regions. While the modelling does include economy wide constraints, it does not provide any insights on "supply", that is, how this projected growth will be met.

We have used an economy-wide approach

The report focuses on the food and fibre sectors workforce. With such a large part of the New Zealand workforce under the microscope, we chose to use an economy-wide model to drive the analysis. We wanted to ensure that we could properly put the food and fibre workforce into the context of the New Zealand economy.

Changes in the food and fibre sectors workforce do have impacts across the economy. They cannot be ignored when trying to understand how, for example, technology will impact on the sectors. No industry lives in isolation, and they will have to compete for labour across all skill levels just like other sectors. The ability to paint a broad picture of the macroeconomic impacts across the whole workforce is the main advantage of taking this approach.

All models have weaknesses, and economy-wide models are no exception. Their generalised nature means that specific sector/industry issues and assumptions may not be able to be addressed. They also represent the current structure of the economy. A partial analysis for a particular industry may (or may not) produce a different result since some of the critical workforce detail may be missing in the economy-wide approach. This may need to be revisited subsequently as work progresses on workforce challenges.

Three scenarios drive our workforce planning views of 2032

The scenarios are:

- BAU (Business as usual): This scenario uses past performance (with some adjustments)[1] to describe the food and fibre sectors in 2032. It is based on trends in the recent past around investment, productivity and technology.
- Increased use of technology: Scenario 2 envisions food and fibre sectors that take maximum advantage of existing and emerging technologies. Potential changes generally involve mechanisation, automation or greater use of digital and information technologies. The use of technology varies by sector, and assumptions were developed in consultation with sector representatives.
- Transformed sector: Scenario 3 builds on the increased use of technology in Scenario 2 and adds an increased focus on sustainability and high-value products and markets, similar to what is outlined in the Government and sector roadmap, *Fit for a Better World*. Market trends also vary by industry and sector, and we consulted with them to develop our assumptions.

These views of the future should not be taken in isolation. The scenarios have been developed as a continuum so that stakeholders can better understand the different drivers of food and fibre workforce change over time.

Assumptions that drive the modelling approach

The assumptions drive the results that provide insights into the actions that could be taken between now and 2032. For example, undertaking actions to lift productivity will influence the demand for labour and skills. This is especially true in industries such as red meat processing, where a lift in productivity may reduce the possible need for more processing

[1] Dairy productivity growth has been reduced to zero on advice from the Working Group, for example.

workers. Likewise, taking actions to change the composition of exports to higher value products valued by consumers, will have major impacts on the food and fibre sector, and its future workforce.

Therefore, ensuring that the assumptions are understood is a critical part of understanding the results. We have made a series of assumptions:

- Estimates of annual average workforce counts. This is important since the food and fibre workforce comprises a large proportion of part-year workers. Seasonal demand for labour is particularly evident in the horticulture industries because of the nature of the work.
- Total workforce income[2] has been calculated by using an economy-wide model. The results have been driven by:
  - Strong historical productivity in New Zealand agriculture and weak productivity growth in processing. Productivity growth in services and manufacturing (including food and fibre manufacturing) has historically been much weaker than in the primary sector.[3]
  - Demand forecasts of industry export value in the major agricultural sectors.
- Estimated workforce skill composition in 2020, based on industry consultation. There are wide confidence intervals associated with this data and we expect as time goes on that this data will be improved.
- Expected change in workforce composition by 2032, based on an OECD paper, *Automation, skill use and training,* by Nedelkoska and Quintini (2018). Although we expect automation and mechanisation may reduce the demand for some roles that are more at risk of automation, they will also increase the demand for more highly skilled roles to meet the trend for more complex and sophisticated business needs.
- Expected increases in labour costs for each type of worker based on NZIER and Treasury forecasts.

These assumptions drive the modelling approach, and this report presents the results and the analysis based on these assumptions. We know that different assumptions would produce different results, and we expect that these assumptions will be revisited over time as a clearer picture of future food and fibre activity is developed. The aim is to link drivers to potential outcomes and inform discussions about the workforce.

High-level results

Taking the scenarios as a whole, the following conclusions can be drawn:

- Employment grows solidly in all scenarios, between 8 percent and 16 percent from the 2020 base to 2032. Growth is driven by continued productivity growth and demand for food and fibre products. Over the same period the overall New Zealand workforce is expected to grow around 11 percent.
- Lifting food and fibre sectors productivity and export demand will make it easier for the sectors to attract labour and skills. Both factors are important, but lifting export

[2] We have approximated current and future workforce counts from total workforce income nationally and regionally.

[3] For the modelling, the Dairy sector was treated differently: future productivity growth constrained. We took this approach because key informants suggested that regulation would limit the sector in the future.

demand, which is a combination of price changes, changing product mix towards higher value products, and volume (as modelled in the transformed scenario) the greater the gains.

- Forecasted employment growth is sensitive to the assumptions. The more we can lift export demand the greater the likely employment growth in the sectors.
- There is a trend towards more highly skilled people within the food and fibre sector. Results show an increase of between 1 percent and 3 percent from the 2020 base. Highly skilled workers are required to support the expected growth of technology and complexity in the next decade.
- Technology creates employment in the sector. This is a positive story about what technology can offer the food and fibre sectors. As technology is introduced and demand increases, it improves the efficiency and effectiveness of operations, increasing labour demand.
- All scenarios point toward the need to improve skills within the sectors.

The high-level results and the tables below are designed to provide a factual basis for workforce planning and discussion between each sector/industry and MPI. It is from those deliberations that agreed actions will be formulated.

Examining possible workforce futures – the scenarios

Table 1 shows the **Business as usual (BAU) scenario**, based on historical performance, to describe the situation in the food and fibre sectors in 2032. We assume the food and fibre sectors and the rest of the economy continue their historical multifactor productivity growth rates.[4] We estimate an increase in the food and fibre workforce to 391,000 workers in 2032.[5] This is an increase of 7.7 percent over the base year (2020).

The composition of the workforce also changes. Managers (+1.7 percentage points) and Semi-autonomous (+1.9 percentage points) increase while the numbers of Managed (-3.5 percentage points) drop slightly. More highly skilled workers are required, which highlights the importance of upskilling the existing workforce.

[4] Multifactor productivity measures how efficiently combined production inputs (capital and labour) are used within the economy to produce a given level of output. It is a ratio of output to input.

[5] The workforce number differs slightly from that reported in the Data report. The difference is due to the double count of some workers working in different industries/sectors in the same month.

Table 1 Workforce numbers – BAU scenario by sector and value chain

Workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Relevant	Other	Total	% Change from 2020
Arable	4,707	2,394	16,062	317	-	23,481	**4.8%**
Dairy	40,859	13,572	1,409	-	-	55,840	**5.5%**
Forestry and Wood Processing	14,258	12,325	18,186	193	-	44,963	**8.6%**
Horticulture	41,444	27,729	4,268	262	-	73,703	**11.7%**
Pork, Poultry, Bees and Other	10,745	4,874	13,622	-	-	29,241	**12.2%**
Red Meat and Wool	48,099	31,235	5,517	377	-	85,227	**9.7%**
Seafood	6,548	5,296	1,233	498	-	13,574	**5.2%**
Cross Sector	26,067	-	10,818	21,803	6,466	65,155	**2.2%**
Total	192,727	97,425	71,115	23,451	6,466	391,184	**7.7%**
Indicative % (Total)	**49%**	**25%**	**18%**	**6%**	**2%**	**100%**	
% point change from 2020	**-0.9%**	**1.7%**	**-0.5%**	**-0.2%**	**0.0%**		

Sectors are defined in Appendix F

Source: NZIER

Table 2 sets out the **Increased use of technology scenario**, where the food and fibre sectors maximise their use of technology. Estimates suggest that approximately 396,000 workers will be engaged in the food and fibre sectors in 2032, a 9.8 percent increase relative to the base year (2020). This is also an increase on the BAU (+1.5 percentage points).

The composition of the workforce also changes. Managers (+1.2 percentage points) and Semi-autonomous (+2.1 percentage points) increase while the numbers of Managed (-3.3 percentage points) drop slightly.[6] The number of highly skilled workers and managed workers grows slightly more relative to the BAU.

[6] After consultation with sectors/industries we have used broad categories to proxy skills. Managed workers are those who work under supervision. Semi-autonomous workers work independently but within a management structure. Managers manage the other two groups.

Table 2 Workforce numbers – Increased use of technology scenario by sector and value chain

Workforce requirements in 2032

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Relevant	Other	Total	% Change from 2020
Arable	4,778	2,548	15,760	355	-	23,441	**4.6%**
Dairy	40,990	13,653	1,459	-	-	56,102	**6.0%**
Forestry and Wood Processing	14,948	12,130	17,040	185	-	44,303	**7.0%**
Horticulture	42,634	28,133	4,423	269	-	75,458	**14.3%**
Pork, Poultry, Bees and Other	10,953	5,399	14,824	-	-	31,176	**19.6%**
Red Meat and Wool	45,767	34,315	5,772	382	-	86,236	**11.0%**
Seafood	6,767	5,473	1,277	502	-	14,019	**8.7%**
Cross Sector	25,697	-	11,101	22,331	6,605	65,734	**3.1%**
Total	192,534	101,650	71,657	24,023	6,605	396,470	**9.2%**
Indicative % (Total)	**49%**	**26%**	**18%**	**6%**	**2%**	**100%**	
% point change from 2020	**-1.6%**	**2.4%**	**-0.6%**	**-0.1%**	**0.0%**		

Source: NZIER

In the **Transformed sector scenario,** we combine increased use of technology with strong demand for sustainable food and fibre products. The workforce grows to approximately 421,000 workers (see Table 3). This is an increase of 15.8 percent compared to the current workforce. Relative to the BAU, the workforce grows by an additional 8.1 percent points.

It should be noted that, perhaps unexpectedly, there is considerable employment growth in the red meat sector. Under the transformed scenario, it was assumed that export demand would increase by 50 percent over the period, but Core processing/manufacturing productivity would only increase by 1 percent. However, when the productivity shock is increased (in line with other food and fibre processing sectors), the demand for labour in the red meat processing sector declines, but the number of on-farm workers increase. This

sensitivity analysis while demonstrating the sensitivity of the modelling inputs, more importantly demonstrates the importance of lifting productivity.

Managers (+1.6 percentage points) and Semi-autonomous (+2.0 percentage points) increase while the numbers of Managed (-3.6 percentage points) drop. The number of highly skilled workers and managed workers grows slightly more relative to the BAU.

Managers and Semi-autonomous workers increase in numbers in the food and fibre sector. More of these workers are required if we are to achieve the growth set out in this scenario.

Table 3 Workforce numbers – Transformed sector scenario by sector and value chain

Workforce requirements in 2032

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Relevant	Other	Total	% Change from 2020
Arable	4,976	2,563	15,923	366	-	23,828	**6.3%**
Dairy	42,207	14,068	1,496	-	-	57,772	**9.1%**
Forestry and Wood Processing	16,340	12,895	17,328	198	-	46,762	**12.9%**
Horticulture	42,510	28,855	4,531	271	-	76,167	**15.4%**
Pork, Poultry, Bees and Other	11,439	6,272	15,246	-	-	32,957	**26.5%**
Red Meat and Wool	54,080	39,972	6,120	382	-	100,553	**29.4%**
Seafood	7,020	5,659	1,310	504	-	14,492	**12.4%**
Cross Sector	27,374	-	11,352	22,667	6,689	68,083	**6.8%**
Total	205,946	110,284	73,306	24,389	6,689	420,615	**15.8%**
Indicative % (Total)	**49%**	**26%**	**17%**	**6%**	**2%**	**100%**	
% point change from 2020	**-1.2%**	**3.0%**	**-1.3%**	**-0.4%**	**-0.1%**		

Source: NZIER

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Disclaimer

Access to the data used in this study was provided by Stats NZ under conditions designed to give effect to the security and confidentiality provisions of the Data and Statistics Act 2022. The results presented in this study are the work of the author, not Stats NZ or individual data suppliers.

These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI) and Longitudinal Business Database (LBD), which are carefully managed by Stats NZ.

For more information about the IDI and LBD please visit https://www.stats.govt.nz/integrated-data/

The results are based in part on tax data supplied by Inland Revenue to Stats NZ under the Tax Administration Act 1994 for statistical purposes. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements

1 What this project and report are about

The Ministry for Primary Industries (MPI), in conjunction with the Primary Sector Workforce Dataset and Forecasting Working Group (the Working Group), commissioned NZIER to investigate future scenarios in the food and fibre sector and the potential ramifications for the future workforce. The work programme sets out the possible workforce futures for the food and fibre sectors: by sector, industry, region, broad skill category, and role, currently and in 2032.

1.1 Where this report fits

MPI and the Working Group are keen to understand the size and nature of the current workforce and how it might change over time. This report is an output from work by NZIER, MPI and the Working Group to understand the 2032 workforce in the New Zealand food and fibre sectors. It is a companion to three other reports. Together, they are:

- The food and fibre workforce: Data on its size and composition (the Data report).
- Proposed scenarios for estimating the future food and fibre workforce (the Scenarios report).
- Economic forecasts for the food and fibre sector: macroeconomic analysis of the three scenarios using a computable general equilibrium (CGE) model (the CGE report).
- Workforce forecasts for 2032: based on three future scenarios (this report).

2 Scope of this report

2.1 Forecasts of the food and fibre workforce size

The size, skills, and location of the workforce for the food and fibre sectors is an important focus for MPI and the Working Group. The workforce is a key part of a vibrant and productive food and fibre sector and having the right people and skills in the right places allows industries to be productive and achieve their potential growth paths.

MPI can help support the sector through policies and initiatives designed to encourage workers to enter the sector and obtain skills that will be required in the future. It can also support a whole-of-government approach to planning for the infrastructure and services required by the workforce.

2.2 Māori workforce aspirations

The role of Māori in the food and fibre sectors will grow by 2032. Not only will the proportion of Māori grow as part of the general population, but participation rates will increase within the food and fibre sectors. Currently, the role of Māori in the food and fibre sectors includes:

- An asset base. Māori have an asset base of 23.4 billion or 15.7% of total assets in the food and fibre sectors (Reserve Bank of New Zealand, 2018).
- Land ownership. Māori owned land is estimated at 1.5 million hectares (PwC, 2013).

- Participation. Māori make up 15.4 percent of the food and fibre processing sectors employment and 12.7 percent of the food and fibre production sectors production employment (BERL, 2018).

In this series of papers, we have not explicitly addressed the changing demographics associated with the food and fibre sectors. We have had some initial consultation and engagement with iwi stakeholders. MPI is expecting to pick up the initial conversation started in this project and focus on this aspect of the workforce as part of its engagement with the sectors at a later date.

2.3 We use macroeconomic modelling and labour market analysis to illustrate possible food and fibre workforce futures

The base year workforce counts are estimated from ANZSIC06 codes research from Stats NZ's Integrated Data Infrastructure (IDI). Workforce counts are the average of the monthly counts of distinct individuals associated with each ANZSIC06 class, or sector.

Using this base, we have used a mixed methods approach to estimate the approximate possible workforce futures. First, we conducted industry interviews to determine the skill mix of the current workforce. The skill mix of the current workforce is used as the basis of our forecast in the subsequent analysis.

Second, we have estimated the performance of the food and fibre sector using a computable general equilibrium (CGE) model. The model links together all the industries that make up the food and fibre sector and connects them to the whole economy. We examine the performance of the sector in three different scenarios.

Third, we use the macroeconomic forecasts about labour demand to calculate the size of the workforce in each scenario. We can disaggregate the workforce in several ways, as discussed below, to provide detailed forecasts of the workforce by sector and location, as well as skill-level requirements.

2.4 Estimating job numbers in 2032

We want to estimate the number of workers in the food and fibre sector by 2032. The output of NZIER's macroeconomic CGE model TERM-NZ sets out the total income growth for each industry in the sector but does not forecast employee numbers.

The **objective** of this analysis is to estimate the annual average employment counts. We have done this by estimating employment for each sector based on the total labour income growth in 2032 for that sector which the CGE model has calculated.

It is important to understand that we estimate the annual average employment counts because the food and fibre workforce comprises a large proportion of part-year workers. This is particularly evident in the horticulture industries due to the seasonal demand for labour that drives the nature of the work.

At a high level, this analysis forecasts the workforce of the food and fibre sector in 2032 while considering the following three sets of factors:

- Total labour income growth from the CGE model
- Expected workforce composition in 2032

- Expected increases in labour costs for each type of worker.

This report first presents initial results from the modelling based on central estimates of the future economic performance of New Zealand. It then describes the method in detail. Finally, more information is provided in the appendices.

3 How many workers will industries employ?

Below we describe our framework for setting out the food and fibre sectors workforce. We set out the current workforce in 2020 based on ANZSIC06 codes as the starting point of this analysis.

3.1 Framework for the food and fibre sectors

In the following section, we discuss our methods when setting out the 2020 workforce.

Our framework for the food and fibre sectors organises ANZSIC06 Class codes into product-based industries. We divide the sector into these sectors:

- Arable
- Dairy
- Forestry and wood processing
- Horticulture
- Pork, poultry, bees and other
- Red meat and wool
- Seafood
- Cross Sector.

In addition, we do some further analysis of the following horticulture industries:

- Viticulture and winemaking
- Kiwifruit
- Apple and pear growing
- Summerfruit
- Other horticulture.

Other horticulture industry refers to the horticulture industries excluding viticulture and winemaking, kiwifruit, apple and pear growing, and summerfruit but includes fruits and vegetables not broken out separately, plus flowers, mushroom and greenhouse production. Related processing activities (e.g. potato crisp manufacturing) and supporting activities are also included along with any Recognised Seasonal Employer (RSE) scheme workers who are not employed by businesses identified by their ANZSIC06 class code as horticulture related. For example, RSE scheme workers employed by some seasonal labour contractors, who are often involved in apples, pears, kiwifruit and viticulture operations.

Other horticulture also includes support services like packing services, warehousing, and storage services. These industries are important for all horticulture industries.

For a full list of ANZSIC06 industries included in other horticulture, please refer to Appendix F.

And we break down red meat and wool into the following industries:

- Red meat
- Wool.

The red meat industry includes sheep, beef and deer farming and related activities like meat processing and leather tanning.

The wool industry only includes shearing, wool scouring, textile manufacturing, and wholesaling (not sheep farming).

Under each of these industries, we group the ANZSIC06 Class codes into Core production, Core processing/manufacturing, strongly connected, Relevant and Other according to their place in the value chain.

- **Core production** – Primary production activities that produce or capture the initial material for the food and fibre sectors.
- **Core processing/manufacturing** – First-stage or initial processing or manufacturing that results in a minimum saleable product, such as meat processing or dairy manufacturing.
- **Strongly connected** – This includes businesses that are dependent on the Core (such as *Fertiliser Manufacturing* (C183100)), inter-dependent with the Core (such as *Veterinary Services* (M697000)) or immediately downstream of Core activities (such as second-stage processing, e.g. *Bread Manufacturing (Factory based)* (C117100)).
- **Relevant** – Relevant ANZSIC06 Classes contain business entities that support primary production and initial processing (such as Shipbuilding and Repair Services (C239100)) or add additional value to primary production by being part of the value chain (such as Wooden Furniture and Upholstered Seat Manufacturing (C251100)).
- **Other**: Labour Supply Services that supply labour across the whole economy to various industries, e.g. trade staff that hire labour out to other businesses.

"Relevant" classes are important for supporting and enabling the production associated with the food and fibre sectors. However, they are also involved in non-food and fibre activities or depend heavily on other sectors' inputs. As a result, we determined to assign 15 percent of the people associated with these industries to the food and fibre workforce. This is based on NZIER estimates of the food and fibre sectors share of GDP.[7]

The full categorisation of ANZSIC06 classes to food and fibre industries and value chain designations is provided in Appendix F.

[7] The GDP share of food and fibre sectors is volatile. In the latest SOPI forecasts it is estimated at 11%, however in previous years it has been higher.

3.1.1 We used ANZSIC06 to define the sectors

The virtue of ANZSIC06 is that it provides a pre-existing framework and organises official data provided by Stats NZ. It links together the macroeconomy and the microeconomy. Each business entity[8] is assigned to a class based on its predominant activity, and the classification provides a picture of the whole economy.

Using ANZSIC06 codes to categorise businesses is convenient because:

- Businesses will already be classified under this framework in government administrative datasets. We can access these datasets through the Integrated Data Infrastructure (IDI) managed by Stats NZ.[9]
- These datasets enable a consistent approach to monitoring activity over time, including investigating historical data at a very large scale. The datasets also provide linked data about the people in these businesses.
- Developing a wholly bespoke classification system, and classifying businesses against it, is not likely to be feasible, given the size of the food and fibre sectors.

Using ANZSIC06, we have a consistent, transparent, replicable approach to analysing the food and fibre sectors.

The average current workforce counts are derived from ANZSIC06 codes research from the IDI. These are the average monthly counts of distinct individuals associated with each ANZSIC06 class or sector. The IDI is a large research database with microdata about people and households. The data comes from government agencies, Stats NZ surveys, and non-government organisations. These numbers will be used as the basis for our forecasts in the upcoming sections.

3.1.2 Limitations with using ANZSIC06

There are limitations with workforce counts derived from the ANZSIC06 classification, especially when attempting to get complete and accurate counts by sector or industry. A sector or industry may be found across many ANZSIC06 classes.

- ANZSIC06 classes do not precisely map to individual food and fibre sectors. For example, *Other Agriculture and Fishing Support Services* include businesses carrying out a range of support services – activities such as contract milking, fruit picking contractors, wool grading, and artificial insemination services are all included within this ANZSIC06 class.
- ANZSIC06 classes do not always solely relate to the food and fibre sectors. For example, the *Packaging Services* ANZSIC06 class includes packhouse businesses but would also include businesses involved in packaging non-food and fibre sector goods.
- The ANZSIC06 class of a business cannot always reflect all activities carried out, where business units carry out multiple activities.
- We set out the regional analysis and results in section 7. Our regional analysis workforce numbers are derived from NZIER's TERM-NZ CGE model, which is built from

8 The term business entity is used in its widest sense to include any organisation undertaking productive activities, including companies, non-profit organisations, government departments and enterprises.

9 This is a large research database, comprised mostly of administrative data from a range of government agencies. For a discussion of the IDI database and the research made possible through the IDI, please refer to (Song, 2022).

data from Stats NZ's New Zealand Standard Industrial Output Categories (NZSIOC). There are differences in how economic activity is categorised in the NZSIOC and ANZSIC06 systems. The differences are especially noticeable when disaggregating results by sector and region. For example, the Horticulture workforce is partly counted in ANZSIC06 code N732000 "Packing Services". This industry cannot be matched with the NZSIOC classification because the NZSIOC classification aggregates packing services together with other services industries like cleaning services. As a result, the TERM-NZ model estimates comparatively more Horticulture processing workers in Auckland, while MPI's data which uses the more granular ANZSIC06 classification, suggests many of the workers under this designation should be in the Bay of Plenty region. This imperfect matching means that there is more uncertainty associated with the regional sector results than with the national-level results.

The net effect of these limitations is to add uncertainty around these estimates of the food and fibre sectors workforce. The estimates may be low if they miss workers classified in other parts of the economy, but they could also be high if they include too many workers outside the sectors or overestimate the time that part-year workers are in the sectors. However, we believe the estimates approximate the actual number of workers in the food and fibre sectors for two reasons. First, the team investigated many issues with specific ANZSIC06 industries, so there are limited opportunities for significant errors. Second, the results of the data analysis were similar to the findings from consultation with the sectors: the two methods for estimating the workforce provide *convergent validity* for the final estimate.

3.2 Current average workforce counts in 2019

Table 4 shows the current workforce counts tabulated by value chain components. The current workforce is classified into five areas of the value chain in our report (see section 1.1. for a description of the reports).[10] There were around 363,000 workers in the food and fibre sectors in 2019 in total, according to the ANZSIC06 codes. We have used 363,000 workers instead of the 356,000 estimated in the Data report to model the scenarios. This is because a small degree of overcounting is involved when workers are tabulated by ANZSIC06 codes. It occurs when workers work in two different industries in one month. This means that the change from the base (in number or percent) is more important in the scenarios than the totals.

Of the workforce estimated, 50 percent work in core production, 23 percent work in core processing/manufacturing, 19 percent are strongly connected to the sectors, 6 percent are relevant, and 2 percent are Other.

[10] For a more detailed explanation of the value chain components, please refer to the Data report.

Table 4 Workforce numbers – 2019 average workforce counts by sector and value chain

Average workforce counts, based on analysis of data from the Stats NZ IDI, carried out by MPI

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Relevant	Other	Total
Arable	4,525	1,930	15,662	289	-	22,406
Dairy	38,533	13,007	1,400	-	-	52,940
Forestry and Wood Processing	12,766	11,189	17,288	171	-	41,414
Horticulture	35,745	25,792	4,211	244	-	65,992
Pork, Poultry, Bees and Other	9,674	3,683	12,700	-	-	26,057
Red Meat and Wool	48,450	23,847	5,041	371	-	77,709
Seafood	6,365	4,808	1,225	500	-	12,898
Cross Sector	26,275	-	10,461	20,827	6,181	63,744
Total	182,333	84,256	67,988	22,402	6,181	363,160
Indicative % (Total)	**50%**	**23%**	**19%**	**6%**	**2%**	**100%**

Note (1) The core of the NZIER work is based on the CGE model that is built on a Stats NZ database based on the March year 2020. We have assumed that the year ending December 2019 workforce data is equivalent to the March 2020 year workforce data. Year ending December 2019 workforce data is assumed to be equivalent to year ending March 2020 workforce data in the forecasting analysis in Sections 4 to 7.

Source: NZIER, MPI

3.3 Skill mix of the 2019 workforce

Table 5 shows the skill mix of the current workforce, tabulated by sectors. The skill mix is classified into the following categories:

- Managed. The number of people who are entry-level/semi-skilled. These workers are supervised daily.
- Semi-autonomous. The number of people who are skilled and can work independently. Typically, they are not actively managed but work within a management structure.
- Managers. Those people who can be skilled and work in managerial roles.

One classification system for job types and skill levels is the Australian and New Zealand Standard Classification of Occupations (ANZSCO). This is a classification of occupations and skills. ANZSIC06 codes are a classification of business activity. This means that they do not match. In addition, we have not used ANZSCO codes since we found in previous work that

they do not match how employers viewed job skill levels. We also found in bigger operations that entities tended to use their own skill grades that were not comparable across industries.

This project is focused on the workforce and is interested in the types of positions or roles and the broad skills categories involved. Classifying the roles into 'skilled labour' and 'unskilled labour' tends to misrepresent what is required for these roles. Therefore, we have chosen to classify roles into the above categories, which are more informative and feasible across industries.[11]

The current skill mix shows that 39 percent of the workers are managed, 36 percent of the workforce is semi-autonomous, and 25 percent of the workforce are managers.

The skill mix percentages in this report for the sectors are slightly different from the skill mix percentages for the 2019 workforce in the Data report. This is because we based our forecasts on the skill mix for each of the ANZSIC06 codes listed in Appendix F. This requires us to have a skill mix estimation for each of the ANZSIC06 codes. However, as many of the ANZSIC06 codes are not covered in the Data report, this poses a challenge in this forecasting exercise.

To solve this problem, for all the ANZSIC06 codes that do have a skill mix estimation in the Data report, we used those skill mix percentages directly. For the ANZSIC06 codes that have missing skill mix estimations, we used expert opinions on what the skill mix percentages are likely to be. As a result, our skill mix for the sectors used in this report is slightly different from the Data report. It also means that there are wide confidence intervals around skill mix estimations.

[11] For more detailed information on skill mix classification, please refer to the Data report.

Table 5 Workforce numbers – Average current workforce counts by skill mix

Based on analysis of data from the Stats NZ IDI, carried out by MPI, and interviews with industries

Sector	Managers	Semi-autonomous	Managed	Total
Arable	6,036	5,943	10,427	22,406
Dairy	12,826	18,965	21,149	52,940
Forestry and Wood Processing	9,249	12,068	20,097	41,414
Horticulture	16,233	22,798	26,961	65,992
Pork, Poultry, Bees and Other	7,613	10,793	7,651	26,057
Red Meat and Wool	29,725	27,969	20,015	77,709
Seafood	1,305	2,816	8,777	12,898
Cross Sector	8,891	26,682	28,172	63,744
Total	91,878	128,035	143,248	363,160
Indicative % (Total)	**25%**	**35%**	**39%**	**100%**

Source: NZIER, MPI

We show the average skill mix of each value chain component for the 2019 workforce by sector in the following sections.

3.3.1 Arable

The arable sector includes grain and seed production and a diverse range of downstream industries such as flour milling, bread, bakery, cake and beer manufacturing. It also includes grain storage and wholesaling.

The industry view of the value chain does not align neatly with the ANZSIC06 classification. We considered it important and helpful to collect as much information as possible as it provides a richer picture of the sector. This does mean, however, that care is needed in interpreting the results. More details are available in the Data report.

Table 6 Current workforce for the arable sector, by value chain and skill mix

Workforce counts in 2019

Value chain designation	Managers	Semi-autonomous	Managed	Total
Core Production	2,534	1,584	407	4,525
Core Processing/Manufacturing	193	227	1,510	1,930
Strongly Connected	3,283	3,902	8,477	15,662
Relevant	26	231	32	289
Total	6,036	5,943	10,427	22,406
Indicative % (total)	**27%**	**27%**	**47%**	**100%**

Note (1) The core of the NZIER work is based on the CGE model that is built on a Stats NZ database based on the March year 2020. We have assumed that the year ending December 2019 workforce data is equivalent to the March 2020 year workforce data.

Source: NZIER, MPI

3.3.2 Dairy

The dairy sector includes dairy farming and dairy processing, along with cheese, ice cream and other dairy product manufacturing and wholesaling.

Table 7 Current workforce for the dairy sector, by value chain and skill mix

Workforce counts in 2019

Value chain designation	Managers	Semi-autonomous	Managed	Total
Core Production	11,376	14,133	13,025	38,533
Core Processing/Manufacturing	1,171	4,552	7,284	13,007
Strongly Connected	280	280	840	1,400
Total	12,826	18,965	21,149	52,940
Indicative % (total)	**24%**	**35%**	**40%**	**100%**

Note (1) The core of the NZIER work is based on the CGE model that is built on a Stats NZ database based on the March year 2020. We have assumed that the year ending March 2019 workforce data is equivalent to the March 2020 year workforce data.

Source: NZIER, MPI

3.3.3 Forestry and Wood Processing

Forestry and wood processing includes silviculture and harvesting, sawmilling, wood product manufacturing, pulp and paper production, furniture making and timber wholesaling.

Table 8 Current workforce for the forestry and wood processing sector, by value chain and skill mix

Workforce counts in 2019

Value chain designation	Managers	Semi-autonomous	Managed	Total
Core Production	4,596	638	7,532	12,766
Core Processing/Manufacturing	1,161	5,145	4,883	11,189
Strongly Connected	3,458	6,224	7,607	17,288
Relevant	34	62	75	171
Total	9,249	12,068	20,097	41,414
Indicative % (total)	**22%**	**29%**	**49%**	**100%**

Note (1) The core of the NZIER work is based on the CGE model that is built on a Stats NZ database based on the March year 2020. We have assumed that the year ending December 2019 workforce data is equivalent to the March 2020 year workforce data. (2) The skill mix composition data used here are derived from the Data report and the Forestry and Wood Processing report, available at: https://www.mpi.govt.nz/forestry/forest-industry-and-workforce/forestry-wood-processing-data. We estimated our forecasts by each individual ANZSIC06 codes under the Forestry sector. In the Data report, skill mix composition estimates are only available for some ANZSIC06 industries. For those ANZSIC06 industries not covered by the Data report, we used observations from the Forestry and Wood Processing report. This incorporation of data from multiple sources results in some discrepancies in the skill mix composition for Forestry and Wood Processing between this report and the Data report at the aggregate level. Therefore, the composition is from different sources and is subject to interpretation.

Source: NZIER, MPI

3.3.4 Horticulture

Horticulture is a diverse sector, including apples, pears, viticulture, winemaking, kiwifruit, vegetables, nursery (plants/seedlings/fruit trees), floriculture, mushrooms, berry fruit, summerfruit, citrus fruits, olives and nuts.

Table 9 Current workforce for the horticulture sector, by value chain and skill mix

Workforce counts in 2019

Value chain designation	Managers	Semi-autonomous	Managed	Total
Core Production	7,829	8,159	19,757	35,745
Core Processing/Manufacturing	7,525	13,406	4,861	25,792
Strongly Connected	835	1,042	2,334	4,211
Relevant	44	190	10	244
Total	16,233	22,798	26,961	65,992
Indicative % (total)	**25%**	**35%**	**41%**	**100%**

Note (1) The core of the NZIER work is based on the CGE model that is built on a Stats NZ database based on the March year 2020. We have assumed that the year ending December 2019 workforce data is equivalent to the March 2020 year workforce data.

Source: NZIER, MPI

3.3.5 Pork, Poultry, Bees and Other

Pork, Poultry, Bees and Other consists of a diverse range of activities, including pig farming; poultry farming and processing; beekeeping; horse farming; hunting and trapping, other livestock farming, such as alpacas, not classified elsewhere.

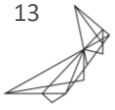
Table 10 Current workforce for the pork, poultry, bees and other sector, by value chain and skill mix

Workforce counts in 2019

Value chain designation	Managers	Semi-autonomous	Managed	Total
Core Production	4,985	2,403	2,287	9,674
Core Processing/Manufacturing	184	233	3,266	3,683
Strongly Connected	2,445	8,157	2,098	12,700
Total	7,613	10,793	7,651	26,057
Indicative % (total)	**29%**	**41%**	**29%**	**100%**

Note (1) The core of the NZIER work is based on the CGE model that is built on a Stats NZ database based on the March year 2020. We have assumed that the year ending December 2019 workforce data is equivalent to the March 2020 year workforce data.

Source: NZIER, MPI



3.3.6 Red Meat and Wool

The Red Meat and Wool sector includes sheep, beef and deer farming, meat (beef, sheep and venison) processing and wholesaling, shearing, scouring, wool and hide processing, and textile manufacturing.

Table 11 Current workforce for the red meat and wool sector, by value chain and skill mix

Workforce counts in 2019

Value chain designation	Managers	Semi-autonomous	Managed	Total
Core Production	28,244	13,148	7,059	48,450
Core Processing/Manufacturing	1,165	12,130	10,552	23,847
Strongly Connected	301	2,498	2,242	5,041
Relevant	15	193	163	371
Total	29,725	27,969	20,015	77,709
Indicative % (total)	**38%**	**36%**	**26%**	**100%**

Note (1) The core of the NZIER work is based on the CGE model that is built on a Stats NZ database based on the March year 2020. We have assumed that the year ending December 2019 workforce data is equivalent to the March 2020 year workforce data.

Source: NZIER, MPI

3.3.7 Seafood

The seafood sector includes deep sea and inshore fisheries, aquaculture and seafood processing and wholesaling, along with ship and boat building and repair services. As mentioned earlier, the way industry views the value chain can be different from the standard industry classification within ANZSIC06. It is impossible to directly align ANZSIC06 class codes with deep sea and in-shore fishing, nor necessarily distinguish seafood processing between the aquaculture sector and the rest of the seafood sector.

More information is available in the Data report.

Table 12 Current workforce for the seafood sector, by value chain and skill mix

Workforce counts in 2019

Value chain designation	Managers	Semi-autonomous	Managed	Total
Core Production	700	1,846	3,819	6,365
Core Processing/Manufacturing	433	625	3,750	4,808
Strongly Connected	123	245	858	1,225
Relevant	50	100	350	500
Total	1,305	2,816	8,777	12,898
Indicative % (total)	**10%**	**22%**	**68%**	**100%**

Note (1) The core of the NZIER work is based on the CGE model that is built on a Stats NZ database based on the March year 2020. We have assumed that the year ending December 2019 workforce data is equivalent to the March 2020 year workforce data.

Source: NZIER, MPI

3.3.8 Cross Sector

Many people are employed by businesses operating in the food and fibre sectors that cannot be attributed to a single sector and value chain. This could be because they are difficult to identify within the data or because the businesses provide services across various primary sectors and/or to other industries or consumers. Many tasks that are outsourced to contracting firms are included within this category; in particular, many provide services to the horticulture sector (including viticulture).

Table 13 Current workforce for the Cross Sector, by value chain and skill mix

Workforce counts in 2019

Value chain designation	Managers	Semi-autonomous	Managed	Total
Core Production	2,628	5,255	18,393	26,275
Core Processing/Manufacturing	0	0	0	0
Strongly Connected	1,046	4,681	4,734	10,461
Relevant	4,908	11,801	4,118	20,827
Other	309	4,945	927	6,181
Total	8,891	26,682	28,172	63,744
Indicative % (total)	**14%**	**42%**	**44%**	**100%**

Note (1) The core of the NZIER work is based on the CGE model that is built on a Stats NZ database based on the March year 2020. We have assumed that the year ending December 2019 workforce data is equivalent to the March 2020 year workforce data.

Source: NZIER, MPI

3.4 The scenarios

Sections 4 to 6 of the report detail the workforce forecasting results by sector and skill mix in 2032, according to the three scenarios previously set out in the CGE and Scenarios reports.

The three scenarios are:

- BAU (Business as usual): This scenario extrapolates from past performance to describe the situation in the food and fibre sectors in 2032. It is based on trends in the recent past around investment, productivity and technology.
- Increased use of technology: Scenario 2 envisions that the food and fibre sectors take maximum advantage of existing and emerging technologies. Potential changes generally involve mechanisation, automation or greater use of digital and information technologies.
- Transformed sector: Scenario 3 builds on the increased use of technology in Scenario 2 and adds an increased focus on sustainability and high-value products and markets, similar to what is outlined in the Government and sector roadmap, *Fit for a Better World*, but we haven't explicitly modelled *Fit for a Better World* as a scenario. Sustainability is based on the Māori concept of Te Taiao, so it encompasses not just the natural environment but also people and their relationships. The workforce and its wellbeing are thus part of Te Taiao and Scenario 3.

It is important to note that while three scenarios are specified, they are part of a continuum in that the transformed scenario includes the impact of increased mechanisation and automation. One purpose of having the three scenarios is to understand better the drivers of changes in workforce size and skill composition.

We used NZIER's TERM-NZ CGE model to model these scenarios.

The **main purpose** of this report is to understand how many workers each sector will employ. An input to this is the results of the CGE modelling of the three scenarios, which shows the total labour income growth of 2032 for that sector/industry. To do this, we are taking into account the following inputs to inform this analysis:

- The CGE modelling results: **Captures productivity growth and export demand growth**.
- Expected workforce composition in 2032: Captures the relative risk of automation for the workforce.
- Expected increases in labour costs for each type of worker: Captures the wage outlook for the workforce.

We discuss how we set out the input assumptions, methodology and limitations for this analysis at a high level in sections 3.5 to 3.9.

3.5 Productivity growth and export demand growth assumptions for the scenarios

We modelled the growth assumptions of each sector using a combination of historical growth figures, working group opinions,[12] and the *Situation and Outlook for Primary Industries* (SOPI) report (Ministry for Primary Industries, 2022a).

We define productivity and export demand as follows:

- Productivity growth: We use multifactor productivity[13] as the productivity growth measure for each sector. Multifactor productivity measures the overall efficiency with which labour and capital inputs are used together in the production process. It is a ratio of output to input. On the one hand, with a higher level of multifactor productivity, sectors can increase production with fewer inputs, allowing the sector to attract more resources and pay higher wages. On the other hand, higher productivity can also potentially limit the workforce requirements for the sectors, as the sectors can expand production with fewer resources when efficiency improves.
- Export demand growth: Export demand growth measures the **growth in value** of New Zealand exports for the food and fibre sectors. Higher levels of export demand can increase export revenue and drive up production, allowing the sectors to lift the workforce requirement, attract more resources and pay higher wages.

Historically, core production productivity gains have been higher in food and fibre industries than in core processing/manufacturing. See Table 14 below for historical multifactor productivity growth between 2008 and 2020. Multifactor productivity for the agriculture, forestry, and fishing sectors have been growing at around 2 percent per annum, while the manufacturing sector – which includes core processing/manufacturing – has been growing at a much slower pace, at around 0.1 percent per annum.

12 Feedback from the Working Group from 4 workshops.

13 Multifactor productivity measures how efficiently combined production inputs (capital and labour) are used within the economy to produce a given level of output. It is a ratio of output to input

Table 14 Productivity statistics, 2008–2020

Multifactor productivity in the most recent economic growth cycle

Sector	Annual % change
Agriculture, forestry, and fishing	2.0%
Manufacturing	0.1%
Services	0.5%

Source: Stats NZ

The slow growth in manufacturing productivity is partly because New Zealand has historically experienced relatively low capital investment compared to many other OECD countries, especially in the manufacturing and processing industries. Low productivity in the manufacturing industries means that manufacturing sectors will need more workers to expand production compared to other industries with higher productivity growth.

To reflect this, in our CGE modelling, we assign higher productivity growth in core production and lower productivity growth in core processing/manufacturing industries to simulate what would happen in 2032. We detail our productivity assumptions for the three scenarios in the following sections. In addition to the productivity growth, we also increased export demand to all food and fibre sectors by combining the Working Group's opinion and forecasts from the SOPI report (Ministry for Primary Industries, 2022a).

3.5.1 Growth assumption for the business as usual scenario

We assume that productivity growth over the 12 years by sector under the business as usual (BAU) scenario follows, in most instances, the historical multifactor productivity trend during the economic cycle between 2008 and 2020, collected from Stats NZ (2021a).

We applied a cumulative productivity growth to increase each sector's 'core production' and 'core processing/manufacturing' across all food and fibre sectors except dairy, and 15 percent of the full shocks to industries relevant to the food and fibre sectors to reflect the economy in 2032. We have also done further analysis on some sectors in response to feedback from the Working Group.

The productivity growth and export demand growth assumptions under this scenario are listed in Table 15. For most sectors, we assume 27 percent productivity growth in core production, 1 percent productivity growth in core processing/manufacturing and 10 percent export demand growth,[14] with some variation for the dairy and horticulture sectors. This is based on the economic cycle between 2008 and 2020.

For the dairy sector, we constrained productivity growth given expected regulatory constraints on water quality and climate change emissions (methane) in the near future. However, we forecast export growth based on innovation and an increase in value. For the horticulture sector, we expect horticulture exports to grow by 42 percent, given forecasts from (Ministry for Primary Industries, 2022a).

[14] Industries will need to respond to the increase in demand growth. The nature of that response could be an increase in value, increase in volume, or even changes to the product mix.

Table 15 Productivity and export increases under BAU

Sectors	Core production	Core processing/ manufacturing	Export
Arable	27%	1%	10%
Dairy	0%	0%	10%
Forestry and Wood Processing	27%	1%	10%
Horticulture	27%	1%	42%
Pork, Poultry, Bees and Other	27%	1%	10%
Red Meat and Wool	27%	1%	10%
Seafood	27%	1%	10%

Source: NZIER

3.5.2 Growth assumption for the increased use of technology scenario

The increased use of technology scenario draws on the BAU but also considers the potential impacts of greater automation and mechanisation through increased use of technology across the sector. Application of a range of technology saves management effort and improves efficiency by increasing output per land unit or worker.

Our research and discussions with sector representatives find that there is no single assessment we can make about all the food and fibre sectors. Each sector works on its own set of issues and opportunities. As a result, we developed a set of accumulated productivity and export demand assumptions for each food and fibre sector by combining historical productivity growth and the Working Group members' expert opinion. Doing so helps us better understand how our economy and food and fibre sectors respond to technology use in the labour market and across the wider economy.

Table 16 sets out the productivity growth and export demand growth assumptions under this scenario. For most sectors, we assume 27–37 percent productivity growth in core production, 1–21 percent productivity growth in core processing/manufacturing and 10–20 percent export demand growth for most sectors, with some variation for the dairy and horticulture sectors (for the reasons outlined above). For more information on this variation, please refer to the CGE report.

The percentages in productivity growth and export demand growth assumptions differ across the food and fibre sectors. The growth assumptions are derived from industry interviews and forecasts (Ministry for Primary Industries 2022a). For example, productivity in the seafood sector core production is estimated to grow the same amount as the BAU scenario, while for the other food and fibre sectors, industry representatives expect the productivity to grow an additional 10 percentage points for core production compared to the BAU scenario. Therefore, we set 37 percent productivity growth for most food and fibre sectors while keeping the seafood sector at 27 percent. We assume dairy will grow at 10 percent given regulatory constraints.

We repeat this process for core processing/manufacturing productivity and export demand and set out the growth assumptions under this scenario.

The industry representative expected a 10 percent more growth in the export demand for arable goods relative to BAU. Thus, we added 10 percent to the export shock of arable goods in BAU, that is, 20 percent, as shown in Table 16.

Table 16 Productivity and export shock under increased use of technology

Sectors	Core production	Core processing/ manufacturing	Export
Arable	37%	11%	20%
Dairy	0%	0%	10%
Forestry and Wood Processing	37%	21%	10%
Horticulture[15]	37%	11%	42%
Pork, Poultry, Bees and Other	37%	11%	10%
Red Meat and Wool	37%	1%	10%
Seafood	27%	11%	10%

Note (1) Productivity sensitivity analysis for Red Meat and Wool has also been conducted and reported at the 11% level.

Source: NZIER

3.5.3 Growth assumption for the transformed sector scenario

This scenario draws on the increased use of technology scenario and incorporates concerns for sustainability with a focus on environmental-friendly high-value products and markets. This conveys a promising future of positive demand through a better marketing strategy and supply side by providing high-value products through increased application of technology. To reflect the principles and themes of this scenario, we continued using the productivity shocks from the 'Increased use of technology' scenario, and we revised export demand.

We set out the productivity growth and export demand growth assumptions for this scenario in Table 17. For most sectors, we assume 27–37 percent productivity growth in core production, 1–21 percent productivity growth in core processing/manufacturing and 20–50 percent export demand growth for most sectors, with some variation for the dairy and horticulture sectors. For more information on this variation, please refer to the CGE report.

[15] Within the horticulture sector, kiwifruit is assigned 32% to core production, 11% to core processing, and 42% to export demand; viticulture is assigned 37% to core production, 6% to core processing, and 10% to export demand.

We are forecasting export demand growth to be highest and processing productivity growth to be the lowest for the red meat sector. This combination is therefore driving a larger than expected expansion in the processing workforce.

Further scenario analysis is required on the red meat sector since the combination of these two assumptions is driving increases in red meat value. We are forecasting export demand to be highest for red meat and processing productivity to be the lowest, thus driving a larger than expected expansion in the processing workforce.

The sensitivity analysis is included under section 5.9.1.

Table 17 Productivity and export increases under the transformed sector

Sectors	Core production	Core processing/ manufacturing	Export
Arable	37%	11%	30%
Dairy	0%	0%	20%
Forestry and Wood Processing	37%	21%	30%
Horticulture[16]	37%	11%	42%
Pork, Poultry, Bees and Other	37%	11%	20%
Red Meat and Wool	37%	1%	50%
Seafood	27%	11%	20%

Note (1) Productivity sensitivity analysis for Red Meat and Wool has also been conducted and reported at the 11% level.

Source: NZIER

3.6 Change in sector production and exports from the CGE model

To see how these productivity and export demand assumptions flow through the economy in our CGE modelling, we set out the change in production and exports from the CGE model in the following section. We define production and exports as follows:

- Production: Total goods produced in the food and fibre sectors in New Zealand.
- Export: Total goods exported from the food and fibre sectors.

The production and export figures use different economic bases. The production figures are based on the definition of the food and fibre sectors that underpins the workforce counts. They come directly from the NZIER CGE model, which is built on the New Zealand Standard Industrial Output Categories (NZSIOC) and links to the ANZSIC06 system. They are, therefore, a macroeconomic view of production from the full sectors. The export figures are based on the calculation used for SOPI reports, which uses data from the Harmonised

[16] Within the horticulture sector under the transformed sector scenario, kiwifruit is assigned 32% in core production, 11% in core processing, and 42% in export demand; viticulture and winemaking are assigned 37% in core production, 6% in core processing/manufacturing, and 30% in export demand.

System of trade database. Although the base year figures come from different sources, the scenario results are all derived from growth rates calculated consistently from TERM-NZ.

3.6.1 2020 export revenue figures

Three sets of export revenue numbers are available for this project, listed in the following table. The results in the main text are based on the year to March 2020 actual export revenue provided by MPI (the first column).

We have chosen to use these values because the periods align with the calculation for workforce counts used in this project. For reference, the table also contains additional export figures in column 2 and column 3, both from SOPI reports (Ministry for Primary Industries, 2020b, 2022b). For the pork, poultry, bees and other sector, because export revenue figures are not direct available from the MPI, we used export revenue figures from NZIER's CGE model.

Table 18 Export revenue figures, 2020 ($ millions)

Export revenue, value

Sectors	March actual	March SOPI forecast	June SOPI actual
Arable	$277	$260	$260
Dairy	$19,573	$19,240	$20,135
Forestry and Wood Processing	$5,961	$5,650	$5,538
Horticulture	$6,353	$6,290	$6,555
Pork, Poultry, Bees and Other (From CGE)	$473	$473	$473
Red Meat and Wool	$10,701	$10,210	$10,678
Seafood	$1,991	$1,920	$1,855

Source: NZIER

3.6.2 Change in production and exports, BAU scenario

For each aggregated sector, the forecasted percentage change in production and exports for the BAU scenario are listed in Table 19.

In the dairy sector, we assumed a 0 percent growth in productivity and a 10 percent increase in exports for this sector. As a result, dairy grows slowly compared to the other sectors' growth rate. This is because of the assumed regulatory constraints outlined above.

We also expect increased competition from the rest of the economy for highly skilled workers. This is signalled in dairy by the reduction of exports in the increased use of technology scenario.

Table 19 CGE simulation for 2032 production and exports under the BAU scenario

Growth rates and value

Sectors	% Change for 2032 production compared to 2020	2032 production Real, $ millions	% Change for 2032 export compared to 2020	2032 Export value Real, $ millions
Arable	38%	$11,401	41%	$392
Dairy	34%	$44,673	34%	$26,152
Forestry and Wood Processing	53%	$20,330	85%	$11,009
Horticulture	68%	$16,508	104%	$12,947
Pork, Poultry, Bees and Other	51%	$3,113	77%	$838
Red Meat and Wool	50%	$35,094	68%	$17,944
Seafood	50%	$4,554	58%	$3,136

Source: NZIER

3.6.3 Change in production and exports, increased use of technology scenario

For each aggregated sector, the forecasted percentage change in production and exports for the increased use of technology scenario is listed in Table 20.

We forecast production and export value to increase significantly for most food and fibre sectors, reflecting the productivity and export demand assumptions.

Flat growth is expected in the dairy sector. We assumed 0 percent growth in productivity and a 10 percent increase in exports for this sector. This constraint means that dairy grows slowly compared to other sectors' growth rates. This is in line with the assumptions outlined in section 3.5.2.

Competition for skilled workers intensifies in the increased technology scenario. Increased competition from the rest of the economy for highly skilled workers means a reduction of dairy exports (compared with the BAU) since other parts of the economy compete more effectively for highly skilled workers in the future.

Table 20 CGE simulation for 2032 production and exports under the increased use of technology scenario

Growth rates and value

Sectors	% Change for 2032 production compared to 2020	2032 production Real, $ millions	% Change for 2032 export compared to 2020	2032 Export value, $ millions Based on 2020 dollars
Arable	52%	$12,615	73%	$479
Dairy	33%	$44,180	32%	$25,748
Forestry and Wood Processing	69%	$22,418	125%	$13,412
Horticulture	79%	$17,599	126%	$14,345
Pork, Poultry, Bees and Other	61%	$3,300	98%	$939
Red Meat and Wool	55%	$36,327	80%	$19,237
Seafood	59%	$4,840	69%	$3,359

Source: NZIER

3.6.4 Change in production and exports, transformed sector scenario

For each aggregated sector, the forecasted percentage change in production and exports for the transformed sector scenario is listed in Table 21.

We expect high levels of growth in production and export demand for most of the sectors, especially for the forestry and wood processing sector, horticulture sector, pork, poultry, bees and other sector, and the red meat and wool sector.

This higher growth is motivated by significant growth in productivity and export demand, incentivising the food and fibre sectors to increase production and export to meet the increase in demand for their products.

Table 21 CGE simulation for 2032 production and exports under the transformed sector scenario

Growth rates and value

	% Change for 2032 production compared to 2020	2032 production Real, $ millions	% Change for 2032 export compared to 2020	2032 Export value, $ millions Based on 2020 dollars
Arable	55%	$12,868	78%	$493
Dairy	36%	$45,228	35%	$26,457
Forestry and Wood Processing	79%	$23,846	150%	$14,931
Horticulture	80%	$17,687	126%	$14,367
Pork, Poultry, Bees and Other	73%	$3,547	121%	$1,043
Red Meat and Wool	79%	$42,093	119%	$23,451
Seafood	63%	$4,974	75%	$3,476

Source: NZIER

3.7 Total labour income growth from the CGE model

We used NZIER's TERM-NZ CGE model to capture the growth in productivity and export demand associated with the three scenarios. The total labour income output from the economy-wide model was then used to estimate workforce counts in each sector/industry.

An increase in total labour income reflects changes in productivity growth and export demand growth, combined with model assumptions about the availability of capital and labour. Productivity growth and export demand growth enable the sectors to expand production efficiently, allowing the sectors to generate greater revenue and wage growth. Later in the report, we translate the changes in labour income into changes in employment.

Total labour income results from the CGE modelling are included in the following tables. While the modelling is done at a more granular industry level, for simplicity, we only report the labour total income growth at a sectoral level in this report. In this section, we use total labour income, which captures changes to total labour income for all workers in the food and fibre sectors. This is not an individual wage measure.

We discuss total labour income and labour wage in multiple sections of this report. For clarification, we define total labour income and labour wage as follows:

- Total labour income: the sum of all wages and salaries paid to workers in the food and fibre sectors workforce, also called the *returns to labour*

- Labour wage: compensation paid to an individual employee. We use the annual average wage here, which represents the average wage a worker gets paid working in the food and fibre sectors.

3.7.1 Total labour income, BAU scenario

Under the BAU scenario, we expect the total labour income growth rate to be between 38.4 percent and 42.6 percent for the sectors.

Table 22 Total labour income growth rate, BAU scenario

Growth rate in real terms by 2032

Sector	Change in % compared to 2020
Arable	39.3%
Dairy	39.4%
Forestry and Wood Processing	39.4%
Horticulture	39.4%
Pork, Poultry, Bees and Other	42.6%
Red Meat and Wool	38.9%
Seafood	38.4%
Cross Sector	38.7%
Total food and fibre sector	39.4%

Source: NZIER

3.7.2 Total labour income, increased use of technology scenario

Under the increased use of technology scenario, we expect the total labour income growth rate to be between 41.8 percent and 49.3 percent for the sectors.

Table 23 Total labour income growth rate, increased use of technology scenario

Growth rate in real terms by 2032

Sector	Change in % compared to 2020
Arable	44.1%
Dairy	43.1%
Forestry and Wood Processing	41.7%
Horticulture	43.1%
Pork, Poultry, Bees and Other	49.3%
Red Meat and Wool	42.5%
Seafood	43.3%
Cross Sector	41.8%
Total food and fibre sector	43.1%

Source: NZIER

3.7.3 Total labour income, transformed sector scenario

Under the transformed sector scenario, we expect the total labour income growth rate to be between 43.7 percent and 55.8 percent for the sectors.

Table 24 Total labour income growth rate, transformed sector scenario

Growth rate in real terms by 2032

Sector	Change in % compared to 2020
Arable	47.3%
Dairy	46.9%
Forestry and Wood Processing	44.7%
Horticulture	45.5%
Pork, Poultry, Bees and Other	55.8%
Red Meat and Wool	46.9%
Seafood	47.0%
Cross Sector	43.7%
Total food and fibre sector	46.4%

Source: NZIER

We carry the three sets of total labour income growth rates in the above tables into further analysis and translate them into workforce requirements in 2032 under the three scenarios.

We do this using a combination of automation estimates and labour wage forecasts. We include more details of the analysis below.

3.7.4 Total labour income forecasts, total economy and the food and fibre sector.

We analysed the modelling results and workforce projections to put the changes in the food and fibre sectors in the context of the whole economy. Table 25 shows the growth in total labour income, growth in the workforce, and real wage growth. We show these projected growth rates for the entire economy and for the food and fibre sectors under each scenario by 2032. Growth in total labour income comes from NZIER's TERM-NZ CGE model and is linked to NZIER's projections of economic growth over the period.

Growth in the workforce for the total economy is taken from Stats NZ workforce projections,[17] while growth in the food and fibre sectors workforce forecasts under each scenario are estimated as discussed in later sections of this report. Real wage growth is calculated by dividing growth in total labour income by growth in the workforce.

Table 25 Total labour income growth rate for the economy and the food and fibre sectors

Growth rate in real terms by 2032

Sectors	Total economy	BAU scenario F&F sectors	Increased use of technology scenario F&F sectors	Transformed sector scenario F&F sectors
Growth in total labour income	37.9%	39.4%	43.1%	46.4%
Growth in workforce	10.7%	7.7%	9.2%	15.8%
Real wage growth	24.5%	29.4%	31.0%	26.4%

Source: NZIER, Stats NZ

The figures in Table 25 show that we forecast total labour income to grow by 37.9 percent for the entire economy, while the growth in labour income is faster for the food and fibre sectors under each scenario. Given that we expect the productivity of the food and fibre sectors to grow faster than the rest of the economy, the modelling also lifts the labour income of the food and fibre sectors faster. Similarly, we forecast the food and fibre sectors workforce to grow more slowly than the whole economy because higher productivity growth will allow the food and fibre sectors to produce more efficiently and use fewer labour inputs per unit of output.

[17] Total labour force projections are taken from Stats NZ's, available at: https://www.stats.govt.nz/news/labour-force-projected-to-grow-and-grey.

Our results indicate that the real wage growth for the food and fibre sector is expected to be faster than that of the total economy due to increased efficiency in their production. These results are in line with our productivity assumptions.

Our results also indicate that we expect a higher real wage growth under the increased use of technology scenario. This is because we expect higher productivity levels for the food and fibre sectors under this scenario than the BAU scenario, which allows the real wage to grow more as efficiency improves.

We expect real wage growth to be slower under the transformed sector scenario than in the increased use of technology scenario. This is because although the productivity assumptions are the same under these two scenarios, the food and fibre sectors will produce more under the transformed sector scenario, prompted by higher levels of export demand. The higher total demand creates increased employment, but larger employment increases in less-efficient industries, such as core processing/manufacturing.

As a result, the average productivity per worker declines, which is reflected in lower growth in real wages. In the context of the way the food and fibre sectors have been defined and modelled for this work, the increased export demand is creating a *regression to the mean*: real wage growth is bending towards the average for the whole economy as more resources flow into the food and fibre sectors.

3.8 Expected workforce composition in 2032

Changes in workforce composition are incorporated into this analysis to consider changes in the skill mix of the workforce between now and 2032. This involves factoring the risks of automation by occupation into our analysis to consider shifts in workforce composition. To do this, we reviewed the literature on automation and job losses and sourced our risk of automation estimates by skill mix from an OECD working paper, *Automation, skill use and training,* by Nedelkoska and Quintini (2018).

Although we expect automation and mechanisation may reduce the demand for some roles that are more at risk of automation, they will also increase the demand for more highly skilled roles to meet the trend for more complex and sophisticated business needs. These highly skilled roles may include managing technology, marketing, etc.

Details of the automation estimates are available in Appendix C.

3.9 Estimating the wage forecast

To provide the estimated 2032 workforce counts by high-level sector and by the skill mix of roles, wage forecasts associated with the skill mix are required. We incorporate three income growth forecasts into our analysis to reflect the wage outlook from NZIER and the New Zealand Treasury:

- NZIER's Labour Cost Index forecast.
- New Zealand Treasury's (2021b) wage forecast in the Treasury's Half Year Economic and Fiscal Update and Treasury's Long-term Fiscal Position (New Zealand Treasury, 2021a).
- The average of NZIER and Treasury's forecasts.

We include a detailed description of the wage forecasts and methodology in Appendix C. In the appendix, we explain NZIER's and Treasury's wage forecasts. Our preferred approach is to average the two sources to illustrate the growth in wages expected.

The results in sections 4 to 6 below are based on a central forecast of economic performance in 2032 by taking the mean of NZIER and the Treasury's forecast. However, we also tested the high and low scenarios. These tables are reported in Appendices A and B and provide forecasts based on two different wage forecasts: NZIER (lower) and Treasury (higher). Total labour compensation is an output of the CGE model and is used to estimate the future workforce. A lower estimate of wage growth produces a *higher* workforce count, whereas higher projected wages lead to a *lower* estimate of future workers. Projected wage growth is, therefore, a key input to the analysis.

4 Business as usual scenario

In the BAU scenario, we extrapolate from past performance to describe the situation in the food and fibre sectors in 2032. It is based on trends in the recent past around investment, productivity and technology. Specifically, we assume the food and fibre sectors and the rest of the economy continues their historical multifactor productivity growth rates between 2008 and 2020. Historical productivity is available from Stats NZ (2021b).

Table 26 below shows the workforce forecasting results for the BAU scenario in 2032. The overall results estimate that there will be around 391,000 workers in the food and fibre sectors in 2032, which is a 7.7 percent increase compared to the current workforce.

We report the percentage point change of the 2032 workforce by each value chain designation compared to the 2020 workforce in the last row of Table 26.

The percentage point changes detailed in the last row of Table 26 represent how the workforce percentage of each designation is forecast to change between 2020 and 2032. It is calculated by subtracting the 2032 workforce percentage of each designation from the 2020 value. These capture the change in workforce requirements across the value chain in the next decade.

Table 26 Workforce numbers – BAU scenario by sector and value chain

Workforce requirements in 2032

Sectors	Core production	Core processing /manufacturing	Strongly connected	Relevant	Other	Total	% Change from 2020
Arable	4,707	2,394	16,062	317	-	23,481	**4.8%**
Dairy	40,859	13,572	1,409	-	-	55,840	**5.5%**
Forestry and Wood Processing	14,258	12,325	18,186	193	-	44,963	**8.6%**
Horticulture	41,444	27,729	4,268	262	-	73,703	**11.7%**
Pork, Poultry, Bees and Other	10,745	4,874	13,622	-	-	29,241	**12.2%**
Red Meat and Wool	48,099	31,235	5,517	377	-	85,227	**9.7%**
Seafood	6,548	5,296	1,233	498	-	13,574	**5.2%**
Cross Sector	26,067	-	10,818	21,803	6,466	65,155	**2.2%**
Total	192,727	97,425	71,115	23,451	6,466	391,184	**7.7%**
Indicative % (Total)	**49%**	**25%**	**18%**	**6%**	**2%**	**100%**	
% point change from 2020	**-0.9%**	**1.7%**	**-0.5%**	**-0.2%**	**0.0%**	**-**	

Source: NZIER

4.1 Results by sectors and value chain

Our approach is to describe our forecasting results for each sector by relating the forecasting results to the output that was used to inform them:

- The CGE modelling results: Captures productivity growth and export demand growth.
- Expected workforce composition in 2032: Captures the relative risk of automation for the workforce.
- Expected increases in labour costs for each type of worker: Captures the wage outlook for the workforce.

As the results in sections 4 to 6 are based on the average wage forecast of NZIER and The Treasury, we focus on describing results from changes in the other inputs. Specifically, productivity growth, export demand growth, and the relative risk of automation.

4.1.1 The number of workers increases in the sector driven by core processing/manufacturing

We forecast the overall workforce counts to increase by 7.7 percent between now and 2032, from a total of 365,000 to a total of around 391,000. Our forecast also shows that core production will take up around 49 percent of the workforce in the food and fibre sectors in 2032, which is a similar percentage to the current workforce. Core processing/manufacturing will take up 25 percent of the total workforce in 2032, which is a 1.7 percentage point increase compared to the current workforce composition.

These results reflect the expected growth in export demand for the food and fibre sectors in 2032 and the relative change in productivity between the sectors and the value chain. At a high level, our results indicate that although there is an increase in the number of workers in both core production and core processing/manufacturing, a bigger increase is coming from the core processing/manufacturing industries. This is because we modelled the 2032 economy according to the historical productivity growth in the food and fibre sectors, detailed in the CGE section of this report.[18]

In the BAU scenario, we model the future performance of the sectors based on historical trends. Historically, core production productivity gains have been higher in food and fibre industries than in core processing/manufacturing. Lower productivity in the processing/manufacturing industries means that processing/manufacturing industries will need more workers to expand production compared to the core production industries. This means the processing/manufacturing industries in the food and fibre sectors will need to increase their workforce to meet the processing demand for their products.

Another driver of the results is the export demand growth for the sectors. In the BAU scenario, we developed a shock to export demand to all food and fibre sectors by combining the Working Group's opinion and SOPI forecasts (Ministry for Primary Industries, 2022a).

Increased export demand will drive up production and export returns for the sector, making the sector more attractive to the workforce.

Our results suggest that increased export demand leads to more production across the value chain in 2032. However, as higher productivity increases are associated with the core production industries, a moderate increase in workers is enough to expand production. In contrast, a bigger increase in the workforce is required in core processing/manufacturing to keep up with the increased output from production.

This pattern is also evident when we break down the results by sector.

4.2 Growth in need for more highly skilled workers in the food and fibre sectors

Table 27 details our forecast by sector and skill mix for the food and fibre sectors.

[18] For more information on the CGE model and modelling assumptions, please refer to the CGE report.

Table 27 Workforce numbers – BAU scenario by skill mix

Workforce requirements in 2032

Sectors	Managers	Semi-autonomous	Managed	Total	% Change from 2020
Arable	6,972	6,569	9,939	23,481	**4.8%**
Dairy	15,128	21,233	19,479	55,840	**5.5%**
Forestry and Wood Processing	11,563	13,974	19,425	44,963	**8.6%**
Horticulture	19,736	25,732	28,234	73,703	**11.2%**
Pork, Poultry, Bees and Other	9,054	11,907	8,279	29,241	**12.2%**
Red Meat and Wool	31,185	33,377	20,665	85,227	**9.7%**
Seafood	1,643	3,305	8,626	13,574	**5.2%**
Cross Sector	10,168	29,068	25,920	65,155	**2.2%**
Total	**105,451**	145,165	140,568	391,184	**7.7%**
Indicative % (Total)	**27%**	**37%**	**36%**	**100%**	
% point Change from 2020	**1.7%**	**1.9%**	**-3.5%**		

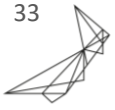
Source: NZIER

When tabulated by skill mix, our forecasts indicate that we expect 27 percent of the 2032 workforce to be in the manager category, 37 percent of the workforce to be in the semi-autonomous category, and 39 percent of the workforce to be managed. Compared to the current composition: 25 percent managers, 35 percent semi-autonomous and 39 percent managed, this indicates growth in the need for more highly skilled workers in the food and fibre sectors.

The changes in the skill mix are informed by estimates from Nedelkoska and Quintini (2018). Their working paper suggests that managers have a lower probability of being automated, a semi-autonomous workforce has a moderate probability of being automated, and managed workers have a higher risk of being automated.

This result doesn't mean jobs are disappearing. Our overall results still indicate that there will be more workers in the food and fibre sectors by 2032. It merely suggests that there will be a change in workforce composition in 2032. However, when we look specifically at managed workforce, we forecast the food and fibre sectors would need around 141,000 workers by 2032, while this number is around 143,000 today.

This suggests that there will be a decrease in workforce requirements for managed workers, although the size of this decrease in managed workers is smaller than the increase



in manager and semi-autonomous workers. This suggests an increased demand for highly skilled workers in the future, as our forecasting results show. These results also highlight the importance of upskilling the existing workforce to prepare for the changing workforce requirements in the future. Our results also highlight the importance of helping transition existing managed workers into semi-autonomous and manager roles by 2032.

This trend is also evident when broken down by each sector. We see a bigger increase in the number of managers in most sectors, while the demand for the managed workforce has been relatively stable compared to the current workforce.

Historically we have seen productivity growth in the food and fibre sectors, especially in the core production industries. These productivity gains are supported by the adoption of technologies and automation that the industries are experiencing. For example, precision farming allows for the targeted and calculated application of water and nutrients, making resource allocation more efficient in New Zealand. Electronic livestock identification makes it easier for New Zealand farmers to manage animals and harvest wool and meat. Robotic milking facilities make milking more efficient than traditional milking methods. Other examples include rotary cowsheds, cup removers, milk sensors, etc.

Technology has been changing how we farm in the past decades, and changes will likely continue as new technologies are adopted in New Zealand. New technologies are constantly being adopted to increase productivity and efficiencies across the food and fibre sectors. With automation and technology, we expect New Zealand's food and fibre sectors to gradually transform their workforce requirements towards a need for more training.

In the following sections, we delve deeper into each sector. For most sectors, we are forecasting growth in overall workforce requirements by 2032. However, there are some differences in the growth profile for each sector, as we forecast some sectors will grow more and others less (than currently). Less growth in the workforce doesn't mean that the output of these sectors is forecast to grow less. Our forecasts are driven partly by growth in the productivity of the industries. For these industries, we're forecasting that moderate growth in workforce requirement is enough to produce more output due to productivity increases and efficiency gains.

4.3 Growth in food and fibre sectors compared to the total economy.

Table 28 compares our forecast of the food and fibre sectors workforce with Stats NZ's labour force projections for the entire economy by 2032.[19] Stats NZ forecast the workforce for the entire economy to grow by 10.7 percent in the next decade, while we project the food and fibre sectors workforce to grow by 7.7 percent between 2020 and 2032.

Historically the food and fibre sectors have experienced higher productivity growth than the rest of the economy, and we assume this higher level of productivity growth will continue in the next decade under this scenario. Higher levels of productivity growth allow the food and fibre sectors to engage in production more efficiently, using fewer labour inputs per unit of output. Our CGE modelling calculates the net effect of productivity changes by industry and changes in demand, both in the food and fibre sectors and the rest of the economy. Our further analysis considers the impact of automation on skills levels and wages in the food and fibre workforce. The final result is a food and fibre workforce

[19] Total labour force projections are taken from Stats NZ's, available at: https://www.stats.govt.nz/news/labour-force-projected-to-grow-and-grey.

that grows by 7.7 percent, less than the projected growth of the total workforce of 10.7 percent by Stats NZ.

Table 28 Labour force projections for the food and fibre sector and the total economy

Workforce requirements in 2032

Sectors	2020 workforce	2032 workforce forecast	% Change from 2020
Food and fibre sector	363,160	391,184	**7.7%**
Total economy	2,904,000	3,215,300	**10.7%**

Source: Stats NZ, NZIER

4.4 Arable

We forecast relatively moderate growth in total workforce counts for the arable sector. We set out the skill mix for the arable sector in Table 29.

For the arable sector, our forecasts indicate an increase in workforce counts in core production, core processing/manufacturing, and relevant industries, with a small decrease in strongly connected industries. Employment growth is mainly driven by the increase in productivity and export demand by 2032.

Regarding the skill mix, we forecast an increase of 2.8 percentage points in managers, an increase of 1.5 percentage points in the semi-autonomous workforce and a decrease of 4.2 percentage points in the managed workforce compared to the 2020 workforce composition. Jobs do not disappear; the workforce composition will change by 2032. In fact, we forecast the overall number of workers will increase by 2 percent for the arable sector. Our results by skill mix highlight the importance of upskilling the existing workforce to meet future labour demand.

The demand for New Zealand's arable products is solid. This has been driven by COVID-19 lockdowns and the Ukraine and Russia conflict in the northern hemisphere. Global low inventory and stagnant production in arable products indicate solid demand for New Zealand's arable exports in the near future.

Table 29 Workforce numbers in the arable sector – BAU scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	2,747	1,620	341	4,707	**4.0%**
Core Processing/Manufacturing	294	317	1,783	2,394	**24.1%**
Strongly Connected	3,901	4,375	7,786	16,062	**2.6%**
Relevant	31	258	29	317	**9.8%**
Total	6,972	6,569	9,939	23,481	**4.8%**
% of total	**29.7%**	**28%**	**42.3%**	-	
% point Change from 2020	**2.8%**	**1.5%**	**-4.2%**		

Source: NZIER

4.5 Dairy

We also forecast relatively slow growth in the dairy sector. The forecasting results are listed in Table 30.

Table 30 Workforce numbers in the dairy sector – BAU scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	13,366	15,667	11,826	40,859	**6.0%**
Core Processing/Manufacturing	1,432	5,254	6,886	13,572	**4.3%**
Strongly Connected	331	312	766	1,409	**0.6%**
Total	15,128	21,233	19,479	55,840	**5.5%**
% of total	**27.1%**	**38%**	**34.9%**	-	
% point Change from 2020	**2.9%**	**2.2%**	**-5.1%**		

Source: NZIER

Our results indicate that we expect the workforce required for the dairy sector to grow by 5.5 percent by 2032.

Productivity in the dairy sector will remain relatively stable for the foreseeable future. Productivity gains are expected to be 0 percent in both core production and core

processing/manufacturing (Working Group assumption).[20] We expect a 10 percent increase in export demand, which suggests production will still increase. Therefore, slightly more workers are still required to meet the expected increase in production.

Our results by skill mix again indicate the need for more higher-skilled workers in 2032. We forecast an increase of 2.9 percentage points in managers, an increase of 2.2 percentage points in the semi-autonomous workforce and a decrease of 5.1 percentage points in the managed workforce in the next decade.

While global dairy prices remain high, we expect production growth in the dairy sector to remain relatively static in New Zealand. This is due to expected on-going regulatory constraints on water quality and climate change emissions (e.g. methane).

4.6 Forestry and Wood Processing

Significant growth is evident in the forestry and wood processing sector, at around 8.6 percent. The growth by value chain designation and skill mix are shown in Table 31.

Table 31 Workforce numbers in the forestry and wood processing sector – BAU scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	5,947	779	7,532	14,258	**11.7%**
Core Processing/Manufacturing	1,438	6,098	4,789	12,325	**10.2%**
Strongly Connected	4,135	7,022	7,030	18,186	**5.2%**
Relevant	44	74	75	193	**12.8%**
Total	11,563	13,974	**19,425**	44,963	**8.6%**
% of total	**25.7%**	**31.1%**	**43.2%**	**100%**	
% point Change from 2020	**3.4%**	**1.9%**	**-5.3%**		

Source: NZIER

For the forestry and wood processing sector, we forecast growth in workforce requirements across the value chain. Driven by increased productivity and export demand for the sector.

The growth in the forestry and wood processing sector is primarily driven by increases in the workforce for core production, while the core processing/manufacturing workforce grows less, despite a small productivity growth in processing/manufacturing. The significant demand for log exports drives direct exports from core production, and growth in outputs

[20] Based on feedback from the Working Group.

in core production designations puts less processing pressure on the processing/manufacturing industries.

In terms of skill mix, our results indicate an increase of 3.4 percentage points in managers, an increase of 1.9 percentage points in the semi-autonomous workforce and a decrease of 5.3 percentage points in the managed workforce in the next decade.

Globally we're expecting a positive construction outlook. China imported 57 percent of New Zealand's forestry exports in 2020/2021. Although the Chinese property market has been slowing down in recent years, limiting their construction outlook and demand for forestry exports, this downturn is forecast to be offset by increased infrastructure investment from the Chinese government. This will likely boost demand for New Zealand forestry exports in the next decade.

4.7 Horticulture

The workforce in the Horticulture sector is expected to grow by 11.7 percent by 2032, from the current 66,000 to around 74,000 in 2032. This growth is primarily driven by growth in "core production" sectors/industries such as kiwifruit growing and apples and pear growing. We include a breakdown of the Horticulture sector in Table 32.

Table 32 Workforce numbers in the horticulture sector – BAU scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	10,064	9,893	21,487	41,444	**15.9%**
Core Processing/Manufacturing	8,638	14,481	4,610	27,729	**7.5%**
Strongly Connected	985	1,154	2,129	4,268	**1.3%**
Relevant	50	204	9	262	**7.6%**
Total	19,736	25,732	28,234	73,703	**11.7%**
% of total	**26.8%**	**34.9%**	**38.3%**	**100%**	
% point Change from 2020	**2.2%**	**0.4%**	**-2.5%**		

Source: NZIER

There are limitations with workforce counts derived from the ANZSIC06 classification, especially when attempting to get complete and accurate counts by sector or industry. We describe this issue in section 3.1.2 of this report.

One of the key limitations is the scale of the seasonal peaks in demand, with large changes in the workforce required, occurring throughout the year. In addition, some industries, such as kiwifruit and viticulture, employ contractors to carry out seasonal tasks. This may result in a proportion of the horticultural workforce being found in Cross Sector Core Production,

in the *Other Agriculture and Fishing Support Services* ANZSIC06 class, and potentially under Cross Sector Other, in the *Labour Supply Services* ANZSIC06 class (although to a much lesser extent) – instead of in the horticulture categories/codes.

The growth in the workforce for the viticulture, kiwifruit, apple and pear growing, summerfruit and other horticulture industries is primarily driven by growth in 'core production' industries, especially for kiwifruit growing and apple and pear growing.

The kiwifruit growing industry (ANZSIC06 Code A013200) currently employs 4,825 workers, while the apple and pear growing industry (ANZSIC06 Code A013400) currently employ 5,892 workers. Our forecasts show that these industries are expected to grow by 2,331 and 2,432 workers in 2032, a growth rate of 48 percent and 41 percent, respectively.

The workers in kiwifruit, and apple and pear production are found in a number of ANZSIC06 codes. Many workers are employed by contractors who work across the major horticultural industries: viticulture, apples and pears, and kiwifruit. In addition, kiwifruit packhouses workers are also largely not going to be included in the kiwifruit ANZSIC06 code A013200 but are an important part of the workforce.

The growth in the workforce associated with these industries is driven by the large growth expected in export demand for apples, pears, and kiwifruit in 2032. Historically, the export value of the horticulture sector has been growing at around 9 percent per annum between 2015 to 2021. We combine this historical growth rate with MPI's "*Situation and outlook for primary industries*" (Ministry for Primary Industries, 2022b) forecasts and find that the export value of apple and pear and kiwifruit is expected to grow by 6.9 percent per annum. This impressive growth in export demand is the driving force behind growth in the workforce for these industries.

Demand for apples, pears, and kiwifruit has been strong despite the COVID-19 disruptions, which is expected to continue. This growing demand mainly comes from Asia, especially China, Vietnam, Taiwan, India, and Japan. We expect this increase in demand to continue because:

- We expect developing economies in Asia to continue growing. Lifting the standard of living in the region and the demand for high-value food.
- New and premium varieties of apples and kiwifruits are already in the market, including premium varieties of apples and kiwifruit, such as Envy, Dazzle, and the gold and red kiwifruit. These varieties are highly in demand worldwide, and we can continue to expect premium varieties to grow the market.
- High demand in this industry supports higher export prices for most varieties. With boosted demand and prices, we expect the industry to grow significantly by 2032.

Increased demand will boost production and post-harvest activities for apples, pears, and kiwifruit industries and lift the workforce requirements.

For viticulture and winemaking, we modelled productivity growth and export demand growth based on their historical performance. Our results suggest that fewer workers are needed in production, while more workers are required in the wine manufacturing industry. The reason is:

- Higher productivity growth is historically associated with the grape production industry, indicating that fewer workers are needed to expand production. In contrast,

a bigger increase in the wine making workforce is required in the processing industry to keep up with the increased output from production in viticulture.

The viticulture industry uses a significant number of contract workers, and many of these workers are not captured in our analysis of viticulture specific ANZSIC06 codes. Therefore, we may have underestimated the workforce for viticulture. New Zealand wine is recognised worldwide, with wine exports increasing steadily since 1990. Customers pay higher export prices for New Zealand wine compared to similar products from many other countries. The wine industry is expected to continue growing as global demand for New Zealand wine continues to increase.

The viticulture and winemaking industry have been resilient despite border restrictions under COVID. Despite a tight labour market, the harvest was successful, partly due to the lower volume of harvests from frosts in the Marlborough and other South Island wine regions.

We forecast a small growth in core production for the summerfruit industry. This is mainly driven by the increase in export demand for this industry. The summerfruit industry in New Zealand is relatively small compared to other industries. The demand for summerfruit is mainly driven by the increasing demand for cherries in the Asian market (mainly China). New Zealand cherries enter the Chinese market around the Chinese New Year when the demand is the highest. We expect this demand to increase steadily in the next decade.

4.8 Pork, Poultry, Bees and Other

The workforce for the pork, poultry, bees and other sector is also forecast to have a big increase, exceeding 12 percent between now and 2032. This growth is distributed relatively evenly across the value chain of these industries, with increased workforce counts in almost all parts of the value chain. Table 33 details the growth figures by value chain and skill mix.

Table 33 Workforce numbers in the pork, poultry, bees and other sector – BAU scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	5,911	2,671	2,164	10,745	**11.1%**
Core Processing/Manufacturing	306	366	4,201	4,874	**32.3%**
Strongly Connected	2,838	8,870	1,915	13,622	**7.3%**
Total	9,054	11,907	8,279	29,241	**12.2%**
% of total	**31.0%**	**40.7%**	**28.3%**	**100%**	
% point Change from 2020	**1.7%**	**-0.7%**	**-1.0%**		

Source: NZIER

This growth is mainly concentrated in the core processing/manufacturing industries. This is mainly due to unequal growth in productivity between core production and core processing/manufacturing. In the BAU scenario, we expect core production industries to increase productivity by 27 percent, while the productivity for core processing/manufacturing industries will only increase by 1 percent. Therefore, a bigger increase in workforce requirements is needed to process the extra output from the core production industries.

The pork, poultry, bees and other industries are mainly domestically focused and compete with imports. We forecast some growth in the domestic market as the population is expected to increase gradually in the next decade. This high demand will likely persist as the demand for healthier food options increases in New Zealand.

4.9 Red Meat and Wool

We also forecast a growth of 9.7 percent in the workforce requirements for the red meat and wool sector, driven by strong demand from Asia.

53 percent of New Zealand's lamb export goes to the Chinese market, along with 84 percent of New Zealand's mutton exports, and 39 percent of beef exports. These figures have been growing in the past decade, and we expect this growth to continue as the standard of living in China continues to rise.

Global red meat exports are forecast to increase in the next decade. Constrained global meat supply also lifts export prices for the sector, incentivising New Zealand suppliers to ramp up production and hire more workers.

Table 34 provides a breakdown of the red meat and wool sector.

Table 34 Breakdown of the red meat and wool sector – BAU scenario, by value chain

Workforce requirements in 2032

Industry	Core production	Core processing/ Manufacturing	Strongly connected	Relevant	Other	Total Forecast	% Change
Red Meat	44,317	30,336	4,377	-	-	79,030	**10.4%**
Wool[21]	3,782	898	1,140	377	-	6,197	**0.9%**
Total Red Meat and Wool	48,099	31,235	5,517	377	-	85,227	**9.7%**

Source: NZIER

We also provide a breakdown by value chain designation and skill mix in Table 35.

[21] This includes the following ANZSIC06 classes: *Shearing Services*, *Cut and Sewn Textile Product Manufacturing, Natural Fibre Textile Manufacturing, Textile Floor Covering Manufacturing*, *Wool Scouring, Wool Wholesaling*. These ANZSIC06 classes were included within Red Meat and Wool in the data report, and appendix F of this report.

Table 35 Workforce numbers in the red meat and wool sector – BAU scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	29,111	12,898	6,090	48,099	**-0.7%**
Core Processing/Manufacturing	1,689	17,293	12,253	31,235	**31.0%**
Strongly Connected	368	2,974	2,175	5,517	**9.4%**
Relevant	17	212	147	377	**1.6%**
Total	31,185	33,377	20,665	85,227	**9.7%**
% of total	**36.6%**	**39.2%**	**24.2%**	**100%**	
% point Change from 2020	**-1.7%**	**3.2%**	**-1.5%**		

Source: NZIER

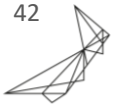
Global red meat exports are forecast to increase in the next decade in value terms. Constrained global meat supply also lifts export prices for the industry, incentivising New Zealand suppliers to ramp up production and hire more workers.

As a result of this increase in demand for New Zealand meat, we forecast the growth in workforce requirements for the red meat industry will primarily be focused on the core processing/manufacturing industries (relative to other sectors). In fact, we forecast the core production workforce for this industry to decrease very slightly in 2032. This is due to the disparity in historical productivity growth associated with core production and core processing/manufacturing for the meat industry. In the past decade, there has been significant productivity growth in the core production industries for the red meat industry, while growth in productivity has been static in the processing industries. Static productivity growth is the main driver of the expected increase in workforce. We expect this trend to continue in the coming years because:

- On-farm meat production becomes more efficient as farmers grow heavier lambs in shorter timeframes and increase lambing percentages
- Meat companies continue to focus on the volume of throughput and report low margins and return on assets.

Because of this, our productivity assumptions indicate that fewer workers are required to produce a higher output for red meat core production to account for the high productivity growth associated with core production industries. At the same time, a higher number of workers are required in the processing industries to process these increased outputs from core production (compared to the base year 2020).

The growth in red meat processing/manufacturing may be unexpected, considering recent trends in the sector. From our recent discussions with the red meat sector on developments and industry trends, we see a net positive effect on the workforce (increased



number of workers) but only incremental increases in productivity. Though, increasing the value of cuts produced may require more workers.

NZIER's understanding of the meat industry, discussions with the meat industry, and MPI views point to the following trends/challenges:

- If labour productivity increases, especially if the industry can produce higher-value products without needing more labour, the future workforce requirement will be lower
- Alternatively, our results suggest that processing capacity could be a pinch-point in the future because of labour constraints i.e. we do not have the supply of labour to match the significant increase in demand for labour.

How the meat industry evolves depends on how the industry meets its productivity challenges and the ability to attract workers in what is demographically an ageing industry. For wool, we forecast a small increase in workforce requirements in 2032 of around 0.9 percent. The wool industry includes shearing, wool scouring, textile manufacturing and related activities. These activities are expected to decrease due to continued trends in the sector, especially low prices for cross-bred wool. Wool is a co-product of sheepmeat for the industry.

As the sector shifts towards producing more meat and less wool (because of the relative prices of meat versus wool), it changes the balance of production to focus on meat, resulting in a decline in the quantity of wool produced. In terms of skill mix, we expect growth in the percentage for the semi-autonomous workforce while a slight decrease in the percentage of managers and managed workforce.

We are still forecasting a small growth in the number of managers and managed workforce required in 2032; the decrease in percentage points merely shows that the increase in the semi-autonomous workforce is higher than the other groups of workers. This is mainly because there are many semi-autonomous workers in the red meat and wool core processing/manufacturing industries. As we expect the core processing/manufacturing workforce to grow significantly in the next decade, the associated semi-autonomous workforce is also expected to grow by a corresponding amount.

4.10 Seafood

We forecast the seafood workforce sector to grow by 5.2 percent between 2020 and 2032. Table 36 details this growth by value chain designation and skill mix.

Table 36 Workforce numbers in the seafood sector – BAU scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	850	2,114	3,583	6,548	**2.9%**
Core Processing/Manufacturing	584	797	3,915	5,296	**10.1%**
Strongly Connected	149	280	804	1,233	**0.6%**
Relevant	60	113	325	498	**-0.4%**
Total	1,643	3,305	8,626	13,574	**5.2%**
% of total	**12.1%**	**24.3%**	**63.6%**	**100%**	
% point Change from 2020	**2.0%**	**2.5%**	**-4.5%**		

Source: NZIER

The seafood sector's growth in workforce requirements is focused on the processing industry. This is because although productivity in core production and core processing/manufacturing is expected to grow, productivity growth in core production is expected to be higher than in core processing/manufacturing. Therefore, the processing industry needs to hire more people to keep up with the demand for seafood processing that stems from the growth in seafood production.

As a sector that is highly dependent on regulation to operate, the outlook of the seafood sector will likely depend on the success of new innovations in aquaculture, government policies for aquaculture and fisheries, and fishing stock in our oceans. In New Zealand, the fish stocks are managed under the Quota Management System (QMS). The QMS sets out the limits of how much is allowed to be caught by fishers to support sustainable fishing (Ministry for Primary Industries, 2020a). Therefore, any increase in physical growth for the sector is likely to be dependent on QMS. However, we do expect prices for seafood products to increase in the coming decade as demand increases both domestically and internationally.

Aquaculture in New Zealand is driven by Greenshell™ mussels, King salmon, and Pacific oysters. Other industries are at varying stages of development. All are exported, but salmon and Greenshell™ mussels are driving industry growth.

4.11 Cross Sector

We forecast an increase in workforce counts of around 2.2 percent for the Cross Sector industries. These include a number of diverse industries, including Other Agriculture and Fishing Support Services, Veterinary Services, and road transport, so they are subject to several different drivers. One major part of the workforce that is partly in the Cross Sector workforce are contract workers for the Horticulture sector, but these cannot be easily separated from other Cross Sector businesses.

We include the skill mix forecast for the Cross Sector in Table 37.

Table 37 Workforce numbers in the Cross Sector – BAU scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	3,142	5,929	16,997	26,067	**-0.8%**
Strongly Connected	1,242	5,170	4,406	10,818	**3.4%**
Relevant	5,432	12,668	3,703	21,803	**4.7%**
Other	351	5,301	814	6,466	**4.6%**
Total	10,168	29,068	25,920	65,155	**2.2%**
% of total	**15.6%**	**44.6%**	**39.8%**	**100%**	
% point Change from 2020	**1.7%**	**2.8%**	**-4.4%**		

Source: NZIER

For the Cross Sector, we forecast a small decrease in workforce counts in core production. From a modelling perspective, this results from assuming more significant productivity increases in other food and fibre sectors. A larger productivity increase in other sectors means the Cross Sector have difficulties attracting workers. Given the increase in productivity in other sectors, and the constrained growth in some sectors like dairy and seafood, we expect growth in the Cross Sector workforce to be relatively limited, especially for industries closely linked to the dairy and seafood industries, like fishing support.

5 Increased use of technology scenario

In the increased use of technology scenario, we envision that food and fibre sectors take maximum advantage of existing and emerging technologies. This could mean better use of mechanisation, automation, or greater use of digital and information technologies.[22]

We expect that in this scenario, there are chances for larger productivity improvements associated with replacing human labour in some tasks for the core production industries. However, given the nature of tasks in the food and fibre workforce – the variability in plants, animals and terrain and working conditions such as dust, heat and rain – limit the use of machines.

There is potential for the core processing/manufacturing industries to adopt labour-saving technologies, e.g. the introduction of artificial intelligence and machine learning in horticultural post-harvest facilities to pack produce more efficiently and effectively.

[22] Some of this "greater user" of technology is measurable and some of it is difficult to measure. What we do know is that it is important for economic growth.

Although some processing industries, such as dairy processing, are already highly mechanised or automated, limiting the potential for future technological change.

This scenario is an attempt to summarise these changes by industry and forecast potential growth from a high uptake of technology.

5.1 Results by industries and value chain

Table 38 detail our forecasts for this scenario by sector and value chain. The results estimate that there will be around 396,000 workers in the food and fibre sectors in 2032, which is a 9.2 percent increase compared to the current workforce. This is also a 1.5 percentage point increase compared to the BAU scenario.

Table 38 Workforce numbers – increased use of technology scenario by sector and value chain

Workforce requirements in 2032

Sectors	Core production	Core processing/ Manufacturing	Strongly connected	Relevant	Other	Total	% Change from 2020
Arable	4,778	2,548	15,760	355	-	23,441	**4.6%**
Dairy	40,990	13,653	1,459	-	-	56,102	**6.0%**
Forestry and Wood Processing	14,948	12,130	17,040	185	-	44,303	**7.0%**
Horticulture	42,634	28,133	4,423	269	-	75,458	**14.3%**
Pork, Poultry, Bees and Other	10,953	5,399	14,824	-	-	31,176	**19.6%**
Red Meat and Wool	45,767	34,315	5,772	382	-	86,236	**11.0%**
Seafood	6,767	5,473	1,277	502	-	14,019	**8.7%**
Cross Sector	25,697	-	11,101	22,331	6,605	65,734	**3.1%**
Total	192,534	101,650	71,657	24,023	6,605	396,470	**9.2%**
Indicative % (Total)	**49%**	**26%**	**18%**	**6%**	**2%**	**100%**	
% point change from 2020	**-1.2%**	**2.4%**	**-0.6%**	**-0.1%**	**0%**		

Source: NZIER

5.1.1 Growth is evident across the food and fibre sectors, especially in core processing/manufacturing

The workforce counts across all the sectors will grow, ranging from 19.6 percent growth for the pork, poultry, bees and other sector to 4.6 percent growth in the arable sector. In most cases, this growth is driven by increased productivity and export demand for each industry.

Most of the workforce will be in core production (49 percent). Core processing/manufacturing is expected to have 26 percent of the workforce, while strongly connected industries (18 percent), relevant industries (6 percent) and other (2 percent) make up other parts of the value chain. The core processing/manufacturing industry currently takes up around 23 percent of the workforce. We forecast the core processing/manufacturing industries to have the biggest growth compared to other roles in the value chain, which is a 2.4 percentage points increase compared to the 2020 workforce.

Under this scenario, we modelled export demand to grow between 10 and 42 percent for the sectors (see Table 16 for more details). This is the same export demand growth as the BAU scenario (except for arable). This means that this scenario allows us to examine how technology influences how we produce and process food and fibre and how that may influence the demand for labour and skills (by varying the technology parameter).

As demand for exports increases, the price for New Zealand exports will increase, and export revenue will grow, incentivising the sectors to expand production and engage more in export. This growth in production and disparities in productivity growth between core production and core processing/manufacturing in most sectors means that a bigger increase in the core processing/manufacturing workforce is required to expand processing ability to keep up with the increased output from core production.

Specifically, we modelled core production productivity to grow by around 27–37 percent for most sectors under this scenario. In comparison, we modelled core processing/manufacturing productivity to grow by around 11 percent for most sectors. This disparity in growth between production and processing means that processing/manufacturing industries will need more workers to expand their processing ability. This means the processing/manufacturing industries in the food and fibre sectors will need to increase their workforce to meet the processing demand for their products.

5.2 Results by sectors and skill mix

Table 39 tabulates our workforce forecast by skill mix.

If we tabulated our forecasting results by skill mix, the numbers indicate that we expect 27 percent of the 2032 workforce to be in the manager category, 37 percent of the workforce to be in the semi-autonomous category, and 36 percent of the workforce to be managed. Again, this indicates the need for more highly skilled workers in the food and fibre sectors and highlights the importance of upskilling the existing workforce by 2032.

One interesting aspect of our forecast under this scenario is that we expect slightly bigger growth in the managed and semi-autonomous categories for the 2032 workforce compared to the BAU. Growth in managed and semi-autonomous roles is mostly focused on the core processing/manufacturing industries. This is because although we have lifted productivity for core processing/manufacturing and core production under this scenario, we still expect higher productivity gains for core production, given the historical context.

We expect productivity in core production to increase significantly and lift the processing requirements for the food and fibre sectors. Therefore, even with lifted processing productivity, we still require a bigger growth in the core processing/manufacturing managed and semi-autonomous workforce to process outputs generated from the production industries.

We will dive deeper into the skill mix of each sector in the following section.

Table 39 Workforce numbers – increased use of technology scenario by skill mix

Workforce requirements in 2032

Sector	Managers	Semi-autonomous	Managed	Total	% Change from 2020
Arable	6,962	6,561	9,917	23,441	**4.6%**
Dairy	15,191	21,326	19,585	56,102	**6.0%**
Forestry and Wood Processing	11,569	13,470	19,265	44,303	**7.0%**
Horticulture	20,151	26,289	29,019	75,458	**14.3%**
Pork, Poultry, Bees and Other	9,454	12,728	8,995	31,176	**19.6%**
Red Meat and Wool	29,854	34,617	21,765	86,236	**11.0%**
Seafood	1,697	3,413	8,909	14,019	**8.7%**
Cross Sector	10,309	29,530	25,895	65,734	**3.1%**
Total	105,187	147,933	143,349	396,470	**9.2%**
Indicative % (Total)	**27%**	**37%**	**36%**	**100%**	
% point Change from 2020	**1.2%**	**2.1%**	**-3.3%**		

Source: NZIER

5.3 Growth in food and fibre sectors compared to the total economy.

Table 40 compares our forecast of the food and fibre sectors workforce under the increased use of technology scenario with Stats NZ's labour force projections for the entire economy. We forecast the food and fibre sectors workforce to grow by 9.2 percent under this scenario, which is slightly slower compared to the entire economy.

We expect the food and fibre sectors workforce to grow slightly slower than the rest of the economy. Our modelling is balancing several drivers of the workforce, and the net effect is this slightly slower growth. First, higher levels of productivity associated with the food and fibre sectors can expand their production and exports more efficiently than the rest of the

economy. This allows the sectors to expand production while using relatively fewer labour resources. On the other hand, this efficiency improvement also allows the sectors to attract more labour resources and pay higher wages, allowing them to produce more to meet the increasing demand. Finally, increases in export demand also affect the modelled output from the sectors.

Table 40 Labour force projections for the food and fibre sector and the total economy

Workforce requirements in 2032

Sectors	2020 workforce	2032 workforce forecast	% Change from 2020
Food and fibre sectors	363,160	396,470	**9.2%**
Total economy	2,904,000	3,215,300	**10.7%**

Source: Stats NZ, NZIER

5.4 Arable

Table 41 shows the skill mix forecast for the arable sector.

Table 41 Workforce numbers in the arable sector – increased use of technology scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	2,788	1,644	346	4,778	**5.6%**
Core Processing/Manufacturing	313	337	1,898	2,548	**32.0%**
Strongly Connected	3,828	4,292	7,641	15,760	**0.6%**
Relevant	34	288	32	355	**22.9%**
Total	6,962	6,561	9,917	23,441	**4.6%**
% of total	**29.7%**	**28%**	**42.3%**	**100%**	
% point Change from 2020	**2.8%**	**1.5%**	**-4.2%**		

Source: NZIER

For the arable sector, we forecast a 4.6 percent increase in workforce requirement by 2032 under the increased use of technology scenario compared to the 2020 workforce. With growth focused on core processing/manufacturing industries. This is mainly due to lower

expected growth in productivity for core processing/manufacturing. Therefore, the core processing/manufacturing industries need to acquire more labour resources to keep up with the increased processing demand from upstream industries like core production industries.

Although the sector is still expected to grow, the growth is less under this scenario than in the BAU scenario. The reasoning behind these results is twofold:

- Increased productivity in the arable sector: We forecast arable core production and core processing/manufacturing productivity to grow by an additional 10 percentage points compared to the BAU. This increase in processing productivity means that the arable industry can use labour resources more efficiently and hire fewer people.
- Constraints in the 2032 labour market: Our CGE model constrains the overall resources each sector can access. In other words, industries have to compete for resources like labour to expand their production. Under this assumption, industries with a better growth outlook and bigger productivity improvements can attract more labour than other industries. Therefore, the arable sector has to compete with other more successful sectors for labour resources.

Overall, we still expect both the production and workforce requirement of this sector to grow compared to 2020 but increased productivity, and labour market constraint means that the growth in workforce requirement is likely to be moderate.

5.5 Dairy

We show our forecast by value chain designations and skill mix for the dairy sector in Table 42.

Table 42 Workforce numbers in the dairy sector – increased use of technology scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	13,408	15,717	11,864	40,990	**6.4%**
Core Processing/Manufacturing	1,441	5,286	6,927	13,653	**5.0%**
Strongly Connected	342	323	794	1,459	**4.%**
Total	15,191	21,326	19,585	56,102	**6.0%**
% of total	**27.1%**	**38%**	**34.9%**	**100%**	
% point Change from 2020	**2.9%**	**2.2%**	**-5.0%**		

Source: NZIER

We forecast the dairy industry workforce to grow by 6 percent compared to the 2020 workforce because we expect the dairy industry to face regulatory constraints on water quality and climate change emissions.

These constraints mean that the dairy sector may have limited access to capital and experience lower levels of productivity gains, as reflected in our CGE productivity assumptions. However, we still expect the export demand for the dairy sector to grow by 10 percent under this scenario compared to the 2020 economy. Therefore, there's still workforce growth associated with the sector to expand.

5.6 Forestry and Wood Processing

We show our forecast by value chain designations and skill mix for forestry and wood processing sector in Table 43.

Table 43 Workforce numbers in the forestry and wood processing sector – increased use of technology scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	6,235	817	7,897	14,948	**17.1%**
Core Processing/Manufacturing	1,418	6,002	4,710	12,130	**8.4%**
Strongly Connected	3,874	6,579	6,587	17,040	**-1.4%**
Relevant	42	71	72	185	**8.2%**
Total	11,569	13,470	19,265	44,303	7.0%
% of total	**26.1%**	**30.4%**	**43.5%**	**100%**	
% point Change from 2020	**3.8%**	**1.3%**	**-5.0%**		

Source: NZIER

We forecast a 7.0 percent growth in labour requirements for the forestry and wood processing sector. Growth is focused mainly on core production and core processing/manufacturing industries. Interestingly, for the forestry and wood processing sector, we are not seeing disproportionately big growth in core processing/manufacturing industries evident in other sectors. This relatively even growth across the value chain is mainly because of the following:

- Even growth in productivity across the value chain – For the forestry and wood processing sector, we modelled core processing/manufacturing productivity to grow by 20 percent, based on interviews with industry experts. We are expecting increased investment in core processing/manufacturing as forestry grows. This growth rate is high and relatively on par with core production industries. Therefore, the growth in workforce requirements is also more evenly distributed.

- Exporting directly from core production – Core production industries engage heavily in exporting activities, with less need for processing than other sectors. A large share of the outputs from the core production industries in this sector are directly exported, without any need for domestic processing/manufacturing ability. Therefore, there's less processing/manufacturing demand for this sector.

The combination of exports directly from core production (that is, logs going from forest to port) and productivity growth in processing leads to lower levels of employment growth than some other sectors. In turn, the lower growth required in the size of the core processing/manufacturing sector and the general competition for labour in the economy actually produce a reduction in the workforce in strongly connected industries. This is an example of the importance of using a CGE model: the predicted workforce growth in many industries and sectors has to produce an offsetting decline somewhere in the economy.

5.7 Horticulture

Our forecasts for the horticulture sector by value chain designations and skill mix is included in Table 44.

Table 44 Workforce numbers in the horticulture sector – increased use of technology scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	10,316	10,127	22,190	42,634	**19.3%**
Core Processing/Manufacturing	8,763	14,755	4,615	28,133	**9.1%**
Strongly Connected	1,020	1,198	2,205	4,423	**5.0%**
Relevant	51	209	9	269	**10.1%**
Total	20,151	26,289	29,019	75,458	**14.3%**
% of total	**27%**	**34.8%**	**38%**	**100%**	
% point Change from 2020	**2.1%**	**0.3%**	**-2.4%**		

Source: NZIER

The workforce in the horticulture sector is expected to grow significantly by 2032 under this scenario. Similar to the BAU scenario, we expect this growth to be mainly driven by growth in the kiwifruit industry and the apple, wine, and pear growing industry.

This growth is largely driven by an increase in productivity and export demand. Under this scenario, we expect productivity in core production and core processing/manufacturing for these industries to increase by 10 percentage points compared to the BAU scenario, and export demand for the horticulture sector to grow by 42 percent compared to 2020. This increase in export demand increases exporting revenue and incentivizes the industry to

expand production, while productivity gains allow the industry to produce more outputs while using the inputs efficiently. This increase in efficiency also allows the industry to gain more revenue and better access to the labour market, allowing more workers to be hired to expand production further. We expect this positive loop to reinforce itself and boost the workforce numbers under this scenario.

Specifically, we forecast the workforce for the apple and pear and kiwifruit industries to grow by 52.1 and 48.1 percent. We expect these industries to benefit from productivity gains and increased output, therefore being able to hire more people and increase production.

5.8 Pork, Poultry, Bees and Other

Our forecasts for the pork, poultry, bees and other sector by value chain designations and skill mix is shown in Table 45.

Table 45 Workforce numbers in the pork, poultry, bees and other sector – increased use of technology scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	6,019	2,722	2,213	10,953	**13.2%**
Core Processing/Manufacturing	339	406	4,654	5,399	**46.6%**
Strongly Connected	3,096	9,600	2,128	14,824	**16.7%**
Total	9,454	12,728	8,995	31,176	**19.6%**
% of total	**30.3%**	**40.8%**	**28.5%**	**100%**	
% point Change from 2020	**1.1%**	**-0.6%**	**-0.5%**		

Source: NZIER

The pork, poultry, bees and other industry is also expected to experience large growth under this scenario. We forecast the workforce for the pork, poultry, bees and other industry to grow by 19.6 percent. We attribute this growth to large productivity gains in core production and core processing/manufacturing.

Although given the historical context, we still expect productivity in the core processing/manufacturing industries to be lower compared to core production. This is because core processing/manufacturing industries need to hire more workers to keep up with the increased processing/manufacturing demand coming from core production industries. Therefore, workforce growth in this sector is primarily focused on core processing/manufacturing.

5.9 Red Meat and Wool

Table 46 and Table 47 shows the workforce breakdown and the skill mix breakdown for the red meat and wool sector.

We expect the red meat industry to grow by 11 percent under this scenario compared to the current workforce. This is driven largely by increased output, productivity, and export demand. These improvements allow the industries to gain a comparative advantage over the other industries and hire more people.

One of the sectors in that we're forecasting a decrease in workforce requirement is the wool sector. Similar to the BAU scenario, we think this is mainly due to increased productivity boosting the industry's efficiency, allowing the industry to increase production by using fewer labour inputs.

Table 46 Breakdown of the red meat and wool sector workforce

Workforce requirements in 2032

Industry	Core production	Core processing/ Manufacturing	Strongly connected	Relevant	Other	Total Forecast	% Change
Red meat	42,039	33,410	4,613	-	-	80,062	**11.9%**
Wool[23]	3,728	905	1,159	382	-	6,174	**0.5%**
Total Red meat and wool	45,767	34,315	5,772	382	-	86,236	**11%**

Source: NZIER

[23] This includes the following ANZSIC06 classes: *Shearing Services*, *Cut and Sewn Textile Product Manufacturing, Natural Fibre Textile Manufacturing, Textile Floor Covering Manufacturing*, *Wool Scouring, Wool Wholesaling*. These ANZSIC06 classes were included within Red Meat and Wool in the data report, and Appendix F of this report.

Table 47 Workforce numbers in the red meat and wool sector – increased use of technology scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	27,620	12,263	5,884	45,767	**-5.5%**
Core Processing/Manufacturing	1,832	19,026	13,457	34,315	**43.9%**
Strongly Connected	384	3,113	2,275	5,772	**14.5%**
Relevant	18	215	149	382	**2.8%**
Total	29,854	34,617	21,765	86,236	**11%**
% of total	**34.6%**	**40.1%**	**25.2%**	**100%**	
% point Change from 2020	**-3.6%**	**4.2%**	**-0.5%**		

Source: NZIER

Table 47 shows the workforce forecast by skill mix for the red meat and wool sector, we expect this growth to be mainly focused on core processing/manufacturing industries, and we see a decline in the workforce requirement from core production for the red meat and wool sector. This is because we expect core production industries to achieve higher productivity levels than core processing/manufacturing industries by 2032. Therefore, a smaller number of workers are enough for the core production industries to expand production, while core processing/manufacturing industries still need to increase their workforce requirements to keep up with the increasing processing/manufacturing demand.

Interestingly, we are also forecasting a reduction in the percentage of managers in the red meat and wool sector. The reasons for this are:

- We are forecasting a decline in workforce requirements for red meat and wool core production. In this value chain designation, the majority of the workforce is managers. Therefore, a decline in core production will decrease the number of managers required by 2032.
- The increase in workforce requirement for the red meat and wool sector is focused on the core processing/manufacturing workforce. This value chain designation is dominated by semi-autonomous workers, while the number of managers in this sector is relatively low. Therefore, the increase in the workforce in this value chain designation is focused on semi-autonomous workers.

Together, our results suggest that workforce increases for the red meat and wool sector are primarily focused on semi-autonomous workers.

5.9.1 Red Meat and Wool sensitivity testing

To ensure that the scenarios reflected a continuum of results, we have done further analysis on the productivity within the Red Meat and Wool sector. In our preferred

scenario, described above we have a 1 percent productivity gain over the period. We conducted sensitivity analysis to determine the impact of an 11 percent increase in the Red Meat and Wool sector productivity between 2020 and 2032. By using an 11 percent productivity shock, we bring the Red Meat and Wool sector into line with other food and fibre sectors.

The results for the increased technology scenario are set out in the following tables by workforce breakdown and skill mix. As expected, the number of workers in the Red Meat and Wool processing sector required falls with increased sector productivity. However, the number of on-farm workers increases. This suggests that increased productivity in processing (with a reduced number of workers), is likely to improve profitability and wages in red meat processing, which will also increase returns to farmers, which will likely increase stimulate an increased production (requiring extra workers). Overall, this increases the demand for workers in the sector.

As a result, the skill mix changes in processing as more specialist workers (increased managers and semi-autonomous workers) are required.

This indicates the results are sensitive to the assumptions made. While, it is often challenging to achieve productivity gains, this sensitivity analysis highlights both the importance of continuing to strive for greater productivity gains and also how these gains may impact throughout the value chain and other parts of the economy.

Table 48 Breakdown of the red meat and wool sector workforce

Workforce requirements in 2032: with an 11 percent productivity shift

Industry	Core production	Core processing/ Manufacturing	Strongly connected	Relevant	Other	Total Forecast	% Change
Red meat	44,899	32,315	4,465	-		81,737	**14%**
Wool[24]	3,982	875	1,122	382		6,304	**3%**
Total Red meat and wool	48,881	33,191	5,587	382		88,042	**13.3%**

Source: NZIER

[24] This includes the following ANZSIC06 classes: *Shearing Services*, *Cut and Sewn Textile Product Manufacturing, Natural Fibre Textile Manufacturing, Textile Floor Covering Manufacturing*, *Wool Scouring, Wool Wholesaling*. These ANZSIC06 classes were included within Red Meat and Wool in the data report, and Appendix F of this report.

Table 49 Workforce numbers in the red meat and wool sector – increased use of technology scenario, by skill mix

Workforce requirements in 2032: with an 11 percent productivity shift

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	29,634	13,114	6,133	48,881	**0.9%**
Core Processing/Manufacturing	1,782	18,391	13,018	33,191	**39.2%**
Strongly Connected	377	3,008	2,204	5,587	**10.8%**
Relevant	18	216	150	382	**2.9%**
Total	31,810	34,729	21,505	88,042	**13.3%**
% of total	**36%**	**39%**	**24%**	**100%**	
% point Change from 2020	**-2.1%**	**3.5%**	**-1.3%**		

Source: NZIER

5.10 Seafood

Table 50 shows the skill mix breakdown for the seafood sector.

Table 50 Workforce numbers in the seafood sector – increased use of technology scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	878	2,185	3,703	6,767	**6.3%**
Core Processing/Manufacturing	604	823	4,046	5,473	**13.8%**
Strongly Connected	154	290	832	1,277	**14.2%**
Relevant	60	114	327	502	**0.4%**
Total	1,697	3,413	8,909	14,019	**8.7%**
% of total	**12.1%**	**24.3%**	**63.5%**	**100%**	
% point Change from 2020	**2.0%**	**2.5%**	**-4.5%**		

Source: NZIER

For the seafood sector, we forecast the workforce requirements to grow by 8.7 percent compared to 2020 under this scenario. Growth is evident in core production and

core/processing/manufacturing industries. The growth is attributed to production and processing/manufacturing productivity growth and increased export demand. We also forecast higher growth in core processing/manufacturing because we expect lower productivity growth in this value chain designation. Therefore, more workers need to be hired to expand processing/manufacturing ability.

We discussed the constraints for the seafood sector in section 4.10 of this report. We have not modelled the Aquaculture Strategy in our work. The New Zealand Government's Aquaculture Strategy sets out pathways for the aquaculture sector to grow sustainably. (Ministry for Primary Industries, 2019) This sustainable growth is supported by maximising the value of existing farms, increasing innovation, extending to high value aquaculture, and moving aquaculture production to the open ocean. For that Strategy, these pathways support the growth in both value and volume of New Zealand's aquaculture sector, allowing the sector to increase workforce requirements overtime. This complements the direction of growth to in 2032.

5.11 Cross Sector

Table 51 shows the skill mix breakdown for the Cross Sector industries.

Table 51 Workforce numbers in the Cross Sector – increased use of technology scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	3,097	5,845	16,755	25,697	**-2.2%**
Strongly Connected	1,274	5,323	4,504	11,101	**6.1%**
Relevant	5,579	12,948	3,804	22,331	**7.2%**
Other	359	5,415	832	6,605	**6.9%**
Total	10,309	29,530	25,895	65,734	**3.1%**
% of total	**15.7%**	**44.9%**	**39.4%**	**100%**	
% point Change from 2020	**1.7%**	**3.1%**	**-4.8%**		

Source: NZIER

For the Cross Sector, we expect the overall workforce to increase by 3.1 percent under this scenario, with some decline coming from core production. Specifically, this decline is attributed to ANZSIC06 code A052900, "Other agriculture and fishing support services". Similar to the BAU scenario, this is because:

- We assumed larger productivity increases in other food and fibre sectors, making it difficult for the Cross Sector to attract workers in a competitive economy.

- The “Other agriculture and fishing support services” industry is also dependent on other sectors like dairy and seafood.[25] With constrained growth in these sectors, the workforce for this ANZSIC06 code is likely to decrease.

Overall, we still forecast the workforce for all sectors to grow by 2032 compared to the current workforce under this scenario.

[25] There is a mixture of managed, semi-autonomous, and managers in this ANZSIC06 code. Some will be more highly paid than others, e.g. artificial insemination services or aerial mustering will be more highly paid than managed horticultural workers. This means it is difficult to estimate workforce counts when wages are so variable.

6 Transformed sector scenario

In the transformed sector scenario, we build on the assumptions/results from the increased use of technology in the previous scenario and add a concern for sustainability. We focus on high-value products and markets in this scenario and ask:

- What if industry and government growth aspirations are met. What will the workforce required to meet those aspirations?
- What if productivity grows faster or slower and what that means for workforces in different sectors.

Although, we have not modelled the Government and sector roadmap, *Fit for a Better World*, this scenario picks on similar themes within that roadmap. The initiative is based on three principles:

- Te Taiao – the food and fibre sectors will be based on a holistic idea of people, the environment and the economy, derived from kaupapa Māori.
- Zero carbon – the sector is producing and processing products using methods that move the sector toward net zero carbon while reducing impacts on freshwater.
- Quality products and a confident sector – the sector has the knowledge and resources it needs to produce high-value products and export them to the world from a position of strength and assurance.

Similar to *Fit for a Better World*, our transformational scenario is ambitious. If the aspirations within this scenario are achieved, then this will result in a story where investment in people and the environment increases, and the sector transformation is reflected through an increased focus on high-value products for high-value markets.

Research and experience have demonstrated that premiums can be achieved for products that can make credible claims for sustainability. They have also shown that moving away from simple commodities to more processed products can move the sector down the value chain and capture more of the consumer's spending

6.1 Results by industries and value chain

The forecasts by industry and value chain are detailed in Table 52. Overall, we estimate that there will be around 421,000 workers in the food and fibre industry in 2032 under this scenario, which is a 15.8 percent increase compared to the current workforce.

Compared to the BAU, we forecast the workforce to grow by an additional 8.1 percentage points under the transformed Sector scenario.

Table 52 Workforce numbers – transformed sector scenario by sector and value chain

Workforce requirements in 2032

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Relevant	Other	Total	% Change from 2020
Arable	4,976	2,563	15,923	366	-	23,828	**6.3%**
Dairy	42,207	14,068	1,496	-	-	57,772	**9.1%**
Forestry and Wood Processing	16,340	12,895	17,328	198	-	46,762	**12.9%**
Horticulture	42,510	28,855	4,531	271	-	76,167	**15.4%**
Pork, Poultry, Bees and Other	11,439	6,272	15,246	-	-	32,957	**26.5%**
Red Meat and Wool	54,080	39,972	6,120	382	-	100,553	**29.4%**
Seafood	7,020	5,659	1,310	504	-	14,492	**12.4%**
Cross Sector	27,374	-	11,352	22,667	6,689	68,083	**6.8%**
Total	205,946	110,284	73,306	24,389	6,689	420,615	**15.8%**
Indicative % (Total)	**49%**	**26%**	**17%**	**6%**	**2%**	**100%**	
% point change from 2020	**-1.2%**	**3.0%**	**-1.3%**	**-0.4%**	**-0.1%**		

Source: NZIER

6.1.1 Growth is largely driven by increased productivity and export demand

We forecast significant growth for most industries compared to the BAU. Especially for red meat and wool and pork, poultry, bees and other.

A combination of factors promotes this significant growth in the food and fibre sectors:

- Increased productivity: The productivity gains under this scenario are expected to be substantial. This productivity gain allows the industries to aim for high-revenue markets and supply high-quality products. The increase in revenue means industries can engage in more production and lift the workforce requirements to a high level.
- Increased export demand: In addition to the increase in productivity, we also expect export demand to increase significantly. Under this scenario, food and fibre exports

are focused on premium products, these products are expected to be in consistently high demand across global markets. Customers pay high prices for New Zealand products and incentivise the production chain to develop and increase their outputs, allowing the sectors to lift up their labour requirements.

Our forecasts also highlight the differences in growth profiles across different industries. For example, we forecast the pork, poultry, bees and other industry to grow by 26.5 percent, while we only forecast the arable industry to grow by 6.3 percent under this scenario. Although these are significant growth rates higher than the BAU, there are still considerable differences in how each sector will likely evolve in the next decade.

Consistent with the increased use of technology scenario, we expect relatively uneven growth results across the sectors. The approach used constrains the use of labour and capital to mimic real world conditions, e.g. we have assumed that the labour force in the economy is a function of demographics, including a low level of natural increase and constrained immigration. These factors are consistent with demographic projections from Stats NZ. This means that the industries have to compete with each other to acquire employees. This competition means that industries with higher growth profiles and export demand can hire more workers by outbidding the competition.

We believe that given New Zealand is a relatively small country with a tight labour market, this assumption is appropriate to reflect the outlook of the New Zealand economy. It also shows that we focus on industries with a strong competitive advantage while ensuring growth across industries under this scenario.

6.2 Results by sectors and skill mix

Table 53 shows the high level skill mix forecast for the food and fibre sectors.

In terms of skill mix, we see growth in the number of workers across the skill mix in the food and fibre sectors under this scenario, with bigger growth associated with managers and the semi-autonomous workforce.

Our forecasts by skill mix detailed in Table 53 under this scenario again highlight the importance of educating and training highly skilled workers to ensure the industries function efficiently and productively. These forecasts indicate the importance of managers and semi-autonomous workers in the food and fibre sectors. It also highlights the need for the food and fibre sectors to upskill the current workforce.

We dive deeper into the skill mix of each sector in the following section.

Table 53 Workforce numbers – transformed sector scenario by skill mix

Workforce requirements in 2032

Sector	Managers	Semi-autonomous	Managed	Total	% Change from 2020
Arable	7,121	6,684	10,023	23,828	**6.3%**
Dairy	15,642	21,962	20,168	57,772	**9.1%**
Forestry and Wood Processing	12,306	14,041	20,415	46,762	**12.9%**
Horticulture	20,328	26,712	29,127	76,167	**15.4%**
Pork, Poultry, Bees and Other	9,881	13,185	9,890	32,957	**26.5%**
Red meat and Wool	35,449	40,217	24,887	100,553	**29.4%**
Seafood	1,755	3,531	9,207	14,492	**12.4%**
Cross Sector	10,639	30,308	27,136	68,083	**6.8%**
Total	113,122	156,638	150,855	420,615	**15.8%**
Indicative % (Total)	**27%**	**37%**	**36%**	**100%**	
% point Change from 2020	**1.6%**	**2.0%**	**-3.6%**		

Source: NZIER

6.3 Growth in food and fibre sectors compared to the total economy.

Table 54 shows the food and fibre sectors workforce projections under the transformed sector scenario and Stats NZ's labour force projections for the entire economy. We forecast the food and fibre sectors workforce to grow by 15.8 percent under the transformed sector scenario, which is about 50 percent higher than the growth rate forecast by Stats NZ for the workforce as a whole.

Under the transformed sector scenario, we modelled productivity and export demand of the food and fibre sectors to increase significantly in the next decade, demonstrating the focus of the food and fibre sector on high-value products and markets. Given these assumptions, we expect the food and fibre sectors to increase production to meet international demand for New Zealand products. We also expect the workforce to grow significantly, allowing the food and fibre sectors to expand production.

Table 54 Labour force projections for the food and fibre sector and the total economy

Workforce requirements in 2032

Sectors	2020 workforce	2032 workforce forecast	% Change from 2020
Food and fibre sectors	363,160	420,615	**15.8%**
Total economy	2,904,000	3,215,300	**10.7%**

Source: Stats NZ, NZIER

6.4 Arable

The skill mix forecast for the Arable sector is shown in Table 55.

Table 55 Workforce numbers in the arable sector – transformed sector scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	2,903	1,712	361	4,976	**10.0%**
Core Processing/Manufacturing	314	339	1,909	2,563	**32.8%**
Strongly Connected	3,867	4,336	7,720	15,923	**1.7%**
Relevant	35	297	33	366	**26.5%**
Total	7,121	6,684	10,023	23,828	**6.3%**
% of total	**29.9%**	**28.1%**	**42.1%**	**100%**	
% point Change from 2020	**2.9%**	**1.5%**	**-4.5%**		

Source: NZIER

For the arable sector, we forecast a 6.3 percent increase in workforce requirement by 2032 compared to the 2020 workforce under this scenario. With growth skewed more towards core processing/manufacturing industries.

Similar to BAU and the increased use of technology scenario, this is mainly due to lower expected productivity growth in core processing/manufacturing. Although we expect core processing/manufacturing productivity to grow by 11 percent under this scenario, it's still relatively low compared to the 37 percent expected productivity growth associated with core production industries. Therefore, core processing/manufacturing industries need to lift their workforce required to keep up with processing demand.

6.5 Dairy

Our skill mix forecast for the dairy sector is detailed in Table 56.

Table 56 Workforce numbers in the dairy sector – transformed sector scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	13,807	16,184	12,217	42,207	**9.5%**
Core Processing/Manufacturing	1,484	5,446	7,138	14,068	**8.2%**
Strongly Connected	351	331	814	1,496	**6.9%**
Total	15,642	21,962	20,168	57,772	**9.1%**
% of total	**27.1%**	**38%**	**34.9%**	**100%**	
% point Change from 2020	**2.8%**	**2.2%**	**-5.0%**		

Source: NZIER

We forecast a 9.1 percent increase in workforce requirement for the dairy sector under this scenario, with the increase distributed relatively evenly across the value chain designations. This increase is driven by the high international demand for New Zealand dairy products, and we assume export demand for New Zealand dairy to increase by 20 percent between 2020 and 2032. The increase in export demand is attributed to shifting our dairy exports into higher-value products and ingredients markets.[26] Under this scenario, we assume New Zealand dairy exports to be highly desirable in the world. This increase in export demand drives up prices for dairy products, incentivising dairy producers to expand production and revenue, and lift their workforce requirement for this sector.

6.6 Forestry and Wood Processing

We forecast a 12.9 percent growth in labour requirements for the forestry and wood processing sector under this scenario. This growth is mainly focused on core production industries. Similar to the increased use of technology scenario, this growth is driven by increased export demand for goods produced by core production industries.

To promote increased capacity in wood processing, the New Zealand government has been encouraging international and domestic investors to invest in the wood processing sector. New Zealand wood processing sector offers the following benefits (Invest New Zealand, 2020):

- Versatility: New Zealand forestry sector offers the most versatile softwood species

[26] Fonterra has developed a strategy that moves product from volume markets into higher value. The focus is on ingredients, consumer, and food service markets.

- Sustainability: Forestry products in New Zealand are required to comply with robust environmental standards
- Availability: New Zealand's harvest wood availability is forecast to exceed 25 million cubic metres every year for the foreseeable future
- Capability: New Zealand has a well-established wood processing sector with infrastructure
- Stability: New Zealand is the best place for business, offering a safe, stable and transparent place to invest.

Although a significant portion of New Zealand forestry products are exported directly, New Zealand has huge potential to process forestry outputs domestically. If the sector can attract more investment and expand its processing capacity, the wood processing sector and the wood processing workforce have the potential to grow in the future. Increased demand in the wood processing sector will drive demand for workers in that sector.

With these factors in mind, our skill mix forecast for the forestry and wood processing sector is detailed in Table 57.

Specifically, with export demand for the sector growing by 30 percent under this scenario, core production industries are more engaged with the international market. Strong international demand bid up prices for New Zealand forestry and wood processing products, lifting workforce requirements for the sector.

In the transformed scenario, the growth in employment is more in silviculture than wood processing. Possibly this reflects the strong productivity and demand for less processed wood products. However, the Forestry and wood processing sector suggests there is plenty of potential beyond the forest and implementing the Forestry and Wood Processing Industry Transformation Plan will likely realise this potential and increase the demand for skills and labour. The ITP aims to increase wood processing in New Zealand and contribute to the growth of a low-carbon, high-value industry through actions that lead to processing more logs and residues onshore, increasing our production of value-added wood products, and through providing fuel to the growing bioeconomy.

The ITP goals include growing the wood processing sector by 3.5 cubic metres (25 percent), along with increasing the use of domestic timber in construction by 25 percent by 2030.

The ITP also supports the emerging woody biomass industry to enhance the utilisation of forestry yields and grow the workforce associated with woody biomass. Woody biomass can be turned into a range of high-value low-emissions products and recent technological developments are expanding what we can make from wood fibre. Emerging products include engineered wood products for construction and furniture, biochemicals and biopharmaceuticals to replace plastics and other products relying on petrochemicals, solid biofuels like wood pellets and energy chip can replace coal and gas for heating, liquid transport biofuels that replace fossil-fuel derived diesel, petrol, aviation and marine fuels.

Table 57 Workforce numbers in the forestry and wood processing sector – transformed sector scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	6,815	893	8,632	16,340	**28.0%**
Core Processing/Manufacturing	1,506	6,381	5,009	12,895	**15.3%**
Strongly Connected	3,940	6,691	6,698	17,328	**0.2%**
Relevant	45	76	77	198	**15.8%**
Total	12,306	14,041	20,415	46,762	**12.9%**
% of total	**26.3%**	**30%**	**44%**	**100%**	
% point Change from 2020	**4.0%**	**0.9%**	**-4.9%**		

Source: NZIER

6.7 Horticulture

We detail our forecast for the horticulture sector in Table 58.

Table 58 Workforce numbers in the horticulture sector – transformed sector scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	10,287	10,160	22,063	42,510	**18.2%**
Core Processing/Manufacturing	8,944	15,117	4,794	28,855	**11.9%**
Strongly Connected	1,045	1,224	2,262	4,531	**7.6%**
Relevant	52	211	9	271	**11.2%**
Total	20,328	26,712	29,127	76,167	**15.4%**
% of total	**26.7%**	**35.1%**	**38.2%**	**100%**	
% point Change from 2020	**2.1%**	**0.5%**	**-2.6%**		

Source: NZIER

For the horticulture sector, we forecast overall workforce requirements to grow by 15.4 percent under the transformed sector scenario. There's growth forecasted along every component of the value chain, with a higher growth rate associated with core production and core processing/manufacturing. The core production industries are expected to grow by 18.2 percent between 2020 and 2032.

The growth in the workforce requirement for horticulture core production is mainly driven by apple and pear growing and kiwifruit growing industries. The apple and pear growing (ANZSIC06 code A013400) and kiwifruit growing (ANZSIC06 code A013200) industries' workforce is forecast to grow by 50 percent and 54 percent, respectively, between now and 2032 under this scenario, which is an additional 8.7 percentage points for apple and pear growing and 6 percentage points for kiwi fruit growing compared to the BAU. This growth is mainly attributed to strong export demand growth and increased core production productivity from these industries.

Industry has suggested (particularly apples and pears) that growth in the workforce will be moderate despite big increases in volume. This is attributed to the increased use of mechanisation both in the orchard and packhouses. This will impact other ANZSIC06 codes associated with horticulture.

Under this scenario, we expect New Zealand apple and pear, and kiwifruit growers to engage closely with high-end markets and deliver good quality goods. Especially given the high expected demand for the products associated with these industries.

Under this scenario, the viticulture and winemaking industries' workforce is also expected to grow by 10 percent in the next decade as New Zealand wine continues to gain increased recognition and customers worldwide pay higher prices for our products.

We also forecast the workforce requirements for the summerfruit industry (ANZSIC06 code A013500) to grow by 5 percent under this scenario, with growth focused on managers and semi-autonomous workers.

6.8 Pork, Poultry, Bees and Other

We detail our forecast for the pork, poultry, bees and other sector in Table 59.

Table 59 Workforce numbers in the pork, poultry, bees and other sector – transformed sector scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	6,304	2,843	2,292	11,439	**18.2%**
Core Processing/Manufacturing	394	471	5,407	6,272	**70.3%**
Strongly Connected	3,184	9,870	2,191	15,246	**20.0%**
Total	9,881	13,185	9,890	32,957	**26.5%**
% of total	**30%**	**40%**	**30%**	**100%**	
% point Change from 2020	**0.8%**	**-1.4%**	**0.6%**		

Source: NZIER

We forecast the pork, poultry, bees and other sector to have the biggest growth in the workforce by 2032 under the transformed sector scenario, with most of the increased workforce coming from core processing/manufacturing industries.

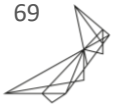
Specifically, we expect the workforce requirements for the core processing/manufacturing sector to grow by 70 percent. Under this value chain designation is the poultry processing industry (ANZSIC06 code C111200). We forecast this industry to have 6,272 workers by 2032, compared to 3,863 workers in 2020.

This growth is driven by disparities in productivity growth between core production and core processing/manufacturing. We have modelled expected productivity in the core processing/manufacturing industries to be lower compared to core production, given the historical context. Therefore, core processing/manufacturing industries need more workers to expand their processing/manufacturing ability and to keep up with increased production from upstream industries.

6.9 Red Meat and Wool

The forecasts for the Red Meat and Wool sector are aspirational. Two critical issues dominate our assumptions:

- It reflects an industry which can overcome the challenges of climate change. The livestock sector has responded positively to challenges before, i.e. the challenges faced by the livestock industry are not that dissimilar to those faced under the 1980s reforms. Agriculture, in general, was characterised as a sunset industry, but it thrived.
- An expected increase in demand for sheepmeat in particular, i.e. OCED/FAO forecasts suggest restricted sheepmeat supply from New Zealand will positively impact on the price of sheepmeat for producers. Couple this with the marketing assumptions associated with the Transformation scenario, the expected value improvements are possible, albeit at the high end of the spectrum of forecasts.



These two assumptions have a significant impact on workforce requirements. Table 60 shows the workforce breakdown for the red meat and wool sector.

Table 60 Breakdown of the red meat and wool sector

Workforce requirements in 2032

Industry	Core production	Core processing/ Manufacturing	Strongly connected	Relevant	Other	Total Forecast	% change from 2020
Red meat	50,108	38,949	4,931	-	-	93,988	**31.3%**
Wool[27]	3,972	1,023	1,189	382	-	6,565	**6.9%**
Total Red meat and wool	54,080	39,972	6,120	382	-	100,533	**29.4%**

Source: NZIER

For the red meat sector, our forecasts suggest that this sector will grow by 31.3 percent between now and 2032 under this scenario. Similar to our overall results, this growth is largely driven by increased productivity and export demand, given the strength of New Zealand exports. We also forecast the workforce requirements for the New Zealand wool sector to grow by 6.9 percent in 2032.

Table 61 Workforce numbers in the red meat and wool sector – transformed sector scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	32,903	14,523	6,653	54,080	**11.6%**
Core Processing/Manufacturing	2,125	22,174	15,673	39,972	**67.6%**
Strongly Connected	403	3,305	2,412	6,120	**21.4%**
Relevant	18	215	149	382	**2.9%**
Total	35,449	40,217	24,887	100,553	**29.4%**
% of total	**35.3%**	**40%**	**24.7%**	**100%**	
% point Change from 2020	**-3.0%**	**4.0%**	**-1.0%**		

Source: NZIER

[27] This includes the following ANZSIC06 classes: *Shearing Services*, *Cut and Sewn Textile Product Manufacturing, Natural Fibre Textile Manufacturing, Textile Floor Covering Manufacturing*, *Wool Scouring, Wool Wholesaling*. These ANZSIC06 classes were included within Red Meat and Wool in the data report, and appendix F of this report.

Under this scenario, we expect New Zealand red meat products to be highly valued in the international market. We modelled export demand growth for this sector to grow by 50 percent according to consultation with the working group, which means international demand for New Zealand red meat products will be very high. This high demand bids up prices for red meat products, making the sector highly profitable and can easily attract labour and capital resources.

Similar to the pork, poultry, bees and other sector, we forecast higher growth for the core processing/manufacturing industries compared to other parts of the value chain designations due to disparities in productivity growth between core production and core processing/manufacturing. Because we expect core production industries to have a higher level of productivity, a smaller workforce will be enough for the core production industries to expand production, while significant growth in workforce requirement for core processing/manufacturing industries is needed to meet the demand for processing/manufacturing.

6.9.1 Sensitivity testing for Red Meat and Wool

Further analysis of the productivity within the Red Meat and Wool sector has been done in the Transformation scenario. Sensitivity analysis has focused on productivity by illustrating the impact of an 11 percent increase in red meat and wool productivity between 2020 and 2032. This brings the productivity and demand assumptions for the sector into line with other food and fibre sectors.

The results for the transformation scenario are set out in the following tables by workforce breakdown and skill mix. As expected, the number of workers in the red meat and wool processing sector required falls with increased sector productivity. However, the production sector gains workers. Strong productivity in processing (with fewer workers) removes impediments that stimulate growth in production (with increased workers). Overall, this increases the demand for workers in the sector.

Increased productivity drives the demand for increased skills. More workers are required in the manager and semi-autonomous categories.

As mentioned earlier, this analysis indicates the results are sensitive to the assumptions made in the analysis. While, it is often challenging to achieve productivity gains, this sensitivity analysis highlights both the importance of continuing to strive for greater productivity gains and also how these gains may impact throughout the value chain and other parts of the economy.

Table 62 Breakdown of the red meat and wool sector

Workforce requirements in 2032: with an 11 percent productivity shift

Industry	Core production	Core processing/ Manufacturing	Strongly connected	Relevant	Other	Total Forecast	% change from 2020
Red meat	53,522	37,647	4,775	-		96,001	**34%**
Wool[28]	4,242	989	1,151	383		6,706	**9%**
Total Red meat and wool	57,764	38,635	5,926	383		102,708	**32%**

Source: NZIER

Table 63 Workforce numbers in the red meat and wool sector – transformed sector scenario, by skill mix

Workforce requirements in 2032: with an 11 percent productivity shift

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	35,288	15,531	6,946	57,764	**19.2%**
Core Processing/Manufacturing	2,069	21,414	15,153	38,635	**62.0%**
Strongly Connected	395	3,195	2,336	5,926	**17.6%**
Relevant	18	216	150	383	**3.2%**
Total	37,769	40,355	24,583	102,708	**32.2%**
% of total	**37%**	**39%**	**24%**	**100%**	
% point Change from 2020	**-1.5%**	**3.3%**	**-1.8%**		

Source: NZIER

6.10 Seafood

The Aquaculture Strategy by the New Zealand Government set out pathways for the aquaculture sector to grow sustainably (Ministry for Primary Industries, 2019). The strategy presents the following growth pathway for aquaculture:

- Maximising the value of existing farms and fishing methods through innovation: increase productivity, efficiency, and sustainability in the aquaculture and wild catch sector, and derive more value

[28] This includes the following ANZSIC06 classes: *Shearing Services*, *Cut and Sewn Textile Product Manufacturing, Natural Fibre Textile Manufacturing, Textile Floor Covering Manufacturing*, *Wool Scouring, Wool Wholesaling*. These ANZSIC06 classes were included within Red Meat and Wool in the data report, and appendix F of this report.

- Extending into high-value land-based aquaculture: Grow land-based hatcheries to increase aquaculture farming outputs
- Extending aquaculture into the open ocean. Open ocean farming may be a big opportunity for aquaculture growth instead of enclosed bays and harbours where there are other legitimate uses and values.

Together with the Fisheries Industry Transformation Plan being developed, the aquaculture strategy sets out pathways for aquaculture and wild catch fisheries in a to sustainably grow to meet international demand.

Access to water space is the key constraint to aquaculture volume growth. The Government and industry continue to work together to resolve regulatory barriers to growth, and generate greater value from existing water space as set out in the Aquaculture Strategy.

In past decades, we have seen efficiency gains in the seafood sector in New Zealand. The Aquaculture Strategy and the ITP sets out pathways for aquaculture and wild catch fisheries in a sustainable manner, supporting growth in output and prices for seafood products in the coming decade as demand increases both domestically and internationally.

These efforts are driving the expected workforce in 2032 in these forecasts. In Table 64 we break down our forecast the seafood sector by skill mix.

Table 64 Workforce numbers in the seafood sector – transformed sector scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	911	2,267	3,841	7,020	**10.3%**
Core Processing/Manufacturing	625	851	4,183	5,659	**17.7%**
Strongly Connected	158	298	854	1,310	**6.9%**
Relevant	61	115	329	504	**0.9%**
Total	1,755	3,531	9,207	14,492	**12.4%**
% of total	**12.1%**	**24.4%**	**63.5%**	**100%**	
% point Change from 2020	**2.0%**	**2.5%**	**-4.5%**		

Source: NZIER

We forecast the seafood sector workforce to grow by 12.4 percent by 2032, with growth in core production and core processing/manufacturing value chain designations. We modelled core production and core processing/manufacturing productivity to grow by 27 percent and 11 percent, respectively. We also forecast global export demand for New Zealand seafood products to grow by 20 percent under the transformed sector scenario due to increased value and demand for New Zealand exports. We assume New Zealand seafood products will

focus on high-value products and export to high-value markets, lifting production and export revenue under this scenario. We forecast the sector will expand production to meet international, and in turn, higher revenue will make it easier for the seafood sector to attract labour.

We discussed the constraints for the aquaculture sector in section 4.10 of this report.

6.11 Cross Sector

Table 65 includes a breakdown by value chain designation and skill mix for the Cross Sector.

Table 65 Workforce numbers in the Cross Sector – transformed sector scenario, by skill mix

Workforce requirements in 2032

Value chain designation	Managers	Semi-autonomous	Managed	Total	% change from 2020
Core Production	3,299	6,226	17,849	27,374	**4.2%**
Strongly Connected	1,303	5,476	4,574	11,352	**8.5%**
Relevant	5,674	13,122	3,871	22,667	**8.8%**
Other	363	5,484	842	6,689	**8.2%**
Total	10,639	30,308	27,136	68,083	**6.8%**
% of total	**15.7%**	**44.5%**	**39.9%**	**100%**	
% point Change from 2020	**1.7%**	**2.7%**	**-4.3%**		

Source: NZIER

For the Cross Sector, we forecast the workforce requirements to grow by 6.8 percent. This growth is mainly; focused on strongly connected, relevant and other industries. Some of the industries we forecast strong growth for are:

- Strongly connected: fertiliser manufacturing (ANZSIC06 code C183100), veterinary services (ANZSIC06 code M697000).
- Relevant: road freight transport (ANZSIC06 code I461000), scientific research services (ANZSIC06 code M691000), etc.
- Other: labour supply services (ANZSIC06 code N721200).

The growth in these industries reflects the need for the Cross Sector to expand its services to better support other food and fibre sectors in their production activities.

7 Regional results

The following subsections discuss the regional impacts of each of the 15 regions.[29] For each region, we detail our forecast of the 2032 workforce by including the following results:

- Average 2020 workforce of each region
- Forecast of the average workforce requirement by 2032 under the BAU scenario.
- Forecast of the average workforce requirement by 2032 under the increased use of technology scenario.
- Forecast of the average workforce requirement by 2032 under the transformed sector scenario.
- Skill mix composition of the workforce for each scenario.

Before examining the regional analysis, we want to reiterate that our regional results derived from NZIER's TERM-NZ model are based on the NZSIOC classification. The NZSIOC classification can be matched with the ANZSIC06 classification in most circumstances, but this matching is imperfect. The imperfect matching means that the regional disaggregation is mostly in line with the current food and fibre workforce estimates. However, some discrepancies are evident in the regional analysis, especially for the Horticulture sector in regions like the Bay of Plenty. For more details on this limitation, please refer to section 3.1.2.

The following points also need to be considered:

- We do not report "Relevant" and "Other" value chain designations in the regional forecasts because it's unclear whether the resulting distribution will be sufficiently accurate.
- The impact of the broader NZSIOC classification is to increase the uncertainty around forecasts at the detailed region and sector level. We recommend combining our results with MPI's regional workforce counts to better understand the regional workforce.
- We will reference the regional growth production outlook in the following sections to provide some background for our workforce forecasts. For more details on the regional output growth, please refer to the CGE report.
- We have combined some designations, consistent with the data in www.workforceinsights.govt.nz. Data from this source was one input into deriving regional totals. A * has been used to identify where the value is combined with that in the column or columns to its left. Values that have been combined in this way have been excluded from column totals and indicative percentages.

7.1 Northland

7.1.1 2020 workforce, Northland

The 2020 workforce composition for the Northland Region is included in Table 66. On average, there were around 16,000 workers in the food and fibre sectors in 2020. Sixty-nine

[29] Nelson and Tasman regions have been combined together.

percent of the workforce is in core production, 15 percent in core processing/manufacturing, 9 percent in strongly connected.

In the Northland region, a significant portion of the food and fibre workforce works in the red meat and wool sector, the forestry sector and the horticulture sector.

The majority of people who are involved in Core processing/manufacturing and Strongly connected are involved in wood processing.

Table 66 Northland workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Total
Arable	118	128	*	246
Dairy	2,016	279	*	2,295
Forestry and Wood Processing	1,065	1,360	919	3,344
Horticulture	2,561	420	96	3,077
Pork, Poultry, Bees and Other	482	760	*	1,242
Red Meat and Wool	3,677	526	84	4,287
Seafood	280	108	30	418
Cross Sector	849	-	311	1,160
Total*	11,048	2,414	1,440	16,073
Indicative % (Total)*	**69%**	**15%***	**9%***	

Note: Some categories have been combined.

Source: NZIER

7.1.2 BAU scenario, Northland

Under the BAU scenario, our CGE modelling results suggest that Northland food and fibre production is forecast to be $6,560 million in 2032, equivalent to 4 percent of New Zealand's total national food and fibre production. Production in the food and fibre sectors is growing strongly, with horticulture leading the way (92 percent growth at $879 million). forestry and wood processing (57 percent at $1,725 million), and red meat and wool (47 percent at $1,437 million) are also rising steadily. Dairy is constrained but still is expected to grow (34 percent at $1,524 million). (More details on the regional growth profile are available in the CGE report.)

The workforce numbers for the BAU scenario are detailed in Table 67 below.

We forecast that by 2032, the average total workforce requirement in the Northland region will grow by 8.3 percent compared to 2020. This growth is mainly focused on sectors like horticulture, pork, poultry bees and other, and forestry and wood processing sectors.

In terms of growth by value chain designations, we forecast bigger growth in core processing/manufacturing compared to other designations, mainly due to disparities in productivity assumptions. (Productivity growth in core processing/manufacturing is forecast to be smaller than core production.)

Table 67 Northland workforce numbers – BAU scenario, by sector and value chain

Average Workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	114	132	*	246	**0.0%**
Dairy	2,148	291	*	2,439	**6.3%**
Forestry and Wood Processing	1,234	1,519	1,000	3,753	**12.2%**
Horticulture	2,901	459	99	3,459	**12.4%**
Pork, Poultry, Bees and Other	560	844	*	1,404	**13.0%**
Red Meat and Wool	3,649	694	90	4,433	**3.4%**
Seafood	297	121	31	449	**7.4%**
Cross Sector	886	-	334	1,220	**5.2%**
Total*	11,789	2,793	1,554	17,412	**8.3%**
% of total*	**68%**	**16%***	**9%***		
% point change from 2020*	**-1.0%**	**1.0%**	**0.0%**		

Note: Some categories have been combined.

Source: NZIER

7.1.3 Increased use of technology scenario, Northland

Northland's total food and fibre production is forecast to be $6,986 million in 2032 under this scenario, equivalent to 5 percent of New Zealand's total national food and fibre production.

Production in the food and fibre sectors is growing strongly, with horticulture leading the way (105 percent growth at $939 million). Forestry and wood processing (79 percent at $1,976 million), red meat, and wool (51 percent at $1,477 million) are also rising steadily. Dairy is constrained but still is expected to grow (33 percent at $1,509 million).

We detail our workforce forecast for Northland in Table 68. Under the increased use of technology scenario, we forecast the food and fibre workforce to grow by 9.6 percent compared to 2020. This growth is again mainly focused on sectors like horticulture, pork, poultry bees and other, and forestry and wood processing.

Table 68 Northland workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	110	129	*	239	**-2.8%**
Dairy	2,168	293	*	2,461	**7.2%**
Forestry and Wood Processing	1,323	1,552	974	3,849	**15.1%**
Horticulture	2,945	475	103	3,523	**14.5%**
Pork, Poultry, Bees and Other	580	926	*	1,506	**21.3%**
Red Meat and Wool	3,467	767	95	4,329	**1.0%**
Seafood	305	123	33	461	**10.3%**
Cross Sector	890	-	349	1,239	**6.8%**
Total*	11,788	2,917	1,554	17,614	**9.6%**
% of total*	**67%**	**17%***	**9%***		
% point change from 2020*	**-1.8%**	**1.5%**	**-0.1%**		

Note: Some categories have been combined.

Source: NZIER

7.1.4 Transformed sector scenario, Northland

Northland's total food and fibre production is forecast to be $7,463 million in 2032 under this scenario, equivalent to 5 percent of New Zealand's total national food and fibre production.

We estimate the horticulture sector output to grow by 103 percent at $927 million. Forestry and wood processing output to grow by 94 percent at $2,137 million, red meat and wool sector output to grow by 77 percent at $1,724 million, and the dairy sector output to grow by 36 percent at $1,547 million.

We detail our workforce forecast for Northland under the transformed sector scenario in Table 69. We forecast the food and fibre workforce to employ around 19,000 people by 2032, which is a growth of 17.5 percent compared to 2020. Strong growth is evident in all food and fibre sectors except arable, which is a relatively small workforce compared to the other sectors.

Table 69 Northland workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	114	131	*	245	**-0.4%**
Dairy	2,232	302	*	2,534	**10.4%**
Forestry and Wood Processing	1,453	1,648	1,008	4,109	**22.9%**
Horticulture	2,926	486	106	3,518	**14.3%**
Pork, Poultry, Bees and Other	606	969	*	1,575	**26.8%**
Red Meat and Wool	4,116	892	100	5,108	**19.2%**
Seafood	317	127	34	478	**14.4%**
Cross Sector	948	-	359	1,307	**12.7%**
Total*	12,712	3,153	1,607	18,884	**17.5%**
% of total*	**67%**	**17%***	**9%***		
% point change from 2020*	**-1.4%**	**1.7%**	**-0.4%**		

Note: Some categories have been combined.

Source: NZIER

7.1.5 Skill mix change, Northland

Regarding skill mix change, we forecast a bigger increase in managers and semi-autonomous workers for the Northland region. The percentage of managers in the workforce is forecast to increase by 1.4, 0.7 and 1.5 percentage points, respectively, under the three scenarios compared to 2020, while the percentage for semi-autonomous workers is also forecast to increase by 1.2, 1.4 and 1.3 percentage points, respectively.

Our results for Northland resonate with our findings at the national level, stressing the importance of up-skilling the workforce in the next decade.

Table 70 Northland workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	5,136	4,993	5,943	16,073
Percentage	32%	31%	37%	100%
BAU	5,805	5,625	5,982	17,412
% of total	33%	32%	34%	100%
% point change from 2020	1.4%	1.2%	-2.6%	
Increased use of technology	5,760	5,714	6,140	17,614

Scenarios	Managers	Semi-autonomous	Managed	Total
% of total	33%	32%	35%	100%
% point change from 2020	0.7%	1.4%	-2.1%	
Transformed sector	6,314	6,118	6,452	18,884
% of total	33%	32%	34%	100%
% point change from 2020	1.5%	1.3%	-2.8%	

Source: NZIER

7.2 Auckland

7.2.1 2020 workforce, Auckland

For the Auckland region, the 2020 workforce composition is detailed in Table 71. On average, we estimate around 50,000 workers in the food and fibre sectors, with most of the workforce in horticulture, arable, and forestry and wood processing.

Less than half of the food and fibre workforce in the Auckland region is involved in either Core production or Core processing/manufacturing activities, and more people are employed in Strongly connected, reflecting the large urban base. People involved in Core production or Core Processing/manufacturing in the Auckland region tend to be involved in horticulture.

Table 71 Auckland workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Total
Arable	102	551	9,878	10,531
Dairy	497	1,563	572	2,632
Forestry and Wood Processing	605	1,559	5,133	7,297
Horticulture	4,459	9,047	1,784	15,290
Pork, Poultry, Bees and Other	901	267	3,375	4,543
Red Meat and Wool	1,277	1,754	2,369	5,400
Seafood	181	912	500	1,593
Cross Sector	553	-	2,067	2,620
Total	8,575	15,652	25,678	49,905
Indicative % (Total)	**17%**	**31%**	**51%**	

Source: NZIER

7.2.2 BAU scenario, Auckland

Auckland's total food and fibre production is forecast to be $18,050 million in 2032 under the BAU scenario, which would be a 12 percent contribution to the total national food and fibre output. Auckland's economy is largely driven by manufacturing and service industries. By contrast, the food and fibre sectors' contribution is small.

Nonetheless, our workforce forecasts in Table 72 show that strong growth is still expected in Auckland's food and fibre sectors. The pork, poultry, bees and other sector is expected to grow by 9.4 percent, and the red meat and wool sector is forecast to grow by 13.2 percent. The arable and horticulture sector workforce is forecast to remain relatively static. We still expect production in these sectors to increase; however, given productivity growth in these two sectors, they can increase production efficiency without acquiring additional labour inputs.

Growth in value chain designations is centred around core processing/manufacturing. This is mainly due to core processing/manufacturing productivity being forecast to grow slower than productivity in core production. Therefore, more workers are required to expand processing/manufacturing ability.

Table 72 Auckland workforce numbers – BAU scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	119	647	10,081	10,847	**3.0%**
Dairy	527	1,630	565	2,722	**3.4%**
Forestry and Wood Processing	548	1,652	5,247	7,447	**2.1%**
Horticulture	4,510	9,524	1,785	15,819	**3.5%**
Pork, Poultry, Bees and Other	1,053	349	3,566	4,968	**9.4%**
Red Meat and Wool	1,316	2,266	2,532	6,114	**13.2%**
Seafood	188	1,003	495	1,686	**5.8%**
Cross Sector	490	-	2,072	2,562	**-2.2%**
Total	8,751	17,071	26,342	52,164	**4.5%**
% of total	**17%**	**33%**	**50%**		
% point change from 2020	**-0.4%**	**1.4%**	**-1.0%**		

Source: NZIER

7.2.3 Increased use of technology scenario, Auckland

Auckland's total food and fibre production is forecast to be $18,673 million in 2032; it will continue to make up 12 percent of the total national food and fibre output.

Like the BAU scenario, the city's economy is primarily driven by manufacturing and service industries, taking up 95 percent of the local economy. The food and fibre sectors contribute slightly to the remaining 5 percent.

In terms of outputs for the food and fibre sectors, the pork, poultry, bee and other sector is forecast to grow by 55 percent at $784 million, red meat and wool will grow 48 percent at $3,305 million, and arable by 47 percent at $3,712 million by 2032.

Under the increased use of technology scenario, we forecast the Auckland food and fibre workforce to grow by 4.6 percent compared to 2020. The detailed growth by sectors and value chain designation are listed in Table 73. The sectors with the biggest growth are pork, poultry, bees and other (15.2 percent growth) and the red meat and wool sector (18.2 percent growth). The horticulture sector workforce is also estimated to grow, primarily driven by increased export demand.

Table 73 Auckland workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	129	680	9,906	10,715	**1.7%**
Dairy	533	1,643	580	2,756	**4.7%**
Forestry and Wood Processing	539	1,463	4,852	6,854	**-6.1%**
Horticulture	4,471	9,641	1,836	15,948	**4.3%**
Pork, Poultry, Bees and Other	1,096	384	3,754	5,234	**15.2%**
Red Meat and Wool	1,292	2,471	2,619	6,382	**18.2%**
Seafood	193	1,038	507	1,738	**9.1%**
Cross Sector	467	-	2,104	2,571	**-1.9%**
Total	8,720	17,320	26,158	52,198	**4.6%**
% of total	**17%**	**33%**	**50%**		
% point change from 2020	**-0.5%**	**1.8%**	**-1.3%**		

Source: NZIER

7.2.4 Transformed sector scenario, Auckland

Auckland's total food and fibre production is forecast to be $19,539 million in 2032; it will continue to make up 12 percent of the total national food and fibre output.

Similar to the BAU scenario, the city's economy is primarily driven by manufacturing and service industries, taking up 95 percent of the local economy. As opposed to the food and fibre sectors, which contribute slightly to the remaining 5 percent.

In the food and fibre sectors, the pork, poultry, bee and other sector output will grow 68 percent at $852 million, red meat and wool sector output will grow by 70 percent at $3,789 million, and arable sector output is estimated to grow by 49 percent at $3,771 million.

The workforce forecast for the Auckland region under the transformed sector scenario is outlined in Table 74. We forecast Auckland's food and fibre sectors to grow by 8.2 percent. This growth is primarily driven by increased workforce requirements for core processing/manufacturing, given the need to expand processing ability.

Table 74 Auckland workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	135	685	9,979	10,799	**2.5%**
Dairy	549	1,693	595	2,837	**7.8%**
Forestry and Wood Processing	591	1,556	4,910	7,057	**-3.3%**
Horticulture	4,487	9,865	1,880	16,232	**6.2%**
Pork, Poultry, Bees and Other	1,138	446	3,858	5,442	**19.8%**
Red Meat and Wool	1,531	2,889	2,756	7,176	**32.9%**
Seafood	200	1,073	521	1,794	**12.6%**
Cross Sector	497	-	2,151	2,648	**1.1%**
Total	9,128	18,208	26,650	53,986	**8.2%**
% of total	**17%**	**34%**	**49%**		
% point change from 2020	**-0.3%**	**2.4%**	**-2.1%**		

Source: NZIER

7.2.5 Skill mix change, Auckland

In Table 75, we show the skill mix change for the Auckland region under each of the scenarios. With strong growth in managers and semi-autonomous workforce requirements under all scenarios, our results indicate the need for more skilled workers by 2032.

The urban/rural workforce skill mix is different in the food and fibre sectors. In Auckland, for example, there is a larger proportion of Strongly Connected food and fibre workforces, reflecting the number of head offices or people more focused on exporting, marketing and logistics. This may mean that the estimated skill mix may have larger confidence intervals than other regions.

Table 75 Auckland workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	10,246	21,459	18,200	49,905
Percentage	21%	43%	36%	100%
BAU	11,701	23,487	16,977	52,164
% of total	22%	45%	33%	100%
% point change from 2020	1.9%	2.0%	-3.9%	
Increased use of technology	11,668	23,609	16,920	52,198
% of total	22%	45%	32%	100%
% point change from 2020	1.8%	2.2%	-4.1%	
Transformed sector	12,066	24,411	17,509	53,986
% of total	22%	45%	32%	100%
% point change from 2020	1.8%	2.2%	-4.0%	

Source: NZIER

7.3 Waikato

7.3.1 2020 workforce, Waikato

We set out the 2020 workforce for the Waikato region in Table 76. With around 12,000 workers in the dairy sector, the food and fibre workforce in this region is dominated by dairy. Red meat and wool and Cross Sector also represent a significant share of the average workforce currently working in the food and fibre sectors in Waikato.

Table 76 Waikato workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Total
Arable	953	184	490	1,627
Dairy	8,584	3,222	102	11,908
Forestry and Wood Processing	1,287	1,388	1,776	4,451
Horticulture	2,323	1,057	281	3,661
Pork, Poultry, Bees and Other	2,085	487	467	3,039
Red Meat and Wool	5,776	2,975	197	8,948
Seafood	330	239	89	658
Cross Sector	2,616	-	1,879	4,495
Total	23,954	9,551	5,282	38,787
Indicative % (Total)	**62%**	**25%**	**14%**	

Source: NZIER

7.3.2 BAU scenario, Waikato

Under our CGE simulation, the Waikato region's total food and fibre production output is forecast to be $19,521 million, contributing 13 percent to the national food and fibre output in 2032.

Dairy dominates the Waikato economy by taking up 60 percent of the local food and fibre goods produced in the base year, but the figure will drop to 56 percent in 2032 due to constraints in productivity. Despite slow growth, the value of dairy production will still dominate Waikato's food and fibre sectors.

Table 77 shows our workforce forecast for the food and fibre sectors for the Waikato region. Although the dairy sector dominates the workforce in this region, we expect the dairy sector workforce to grow by only 5.3 percent, given potential regulatory constraints on land and environment.

In terms of value chain designation, we expect most of the increase to come from core processing/manufacturing industries.

Table 77 Waikato workforce numbers – BAU scenario, by sector and value chain

Average Workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	984	239	505	1,728	**6.2%**
Dairy	9,085	3,355	102	12,542	**5.3%**
Forestry and Wood Processing	1,361	1,531	1,878	4,770	**7.2%**
Horticulture	2,550	1,126	284	3,960	**8.2%**
Pork, Poultry, Bees and Other	2,419	658	497	3,574	**17.6%**
Red Meat and Wool	5,784	4,023	208	10,015	**11.9%**
Seafood	345	261	90	696	**5.8%**
Cross Sector	2,474	-	1,923	4,397	**-2.2%**
Total	25,002	11,192	5,487	41,681	**7.5%**
% of total	**60%**	**27%**	**13%**		
% point change from 2020	**-1.8%**	**2.2%**	**-0.5%**		

Source: NZIER

7.3.3 Increased use of technology scenario, Waikato

Total food and fibre production output is forecast to be $20,016 million, contributing 13 percent to the national food and fibre output in 2032.

Dairy dominates the Waikato economy by taking up 60 percent of the local food and fibre goods produced in the base year, but the figure will drop to 54 percent by 2032 due to constraints in productivity. Dairy production will be $10,378 million in total production by 2032. This is a rise of 32 percent in 2032. Other food and fibre sectors also are significant contributors.

Output from the red meat and wool sector is forecast to grow significantly to $4,287 million by 2032, which is a 63 percent increase; we also forecast forestry and wood processing sector output to grow by 65 percent by 2032 ($2,513 million).

Our workforce forecasts for the increased use of technology scenario are listed in Table 78. Under this scenario, we forecast the region's total food and fibre workforce to increase by 8.6 percent compared to 2020, with growth evident for most sectors. The dairy sector workforce is forecast to grow by 5.7 percent under this scenario, employing around 12,600 people. This growth is mainly attributed to increased demand for dairy products in the next decade.

Table 78 Waikato workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	1,001	257	488	1,746	**7.3%**
Dairy	9,110	3,370	106	12,586	**5.7%**
Forestry and Wood Processing	1,426	1,496	1,756	4,678	**5.1%**
Horticulture	2,594	1,157	294	4,045	**10.5%**
Pork, Poultry, Bees and Other	2,502	735	524	3,761	**23.8%**
Red Meat and Wool	5,526	4,478	217	10,221	**14.2%**
Seafood	354	271	93	718	**9.1%**
Cross Sector	2,411	-	1,960	4,371	**-2.8%**
Total	24,924	11,763	5,438	42,125	**8.6%**
% of total	**59%**	**28%**	**13%**		
% point change from 2020	**-2.6%**	**3.3%**	**-0.7%**		

Source: NZIER

7.3.4 Transformed sector scenario, Waikato

Total food and fibre production output is forecast to be $21,240 million under the transformed sector scenario, contributing 13 percent to the national food and fibre output in 2032.

Dairy production will be $10,641 million by 2032. This is a rise of 36 percent compared to 2020. Other food and fibre sectors also contribute significantly to the local economy. Production in the red meat and wool sector is estimated to grow by 91 percent by 2032, at $5,018 million, and production in the forestry and wood processing sector is estimated to grow by 5 percent compared to 2020, at $2,667 million.

Under the transformed sector scenario, we forecast the total workforce requirement for the sectors to increase by 16.1 percent. The growth rates by sector are shown in Table 79. With around 47,000 workers in the sectors by 2032, our forecasts highlight workforce growth in the pork, poultry, bees and other sector and the red meat and wool sector. As an important contributor to the local economy, the dairy sector workforce is forecast to grow by 8.8 percent, employing around 13,000 people under this scenario.

Table 79 Waikato workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	1,040	258	496	1,794	**10.3%**
Dairy	9,380	3,472	109	12,961	**8.8%**
Forestry and Wood Processing	1,559	1,590	1,792	4,941	**11.0%**
Horticulture	2,580	1,174	302	4,056	**10.8%**
Pork, Poultry, Bees and Other	2,612	854	538	4,004	**31.8%**
Red Meat and Wool	6,542	5,214	226	11,982	**33.9%**
Seafood	368	280	95	743	**12.9%**
Cross Sector	2,568	-	1,991	4,559	**1.4%**
Total	26,648	12,842	5,549	45,039	**16.1%**
% of total	**59%**	**29%**	**12%**		
% point change from 2020	**-2.6%**	**3.9%**	**-1.3%**		

Source: NZIER

7.3.5 Skill mix change, Waikato

The workforce forecasts by scenarios and skill mix are listed in

Table 80. Similar to the national results, we expect more workers in the food and fibre sectors to be managers and semi-autonomous by 2032 across all three scenarios.

Table 80 Waikato workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	10,454	13,257	15,075	38,787
Percentage	27%	34%	39%	100%
BAU	11,984	15,144	14,552	41,681
% of total	29%	36%	35%	100%
% point change from 2020	1.8%	2.2%	-4.0%	
Increased use of technology	11,940	15,389	14,796	42,125
% of total	28%	37%	35%	100%
% point change from 2020	1.4%	2.4%	-3.7%	
Transformed sector	12,919	16,438	15,682	45,039
% of total	29%	36%	35%	100%
% point change from 2020	1.7%	2.3%	-4.0%	

Source: NZIER

7.4 Bay of Plenty

7.4.1 2020 workforce, Bay of Plenty

The 2020 food and fibre workforce for the Bay of Plenty region is included in Table 81. There are around 33,000 workers currently working in the food and fibre sectors in the Bay of Plenty region, with most of the workers in the forestry and wood processing sector, horticulture sector and Cross Sector.

Table 81 Bay of Plenty workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Total
Arable	113	180	652	945
Dairy	3,843	210	88	4,141
Forestry and Wood Processing	2,723	1,550	1,479	5,752
Horticulture	4,093	1,198	262	5,553
Pork, Poultry, Bees and Other	958	3,428	*	4,386
Red Meat and Wool	3,492	442	148	4,082
Seafood	251	481	77	809
Cross Sector	6,396	-	705	7,101
Total*	21,869	4,061	3,411	32,772
Indicative % (Total)*	**67%**	**12%***	**10%***	

Note: Some categories have been combined.

Source: NZIER

7.4.2 BAU scenario, Bay of Plenty

The Bay of Plenty's total food and fibre goods and services is estimated at $14,808 million in 2032, contributing 10 percent to the national food and fibre output under the BAU scenario.

Forestry and horticulture (mainly kiwifruit production) are the primary drivers supporting the economic development in the Bay of Plenty region. The total output from the forestry and wood processing sector is forecast to grow by 63 percent to $3,241, and horticulture is estimated to grow by 112 percent to $2,828 million.

The workforce forecast under the BAU scenario is detailed in Table 82. Overall, we forecast an 11.8 percent growth rate for the food and fibre sectors workforce by 2032. We forecast the Bay of Plenty horticulture workforce to grow by 31.5 percent, powered mainly by increased workforce requirements from the kiwifruit industry. The forestry and wood processing sector is also forecast to grow by 13.4 percent by 2032.

Table 82 Bay of Plenty workforce numbers – BAU scenario, by sector and value chain

Average Workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	127	232	686	1,045	**10.6%**
Dairy	4,070	218	94	4,382	**5.8%**
Forestry and Wood Processing	3,186	1,737	1,599	6,522	**13.4%**
Horticulture	5,688	1,335	279	7,302	**31.5%**
Pork, Poultry, Bees and Other	1,102	3,738	*	4,840	**10.4%**
Red Meat and Wool	3,512	627	160	4,299	**5.3%**
Seafood	278	525	82	885	**9.4%**
Cross Sector	6,616	-	750	7,366	**3.7%**
Total*	24,579	4,674	3,650	36,642	**11.8%**
% of total*	**67%**	**13%***	**10%***		
% point change from 2020*	**0.3%**	**0.4%**	**-0.4%**		

Note: Some categories have been combined.

Source: NZIER

7.4.3 Increased use of technology scenario, Bay of Plenty

Under this scenario, the Bay of Plenty's total food and fibre goods and services is estimated at $16,053 million in 2032, contributing 10 percent to the national food and fibre output.

The total output from the forestry and wood processing sector is forecast to grow to $3,720 million (87 percent growth), and horticulture is estimated to be $3,037 million (127 percent growth).

Table 83 shows the workforce forecasts for the Bay of Plenty region under the increased use of technology scenario. We forecast the overall workforce requirements to grow by 15.2 percent by 2032, with strong growth in the horticulture sector (38.5 percent). We also forecast strong growth in the pork, poultry, bees and other sector (22.4 percent), as well as the forestry and wood processing sector (16.6 percent).

Table 83 Bay of Plenty workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	135	252	700	1,087	**15.0%**
Dairy	4,086	218	100	4,404	**6.4%**
Forestry and Wood Processing	3,355	1,837	1,516	6,708	**16.6%**
Horticulture	6,003	1,392	298	7,693	**38.5%**
Pork, Poultry, Bees and Other	1,136	4,233	*	5,369	**22.4%**
Red Meat and Wool	3,365	706	171	4,242	**3.9%**
Seafood	283	554	88	925	**14.3%**
Cross Sector	6,554	-	776	7,330	**3.2%**
Total*	24,917	4,959	3,649	37,761	**15.2%**
% of total*	**66%**	**13%***	**10%***		
% point change from 2020*	**-0.7%**	**0.7%**	**-0.7%**		

Note: Some categories have been combined.

Source: NZIER

7.4.4 Transformed sector scenario, Bay of Plenty

Under this scenario, the Bay of Plenty's total food and fibre goods and services is estimated at $16,831 million in 2032, contributing 10 percent to the national food and fibre output.

The total output from the forestry and wood processing sector is forecast to grow by 104 percent, at $4,059 million, and the horticulture sector output is estimated to be $2,984 million (123 percent growth compared to 2020).

Table 84 shows the workforce forecasts under the transformed sector scenario. We forecast the food and fibre sectors to employ around 39,600 workers by 2032 in this region, which is a 20.9 percent growth compared to the 2020 food and fibre workforce. We again forecast strong growth for the horticulture sector, mainly attributed to the kiwifruit growing industry.

It should also be noted that under the Government's Aquaculture Strategy that the Bay of Plenty is expected to be the location of significant aquaculture growth with potentially more than 10,000 hectares of space to be developed, with a predominate focus on shellfish and potentially some finfish.

Table 84 Bay of Plenty workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	141	254	713	1,108	**17.2%**
Dairy	4,208	225	103	4,536	**9.5%**
Forestry and Wood Processing	3,664	1,954	1,538	7,156	**24.4%**
Horticulture	5,926	1,420	306	7,652	**37.8%**
Pork, Poultry, Bees and Other	1,187	4,373	*	5,560	**26.8%**
Red Meat and Wool	3,890	820	177	4,887	**19.7%**
Seafood	294	572	90	956	**18.2%**
Cross Sector	6,982	-	795	7,777	**9.5%**
Total*	26,292	5,245	3,722	39,629	**20.9%**
% of total*	**66%**	**13%***	**9%***		
% point change from 2020*	**-0.4%**	**0.8%**	**-1.0%**		

Note: Some categories have been combined.

Source: NZIER

7.4.5 Skill mix change, Bay of Plenty

Regarding skill mix, our results for the Bay of Plenty region indicate strong growth for managers and semi-autonomous workers by 2032. We detail the forecasts in Table 85.

Table 85 Bay of Plenty workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	7,390	9,816	15,566	32,772
Percentage	23%	30%	47%	100%
BAU	8,985	11,364	16,293	36,642
% of total	25%	31%	44%	100%
% point change from 2020	2.0%	1.1%	-3.0%	
Increased use of technology	9,176	11,815	16,771	37,761
% of total	24%	31%	44%	100%
% point change from 2020	1.8%	1.3%	-3.1%	
Transformed sector	9,785	12,379	17,465	39,629
% of total	25%	31%	44%	100%
% point change from 2020	2.1%	1.3%	-3.4%	

Source: NZIER

7.5 Gisborne

7.5.1 2020 workforce, Gisborne

The 2020 Gisborne food and fibre sectors workforce is outlined in Table 86. Around 10,000 food and fibre workers were attributed to the Gisborne region in 2020, with most of them in the red meat and wool, horticulture, forestry and wood processing sectors. Also, over 80 percent of the food and fibre workforce in the Gisborne region is employed in the Core production part of the value chain.

Table 86 Gisborne workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Total
Arable	43	103	*	146
Dairy	91	*	*	91
Forestry and Wood Processing	935	326	207	1,468
Horticulture	1,713	829	35	2,577
Pork, Poultry, Bees and Other	132	71	*	203
Red Meat and Wool	4,186	225	*	4,411
Seafood	64	57	*	121
Cross Sector	1,276	-	58	1,334
Total*	8,349	1,155	300	10,357
Indicative % (Total)*	**81%***	**11%***	**3%***	

Note: Some categories have been combined.

Source: NZIER

7.5.2 BAU scenario, Gisborne

Our CGE model forecasts Gisborne's total food and fibre sectors will be $3,946 million in 2032, contributing 3 percent to the national food and fibre output. Like its neighbouring region, the Bay of Plenty, this region also benefits from the forestry and wood processing sector.

The forestry and wood processing production is forecast to be $943 million in 2032, an increase of 81 percent relative to the current economy. In addition, we forecast the horticulture sector output to be $972 million in 2032, which is a 63 percent increase under this scenario. The red meat and wool sector is also forecast to grow by 44 percent relative to the current values, at $1,259 million over the next twelve years.

The workforce forecasts by sector and value chain designations are listed in Table 87. We forecast a total growth of 9.5 percent in workforce counts by 2032 under BAU. Forestry and wood processing, and horticulture are forecast to have the biggest growth in workforce counts.

Table 87 Gisborne workforce numbers – BAU scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	50	111	*	161	**10.3%**
Dairy	97	*	*	97	**6.6%**
Forestry and Wood Processing	1,195	364	227	1,786	**21.7%**
Horticulture	1,974	927	39	2,940	**14.1%**
Pork, Poultry, Bees and Other	151	89	*	240	**18.2%**
Red Meat and Wool	4,184	296	*	4,480	**1.6%**
Seafood	68	63	*	131	**8.3%**
Cross Sector	1,433	-	67	1,500	**12.4%**
Total*	9,055	1,291	333	11,341	**9.5%**
% of total*	**80%***	**11%***	**3%***		
% point change from 2020*	**-0.8%**	**0.2%**	**0.0%**		

Note: Some categories have been combined.

Source: NZIER

7.5.3 Increased use of technology scenario, Gisborne

Gisborne's total food and fibre sector production is forecast to be $4,237 million in 2032, contributing 3 percent to the national food and fibre output.

The forestry and wood processing production is forecast to be $1,109 million in 2032, around 113 percent relative to 2020. The horticulture sector will provide $1,022 million in production, equivalent to a 72 percent increase relative to 2020. The red meat and wool sector will contribute a 47 percent rise relative to 2020, at $1,281 million over the next twelve years.

The forecasts for the increased use of technology scenario for the Gisborne region are detailed in Table 88. We forecast a growth of 10.3 percent in the total workforce requirements by 2032 for the region, with growth primarily focused on the forestry and wood processing sector and the horticulture sector.

Table 88 Gisborne workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	52	109	*	161	**10.3%**
Dairy	98	*	*	98	**7.7%**
Forestry and Wood Processing	1,297	396	239	1,932	**31.6%**
Horticulture	2,017	926	42	2,985	**15.8%**
Pork, Poultry, Bees and Other	155	98	*	253	**24.6%**
Red Meat and Wool	3,982	327	*	4,309	**-2.3%**
Seafood	70	65	*	135	**11.6%**
Cross Sector	1,472	-	72	1,544	**15.7%**
Total*	9,045	1,322	353	11,424	**10.3%**
% of total*	**79%***	**12%***	**3%***		
% point change from 2020*	**-1.4%**	**0.4%**	**0.2%**		

Note: Some categories have been combined.

Source: NZIER

7.5.4 Transformed sector scenario, Gisborne

Gisborne's total food and fibre sectors is forecast at $4,581 million in 2032 under the transformed sector scenario, contributing 3 percent to the national food and fibre output.

The forestry and wood processing production is forecast to be $1,208 million in 2032, a rise of 132 percent relative to 2020. The Horticulture sector output is forecast to be $1,014 million, which is a 70 percent increase compared to 2020. The red meat and wool sector will grow by 71 percent relative to 2020, at $1,493 million over the next twelve years.

Table 89 details the workforce requirement growth for Gisborne under the transformed sector scenario. We forecast the forestry and wood processing sector workforce to grow by 42.4 percent and the total workforce for the food and fibre sectors to grow by 20.9 percent by 2032.

Table 89 Gisborne workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	55	111	*	166	**13.7%**
Dairy	101	*	*	101	**11.0%**
Forestry and Wood Processing	1,421	420	249	2,090	**42.4%**
Horticulture	2,022	945	43	3,010	**16.8%**
Pork, Poultry, Bees and Other	162	107	*	269	**32.5%**
Red Meat and Wool	4,719	378	*	5,097	**15.6%**
Seafood	73	68	*	141	**16.5%**
Cross Sector	1,568	-	74	1,642	**23.1%**
Total*	10,020	1,365	366	12,522	**20.9%**
% of total*	**80%***	**11%***	**3%***		
% point change from 2020*	**-0.6%**	**-0.3%**	**0.0%**		

Note: Some categories have been combined.

Source: NZIER

7.5.5 Skill mix change, Gisborne

The skill mix of the food and fibre sectors under each scenario is listed in Table 90. Similar to other regions, we forecast an increase in workforce percentages for managers and the semi-autonomous workforce for all scenarios.

Table 90 Gisborne workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	3,770	2,688	3,898	10,357
Percentage	36%	26%	38%	100%
BAU	4,262	3,014	4,065	11,341
% of total	38%	27%	36%	100%
% point change from 2020	1.2%	0.6%	-1.8%	
Increased use of technology	4,195	3,032	4,196	11,424
% of total	37%	27%	37%	100%
% point change from 2020	0.3%	0.6%	-0.9%	
Transformed sector	4,753	3,330	4,440	12,522
% of total	38%	27%	35%	100%
% point change from 2020	1.6%	0.6%	-2.2%	

Source: NZIER

7.6 Hawke's Bay

7.6.1 2020 workforce, Hawke's Bay

The 2020 food and fibre workforce for Hawke's Bay is detailed in Table 91. Hawke's Bay currently employs over 25,000 workers in the food and fibre sectors, of which over 9,000 work in the horticulture sector (mainly in apples and pear growing and fruit and vegetable processing industries) and about 8,000 workers in the red meat and wool sector. There are, on average, a further 3,600 people employed in Cross Sector industries, many of which will be involved in horticulture.

On average, the local apple and pear growing industry (ANZSIC06 code A013400) employs around 3,900 workers, representing a significant proportion of the local horticulture workers.[30]

30 Additional packhouse workers and some seasonal workers may be found in other ANZSIC06 classes – Packaging Services (ANZSIC06 class code N732000) and Other Agriculture and Fishing Support Services (ANZSIC06 class code A052900).

Table 91 Hawke's Bay workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing*	Strongly connected	Total
Arable	104	153	267	524
Dairy	474	84	*	558
Forestry and Wood Processing	1,153	264	696	2,113
Horticulture	6,675	2,545	112	9,332
Pork, Poultry, Bees and Other	627	666	*	1,293
Red Meat and Wool	5,042	2,751	121	7,914
Seafood	37	35	*	72
Cross Sector	3,289	-	347	3,636
Total*	17,401	5,713	1,543	25,445
Indicative % (Total)*	**68%**	**22%***	**6%***	

Note: Some categories have been combined.

Source: NZIER

7.6.2 BAU scenario, Hawke's Bay

Under the BAU scenario, Hawkes' Bay's total food and fibre sectors is estimated at $10,484 million in 2032, contributing 7 percent to the national food and fibre output.

The major sectors in this region are red meat and wool (mainly in the red meat sector), forestry and wood processing, and horticulture. Compared to the base year 2020, the red meat and wool sector's output is forecast to grow by 47 percent at $3,740 million, forestry and wood processing will rise by 67 percent at $1,240 million, and horticulture output will grow by 68 percent at $3,462 million in 2032. The rise in output is driven primarily by increased productivity and export demand. (More details on the regional growth profiles are available in the CGE report.)

The workforce forecasts are detailed in Table 92. The sector with the biggest growth is forecast to be horticulture, with a growth rate of 24.6 percent between 2020 and 2032. The increase in horticulture is mainly attributed to the apple and pear growing industry. The overall food and fibre workforce requirement is forecast to grow by 15.6 percent for the region under BAU.

Table 92 Hawke's Bay workforce numbers – BAU scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing*	Strongly connected	Total	% change from 2020
Arable	124	196	285	605	15.5%
Dairy	501	90	*	591	5.9%
Forestry and Wood Processing	1,363	294	804	2,461	16.5%
Horticulture	8,650	2,856	123	11,629	24.6%
Pork, Poultry, Bees and Other	675	820	*	1,495	15.6%
Red Meat and Wool	5,060	3,509	145	8,714	10.1%
Seafood	42	38	*	80	11.1%
Cross Sector	3,449	-	386	3,835	5.5%
Total*	19,864	6,855	1,743	29,412	15.6%
% of total*	**68%**	**23%***	**6%***		
% point change from 2020*	**-0.8%**	**0.9%**	**-0.1%**		

Note: Some categories have been combined.

Source: NZIER

7.6.3 Increased use of technology scenario, Hawke's Bay

Hawke's Bay's total food and fibre sector output are estimated at $11,172 million in 2032, contributing 7 percent to the national food and fibre output.

The major industries are farming (mainly in the red meat sector), forestry and horticulture. Compared to the base year 2020, the red meat and wool sector's output grows by 51 percent to $3,843 million, forestry by 90 percent to $1,413 million, and horticulture by 82 percent to $3,759 million in 2032.

Table 93 shows the workforce forecasts for Hawke's Bay under this scenario. Similar to the BAU scenario, we forecast the horticulture sector workforce to grow by 30.7 percent in Hawke's Bay under the increased use of technology scenario. We also forecast the forestry and wood processing sector and the total workforce requirement to grow significantly compared to 2020. Similar to the BAU, the growth in the horticulture workforce is driven by the apple and pear growing industry.

Table 93 Hawke's Bay workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing*	Strongly connected	Total	% change from 2020
Arable	136	210	281	627	**19.7%**
Dairy	502	93	*	595	**6.6%**
Forestry and Wood Processing	1,446	307	772	2,525	**19.5%**
Horticulture	9,197	2,869	132	12,198	**30.7%**
Pork, Poultry, Bees and Other	691	910	*	1,601	**23.8%**
Red Meat and Wool	4,834	3,809	156	8,799	**11.2%**
Seafood	42	41	*	83	**15.3%**
Cross Sector	3,487	-	407	3,894	**7.1%**
Total*	20,335	7,195	1,748	30,327	**19.2%**
% of total*	**67%**	**24%***	**6%***		
% point change from 2020*	**-1.3%**	**1.3%**	**-0.3%**		

Note: Some categories have been combined.

Source: NZIER

7.6.4 Transformed sector scenario, Hawke's Bay

Hawke's Bay's total food and fibre sectors is estimated at $11,919 million in 2032, under the transformed sector scenario, contributing 7 percent to the national food and fibre output.

Our CGE model simulation shows that the red meat and wool sector's output will grow by 74 percent at $4,436 million, forestry and wood processing output by 103 percent at $1,515 million, and horticulture sector output by 81 percent at $3,733 million in 2032.

Table 94 shows Hawke's Bay's workforce requirement under the transformed sector scenario. We forecast the total workforce for the food and fibre sectors to grow by 27.2 percent for this region by 2032. Significant growth rates are evident across Hawke's Bay's food and fibre sectors. The horticulture sector workforce is forecast to grow by 30.5 percent, and this growth is mainly attributed to the local apple and pear growing industry. The red meat and wool sector is forecast to grow by 30.4 percent, mainly through core processing/manufacturing designations.

Table 94 Hawke's Bay workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing*	Strongly connected	Total	% change from 2020
Arable	142	211	285	638	**21.8%**
Dairy	517	96	*	613	**9.9%**
Forestry and Wood Processing	1,575	326	784	2,685	**27.1%**
Horticulture	9,101	2,946	135	12,182	**30.5%**
Pork, Poultry, Bees and Other	702	1,005	*	1,707	**32.0%**
Red Meat and Wool	5,698	4,453	166	10,317	**30.4%**
Seafood	44	42	*	86	**19.4%**
Cross Sector	3,715	-	418	4,133	**13.7%**
Total*	21,494	7,936	1,788	32,366	**27.2%**
% of total*	**66%**	**25%***	**6%***		
% point change from 2020*	**-2.0%**	**2.1%**	**-0.5%**		

Note: Some categories have been combined.

Source: NZIER

7.6.5 Skill mix change, Hawke's Bay

Our skill mix forecast by scenarios in Table 95 shows the need for more highly skilled workers in the food and fibre sectors in 2032; demand mainly comes from the horticulture and red meat and wool sectors.

Table 95 Hawke's Bay workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	7,017	7,513	10,915	25,445
Percentage	28%	30%	43%	100%
BAU	8,608	9,269	11,534	29,412
% of total	29%	32%	39%	100%
% point change from 2020	1.7%	2.0%	-3.7%	
Increased use of technology	8,705	9,616	12,006	30,327

Scenarios	Managers	Semi-autonomous	Managed	Total
% of total	29%	32%	40%	100%
% point change from 2020	1.1%	2.2%	-3.3%	
Transformed sector	9,386	10,324	12,656	32,366
% of total	29%	32%	39%	100%
% point change from 2020	1.4%	2.4%	-3.8%	

Source: NZIER

7.7 Taranaki

7.7.1 2020 workforce, Taranaki

Table 96 details the 2020 food and fibre sectors workforce for Taranaki. Taranaki employs around 13,000 workers in the food and fibre sectors, and almost one-third of that workforce works in the dairy sector. The red meat and wool sector also represents a significant part of the workforce in this region.

Table 96 Taranaki workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing*	Strongly connected	Total
Arable	182	46	231	**459**
Dairy	3,401	789	33	**4,223**
Forestry and Wood Processing	205	299	503	**1,007**
Horticulture	251	440	*	**691**
Pork, Poultry, Bees and Other	224	1,574	*	**1,798**
Red Meat and Wool	1,431	1,965	134	**3,530**
Seafood	39	*	*	**39**
Cross Sector	469	-	565	**1,034**
Total*	**6,163**	**3,099**	**1,466**	**12,781**
Indicative % (Total)*	**48%***	**24%***	**11%***	

Note: Some categories have been combined.

Source: NZIER

7.7.2 BAU scenario, Taranaki

Our CGE modelling results suggest that Taranaki's total food and fibre production will be $6,838 million in 2032, accounting for 5 percent of the national food and fibre output.

One of the biggest contributors in this region is the dairy sector. Dairy production will rise 34 percent to $3,285 million. We also forecast that the red meat and wool sector output will grow rapidly by 57 percent at $2,052 million in the next decade.

We set out the workforce forecast in Table 97. The total workforce for the region is forecast to grow by 10.0 percent under BAU. The red meat and wool sector workforce is forecast to grow by 20.1 percent, the biggest sectoral growth rate in this region. However, the dairy sector workforce is only forecast to grow by 5.7 percent, mainly due to a low productivity outlook (mainly due to regulatory constraints) limiting the sector from acquiring labour.

Table 97 Taranaki workforce numbers – BAU scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing*	Strongly connected	Total	% change from 2020
Arable	170	60	239	469	**2.2%**
Dairy	3,606	825	33	4,464	**5.7%**
Forestry and Wood Processing	220	330	521	1,071	**6.4%**
Horticulture	246	464	*	710	**2.7%**
Pork, Poultry, Bees and Other	238	1,795	*	2,033	**13.1%**
Red Meat and Wool	1,431	2,656	152	4,239	**20.1%**
Seafood	40	*	*	40	**2.6%**
Cross Sector	429	-	601	1,030	**-0.4%**
Total*	6,340	3,871	1,546	14,057	**10.0%**
% of total*	**45%***	**28%***	**11%***		
% point change from 2020*	**-3.1%**	**3.3%**	**-0.5%**		

Note: Some categories have been combined.

Source: NZIER

7.7.3 Increased use of technology scenario, Taranaki

We forecast total food and fibre production in Taranaki to be at $7,077 million in 2032, accounting for 5 percent of the national food and fibre output under this scenario.

Within the food and fibre sectors, dairy production will rise 32 percent at $3,243 million, red meat and wool will grow rapidly by 66 percent at $2,163 million, and sectors other than the food and fibre sectors will contribute 35 percent to local economic development.

Table 98 shows Taranaki's food and fibre workforce requirements under the increased use of technology scenario. The total labour requirement is forecast to grow by 13.4 percent for the region, with bigger growth in the pork, poultry, bees and other sector, and the red meat and wool sector.

Table 98 Taranaki workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing*	Strongly connected	Total	% change from 2020
Arable	163	64	233	460	**0.2%**
Dairy	3,615	831	35	4,481	**6.1%**
Forestry and Wood Processing	227	322	488	1,037	**3.0%**
Horticulture	248	480	*	728	**5.4%**
Pork, Poultry, Bees and Other	236	1,995	*	2,231	**24.1%**
Red Meat and Wool	1,363	2,957	161	4,481	**26.9%**
Seafood	41	*	*	41	**5.1%**
Cross Sector	409	-	620	1,029	**-0.5%**
Total*	6,261	4,174	1,537	14,488	**13.4%**
% of total*	**43%***	**29%***	**11%***		
% point change from 2020*	**-5.0%**	**4.6%**	**-0.9%**		

Note: Some categories have been combined.

Source: NZIER

7.7.4 Transformed sector scenario, Taranaki

We forecast total food and fibre production in Taranaki to be $7,592 million in 2032, accounting for 5 percent of the national food and fibre output.

Dairy production will rise by 36 percent at $3,324 million, red meat and wool sector production will grow rapidly by 94 percent at $2,533 million.

Table 99 details our forecasts for Taranaki under the transformed sector scenario. The workforce requirement for all sectors is forecast to grow by 2032. The red meat and wool sector workforce is forecast to grow by 48 percent, far exceeding that of any other sectors in the region.

The total food and fibre workforce is forecast to grow by 22.2 percent under this scenario in the Taranaki region.

Table 99 Taranaki workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing*	Strongly connected	Total	% change from 2020
Arable	170	64	237	471	**2.6%**
Dairy	3,723	856	36	4,615	**9.3%**
Forestry and Wood Processing	249	343	492	1,084	**7.6%**
Horticulture	247	390	98	735	**6.4%**
Pork, Poultry, Bees and Other	252	579	1,541	2,372	**31.9%**
Red Meat and Wool	1,617	3,435	173	5,225	**48.0%**
Seafood	11	-	31	42	**7.7%**
Cross Sector	436	-	636	1,072	**3.7%**
Total*	6,705	5,667	3,244	15,615	**22.2%**
% of total*	**43%**	**36%**	**21%**		
% point change from 2020*	**-5.3%**	**12.0%**	**9.3%**		

Note: Some categories have been combined.

Source: NZIER

7.7.5 Skill mix change, Taranaki

The skill mix forecasts in Table 100 show that growth is more evident in the semi-autonomous workforce in this region, mainly due to the increased need for more workers in the red meat processing and poultry processing industries.

Table 100 Taranaki workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	3,028	4,994	4,759	12,781
Percentage	24%	39%	37%	100%
BAU	3,469	5,867	4,722	14,057
% of total	25%	42%	34%	100%
% point change from 2020	1.0%	2.7%	-3.6%	
Increased use of technology	3,477	6,114	4,898	14,488
% of total	24%	42%	34%	100%
% point change from 2020	0.3%	3.1%	-3.4%	
Transformed sector	3,749	6,583	5,284	15,615
% of total	24%	42%	34%	100%
% point change from 2020	0.3%	3.1%	-3.4%	

Source: NZIER

7.8 Manawatū-Whanganui

7.8.1 2020 workforce, Manawatū-Whanganui

Table 101 shows the average 2020 food and fibre workforce for the Manawatū-Whanganui region. This region currently employs around 24,000 people, with almost 9,500 working in the red meat and wool sector. The dairy sector also employs a significant portion of the local food and fibre workforce, with around 5,700 people employed.

Table 101 Manawatū-Whanganui workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Total
Arable	312	328	252	892
Dairy	3,070	2,587	62	5,719
Forestry and Wood Processing	788	303	721	1,812
Horticulture	1,240	663	176	2,079
Pork, Poultry, Bees and Other	926	825	*	1,751
Red Meat and Wool	6,719	2,466	216	9,401
Seafood	119	*	*	119
Cross Sector	1,773	-	820	2,593
Total*	14,828	6,347	2,247	24,365
Indicative % (Total)*	**61%***	**26%***	**9%***	

Note: Some categories have been combined.

Source: NZIER

7.8.2 BAU scenario, Manawatū-Whanganui

Manawatū -Whanganui's local food and fibre production is forecast to be $13,063 million in 2032. This is approximately 9 percent of the total national food and fibre outputs.

The major industries that support the local economy include food manufacturing and production, mainly in dairy processing, wood processing, and red meat and wool processing. Wood processing is primarily focused on supply the needs of the regional economy.

Among the food and fibre sectors, red meat and wool increases its output by 50 percent at $4,062 million, followed by forestry and wood processing by 52 percent at $891 million, and the dairy sector by 34 percent at $6,424 million.

Workforce requirements for the region are depicted in Table 102. We forecast the region's red meat and wool sector workforce to grow by 8.2 percent by 2032 to close to 10,200 people. This growth is mainly attributed to the growing need for more red meat and wool core processing/manufacturing workforce to keep up with the red meat processing/manufacturing demand. The dairy sector workforce is also forecast to grow by 5.1 percent due to the expected growth in demand for dairy products.

The overall workforce is forecast to grow by 6.7 percent, with close to 26,000 workers working in the food and fibre sectors.

Table 102 Manawatū-Whanganui workforce numbers – BAU scenario, by sector and value chain

Average Workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	333	423	259	1,015	**13.8%**
Dairy	3,248	2,702	63	6,013	**5.1%**
Forestry and Wood Processing	820	333	759	1,912	**5.5%**
Horticulture	1,326	713	179	2,218	**6.7%**
Pork, Poultry, Bees and Other	996	985	*	1,981	**13.1%**
Red Meat and Wool	6,675	3,251	246	10,172	**8.2%**
Seafood	126	*	*	126	**5.9%**
Cross Sector	1,703	-	850	2,553	**-1.5%**
Total*	15,101	7,422	2,356	25,989	**6.7%**
% of total*	**58%***	**29%***	**9%***		
% point change from 2020*	**-2.8%**	**2.5%**	**-0.2%**		

Note: Some categories have been combined.

Source: NZIER

7.8.3 Increased use of technology scenario, Manawatū-Whanganui

Manawatū -Whanganui's local food and fibre production is forecast to be at $13,327 million in 2032. This is approximately 9 percent of the total national food and fibre outputs.

Among the food and fibre sectors, forestry and wood processing output will grow by 65 percent at $965 million, followed by red meat and wool sector output by 56 percent at $4,212 million, and the dairy sector output by 33 percent at $6,352 million.

Table 103 shows the workforce requirement under the increased use of technology scenario. The growth profile looks similar to BAU, with the overall workforce counts growing by 7.2 percent by 2032. The red meat and wool, and dairy sector workforces are expected to grow by 8.3 and 5.6 percent, respectively, for this region.

Table 103 Manawatū-Whanganui workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	343	453	247	1,043	**16.9%**
Dairy	3,254	2,719	65	6,038	**5.6%**
Forestry and Wood Processing	842	310	698	1,850	**2.1%**
Horticulture	1,341	729	186	2,256	**8.5%**
Pork, Poultry, Bees and Other	1,007	1,080	*	2,087	**19.2%**
Red Meat and Wool	6,341	3,578	262	10,181	**8.3%**
Seafood	129	*	*	129	**8.4%**
Cross Sector	1,661	-	874	2,535	**-2.2%**
Total*	14,789	7,789	2,332	26,118	**7.2%**
% of total*	**57%***	**30%***	**9%***		
% point change from 2020*	**-4.2%**	**3.8%**	**-0.3%**		

Note: Some categories have been combined.

Source: NZIER

7.8.4 Transformed sector scenario, Manawatū-Whanganui

Manawatū-Whanganui's local food and fibre production is forecast to be $14,235 million by 2032, taking up 9 percent of the total national food and fibre outputs.

Forestry and wood processing sector output is forecast to grow by 74 percent at $1,018 million under this scenario, followed by red meat and wool sector output at $4,873 million, which is an 80 percent growth compared to 2020. The dairy sector output is also forecast to grow by 35 percent at $ 6,484 million.

Table 104 denotes the growth in workforce requirements under the transformed sector. The pork, poultry, bees and other sector and the red meat and wool sector workforce is expected to grow by 27.4 and 27.5 percent, respectively. This reflects the growing need for the sectors to hire more people to expand processing/manufacturing ability and keep up with the increased demand for meat products by 2032.

Table 104 Manawatū-Whanganui workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	356	455	251	1,062	**19.1%**
Dairy	3,351	2,802	67	6,220	**8.8%**
Forestry and Wood Processing	919	330	707	1,956	**7.9%**
Horticulture	1,335	739	191	2,265	**8.9%**
Pork, Poultry, Bees and Other	1,047	1,183	*	2,230	**27.4%**
Red Meat and Wool	7,527	4,182	280	11,989	**27.5%**
Seafood	132	*	*	132	**10.9%**
Cross Sector	1,770	-	893	2,663	**2.7%**
Total*	16,305	8,508	2,389	28,517	**17.0%**
% of total*	**57%***	**30%***	**8%***		
% point change from 2020*	**-3.7%**	**3.8%**	**-0.8%**		

Note: Some categories have been combined.

Source: NZIER

7.8.5 Skill mix change, Manawatū-Whanganui

Table 105 shows the skill mix forecasts for this region. The skill mix change reflects the need for more semi-autonomous workers in the region, mainly because the sector needs more meat processing/manufacturing semi-autonomous workers.

Table 105 Manawatū-Whanganui workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	7,253	8,108	9,004	24,365
Percentage	30%	33%	37%	100%
BAU	8,017	9,215	8,756	25,989
% of total	31%	35%	34%	100%
% point change from 2020	1.1%	2.2%	-3.3%	
Increased use of technology	7,852	9,352	8,914	26,118
% of total	30%	36%	34%	100%
% point change from 2020	1.3%	3.7%	-1.7%	
Transformed sector	8,777	10,193	9,547	28,517
% of total	31%	36%	33%	100%
% point change from 2020	1.0%	2.5%	-3.5%	

Source: NZIER

7.9 Wellington

7.9.1 2020 workforce, Wellington

The average food and fibre sectors workforce in 2020 for the Wellington region is listed in Table 106. Industries in Strongly connected part of the value chain make up a bigger share of the Wellington regional workforce than at a national level. The overall workforce is relatively small, especially in relation to the population of the region. This is not surprising as most major industries in Wellington are related to non-food and fibre sectors, such as public administration and professional services.

Horticulture Core Processing/ Manufacturing is likely to be driven by Packaging Services or Other Warehousing and Storage Services activity, which may actually be non-hort related.

Table 106 Wellington workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Total
Arable	80	38	752	870
Dairy	721	90	125	936
Forestry and Wood Processing	363	722	1,310	2,395
Horticulture	647	2,500	359	3,506
Pork, Poultry, Bees and Other	755	542	*	1,297
Red Meat and Wool	1,653	708	531	2,892
Seafood	145	22	109	276
Cross Sector	675	-	714	1,389
Total*	5,039	4,080	3,900	13,560
Indicative % (Total)*	**37%**	**30%***	**29%***	

Note: Some categories have been combined.

Source: NZIER

7.9.2 BAU scenario, Wellington

Under our CGE modelling simulations, total food and fibre production in Wellington will provide a value of $4,052 million and take up 3 percent of the national food and fibre outputs in 2032.

The major industries in this region are non-food and fibre sectors, such as public administration and professional services, which comprise 96 percent of the local economy. By contrast, the food and fibre sectors do not contribute significantly locally.

The workforce forecasts by sector are detailed in Table 107.

Table 107 Wellington workforce numbers – BAU scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	86	46	759	891	**2.4%**
Dairy	764	94	121	979	**4.6%**
Forestry and Wood Processing	400	810	1,375	2,585	**7.9%**
Horticulture	648	2,598	350	3,596	**2.6%**
Pork, Poultry, Bees and Other	832	573	*	1,405	**8.3%**
Red Meat and Wool	1,596	870	595	3,061	**5.8%**
Seafood	150	24	106	280	**1.4%**
Cross Sector	634	-	729	1,363	**-1.9%**
Total*	5,110	4,442	4,035	14,163	**4.4%**
% of total*	**36%**	**31%***	**28%***		
% point change from 2020*	**-1.1%**	**1.3%**	**-0.3%**		

Note: Some categories have been combined.

Source: NZIER

7.9.3 Increased use of technology scenario, Wellington

Wellington's total food and fibre production will contribute $4,182 million and take up 3 percent of the national food and fibre outputs in 2032.

Table 108 shows the average workforce forecasts for Wellington by 2032 under the increased use of technology scenario. The total food and fibre workforce is forecast to grow by 4.3 percent in the next decade.

Table 108 Wellington workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	88	49	727	864	**-0.7%**
Dairy	766	95	124	985	**5.2%**
Forestry and Wood Processing	417	783	1,293	2,493	**4.1%**
Horticulture	642	2,645	359	3,646	**4.0%**
Pork, Poultry, Bees and Other	843	597	*	1,440	**11.0%**
Red Meat and Wool	1,499	942	628	3,069	**6.1%**
Seafood	154	24	109	287	**4.0%**
Cross Sector	611	-	749	1,360	**-2.1%**
Total*	5,020	4,538	3,989	14,146	**4.3%**
% of total*	**35%**	**32%***	**28%***		
% point change from 2020*	**-1.7%**	**2.0%**	**-0.6%**		

Note: Some categories have been combined.

Source: NZIER

7.9.4 Transformed sector scenario, Wellington

Total food and fibre production in Wellington will contribute $4,478 million under the transformed sector scenario and take up 3 percent of the national food and fibre outputs in 2032.

Table 109 sets out the workforce forecasts for Wellington's food and fibre sectors under the transformed sector scenario. The total workforce is forecast to grow by 10.6 percent to around 15,000 people.

Table 109 Wellington workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	91	49	738	878	**0.9%**
Dairy	789	98	128	1,015	**8.4%**
Forestry and Wood Processing	457	832	1,317	2,606	**8.8%**
Horticulture	650	2,694	368	3,712	**5.9%**
Pork, Poultry, Bees and Other	883	633	*	1,516	**16.9%**
Red Meat and Wool	1,776	1,094	676	3,546	**22.6%**
Seafood	160	25	112	297	**7.6%**
Cross Sector	651	-	770	1,421	**2.3%**
Total*	5,457	4,792	4,109	14,991	**10.6%**
% of total*	**36%**	**32%***	**27%***		
% point change from 2020*	**-0.8%**	**1.9%**	**-1.4%**		

Note: Some categories have been combined.

Source: NZIER

7.9.5 Skill mix change, Wellington

The skill mix forecasts detailed in Table 110 again highlight the importance of up-skilling the workforce by 2032 across all three scenarios.

Table 110 Wellington workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	3,289	6,100	4,172	13,560
Percentage	24%	45%	31%	100%
BAU	3,669	6,611	3,883	14,163
% of total	26%	47%	27%	100%
% point change from 2020	1.6%	1.7%	-3.4%	
Increased use of technology	3,624	6,645	3,876	14,146
% of total	26%	47%	27%	100%
% point change from 2020	1.4%	2.0%	-3.4%	
Transformed sector	3,890	6,986	4,115	14,991
% of total	26%	47%	27%	100%
% point change from 2020	1.7%	1.6%	-3.3%	

Source: NZIER

7.10 Tasman-Nelson

7.10.1 2020 workforce, Tasman-Nelson

The 2020 workforce composition for the region is outlined in Table 111. The Tasman-Nelson region currently employs around 14,000 workers in the food and fibre sectors, most of which are associated with forestry and wood processing, horticulture, and seafood sectors.

Table 111 Tasman-Nelson workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Total
Arable	423	227	*	650
Dairy	498	54	27	579
Forestry and Wood Processing	865	1,202	669	2,736
Horticulture	3,732	572	76	4,380
Pork, Poultry, Bees and Other	358	434	*	792
Red Meat and Wool	786	196	65	1,047
Seafood	2,079	1,104	24	3,207
Cross Sector	460	-	141	601
Total*	9,201	3,128	1,002	13,995
Indicative % (Total)*	**66%**	**22%***	**7%***	

Note: Some categories have been combined.

Source: NZIER

7.10.2 BAU scenario, Tasman-Nelson

Tasman-Nelson region's food and fibre-producing is forecast at $5,372 million, contributing 4 percent to the national food and fibre output. The dominant food and fibre sectors are seafood, forestry and wood processing, and horticulture.

We forecast that under the BAU scenario, the forestry and wood processing sector will grow its output by 52 percent at $1,428 million, seafood by 44 percent at $932 million, horticulture by 86 percent at $1,452 million (mainly in apple and pear growing by 103 percent, and kiwifruit by 116 percent) over the next decade.

Table 112 shows the region's food and fibre sectors workforce under the BAU scenario. We forecast the horticulture sector workforce to grow by 21.7 percent in the next decade, mainly from the apple and pear growing and kiwifruit growing industries. We also forecast the forestry and wood processing industry to grow by 10.3 percent, and the seafood industry is forecast to grow by 4.1 percent. This is less growth compared to the other sectors, largely due to increased productivity for the sector and potential regulatory constraints.

Table 112 Tasman-Nelson workforce numbers – BAU scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	454	238	*	692	**6.5%**
Dairy	528	57	29	614	**6.0%**
Forestry and Wood Processing	978	1,322	719	3,019	**10.3%**
Horticulture	4,612	636	81	5,329	**21.7%**
Pork, Poultry, Bees and Other	398	480	*	878	**10.9%**
Red Meat and Wool	777	271	74	1,122	**7.2%**
Seafood	2,109	1,204	26	3,339	**4.1%**
Cross Sector	487	-	152	639	**6.3%**
Total*	10,343	3,490	1,081	15,630	**11.7%**
% of total*	**66%**	**22%***	**7%***		
% point change from 2020*	**0.4%**	**0.0%**	**-0.2%**		

Note: Some categories have been combined.

Source: NZIER

7.10.3 Increased use of technology scenario, Tasman-Nelson

Tasman-Nelson region's food and fibre production is forecast at $5,809 million, contributing 4 percent to the national food and fibre output.

The forestry and wood processing sector will increase output by 71 percent at $1,611 million, seafood by 53 percent at $992 million, horticulture by 102 percent at $1,580 million (mainly in apple and pear growing, and kiwifruit by 131 percent for each) over the next decade.

Table 113 shows the workforce requirements for the Tasman-Nelson region by 2032 under the increased use of technology scenario. The horticulture and forestry sectors are forecast to have the region's biggest growth in workforce numbers for this region.

Table 113 Tasman-Nelson workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	473	236	*	709	**9.1%**
Dairy	529	57	31	617	**6.6%**
Forestry and Wood Processing	1,039	1,331	693	3,063	**12.0%**
Horticulture	4,822	654	86	5,562	**27.0%**
Pork, Poultry, Bees and Other	404	526	*	930	**17.4%**
Red Meat and Wool	736	303	79	1,118	**6.8%**
Seafood	2,180	1,247	27	3,454	**7.7%**
Cross Sector	491	-	160	651	**8.3%**
Total*	10,674	3,592	1,076	16,105	**15.1%**
% of total*	**66%**	**22%***	**7%***		
% point change from 2020*	**0.5%**	**0.0%**	**-0.5%**		

Note: Some categories have been combined.

Source: NZIER

7.10.4 Transformed sector scenario, Tasman-Nelson

Tasman-Nelson region's food and fibre sector output is forecast to be $6,047 million, contributing 4 percent to the national food and fibre output.

The forestry and wood processing sector will expand output by 84 percent at $1,736 million, seafood by 57 percent at $1,020 million, horticulture by 100 percent at $1,567 million (mainly in apple and pear growing, and kiwifruit by 126 percent for each) over the next decade.

Table 114 denotes the workforce requirement forecasts for this region under the transformed sector scenario. We forecast a 19.4 percent increase in total workforce counts for the food and fibre sectors. Workforce numbers in the horticulture and forestry and wood processing sectors are again forecast to have the biggest growth for this region.

Table 114 Tasman-Nelson workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	490	239	*	729	**12.2%**
Dairy	545	59	32	636	**9.8%**
Forestry and Wood Processing	1,143	1,415	717	3,275	**19.7%**
Horticulture	4,771	675	89	5,535	**26.4%**
Pork, Poultry, Bees and Other	422	548	*	970	**22.5%**
Red Meat and Wool	868	352	83	1,303	**24.5%**
Seafood	2,260	1,290	28	3,578	**11.6%**
Cross Sector	523	-	165	688	**14.5%**
Total*	11,022	3,791	1,114	16,714	**19.4%**
% of total*	**66%**	**23%***	**7%***		
% point change from 2020*	**0.2%**	**0.3%**	**-0.5%**		

Note: Some categories have been combined.

Source: NZIER

7.10.5 Skill mix change, Tasman-Nelson

Table 103 shows the workforce skill mix change for the Tasman-Nelson region. Managers are forecast to have the biggest growth in workforce percentages by 2032 compared to other skill mixes in the workforce.

Table 115 Tasman-Nelson workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	3,082	4,133	6,781	13,995
Percentage	22%	30%	48%	100%
BAU	3,826	4,876	6,928	15,630
% of total	24%	31%	44%	100%
% point change from 2020	2.5%	1.7%	-4.1%	
Increased use of technology	3,923	5,023	7,159	16,105
% of total	24%	31%	44%	100%
% point change from 2020	2.3%	1.7%	-4.0%	
Transformed sector	4,109	5,219	7,385	16,714
% of total	25%	31%	44%	100%
% point change from 2020	2.6%	1.7%	-4.3%	

Source: NZIER

7.11 Marlborough

7.11.1 2020 workforce, Marlborough

Table 116 lists the average 2020 workforce counts for the food and fibre sectors in the Marlborough region. More than one-third of the workforce in this region currently works in the horticulture sector, predominately in viticulture and winemaking. It is also likely that many people identified in the Cross Sector are employed in the horticulture sector.

Table 116 Marlborough workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Total
Arable	35	71	*	106
Dairy	132	*	*	132
Forestry and Wood Processing	535	85	91	711
Horticulture	1,727	1,830	33	3,590
Pork, Poultry, Bees and Other	139	65	*	204
Red Meat and Wool	1,134	169	*	1,303
Seafood	775	550	*	1,325
Cross Sector	1,692	-	79	1,771
Total*	6,037	1,915	203	9,153
Indicative % (Total)*	**66%***	**21%***	**2%***	

Note: Some categories have been combined.

Source: NZIER

7.11.2 BAU scenario, Marlborough

In our CGE modelling for the BAU scenario, Marlborough's total food and fibre production is estimated to be $3,697 million, contributing 3 percent to the national food and fibre output by 2032.

The viticulture and winemaking, forestry and wood processing, and seafood sectors are significant parts of Marlborough's economy in 2032. Viticulture's production is estimated to be $1,300 million, equivalent to 41 percent growth. This increase is powered by boosted productivity and strong demand from overseas markets. Forestry and wood processing is estimated to expand production by 76 percent at $339 million and seafood production by 53 percent at $641 million.

Table 117 shows our forecasting results by sectors and value chain designations for the Marlborough region. We forecast the overall growth in the workforce to be around 3.8 percentage points, with the forestry and wood processing sector growing by 11.4 percent between 2020 and 2032.

The horticulture sector workforce is estimated to grow by 3.6 percent under this scenario. We forecast a decrease in workforce requirements for the grape-growing industry (ANZSIC06 code A013100). This is mainly due to significant growth in grape growing productivity, allowing the industry to expand production while reducing workforce requirements. Most of the growth in the workforce comes from the wine and other

alcoholic beverages manufacturing industry (ANZSIC06 class code C121400) because lower productivity in the wine industry, compared to grape growing, means more workers are needed to expand production.

Table 117 Marlborough workforce numbers – BAU scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing*	Strongly connected	Total	% change from 2020
Arable	38	75	*	113	**6.6%**
Dairy	140	*	*	140	**6.1%**
Forestry and Wood Processing	600	95	97	792	**11.4%**
Horticulture	1,654	2,030	34	3,718	**3.6%**
Pork, Poultry, Bees and Other	149	76	*	225	**10.3%**
Red Meat and Wool	1,110	213	*	1,323	**1.5%**
Seafood	790	613	*	1,403	**5.9%**
Cross Sector	1,691	-	85	1,776	**0.3%**
Total*	6,032	2,125	216	9,500	**3.8%**
% of total*	**63%***	**22%***	**2%***		
% point change from 2020*	**-2.5%**	**1.4%**	**0.1%**		

Note: Some categories have been combined.

Source: NZIER

7.11.3 Increased use of technology scenario, Marlborough

Marlborough's total food and fibre production is estimated to be $3,895 million, contributing 3 percent to the national food and fibre output by 2032 under this scenario.

Viticulture's production is estimated to be $1,351 million, equivalent to 47 percent growth. Forestry and wood processing expand production by 103 percent at $391 million, and seafood production rises by 62 percent at $678 million.

Table 118 shows the workforce forecasts under the increased use of technology scenario. The overall workforce for the food and fibre sectors is estimated to grow by 4.4 percent under this scenario. The workforce outlook for the viticulture and winemaking industries under this scenario looks very similar to that under the BAU scenario. This is because productivity gains allow industries to expand production without increasing labour requirements.

Table 118 Marlborough workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing*	Strongly connected	Total	% change from 2020
Arable	39	74	*	113	**6.6%**
Dairy	142	*	*	142	**7.6%**
Forestry and Wood Processing	629	97	94	820	**15.3%**
Horticulture	1,629	2,052	36	3,717	**3.5%**
Pork, Poultry, Bees and Other	149	81	*	230	**12.7%**
Red Meat and Wool	1,057	232	*	1,289	**-1.1%**
Seafood	827	633	*	1,460	**10.2%**
Cross Sector	1,686	-	89	1,775	**0.2%**
Total*	6,016	2,149	219	9,557	**4.4%**
% of total*	**63%***	**22%***	**2%***		
% point change from 2020*	**-3.0%**	**1.6%**	**0.1%**		

Note: Some categories have been combined.

Source: NZIER

7.11.4 Transformed sector scenario, Marlborough

Marlborough's total food and fibre production is estimated to be $4,138 million under this scenario, contributing 3 percent to the national food and fibre output in 2032.

Viticulture's production is estimated to be $1,453 million, equivalent to 58 percent growth compared to 2020. The forestry and wood processing sector is forecast to expand production by 121 percent at $425 million, and seafood sector production is forecast to rise by 65 percent at $692 million.

The workforce requirement under the transformed sector scenario is detailed in Table 119. We estimate the total workforce for the food and fibre sectors to increase by 11.9 percent under this scenario. We forecast the horticulture sector to grow by 10 percent compared to 2020. This growth is mainly attributed to the viticulture and winemaking industries due to the increased need to expand production and meet domestic and international demand.

Table 119 Marlborough workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing*	Strongly connected	Total	% change from 2020
Arable	41	75	*	116	**9.4%**
Dairy	145	*	*	145	**9.8%**
Forestry and Wood Processing	685	103	95	883	**24.2%**
Horticulture	1,711	2,199	37	3,947	**9.9%**
Pork, Poultry, Bees and Other	156	87	*	243	**19.1%**
Red Meat and Wool	1,228	267	*	1,495	**14.7%**
Seafood	858	655	*	1,513	**14.2%**
Cross Sector	1,796	-	92	1,888	**6.6%**
Total*	6,475	2,302	224	10,243	**11.9%**
% of total*	**63%***	**22%***	**2%***		
% point change from 2020*	**-2.7%**	**1.6%**	**0.0%**		

Note: Some categories have been combined.

Source: NZIER

7.11.5 Skill mix change, Marlborough

Most of the skill mix change for the Marlborough region comes from the viticulture and winemaking industries. The skill mix forecasts show the importance of this region's viticulture and winemaking industries employing more managers and semi-autonomous workers by 2032.

Table 120 Marlborough workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	1,997	2,700	4,456	9,153
Percentage	22%	29%	49%	100%
BAU	2,285	3,009	4,206	9,500
% of total	24%	32%	44%	100%
% point change from 2020	2.2%	2.2%	-4.4%	
Increased use of technology	2,269	3,031	4,257	9,557
% of total	24%	32%	45%	100%
% point change from 2020	1.9%	2.2%	-4.1%	
Transformed sector	2,471	3,248	4,524	10,243
% of total	24%	32%	44%	100%
% point change from 2020	2.3%	2.2%	-4.5%	

Source: NZIER

7.12 West Coast

7.12.1 2020 workforce, West Coast

Table 121 lists the average 2020 workforce counts for the food and fibre sectors on the West Coast. Over half the workforce currently works in the dairy sector. The small size of the region has prevented us from breaking out most of the workforce by designation.

Table 121 West Coast workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Total
Arable	21	46	*	67
Dairy	1,375	*	*	1,375
Forestry and Wood Processing	128	209	156	493
Horticulture	48	116	*	164
Pork, Poultry, Bees and Other	207	64	*	271
Red Meat and Wool	487	249	*	736
Seafood	35	251	*	286
Cross Sector	148	-	55	203
Total*	1,074	209	211	3,595
Indicative % (Total)*	**30%***	**6%***	**6%***	

Note: Some categories have been combined.

Source: NZIER

7.12.2 BAU scenario, West Coast

West Coast's food and fibre production is forecast to be $1,842 million, contributing 1 percent to the national food and fibre output by 2032.

The regional economy is mainly supported by forestry and agricultural activities such as dairy and red meat. In addition to the primary sectors, the general business sectors, such as services, mining and tourism, are a significant part of the local economy.

Among the food and fibre sectors, dairy production rises the least (34 percent) but contributes the largest value at $1,036 million to the local economy. Production in the red meat sector is estimated at $305 million, an increase of 50 percent relative to the baseline. The forestry and wood processing sector's production is $209 million, a 42 percent rise compared to 2020.

Table 122 shows the workforce forecast for the West Coast region under the BAU scenario. We forecast the dairy sector workforce to grow by 5.7 percent due to increased demand for dairy products. We also forecast the red meat and wool sector to increase by 7.3 percent, mainly attributed to red meat processing/manufacturing industries. The forestry and wood processing sector workforce is forecast to increase by 4.9 percent. This is not a huge increase considering the output for this sector is expected to grow by 12 percent. This disparity in workforce growth and output growth is due to productivity gains for the sector.

Table 122 West Coast workforce numbers – BAU scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	21	48	*	69	**3.0%**
Dairy	1,454	*	*	1,454	**5.7%**
Forestry and Wood Processing	124	228	165	517	**4.9%**
Horticulture	48	122	*	170	**3.7%**
Pork, Poultry, Bees and Other	228	76	*	304	**12.2%**
Red Meat and Wool	470	320	*	790	**7.3%**
Seafood	35	276	*	311	**8.7%**
Cross Sector	136	-	57	193	**-4.9%**
Total*	1,062	228	222	3,808	**5.9%**
% of total*	**28%***	**6%***	**6%***		
% point change from 2020*	**-2.0%**	**0.2%**	**0.0%**		

Note: Some categories have been combined.

Source: NZIER

7.12.3 Increased use of technology scenario, West Coast

West Coast's food and fibre production is forecast to be $1,882 million, contributing 1 percent to the national food and fibre output by 2032.

We forecast dairy production to increase by 33 percent, contributing $1,026 million to the local economy. Production in the red meat sector is estimated at $316 million, an increase of 55 percent relative to 2020. The forestry and wood processing sector's production is forecast to be $228 million, a 54 percent rise compared to 2020.

Under the increased use of technology scenario, we expect the total food and fibre workforce to increase by 6.1 percent by 2032. Interestingly, although we expect the forestry and wood processing sector output to grow significantly, we're expecting a decline in workforce requirements for the sector. This is mainly due to a significant increase in productivity for this sector, allowing the sector to expand production with limited workforce requirements. The dairy sector and the red meat and wool sector workforces are also forecast to grow by 6.1 percent and 7.3 percent, respectively.

Table 123 West Coast workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	21	46	*	67	**0.0%**
Dairy	1,459	*	*	1,459	**6.1%**
Forestry and Wood Processing	127	217	158	502	**1.8%**
Horticulture	47	125	*	172	**4.9%**
Pork, Poultry, Bees and Other	231	82	*	313	**15.5%**
Red Meat and Wool	441	349	*	790	**7.3%**
Seafood	37	286	*	323	**12.9%**
Cross Sector	131	-	58	189	**-6.9%**
Total*	1,035	217	216	3,815	**6.1%**
% of total*	**27%***	**6%***	**6%***		
% point change from 2020*	**-2.7%**	**-0.1%**	**-0.2%**		

Note: Some categories have been combined.

Source: NZIER

7.12.4 Transformed sector scenario, West Coast

West Coast's food and fibre production is forecast to be $1,982 million under the transformed sector scenario, contributing 1 percent to the national food and fibre output by 2032.

Dairy sector production is forecast to grow by 36 percent, contributing $1,052 million to the local economy. Production in the red meat sector is estimated at $367 million, an increase of 81 percent relative to 2020. The forestry and wood processing sector's production is forecast to be $241 million, a 63 percent rise compared to 2020.

Under the transformed sector scenario, the West Coast food and fibre workforce is detailed in Table 124. We forecast the total workforce to increase by 13.2 percent compared to 2020. The dairy, forestry and wood processing, and red meat and wool sectors are expected to grow by 9.3, 8.1 and 26 percent, respectively. The relatively strong growth in red meat and wool is mainly attributed to core processing/manufacturing due to smaller productivity gains than other value chain designations.

Table 124 West Coast workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	22	46	*	68	**1.5%**
Dairy	1,503	*	*	1,503	**9.3%**
Forestry and Wood Processing	139	231	163	533	**8.1%**
Horticulture	47	127	*	174	**6.1%**
Pork, Poultry, Bees and Other	241	92	*	333	**22.9%**
Red Meat and Wool	523	404	*	927	**26.0%**
Seafood	38	295	*	333	**16.4%**
Cross Sector	140	-	60	200	**-1.5%**
Total*	1,150	231	223	4,071	**13.2%**
% of total*	**28%***	**6%***	**5%***		
% point change from 2020*	**-1.6%**	**-0.1%**	**-0.4%**		

Note: Some categories have been combined.

Source: NZIER

7.12.5 Skill mix change, West Coast

The skill mix change in the West Coast workforce forecasts highlights the importance of hiring more managers and semi-autonomous workers by 2032 across all three scenarios.

Table 125 West Coast workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	1,001	1,214	1,381	3,595
Percentage	28%	34%	38%	100%
BAU	1,128	1,367	1,313	3,808
% of total	30%	36%	34%	100%
% point change from 2020	1.8%	2.1%	-3.9%	
Increased use of technology	1,113	1,373	1,328	3,815
% of total	29%	36%	35%	100%
% point change from 2020	1.3%	2.2%	-3.6%	
Transformed sector	1,200	1,463	1,408	4,071
% of total	29%	36%	35%	100%
% point change from 2020	1.6%	2.2%	-3.8%	

Source: NZIER

7.13 Canterbury

7.13.1 2020 workforce, Canterbury

Canterbury employs around 48,000 workers in their food and fibre sectors in 2020. This is a significant fraction of the food and fibre workforce in New Zealand. The dairy, and red meat and wool sectors both employ around 11,000 workers; other sectors like arable, forestry and wood processing, and horticulture employ around 3,500 to 7,000 workers.

Among the food and fibre workforce in Canterbury, most work in core production and core processing/manufacturing. Fifty-one percent of the Canterbury food and fibre workforce works in core production, 29 percent works in core processing/manufacturing, and 21 percent works in strongly connected industries.

Table 126 Canterbury workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Total
Arable	1,308	342	2,033	3,683
Dairy	7,568	3,268	196	11,032
Forestry and Wood Processing	902	1,258	2,652	4,812
Horticulture	2,958	3,324	607	6,889
Pork, Poultry, Bees and Other	1,474	588	1,465	3,527
Red Meat and Wool	5,772	4,209	963	10,944
Seafood	1,512	762	172	2,446
Cross Sector	2,730	-	1,805	4,535
Total	24,224	13,751	9,892	47,867
Indicative % (Total)	**51%**	**29%**	**21%**	

Source: NZIER

7.13.2 BAU scenario, Canterbury

Our CGE simulation for this scenario suggests Canterbury's regional food and fibre production is forecast to be $23,398 million, 16 percent of total national food and fibre output. Major industries include arable, dairy, forestry, red meat and wool, and the general service industries.

Production growth in 2032 is led by the red meat and wool sector, with a value of $5,409 million (49 percent growth), the arable sector, with a value of $1,885 million (41 percent growth), Forestry is valued at $1,870 million (43 percent growth) and dairy at $10,108million (35 percent growth).

The workforce for the Canterbury region is listed in Table 127. We expect the dairy sector workforce to grow by 5.6 percent by 2032, reflecting the expanded production due to increased domestic and international demand by 2032. The red meat and wool sector is forecast to grow by 10.6 percent, mainly from red meat processing/manufacturing. The arable and forestry and wood processing sectors workforce are forecast to grow by 5.5 percent and 4.9 percent, respectively, reflecting productivity gains and increased export demand changes.

Table 127 Canterbury workforce numbers – BAU scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	1,368	422	2,094	3,884	**5.5%**
Dairy	8,039	3,412	197	11,648	**5.6%**
Forestry and Wood Processing	901	1,376	2,769	5,046	**4.9%**
Horticulture	3,205	3,576	615	7,396	**7.4%**
Pork, Poultry, Bees and Other	1,553	770	1,573	3,896	**10.5%**
Red Meat and Wool	5,658	5,367	1,088	12,113	**10.7%**
Seafood	1,548	848	172	2,568	**5.0%**
Cross Sector	2,493	-	1,849	4,342	**-4.3%**
Total	24,765	15,771	10,358	50,894	**6.3%**
% of total	**49%**	**31%**	**20%**		
% point change from 2020	**-1.9%**	**2.3%**	**-0.3%**		

Source: NZIER

7.13.3 Increased use of technology scenario, Canterbury

Canterbury's regional food and fibre production is forecast to be $23,928 million, which is 16 percent of total national food and fibre production.

Production in the red meat and wool sector is estimated to be $5,595 million, a 54 percent increase compared to 2020; the arable sector, with a value of $2,065 million will grow by 55 percent, forestry and wood processing production is valued at $1,968 million (51 percent growth). Dairy contributes the most value at $10,009 million but the least growth (33 percent growth).

The Canterbury food and fibre workforce under the increased use of technology scenario is listed in Table 128. Under this scenario, we expect workforce growth in the arable, dairy, and red meat and wool sectors.

We also forecast a decrease in local forestry and wood processing. We still expect the production for the Canterbury forestry and wood processing sector to grow. However, because of expected productivity gains, the workforce will decline since it requires fewer workers to increase output.

Table 128 Canterbury workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	1,381	447	2,054	3,882	**5.4%**
Dairy	8,062	3,433	203	11,698	**6.0%**
Forestry and Wood Processing	909	1,291	2,537	4,737	**-1.6%**
Horticulture	3,257	3,603	637	7,497	**8.8%**
Pork, Poultry, Bees and Other	1,548	849	1,706	4,103	**16.3%**
Red Meat and Wool	5,360	5,835	1,148	12,343	**12.8%**
Seafood	1,601	870	178	2,649	**8.3%**
Cross Sector	2,386	-	1,888	4,274	**-5.8%**
Total	24,504	16,328	10,352	51,184	**6.9%**
% of total	**48%**	**32%**	**20%**		
% point change from 2020	**-2.7%**	**3.2%**	**-0.4%**		

Source: NZIER

7.13.4 Transformed sector scenario, Canterbury

Canterbury's regional food and fibre production is forecast to be $25,346 million under the transformed sector scenario, representing 16 percent of total national food and fibre production.

Production in the red meat and wool sector is forecast to grow by 78 percent, with a value of $6,456 million. The arable sector is forecast to grow by 59 percent, with a value of $2,115 million. Forestry and wood processing sector output and the dairy sector output are valued at $2,047 million and $10,262 million, which is a 57 percent growth and 37 percent growth, respectively.

Table 129 shows the Canterbury food and fibre workforce forecast under the transformed sector scenario. We forecast the arable and dairy sectors to grow by 8.0 percent and 9.2 percent, respectively, reflecting increased demand for the sector's output. We also forecast the red meat and wool sector to grow by 31.4 percent, reflecting the need for more core processing/manufacturing workforce to expand the sector's processing ability. We also forecast the forestry and wood processing sector to remain relatively static, given productivity rises are enough for the sector to engage in more production.

Table 129 Canterbury workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	1,445	449	2,082	3,976	**8.0%**
Dairy	8,302	3,537	209	12,048	**9.2%**
Forestry and Wood Processing	989	1,373	2,572	4,934	**2.5%**
Horticulture	3,255	3,668	652	7,575	**10.0%**
Pork, Poultry, Bees and Other	1,639	987	1,754	4,380	**24.2%**
Red Meat and Wool	6,345	6,801	1,238	14,384	**31.4%**
Seafood	1,661	900	183	2,744	**12.2%**
Cross Sector	2,542	-	1,924	4,466	**-1.5%**
Total	26,177	17,716	10,613	54,506	**13.9%**
% of total	**48%**	**33%**	**19%**		
% point change from 2020	**-2.6%**	**3.8%**	**-1.2%**		

Source: NZIER

7.13.5 Skill mix change, Canterbury

Our forecast for the skill mix change for the Canterbury region is detailed in Table 130. These results mainly reflect the need for the local arable, dairy forestry and wood processing, horticulture, red meat and wool sectors to upskill their current workforce and prepare for the potential skill mix change by 2032.

Table 130 Canterbury workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	11,751	17,206	18,909	47,867
Percentage	25%	36%	40%	100%
BAU	13,316	19,489	18,089	50,894
% of total	26%	38%	36%	100%
% point change from 2020	1.6%	2.3%	-4.0%	
Increased use of technology	13,177	19,744	18,264	51,184
% of total	26%	39%	36%	100%
% point change from 2020	1.2%	2.6%	-3.8%	
Transformed sector	14,176	21,010	19,321	54,506
% of total	26%	39%	35%	100%
% point change from 2020	1.5%	2.6%	-4.1%	

Source: NZIER

7.14 Otago

7.14.1 2020 workforce, Otago

For the Otago region, red meat and wool, horticulture (mainly summer fruit), and dairy are the main contributors to this region's food and fibre sectors. The 2020 workforce is listed in Table 131. There will be around 18,000 workers in the Otago region's food and fibre sectors in 2020. There are about 2,600 workers in dairy and 3,600 in horticulture (around 1,200 horticulture workers work in summer fruit production). There are also approximately 6,000 workers in the red meat and wool sector.

Table 131 Otago workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Total
Arable	326	46	432	804
Dairy	2,445	138	62	2,645
Forestry and Wood Processing	710	255	688	1,653
Horticulture	2,394	1,037	198	3,629
Pork, Poultry, Bees and Other	277	735	*	1,012
Red Meat and Wool	3,513	2,419	108	6,040
Seafood	182	36	54	272
Cross Sector	1,610	-	486	2,096
Total*	11,457	3,931	2,028	18,151
Indicative % (Total)*	**63%**	**22%***	**11%***	

Note: Some categories have been combined.

Source: NZIER

7.14.2 BAU scenario, Otago

Otago's total food and fibre production is forecast to be $7,383 million, contributing 5 percent of total national food and fibre output by 2032.

The major industries are food and tourism-related services, which comprise 84 percent of the total local outputs. The food and fibre sectors are not dominant in this region, but they are still valuable contributors.

In Otago, red meat and wool, dairy, and forestry and wood processing sectors are forecast to be the main contributors to the local food and fibre sectors economy. Central Otago is also a significant wine-producing area. We forecast red meat and wool, dairy, and forestry and wood processing sectors to contribute $3,131 million, $1,553 million, and $726 million in production, respectively, over the next decade. Compared with 2020, production growth is estimated at 51 percent (red meat and wool), 34 percent (dairy), and 65 percent (forestry).

The BAU forecast for the Otago region is listed in Table 132. We expect the dairy sector workforce to grow by 5.8 percent due to increased demand for the sector's output. The red meat and wool sector workforce is forecast to grow by 12 percent compared to 2020 due to increased workforce requirements in the red meat and wool core processing/manufacturing industries. The horticulture sector is forecast to remain relatively static, due to low growth in horticulture productivity in the region.

Table 132 Otago workforce numbers – BAU scenario, by sector and value chain

Average Workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	324	52	448	824	**2.5%**
Dairy	2,593	144	62	2,799	**5.8%**
Forestry and Wood Processing	800	283	722	1,805	**9.2%**
Horticulture	2,438	1,117	203	3,758	**3.6%**
Pork, Poultry, Bees and Other	265	882	*	1,147	**13.3%**
Red Meat and Wool	3,462	3,190	112	6,764	**12.0%**
Seafood	181	40	54	275	**1.1%**
Cross Sector	1,546	-	511	2,057	**-1.9%**
Total*	11,609	4,826	2,112	19,427	**7.0%**
% of total*	**60%**	**25%***	**11%***		
% point change from 2020*	**-3.4%**	**3.2%**	**-0.3%**		

Note: Some categories have been combined.

Source: NZIER

7.14.3 Increased use of technology scenario, Otago

Otago's total food and fibre production is forecast to be $7,664 million, contributing 5 percent of total national production in 2032.

Among the food and fibre sectors, red meat and wool, dairy, and forestry and wood processing will contribute $3,258 million, $1,536 million, and $809 million, respectively, over the next decade. Compared with the base year, production growth is estimated at 58 percent (red meat and wool), 33 percent (dairy), and 84 percent (forestry).

The workforce forecast under the increased use of technology scenario is detailed in Table 133. We forecast the workforces in the dairy sector and forestry and wood processing sector to grow by 6.2 and 8 percent, respectively, due to increased production and productivity. The red meat and wool sector is also forecast to grow by 14.5 percent. Similar to the BAU scenario, the growth in red meat and wool is mainly attributed to the increased workforce in core processing/manufacturing.

Table 133 Otago workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	320	55	435	810	**0.7%**
Dairy	2,601	145	64	2,810	**6.2%**
Forestry and Wood Processing	835	278	673	1,786	**8.0%**
Horticulture	2,412	1,133	209	3,754	**3.4%**
Pork, Poultry, Bees and Other	252	953	*	1,205	**19.1%**
Red Meat and Wool	3,285	3,514	116	6,915	**14.5%**
Seafood	185	40	56	281	**3.3%**
Cross Sector	1,512	-	528	2,040	**-2.7%**
Total*	11,402	5,165	2,081	19,600	**8.0%**
% of total*	**58%**	**26%***	**11%***		
% point change from 2020*	**-4.9%**	**4.7%**	**-0.6%**		

Note: Some categories have been combined.

Source: NZIER

7.14.4 Transformed sector scenario, Otago

Otago's total food and fibre production is forecast to be $8,360 million under this scenario, contributing 5 percent of total national production by 2032.

The red meat and wool, dairy, and forestry and wood processing sectors are forecast to contribute $3,789 million, $1,572 million, and $872 million in production, respectively, over the next decade. Compared to 2020, production growth is estimated to be 83 percent (red meat and wool), 36 percent (dairy), and 98 percent (forestry and wood processing).

The Otago region food and fibre workforce forecast under the transformed sector scenario is listed in Table 134. Under this scenario, the workforce is forecast to grow by 9.4 percent (dairy), 14.2 percent (forestry and wood processing), 5.6 percent (horticulture) and 34 percent (red meat and wool), respectively. This growth is due to increased export demand for the sectors, incentivising the sectors to engage more in production and export, allowing the sectors to gain revenue and hire more workers to expand production further.

Table 134 Otago workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	333	55	441	829	**3.1%**
Dairy	2,678	149	66	2,893	**9.4%**
Forestry and Wood Processing	912	296	680	1,888	**14.2%**
Horticulture	2,444	1,173	214	3,831	**5.6%**
Pork, Poultry, Bees and Other	264	1,057	*	1,321	**30.5%**
Red Meat and Wool	3,888	4,082	121	8,091	**34.0%**
Seafood	192	41	58	291	**7.0%**
Cross Sector	1,611	-	545	2,156	**2.9%**
Total*	12,322	5,796	2,125	21,299	**17.3%**
% of total*	**58%**	**27%***	**10%***		
% point change from 2020*	**-5.3%**	**5.6%**	**-1.2%**		

Note: Some categories have been combined.

Source: NZIER

7.14.5 Skill mix change, Otago

For the skill mix change in the Otago region listed in Table 135, we see a clear trend of the sectors hiring more managers and semi-autonomous workers by 2032 under all scenarios. These skill mix shifts are mainly attributed to the dairy, horticulture and red meat and wool sectors.

Table 135 Otago workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	5,132	6,613	6,407	18,151
Percentage	28%	36%	35%	100%
BAU	5,697	7,499	6,233	19,427
% of total	29%	39%	32%	100%
% point change from 2020	1.0%	2.2%	-3.2%	
Increased use of technology	5,605	7,627	6,368	19,600
% of total	29%	39%	32%	100%
% point change from 2020	0.3%	2.5%	-2.8%	
Transformed sector	6,133	8,256	6,909	21,299
% of total	29%	39%	32%	100%
% point change from 2020	0.5%	2.3%	-2.9%	

Source: NZIER

7.15 Southland

7.15.1 2020 workforce, Southland

The food and fibre sectors in the Southland region currently employ around 18,000 people. The detailed figures by sectors and value chain designations are listed in Table 136. The local dairy sector currently employs around 4,700 people. The red meat and wool sector also employs a significant share of the local food and fibre workforce.

Table 136 Southland workforce numbers – 2020 average workforce counts by sector and value chain

Average workforce in 2020

Sector	Core production	Core processing/ Manufacturing	Strongly connected	Total
Arable	403	44	99	546
Dairy	4,093	581	*	4,674
Forestry and Wood Processing	504	409	288	1,201
Horticulture	923	405	*	1,328
Pork, Poultry, Bees and Other	129	571	*	700
Red Meat and Wool	3,503	2,852	45	6,400
Seafood	472	255	25	752
Cross Sector	1,740	-	428	2,168
Total*	11,767	3,560	885	17,769
Indicative % (Total)*	**66%**	**20%***	**5%***	

Note: Some categories have been combined.

Source: NZIER

7.15.2 BAU scenario, Southland

Southland's total food and fibre production is forecast to be $8,394 million, 6 percent of the total national food and fibre output.

The food and fibre sectors are a strong contributor to Southland's economy. We forecast output for the red meat and wool sector to grow the most at $3,386 million (50 percent), followed by the dairy sector at $3,170 million (33 percent) by 2032 under BAU.

The workforce forecasts for the Southland region are detailed in Table 137. We forecast the total labour workforce to grow by 7.7 percent by 2032, powered mainly by strong growth in the red meat and wool, and dairy sectors. We forecast the red meat and wool sector to employ around 7,200 people under BAU, attributed mainly to an increase in core processing/manufacturing workforce requirements.

Table 137 Southland workforce numbers – BAU scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	396	56	103	555	**1.6%**
Dairy	4,345	607	*	4,952	**5.9%**
Forestry and Wood Processing	527	453	306	1,286	**7.1%**
Horticulture	995	441	*	1,436	**8.1%**
Pork, Poultry, Bees and Other	127	725	*	852	**21.7%**
Red Meat and Wool	3,416	3,746	48	7,210	**12.7%**
Seafood	492	286	26	804	**6.9%**
Cross Sector	1,598	-	453	2,051	**-5.4%**
Total*	11,896	4,541	936	19,146	**7.7%**
% of total*	**62%**	**24%***	**5%***		
% point change from 2020*	**-4.1%**	**3.7%**	**-0.1%**		

Note: Some categories have been combined.

Source: NZIER

7.15.3 Increased use of technology scenario, Southland

Southland's total food and fibre production is forecast to be $8,576 million under this scenario, representing 6 percent of the total national food and fibre output.

Output from the red meat and wool sector will grow the most, by 55 percent at $3,509 million, followed by the dairy sector at $3,125 million (31 percent growth).

The food and fibre workforce forecast under the increased use of technology scenario for Southland is listed in Table 138. We forecast the total food and fibre workforce in the Southland region to increase by 9.1 percent, which is an additional 1.4 percentage points increase compared to the BAU scenario. We forecast the red meat and wool sector to have the biggest growth in workforce counts in this region, with most of the increase coming from core processing/manufacturing to keep up with the increased productivity and output from core production industries.

Table 138 Southland workforce numbers – Increased use of technology scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	386	59	98	543	**-0.5%**
Dairy	4,354	612	*	4,966	**6.2%**
Forestry and Wood Processing	538	450	297	1,285	**7.0%**
Horticulture	1,008	456	*	1,464	**10.2%**
Pork, Poultry, Bees and Other	123	792	*	915	**30.7%**
Red Meat and Wool	3,220	4,114	50	7,384	**15.4%**
Seafood	509	290	28	827	**10.0%**
Cross Sector	1,529	-	467	1,996	**-7.9%**
Total*	11,667	4,913	940	19,380	**9.1%**
% of total*	**60%**	**25%***	**5%***		
% point change from 2020*	**-6.0%**	**5.3%**	**-0.1%**		

Note: Some categories have been combined.

Source: NZIER

7.15.4 Transformed sector scenario, Southland

Southland's total food and fibre production is forecast to be $9,236 million under the transformed sector scenario, representing 6 percent of the total national food and fibre output.

The red meat and wool sector will grow by $4,041 million, by 79 percent, followed by the dairy sector at $3,174 million (33 percent growth).

The Southland food and fibre sectors workforce forecast under the transformed sector scenario is detailed in Table 139. We forecast significant growth for the food and fibre sectors workforce for this scenario, representing strong demand for red meat, wool, and dairy products domestically and internationally.

Specifically, we forecast a 35 percent workforce growth for the red meat and wool sector, mainly attributed to core processing/manufacturing designations. We also forecast a 9.4 percent increase in the dairy workforce, reflecting increased dairy production and dairy export.

It should also be noted that under the Government's Aquaculture Strategy that Southland is expected to be the location of significant aquaculture growth for salmon production.

Table 139 Southland workforce numbers – Transformed sector scenario, by sector and value chain

Average workforce requirements in 2032

Sector	Core production	Core processing /Manufacturing	Strongly connected	Total	% change from 2020
Arable	402	59	100	561	**2.7%**
Dairy	4,484	630	*	5,114	**9.4%**
Forestry and Wood Processing	585	479	304	1,368	**13.9%**
Horticulture	1,008	463	*	1,471	**10.8%**
Pork, Poultry, Bees and Other	127	905	*	1,032	**47.4%**
Red Meat and Wool	3,810	4,780	51	8,641	**35.0%**
Seafood	529	300	28	857	**14.0%**
Cross Sector	1,628	-	480	2,108	**-2.8%**
Total*	12,573	5,618	963	21,154	**19.1%**
% of total*	**59%**	**27%***	**5%***		
% point change from 2020*	**-6.8%**	**6.5%**	**-0.4%**		

Note: Some categories have been combined.

Source: NZIER

7.15.5 Skill mix change, Southland

The skill mix change for the Southland food and fibre workforce is listed in Table 140. The skill mix change forecasts suggest that most of the changes in skill mix come from higher demand for semi-autonomous workers. This is because the red meat and wool core processing/manufacturing workers are forecast to grow significantly under each scenario, mainly consisting of semi-autonomous workers.

Table 140 Southland workforce numbers – all scenarios, by skill mix

Average counts and percentages

Scenarios	Managers	Semi-autonomous	Managed	Total
Current workforce - 2020	4,660	6,010	7,100	17,769
Percentage	26%	34%	40%	100%
BAU	5,190	7,016	6,940	19,146
% of total	27%	37%	36%	100%
% point change from 2020	0.9%	2.8%	-3.7%	
Increased use of technology	5,096	7,186	7,097	19,380
% of total	26%	37%	37%	100%
% point change from 2020	0.1%	3.3%	-3.3%	
Transformed sector	5,613	7,856	7,685	21,154
% of total	27%	37%	36%	100%
% point change from 2020	0.3%	3.3%	-3.6%	

Source: NZIER

8 Method to transform CGE output into worker counts

The future performance of industries in the food and fibre sectors was modelled using NZIER's TERM-NZ CGE model. For more information on the CGE modelling, please refer to the CGE report. The CGE model outputs were then further analysed to produce workforce counts. We have produced a spreadsheet analysis that does this. The main purposes of the analysis spreadsheet are to analyse CGE output and produce detailed workforce counts while taking into account the following information:

- change in workforce composition of 2032
- wage forecasts for 2032.

The basis of our estimates and projections is an analysis that considers shifts in the current workforce composition due to job automation, as well as increases in workers' income and the wider economy. Key components of the analysis are summarised in the analysis wireframe in Appendix C of this report.

The analysis project shifts the worker composition and income growth separately, depicted in Part A and Part B of the analysis wireframe, specifically:

- Part A: Explains the relative trends for workforce composition. Change in workforce composition is informed based on the risk of automation estimates derived from Nedelkoska and Quintini (2018).
- Part B: Explains the relative trends for workforce wage rates. The increase in real income for the workforce is informed by the average wage forecasts of NZIER's wage prediction and the Treasury's wage projection.

We include the structure of the analysis spreadsheet. Then we discuss the methods used in the analysis spreadsheet to transform the macroeconomic modelling results into detailed future worker counts in Appendix C of this report.

9 References

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Appendix A Forecasts based on NZIER's wage projection

A.1 BAU scenario

Table 141 Workforce numbers – BAU scenario by sector and value chain

Workforce requirements in 2032

Sector	Core production	Core processing/ manufacturing	Strongly connected	Relevant	Other	Total	% Change
Arable	5,175	2,558	17,377	346	-	25,457	**13.6%**
Dairy	44,528	14,628	1,521	-	-	60,677	**14.6%**
Forestry and Wood Processing	15,459	13,336	19,729	209	-	48,734	**17.7%**
Horticulture	44,718	30,297	4,613	287	-	79,915	**21.1%**
Pork, Poultry, Bees and Other	11,770	5,169	14,873	-	-	31,812	**22.1%**
Red Meat and Wool	52,794	33,758	5,964	407	-	92,923	**19.6%**
Seafood	7,051	5,657	1,322	534	-	14,564	**12.9%**
Cross Sector	27,954	-	11,697	23,785	7,045	70,481	**10.6%**
Total	209,448	105,404	77,097	25,569	7,045	424,563	**16.9%**
Indicative % (Total)	**49%**	**25%**	**18%**	**6%**	**2%**	**100%**	
% point change from 2020	**-0.9%**	**1.6%**	**-0.6%**	**-0.1%**	**0.0%**		

Source: NZIER

Table 142 Workforce numbers – BAU scenario by sector and skill mix

Workforce requirements in 2032

Sector	Managers	Semi-autonomous	Managed	Total	% Change
Arable	7,588	7,134	10,735	25,457	**13.6%**
Dairy	16,466	23,074	21,138	60,677	**14.6%**
Forestry and Wood Processing	12,542	15,145	21,047	48,734	**17.7%**
Horticulture	21,500	28,035	30,380	79,915	**21.1%**
Pork, Poultry, Bees and Other	9,904	13,008	8,899	31,812	**22.1%**
Red Meat and Wool	34,273	36,299	22,352	92,923	**19.6%**
Seafood	1,763	3,550	9,251	14,564	**12.9%**
Cross Sector	11,065	31,537	27,879	70,481	**10.6%**
Total	115,102	157,781	151,680	424,563	**16.9%**
Indicative % (Total)	**27%**	**37%**	**36%**	**100%**	
% point change from 2020	**1.8%**	**1.9%**	**-3.7%**		

Source: NZIER

A.2 Increased use of technology scenario

Table 143 Workforce numbers – Increased use of technology scenario by value chain

Workforce requirements in 2032

Sector	Core production	Core processing/ manufacturing	Strongly connected	Relevant	Other	Total	% Change
Arable	5,253	2,722	17,051	388	-	25,413	**13.4%**
Dairy	44,671	14,715	1,575	-	-	60,961	**15.2%**
Forestry and Wood Processing	16,207	13,125	18,486	201	-	48,019	**15.9%**
Horticulture	45,999	30,741	4,781	294	-	81,814	**24.0%**
Pork, Poultry, Bees and Other	11,997	5,726	16,185	-	-	33,908	**30.1%**
Red Meat and Wool	50,230	37,087	6,240	412	-	93,970	**20.9%**
Seafood	7,287	5,847	1,369	538	-	15,041	**16.6%**
Cross Sector	27,557	-	12,004	24,360	7,196	71,117	**11.6%**
Total	209,201	109,962	77,690	26,193	7,196	430,242	**18.5%**
Indicative % (Total)	**49%**	**26%**	**18%**	**6%**	**2%**	**100%**	
% point change from 2020	**-1.6%**	**2.4%**	**-0.7%**	**-0.1%**	**0.0%**		

Source: NZIER

Table 144 Workforce numbers – Increased use of technology scenario by sector and skill mix

Workforce requirements in 2032

Sector	Managers	Semi-autonomous	Managed	Total	% Change
Arable	7,578	7,125	10,710	25,413	**13.4%**
Dairy	16,535	23,174	21,252	60,961	**15.2%**
Forestry and Wood Processing	12,548	14,598	20,872	48,019	**15.9%**
Horticulture	21,950	28,641	31,223	81,814	**24.0%**
Pork, Poultry, Bees and Other	10,339	13,903	9,666	33,908	**30.1%**
Red Meat and Wool	32,804	37,627	23,538	93,970	**20.9%**
Seafood	1,821	3,666	9,553	15,041	**16.6%**
Cross Sector	11,222	32,041	27,854	71,117	**11.6%**
Total	114,797	160,776	154,670	430,242	**18.5%**
Indicative % (Total)	**27%**	**37%**	**36%**	**100%**	
% point change from 2020	**1.4%**	**2.1%**	**-3.5%**		

Source: NZIER

A.3 Transformed sector scenario

Table 145 Workforce numbers – Transformed sector scenario by sector and value chain

Workforce requirements in 2032

Sector	Core production	Core processing/ manufacturing	Strongly connected	Relevant	Other	Total	% Change
Arable	5,471	2,738	17,227	399	-	25,835	**15.3%**
Dairy	45,998	15,163	1,616	-	-	62,776	**18.6%**
Forestry and Wood Processing	17,717	13,953	18,798	215	-	50,683	**22.4%**
Horticulture	45,868	31,527	4,898	297	-	82,589	**25.2%**
Pork, Poultry, Bees and Other	12,530	6,652	16,645	-	-	35,827	**37.5%**
Red Meat and Wool	59,368	43,201	6,615	412	-	109,598	**41.0%**
Seafood	7,559	6,045	1,404	541	-	15,549	**20.6%**
Cross Sector	29,355	-	12,277	24,727	7,288	73,647	**15.5%**
Total	223,866	119,279	79,479	26,591	7,288	456,503	**25.7%**
Indicative % (Total)	**49%**	**26%**	**17%**	**6%**	**2%**	**100%**	
% point change from 2020	**-1.2%**	**2.9%**	**-1.3%**	**-0.3%**	**-0.1%**		

Source: NZIER

Table 146 Workforce numbers – Transformed sector scenario by sector and skill mix

Workforce requirements in 2032

Sector	Managers	Semi-autonomous	Managed	Total	% Change
Arable	7,751	7,260	10,824	25,835	**15.3%**
Dairy	17,025	23,865	21,886	62,776	**18.6%**
Forestry and Wood Processing	13,348	15,217	22,118	50,683	**22.4%**
Horticulture	22,143	29,102	31,344	82,589	**25.2%**
Pork, Poultry, Bees and Other	10,806	14,401	10,620	35,827	**37.5%**
Red Meat and Wool	38,956	43,722	26,920	109,598	**41.0%**
Seafood	1,883	3,793	9,874	15,549	**20.6%**
Cross Sector	11,579	32,880	29,188	73,647	**15.5%**
Total	123,491	170,239	162,773	456,503	**25.7%**
Indicative % (Total)	**27%**	**37%**	**36%**	**100%**	
% point change from 2020	**1.8%**	**2.0%**	**-3.8%**		

Source: NZIER

Appendix B Forecasts based on the wage rate from the Treasury

B.1 BAU scenario

Table 147 Workforce numbers – BAU scenario by sector and value chain

Workforce requirements in 2032

Sector	Core production	Core processing/ manufacturing	Strongly connected	Relevant	Other	Total	% Change
Arable	4,317	2,251	14,932	293	-	21,792	**-2.7%**
Dairy	37,748	12,659	1,312	-	-	51,719	**-2.3%**
Forestry and Wood Processing	13,230	11,458	16,867	179	-	41,734	**0.8%**
Horticulture	38,625	25,563	3,971	242	-	68,400	**3.6%**
Pork, Poultry, Bees and Other	9,885	4,610	12,565	-	-	27,061	**3.9%**
Red Meat and Wool	44,176	29,062	5,132	351	-	78,721	**1.3%**
Seafood	6,111	4,978	1,155	466	-	12,711	**-1.5%**
Cross Sector	24,419	-	10,063	20,129	5,976	60,586	**-5.0%**
Total	178,512	90,580	65,997	21,659	5,976	362,724	**-0.1%**
Indicative % (Total)	**49%**	**25%**	**18%**	**6%**	**2%**	**100%**	
% point change from 2020	**-1.0%**	**1.8%**	**-0.5%**	**-0.2%**	**-0.1%**		

Source: NZIER

Table 148 Workforce numbers – BAU scenario by sector and skill mix

Workforce requirements in 2032

Sector	Managers	Semi-autonomous	Managed	Total	% Change
Arable	6,450	6,088	9,254	21,792	**-2.7%**
Dairy	13,991	19,665	18,062	51,719	**-2.3%**
Forestry and Wood Processing	10,726	12,971	18,036	41,734	**0.8%**
Horticulture	18,242	23,780	26,377	68,400	**3.6%**
Pork, Poultry, Bees and Other	8,340	10,979	7,742	27,061	**3.9%**
Red Meat and Wool	28,609	30,894	19,218	78,721	**1.3%**
Seafood	1,538	3,091	8,081	12,711	**-1.5%**
Cross Sector	9,407	26,960	24,219	60,586	**-5.0%**
Total	97,304	134,429	130,990	362,724	**-0.1%**
Indicative % (Total)	**27%**	**37%**	**36%**	**100%**	
% point change from 2020	**1.5%**	**1.8%**	**-3.3%**		

Source: NZIER

B.2 Increased use of technology scenario

Table 149 Workforce numbers – Increased use of technology scenario by value chain

Workforce requirements in 2032

Sector	Core production	Core processing/ manufacturing	Strongly connected	Relevant	Other	Total	% Change
Arable	4,382	2,394	14,652	328	-	21,755	**-2.9%**
Dairy	37,869	12,734	1,359	-	-	51,962	**-1.8%**
Forestry and Wood Processing	13,871	11,276	15,804	172	-	41,122	**-0.7%**
Horticulture	39,736	25,934	4,115	247	-	70,033	**6.1%**
Pork, Poultry, Bees and Other	10,077	5,107	13,675	-	-	28,859	**10.8%**
Red Meat and Wool	42,038	31,928	5,370	355	-	79,691	**2.6%**
Seafood	6,316	5,145	1,196	470	-	13,127	**1.8%**
Cross Sector	24,073	-	10,326	20,616	6,103	61,117	**-4.1%**
Total	178,362	94,518	66,496	22,187	6,103	367,666	**1.2%**
Indicative % (Total)	**49%**	**26%**	**18%**	**6%**	**2%**	**100%**	
% point change from 2020	**-1.7%**	**2.5%**	**-0.6%**	**-0.1%**	**0.0%**		

Source: NZIER

Table 150 Workforce numbers – Increased use of technology scenario by sector and skill mix

Workforce requirements in 2032

Sector	Managers	Semi-autonomous	Managed	Total	% Change
Arable	6,440	6,080	9,235	21,755	**-2.9%**
Dairy	14,050	19,751	18,161	51,962	**-1.8%**
Forestry and Wood Processing	10,732	12,503	17,887	41,122	**-0.7%**
Horticulture	18,627	24,295	27,111	70,033	**6.1%**
Pork, Poultry, Bees and Other	8,709	11,737	8,413	28,859	**10.8%**
Red Meat and Wool	27,391	32,057	20,243	79,691	**2.6%**
Seafood	1,589	3,192	8,346	13,127	**1.8%**
Cross Sector	9,536	27,387	24,194	61,117	**-4.1%**
Total	97,074	137,003	133,590	367,666	**1.2%**
Indicative % (Total)	**26%**	**37%**	**36%**	**100%**	
% point change from 2020	**1.1%**	**2.0%**	**1.1%**		

Source: NZIER

B.3 Transformed sector scenario

Table 151 Workforce numbers – Transformed sector scenario by sector and value chain

Workforce requirements in 2032

Sector	Core production	Core processing/ manufacturing	Strongly connected	Relevant	Other	Total	% Change
Arable	4,563	2,409	14,803	337	-	22,113	**-1.3%**
Dairy	38,994	13,121	1,394	-	-	53,509	**1.1%**
Forestry and Wood Processing	15,163	11,988	16,071	184	-	43,405	**4.8%**
Horticulture	39,619	26,601	4,216	250	-	70,686	**7.1%**
Pork, Poultry, Bees and Other	10,523	5,933	14,064	-	-	30,520	**17.1%**
Red Meat and Wool	49,662	37,192	5,693	355	-	92,902	**19.6%**
Seafood	6,552	5,319	1,227	473	-	13,570	**5.2%**
Cross Sector	25,644	-	10,558	20,927	6,181	63,310	**-0.7%**
Total	190,720	102,563	68,025	22,525	6,181	390,015	**7.4%**
Indicative % (Total)	**49%**	**26%**	**17%**	**6%**	**2%**	**100%**	
% point change from 2020	**-1.3%**	**3.1%**	**-1.3%**	**-0.4%**	**-0.1%**		

Source: NZIER

Table 152 Workforce numbers – Transformed sector scenario by sector and skill mix

Workforce requirements in 2032

Sector	Managers	Semi-autonomous	Managed	Total	% Change
Arable	6,586	6,194	9,333	22,113	**-1.3%**
Dairy	14,467	20,340	18,702	53,509	**1.1%**
Forestry and Wood Processing	11,416	13,034	18,955	43,405	**4.8%**
Horticulture	18,790	24,686	27,210	70,686	**7.1%**
Pork, Poultry, Bees and Other	9,103	12,159	9,257	30,520	**17.1%**
Red Meat and Wool	32,523	37,237	23,142	92,902	**19.6%**
Seafood	1,642	3,302	8,625	13,570	**5.2%**
Cross Sector	9,844	28,110	25,356	63,310	**-0.7%**
Total	104,371	145,063	140,581	390,015	**7.4%**
Indicative % (Total)	**27%**	**37%**	**36%**	**100%**	
% point change from 2020	**1.5%**	**1.9%**	**-3.4%**		

Source: NZIER

Appendix C Details of the analysis

This section details the method used and the equations behind our workforce forecasting analysis.

C.1 Structure of the analysis spreadsheet

The analysis spreadsheet is set up to reflect the structure in the analysis wireframe. The analysis spreadsheet has four components:

- background information
- analysis inputs
- calculations
- results.

C.2 Background information section

The "background information" sheets include a cover for this analysis, the analysis wireframe, as well as some background information for this project.

C.3 Analysis inputs section

The "Analysis inputs" section details all the inputs we use for the main analysis. Specifically, they provide the following information:

- The "Productivity shocks" sheet describes the productivity shocks and export demand shocks that we used to inform the CGE model.
- The "CGE output" sheet details the output of the CGE modelling that we use to transform into detailed worker counts. The results are total labour income growth by each sector and ANZSIC06 codes.
- The "Current Workforce Numbers" sheet sets out the current workforce counts that we use as the basis of our forecasts.
- The "Current Workforce Total Income" sheet provides information on the total labour income by ANZSIC06 codes for the current workforce.
- The "Scaling factor" sheet sets out the scaling factor used to lift up the workforce forecasts.
- The "Part A Risk of Automation" sheet details the risk of automation estimates we sourced from Nedelkoska and Quintini (2018).
- The "Part B Labour wage forecast" sheet includes the wage growth rates forecasts from NZIER and the New Zealand Treasury by job type.
- The "Helper" sheet sets out the unique scenarios, industries, value chain, and wage rates that we will use later to stratify our results in the "Results" section.

C.4 Calculations section

In the "Calculations" section, we use the input listed above to make projections for the 2032 workforce. The sheets in this section include:

- The "Part A Risk of Automation Calc" sheet set out how we calculated the risk of automation estimates for each job type. More detail about our approach can be found in section 3.2 of this report.
- The "Part A Job Composition Calc" sheet applies the above risk of automation estimates to the current workforce to obtain the workforce composition for 2032.
- The "Part B Wage escalation" sheet applies the wage growth rates forecasts from different sources to the current wage to calculate future annual wage rates for different job types. We calculate annual wage projections using wage forecasts from NZIER, the New Zealand Treasury, and the average wage forecast from both sources.
- The "Projection, Wage from NZIER" sheet uses CGE output, the projected workforce composition, and annual wage forecasts by job types from NZIER to calculate the workforce by job types for each ANZSIC06 industry. This procedure is repeated for all three scenarios.
- The "Projection, Wage from TSY" sheet uses CGE output, the projected workforce composition, and annual wage forecasts by job types from the New Zealand Treasury to calculate the workforce by job types for each ANZSIC06 industry. This procedure is repeated for all three scenarios.
- The "Projection, Average Wage" sheet uses CGE output, the projected workforce composition, and average annual wage forecasts by job types from NZIER and the New Zealand Treasury to calculate the workforce by job types for each ANZSIC06 industry. This procedure is repeated for all three scenarios.

C.5 Outputs section

Finally, In the "Outputs" section, we report our results of the calculations using several formats to generate insight into the future workforce. This section is designed to stratify the results by different scenarios and wage rates. We do this by allowing for scenario and wage rate selection, which allows us to compare the results while holding other moving parts constant. This section contains the following worksheets:

- The "Summary results" sheet Includes a high-level description of the forecasting results. There are five tabs listed under this sheet, which set out the current workforce and the workforce forecast by each of the following scenarios:
  - BAU scenario
  - Increased use of technology scenario
  - Transformation scenario.

  There's also a tab at the top of the sheet which allows for the selection of wage forecast we use to produce the results.
- The "Summary results by region" sheet sets out the high-level description of the forecasting results by each region.

- The “Results overview” sheet Includes a more detailed look into the results for each scenario, sector and designation. In this tab, the results are further stratified by the following worker type:
  - Managed
  - Semi-autonomous
  - Managers.

  The current workforce is also listed to facilitate a comparison between the future workforce and the current workforce.

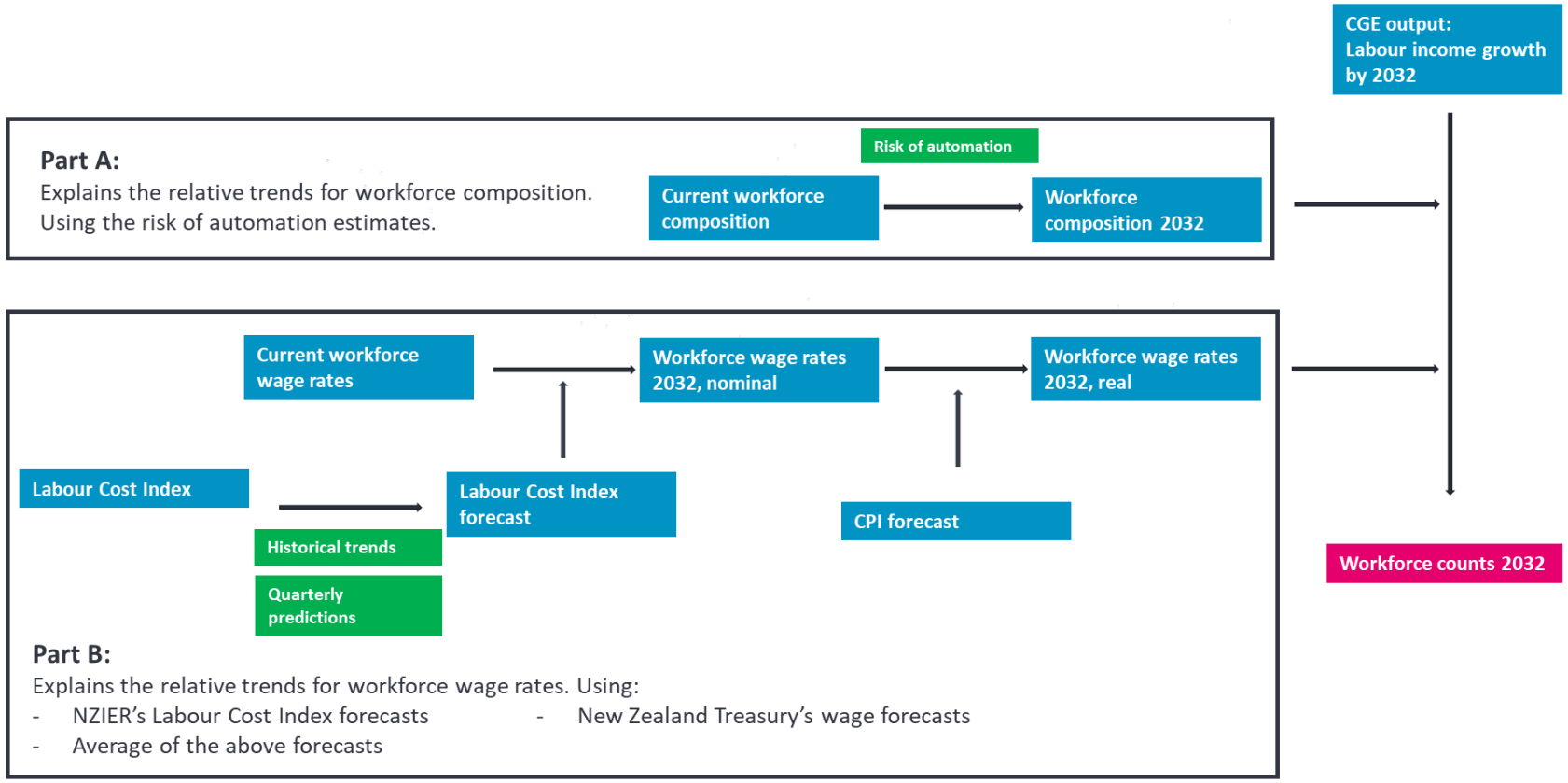
  The tab in the sheet also allows for the selection of scenarios by sector and designation.
- The “Results overview by region” sheet Includes regional details of the results for each scenario, sector and designation.
- The “Sector and Designation” sheet reports results by sector and designation while collapsing multiple ANZSIC06 codes under each sector or designation.
- The “Results by Sector” sheet reports more granular results by each scenario and sector. In this sheet, we report the workforce forecasts for 2032 by each ANZSIC06 code under the selected sector.
- The “Results by Sector and Region” sheet reports regional results by sector.
- The “Workforce growth accounting” sheet is structured similarly to the “Results overview” sheet, listing forecasting results stratified by sectors and designation. This sheet also provides more background information on the modelling inputs behind each scenario. Specifically, this sheet lists the forecasting results together with the following inputs that were used to calculate the future workforce:
  - Wage forecast by job type
  - Risk of automation estimates by job type
  - Productivity growth used to inform the CGE model
  - Output of the CGE model, total labour income growth.

  This sheet is designed to facilitate comparison between the workforce forecasts while taking into account the difference in scenarios and the use of different wage rates.
- The “Results by Designation” sheet reports more granular results by each scenario and designation. In this sheet, we report the workforce forecasts for 2032 by each ANZSIC06 code under the selected designation.
- The “Result, detailed” sheet reports the forecasting results by each ANZSIC06 code under the selected scenario.
- The “Results long table” sheet reports all the forecasting results that this analysis produces in a long table format.
- The “Results long by region” sheet reports all the regional forecasting results that this analysis produces in a long table format.
- Additional sheets for each region is also available at the end of the forecasting worksheet.

C.6 Analysis wireframe

The structure of the analysis is shown in the analysis wireframe below.

Figure 1 Analysis wireframe



Risk of automation estimates sourced from OECD: https://www.oecd-ilibrary.org/employment/automation-skills-use-and-training_2e2f4eea-en
NZIER Quarterly Predictions: https://www.nzier.org.nz/about-member-publications#qp

Source: NZIER

C.7 Change in workforce composition

In Part A of the analysis wireframe, we developed an analysis that captures the composition of the current workforce and how the workforce composition will likely change in the future.

The current workforce for each sector is identified for each of the following job types:

- Managed
- Semi-autonomous
- Managers.

Two key steps are involved in bringing this current workforce composition into the future: reviewing the risk of automation in the existing literature and matching the job types to the risk of automation estimates.

C.8 Risk of automation literature

The first step involves factoring the risks of automation by occupation into our analysis to consider shifts in workforce composition. To do this, we reviewed the literature on automation and job losses. Research around estimating the risk of automation by occupation and industry has been gaining popularity in recent years. The information can help policymakers and workers prepare for changes in workforce composition from labour-saving technology and artificial intelligence.

Frey and Osborne (2013) estimated that 47 percent of jobs in the United States are at high risk of being automated, building on expert assessment methodologies. They conducted interviews with experts in various fields on automation risks by occupation. This estimate is later updated by OECD. Specifically, by building on Frey and Osborne's (2013) methodology, Nedelkoska and Quintini (2018) adopted and improved the original estimates of the individual risk of automation by using a different set of occupation classifications. They expanded the analysis to 32 OECD countries, including New Zealand. We use their New Zealand estimates as the basis of this analysis to consider any changes in workforce composition in the next decade.

One thing to note is that although the above papers estimated the risk of automation based on how likely different tasks are to be automated, there is no clear timeline for how this automation will unfold. At the time of the expert consultation conducted by Frey and Osborne (2013) on automation risks for occupations, the questions related to the next two decades, which by now should mean a time horizon of about 10–15 years. Therefore, we assume that by 2032, the share of jobs at high risk of being automated will be automated.

C.9 Risk of automation by occupation

The second step involves matching the job types based on industry interviews to the risk of automation estimates according to the job description and the tasks they perform. We obtained the original classification of job types in the risk of automation estimates by Nedelkoska and Quintini (2018). Then we matched the job type classifications to the tasks being performed by the above-mentioned job types. Please refer to Section C.14 of this appendix for how this matching is done.

When a job type is matched with multiple occupations in Nedelkoska and Quintini (2018), we take the average of the corresponding risk of automation estimates. The detail of this procedure can be seen in the "Part A Risk of Automation Calc" sheet in the analysis worksheet.

We then apply the matched risk of automation estimates to the current workforce counts to obtain a ratio of future workforce composition in 2032. This workforce composition will be used later, together with the output from Part B of the analysis, to inform future workforce counts. The risk of automation calculation we used for the three types of workers are listed in the table below.

Table 153 Risk of automation estimates

Risk of automation estimates by job types

Managed	Semi-autonomous	Managers
24.19%	7.44%	1.90%

Source: NZIER, Nedelkoska and Quintini (2018)

The risk of automation estimates means that 24.19 percent of the current managed workforce, 7.44 percent of the current semi-autonomous workforce, and 1.9 percent of the managers will be automated by 2032.

C.10 Wage escalation

In Part B of this analysis, we consider any increase in the wage rates of the workforce in the future. We do this by combining the information on the current wage rates of the workforce, and the wage forecast from different sources, to inform future income.

Forecasts from different sources provide key insight into what the future may look like. However, they are sensitive to the modelling practice and assumptions that people make about the future. Often deciphering the best forecasting method is a very difficult task. One way to mitigate this uncertainty from modelling practice is to incorporate forecasts from different sources, which can be beneficial due to diversification gains.

Therefore, when escalating the wage of the workforce into 2032, we incorporate the following income growth forecasts into our analysis to reflect the wage outlook from NZIER and the New Zealand Treasury:

- NZIER's Labour Cost Index (LCI) forecast
- New Zealand Treasury's wage forecast in the Treasury's Half Year Economic and Fiscal Update(New Zealand Treasury, 2021b) and Treasury's Long-term Fiscal Position (New Zealand Treasury, 2021a)
- Mean of NZIER and Treasury's forecast.

The future wage we derive from these sources is nominal. Therefore, we use two price index forecasts to convert them into real wages to facilitate comparison. The price indices are from:

- NZIER's Consumer Price Index forecast

- Deflators from OECD-FAO Agricultural Outlook 2021-2030 (OECD & Food and Agriculture Organization of the United Nations, 2021).

We aim to use the current average wage rates, the above wage growth forecasts, and price indices of the job types mentioned in the previous section of this report.

For more details on wage escalation, please refer to Appendix D of this report.

C.11 CGE modelling

The final step of this analysis is to combine the labour income growth results from the CGE model with the output of Part A and Part B of the analysis to forecast the future workforce. For more information on the CGE outputs, please refer to the CGE report.

Specifically, we apply the labour income growth rates derived from the CGE model to the current total income to obtain the total labour income of 2032 for each industry. Then disaggregate this 2032 labour income using the output from Part A and Part B of this analysis into the number of workers by job type. We can do this disaggregation for each industry in the CGE model.

The main question this analysis attempts to address is: How many workers will each industry in the food and fibre sectors employ, based on the total labour income growth between now and 2032 for that industry? There are three sets of factors to consider: Current total labour income, expected workforce composition in 2032, given the impacts of automation, and expected increases in labour costs for each type of worker. These factors were discussed above.

C.12 CGE modelling output

We use the CGE output as an input for our spreadsheet analysis. CGE output details the growth rate in total labour income for each of the ANZSIC06 industries in the food and fibre sectors. We list the CGE results in the "CGE output" sheet of the analysis spreadsheet.

We denote the total labour income growth rate for each ANZSIC06 industry as "GR ".

C.13 Current workforce numbers and total income

The first step of the analysis is calculating the number of workers by job type for each ANZSIC06 industry in the food and fibre sectors. The job types we consider in this analysis are the following:

- managed
- semi-autonomous
- managers.

We do this using a mix of information from the New Zealand IDI and industry interviews. Specifically, we get the overall number of workers working in each industry from the IDI and the percentage of workers from each job type from industry interviews. This step is done in the "Current Workforce Numbers" sheet in the analysis worksheet. We denote the current workforce numbers for the job types as

$$CW_{Managed}, CW_{semi-autonomous}, and\ CW_{Managers}$$

After obtaining the workforce counts by job types in each ANZSIC06 industry, we calculate the current workforce's total labour income by multiplying the number of workers for each job type by the wage estimate we get from Stats NZ associated with that type of worker. This step is done in the "Current Workforce Total Income" sheet of the analysis worksheet. For future references, we denote the current workforce's total labour income by the industry as:

$$TLI_{Current}$$

C.14 Calculating the risk of automation

We then move on to calculate the risk of automation for each of the job types that we consider in this analysis. The job types are:

- managed
- semi-autonomous
- managers.

The calculation uses inputs from "PART A Risk of Automation" sheet, which sources estimates from the OECD risk of automation report by Nedelkoska and Quintini (2018). In this sheet, we detail the risk of automation by each occupation, as well as the job description for that occupation and the tasks they perform. We reviewed each job description to match the occupations that best describe each job type we consider in this analysis workbook. This selection is made in the "PART A Risk of Automation Calc" sheet in the analysis worksheet. We then take the average estimate for the occupations matched with each job type as the risk of automation for that job type.

The matching results are as follows:

Table 154 Occupation matched by job type

Managed	Semi-autonomous	Managers
Market-oriented skilled agricultural workers	ICT professionals	Admin. & commercial managers
Market-oriented skilled forestry, fishery and hunting workers	IC technicians	Production & specialised serv. managers
Food processing, woodworking, other craft & trades workers	Numerical & material recording clerks	
Stationary plant & machine operators		
Agricultural, forestry & fishery labourers		

Source: NZIER, Nedelkoska and Quintini (2018)

For more details on the description of these occupations and the calculations, please refer to the "PART A Risk of Automation" and the "PART A Risk of Automation Calc" sheets of the analysis spreadsheet. We denote the risk of automation estimates for each job type as:

$$ROA_{Managed}, ROA_{semi-autonomous}, and\ ROA_{Managers}$$

C.15 Calculating future workforce composition

Based on the current workforce counts:

$$CW_{Managed}, CW_{semi-autonomous}, and\ CW_{Managers}$$

As well as the risk of automation estimates for each job type:

$$ROA_{Managed}, ROA_{semi-autonomous}, and\ ROA_{Managers}$$

We calculate the future workforce composition by multiplying the current workforce counts with the risk of automation estimate for each job type:

If we denote the future workforce composition, the workforce as:

$$FW_{Managed}, FW_{semi-autonomous}, and\ FW_{Managers}$$

Then we can obtain the future workforce composition by:

$$FW_{Managed} = CW_{Managed} * ROA_{Managed}$$

$$FW_{semi-autonomous} = CW_{semi-autonomous} * ROA_{semi-autonomous}$$

$$FW_{Managers} = CW_{Managers} * ROA_{Managers}$$

This part of the calculation is done in the "Part A Job Composition Calc" sheet of the workforce analysis spreadsheet.

C.16 Wage escalation

We then move on to forecasting wages associated with each job type. We use three sets of wages in this workforce analysis:

- NZIER's Labour Cost Index (LCI) forecast.
- New Zealand Treasury's wage forecast in the Treasury's Half Year Economic and Fiscal Update(New Zealand Treasury, 2021b) and Treasury's Long-term Fiscal Position (New Zealand Treasury, 2021a).
- Mean of NZIER and Treasury's forecast.

For more details on the wage escalation, please refer to Appendix D of this report.

The "Part B Wage escalation" sheet of the analysis workbook details the values of the wage forecasts used in this analysis. We denote the wage forecast associated with each job type as:

$$W_{Managed}, W_{semi-autonomous}, and\ W_{Managers}$$

C.17 Projecting future workforce counts.

After we organise all the inputs from the calculations detailed above, we calculate the future workforce counts by putting all the inputs together. These calculations are done in

the projection sheets in the analysis spreadsheet. Specifically, we used the wage forecasts from 3 different sources to project future workforce counts in the following sheets:

- The “Projection, Wage from NZIER” sheet.
- The “Projection, Wage from TSY” sheet.
- The “Projection, Average Wage” sheet.

These sheets follow the same structure and use the same risk of automation and CGE output. The only difference is the wage forecasts that are being applied.

We start by calculating the percentage of income that goes to each job type in the future. We do this by multiplying the future workforce composition and the future wage rates associated with each job type:

For example, the percentage of future income that goes to the managed workforce

$$P_{Managed}$$

is calculated by:

$$\frac{FW_{Managed} * W_{Managed}}{FW_{Managed} * W_{Managed} + FW_{semi-autonomous} * W_{semi-autonomous} + FW_{Managers} * W_{Managers}}$$

We do this calculation for semi-autonomous and managers as well.

We then calculate the total labour income for the future by multiplying the current total labour income with the labour income growth rates derived from the CGE model. If we denote total future labour income as:

$$TLI_{Future}$$

The future total labour income is calculated as:

$$TLI_{Future} = TLI_{Current} * GR$$

We then derive the total labour income that goes to each job type, for example, the total labour income that goes to the managed workforce:

$$TLI_{managed}$$

Is calculated as:

$$TLI_{managed} = TLI_{Future} * P_{Managed}$$

Given the calculations above, we have obtained the total labour income associated with each workforce type. The remaining is to derive the actual number of workers for each job type by combing total labour income by job types with wage forecast by job types. For example, if we denote the future managed workforce as:

$$FWC_{managed}$$

Then we can calculate this as:

$$FWC_{managed} = \frac{TLI_{managed}}{W_{Managed}}$$

Appendix D Detailed method behind the wage forecast

The following sections detail the method behind the wage forecasts used in this analysis.

$$W_{Managed}, W_{semi-autonomous}, and\ W_{Managers}$$

We document the Labour Cost Indexes (LCI) and NZIER's LCI forecasting model. We also set out the wage forecasts in the Treasury's Long-term Fiscal Position report.

D.1 Labour Cost Index

This section describes our forecasts of the labour cost indices selected for benchmarking labour wage escalation and the methods used to produce the forecasts.

The LCI forecasts are modelled using econometric models that connect cost escalation to domestic economic-wide trends. We detail our methods in the section below.

D.1.1 Choice of Labour Cost Index

Stats NZ publishes publicly available wage rates and LCI by occupation groups in New Zealand. This occupation group is classified by the Australian and New Zealand Standard Classification of Occupations (ANZSCO).

We aim to match the above job types to the existing wage rates and LCI by occupation and escalate the real wage rates of the current workforce into 2032, using NZIER's LCI forecast models.

The wage rates and LCIs we selected to benchmark costs are listed in the table below.

Table 155 Wage and index measures by job type

Job type	Wage measure	Index measure
Managed	Labourer	LCI labourers
Semi-autonomous	Professionals, Technicians and Trade workers	LCI Professionals, LCI Technicians and Trade workers
Managers	Managers	LCI managers

Source: NZIER

We chose two income and LCI measures for the semi-autonomous workforce, as the composition of this group of workers is a mix of professionals, technicians and trade workers. In the analysis, we use the average of the forecasted wages derived from the corresponding LCIs to calculate their 2032 wages and use these averages to disaggregate income into the number of workers.

These wage rates and Labour Cost Indices are chosen to benchmark the different components of labour costs. We chose occupation-specific wage rates and LCI measures to

ensure indices reflect labour costs and market dynamics relevant to cost escalation faced by different occupations.

Note that the LCIs are generalised measures of cost increases for a fixed quality of Labour, which fits our purpose of escalating wage rates for the same job in the future.

The following sections set out NZIER's forecasting methodology.

D.1.2 Forecast inputs

The labour cost forecast models make use of the following inputs from NZIER's regular forecasts and forecast models:

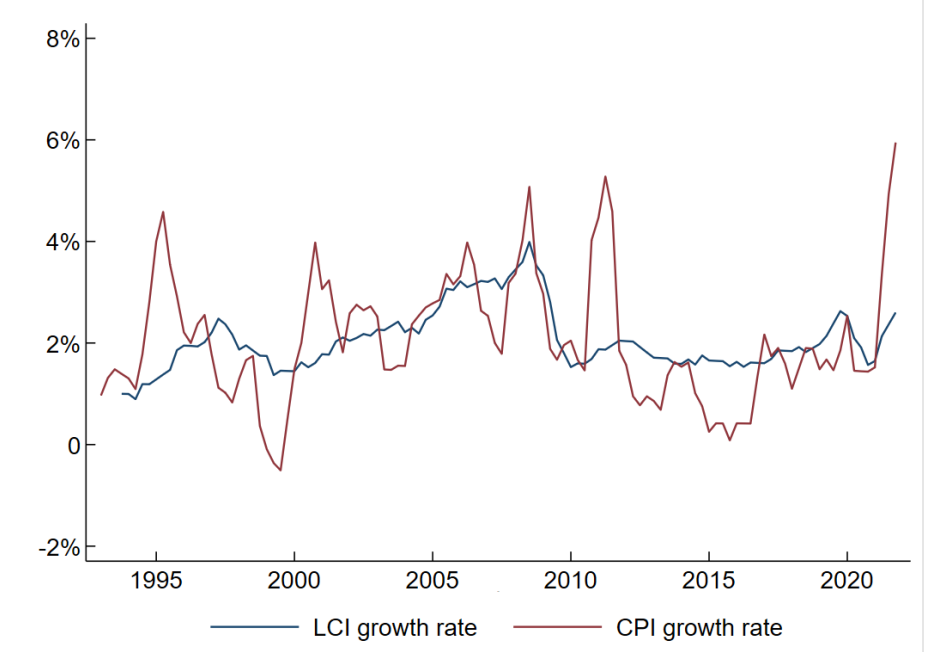
- Forecasts of the all-occupation, all salary and wage rates LCI.
- Forecasts of GDP
    - Short-term forecasts based on sector and expenditure-specific cycles in economic activity.
    - Long-term forecasts based on labour force growth and historical multifactor productivity growth trends.
- Forecasts of population growth and migration growth.

Important points of context are:

- Historically we see CPI growth outpacing LCI in times of high inflation. This pattern will likely persist as inflation soars to a 30-year high in New Zealand.
- Historically we see wages growing faster for the low-income group than the high-income group.
- Economic growth will be slower over the next decade than the past decade's average because of an ageing population and slowing labour force growth.

The figure below shows the historical growth rate of LCI and CPI. In the past, there was a certain degree of co-movement between CPI and LCI. New Zealand has historically experienced stagnant wage growth since the Global Financial Crisis (GFC). Despite the high employment rate, wages have been growing slowly in the past decade, where the economy experienced low inflation and moderate economic growth. However, historically we see periods of LCI growth lagging behind CPI growth in periods of high inflation. This is also the case in the recent high inflation environment.

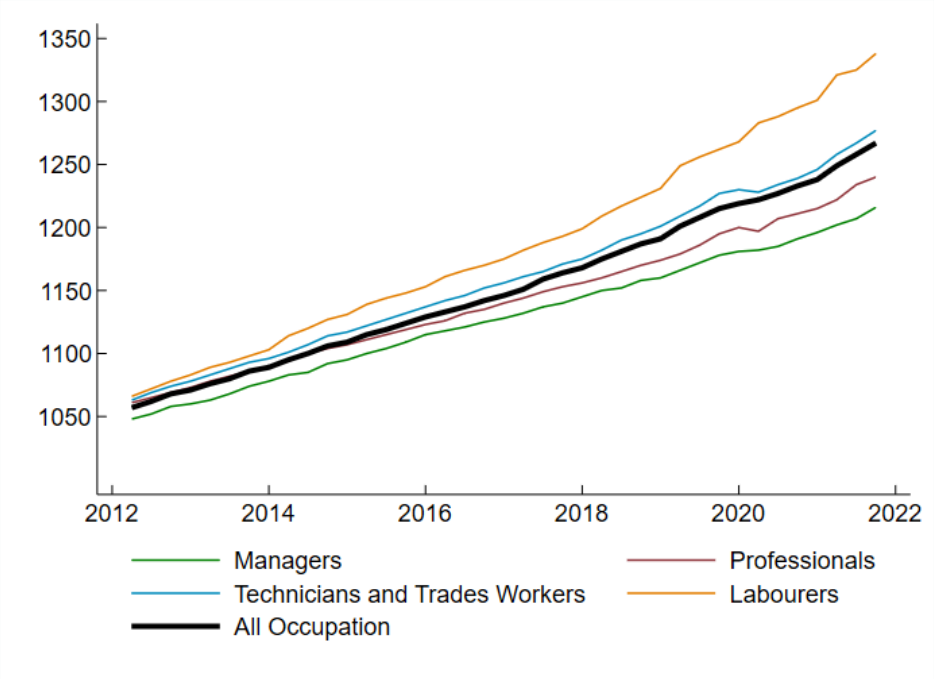
Figure 2 Historic growth rate of LCI and CPI



Source: Stats NZ

On top of the moderate income growth, heterogeneity in income growth by occupation types has also been evident in New Zealand. The figure below shows the historical LCI by occupation type. In the past decade, we have seen faster income growth for labourers, exceeding the average income growth for all occupations in New Zealand. However, at the same time, the income growth for professionals and managers has lagged behind the overall wage growth. We take these patterns as an important point of context in informing our LCI forecasts.

Figure 3 Historic LCIs by occupation



Source: Stats NZ

These disparities in income growth distributions across job types are also evident in other parts of the world. The University of Pennsylvania Budget Model recently estimated that wage growth was distributed unevenly across households in America, with a rise in wage growth concentrated among the lowest-paid 50 percent of workers. By contrast, the hourly earnings growth for higher-paid workers stagnated (Arnon et al., 2021).

These contexts provide important background for analysing the output of NZIER's LCI by occupation forecasting models. We will discuss this further in the following sections.

D.1.3 LCI for all occupations forecast

The forecast of the LCI for all occupations by NZIER is determined jointly with other key measures of macroeconomic activity. The forecasts are produced through an iterative forecast process that considers both demand and supply aspects of the macroeconomy, institutional settings and economic shocks to global demand or local supply, such as droughts.

The forecast can be accurately described as having both a long-term trend component and a cyclical component.

- The trend component is forecast using the relationship between CPI inflation and overall wage inflation.
- Cycles reflect fluctuations in the output gap (actual growth in output in the economy relative to growth in productive capacity). These fluctuations affect labour costs by affecting wage demands and the proportion of wage cost that comes from overtime rates.

Forecast cycles also incorporate the delayed effects of rising labour demand on unemployment, employment, and wage inflation. In our models, growth in the LCI lags rising labour demand by 18 to 24 months.

Historically, we see the LCI struggles to keep up with CPI in New Zealand at times of high inflation. We forecast LCI growth to lag behind CPI growth in the coming years, as New Zealand is facing the most elevated inflationary pressures the country has seen in the past 30 years. This means that NZIER forecasts predict a period of negative real wage growth, followed by moderate growth in both CPI and LCI, similar to the pattern we have seen in New Zealand in the past decades.

D.1.4 LCI by occupation forecast models

The occupation specific LCIs are forecast using econometric models with two parts:

- A model of the long-term trend in the LCI by occupation as a function of all occupations, all salary and wage rates LCI, and population growth (a generalised labour supply measure).
- A model of short-run and cyclical movements in the LCI by occupation as a function of changes in net migration, the GDP output gap, and autoregressive terms.

Model fit and the model equations are detailed in Appendix E.

D.1.5 LCI forecasting results

The figure below shows NZIER's forecast of the LCI growth rate by occupation and CPI growth rate. The models predict CPI will revert to around 2 percent in the medium term and stabilise in the long term. The LCI for all occupations will follow CPI growth in the short term with a lag, but this growth will not be enough to offset the inflationary pressures from the growth in CPI. In the long term, the model predicts LCI and CPI will grow at an annual rate of 2 percentage points.

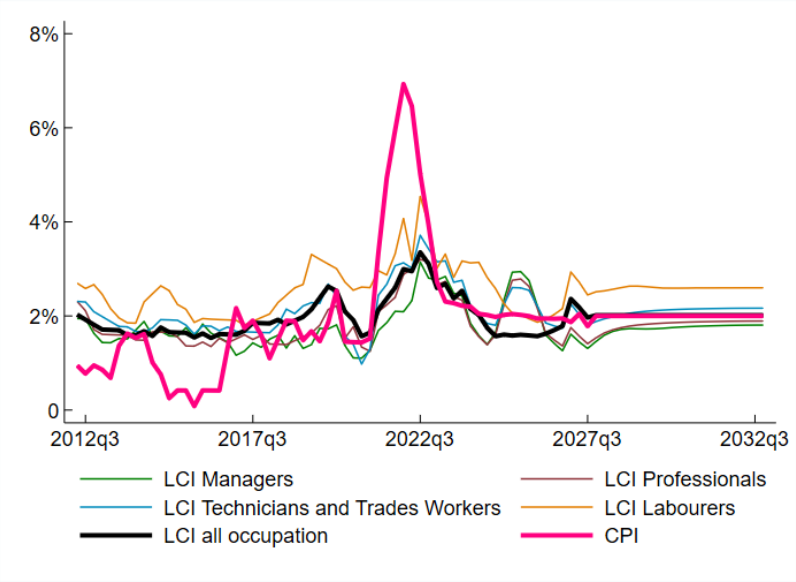
In terms of LCI by occupations, we see similar patterns similar historically. The wages of labourers grow faster than other occupations, while wages for other occupations tend to grow slower. Our models forecast LCI for labourers, technicians and trade workers will grow at a higher rate than CPI. In contrast, LCI for managers and professionals will grow slower than CPI. This means that labourers, technicians and trade workers will experience positive real wage growth. In contrast, the real wage for managers and professionals will tend to fall by a small amount in the coming years.

This is not surprising given that historically wage increases in New Zealand have been stagnant since the GFC. In the past decade, policymakers in New Zealand and worldwide have been trying to understand low wage growth. This is especially puzzling given the high employment rate in New Zealand. Some hypotheses for this stagnant wage growth are low productivity growth, the decline of labour income shares, capital shallowness etc. (Arsov & Evans, 2018; Ball et al., 2019; Conway et al., 2015; Nolan et al., 2018).

On top of the slow increase in wages historically (although in the past, there's been a certain degree of co-movement between CPI and LCI), we also see periods of LCI growth lagging behind CPI growth in periods of high inflation. Given that inflation is at an all-time high now and expected to remain high before reverting to around 2 percent by around

2023 to 2024, NZIER forecasts there will be a certain degree of LCI lagging behind CPI, as we have seen historically.

Figure 4 LCI by occupation forecast



Source: Stats NZ, NZIER

D.2 Wage growth forecast from the New Zealand Treasury

In addition to using NZIER's forecast model to escalate workers' wages, we also used wage estimates from the New Zealand Treasury to provide some additional scenarios on how wages can likely change in the future.

Table 156 New Zealand Treasury's wage forecast

Year	Wage growth
2021	4.0%
2022	4.1%
2023	4.5%
2024	4.6%
2025	4.4%
2026	4.2%
2027	3.53%
2028	3.02%
2029	3.02%
2030	3.02%
2031	3.02%
2032	3.02%

Source: New Zealand Treasury (2021a, 2021b)

We incorporated the above forecasts into our analysis as an alternative scenario and used them to disaggregate future aggregate workforce income into the number of workers by job type.

We ran the alternative scenario as a sensitivity test to see how the workforce forecasts may change depending on income forecasts from different sources. New Zealand Treasury forecasts also provide a view of what New Zealand's fiscal policy decision-makers think the future will look like for the workforce in New Zealand.

D.3 Wage growth using the mean of NZIER's and Treasury's forecasts

In addition to the forecasts above, we also use the mean wage increase estimates of both NZIER's wage forecast and the New Zealand Treasury's wage forecast. We take into account any contribution in terms of forecasting accuracy for both forecasting methodologies. This type of combined forecast is a great way to mitigate any uncertainty and risk concerning the future wage outlook of New Zealand.

Appendix E Econometric model statistics

Table 157 LCI Managers' model

Trend equation

Dependent Variable: LN(LCI_Managers) Method: Fully Modified Least Squares (FMOLS) Sample (adjusted): 2009Q1 2021Q4				
Explanatory variable	Coefficient	Std. Error	z-Statistic	Prob.
LN(LCI_All)	0.889	0.011	82.04	0.000
LN(Population(-16))	-0.009	0.002	-5.42	0.000
C	0.726	0.081	9.00	0.000
R-squared	0.997			
Adjusted R-squared	0.997			

Cycle equation

Dependent Variable: Residual from trend equation Method: Least Squares Sample (adjusted): 2009Q1 2021Q4				
Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
NetMigration(-1)	-0.0001	0.000	-2.09	0.042
GDPGap(-5)	0.026	0.011	2.29	0.026
AR(1)	0.895	0.080	11.24	0.000
R-squared	0.76			
Adjusted R-squared	0.74			

Source: NZIER

Table 158 LCI Professionals' model

Trend equation

Dependent Variable: LN(LCI_professionals) Method: Fully Modified Least Squares (FMOLS) Sample (adjusted): 2009Q1 2021Q4				
Explanatory variable	Coefficient	Std. Error	z-Statistic	Prob.
LN(LCI_All)	0.933	0.009	103.33	0.000
LN(Population(-16))	-0.008	0.001	-5.67	0.000
C	0.432	0.067	6.43	0.000
R-squared	0.999			
Adjusted R-squared	0.999			

Cycle equation

Dependent Variable: Residual from trend equation Method: Least Squares Sample (adjusted): 2009Q1 2021Q4				
Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
NetMigration(-1)	-0.001	0.000	-1.97	0.054
AR(1)	0.775	0.076	10.17	0.000
R-squared	0.71			
Adjusted R-squared	0.70			

Source: NZIER

Table 159 LCI technicians and trade workers' model

Trend equation

Dependent Variable: LN(LCI technicians and trade workers) Method: Fully Modified Least Squares (FMOLS) Sample (adjusted): 2009Q1 2021Q4				
Explanatory variable	Coefficient	Std. Error	z-Statistic	Prob.
LN(LCI_All)	1.068	0.008	134.15	0.000
LN(Population(-16))	-0.006	0.001	-4.85	0.000
C	-0.494	0.059	-8.34	0.000
R-squared	0.999			
Adjusted R-squared	0.999			

Cycle equation

Dependent Variable: Residual from trend equation Method: Least Squares Sample (adjusted): 2009Q1 2021Q4				
Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
NetMigration(-5)	-0.000	0.000	-1.81	0.076
GDPGap	0.031	0.008	3.86	0.000
AR(1)	0.802	0.075	10.66	0.000
R-squared	0.76			
Adjusted R-squared	0.74			

Source: NZIER

Table 160 LCI Labourers' model

Trend equation

	Dependent Variable: LN(LCI_Labourers) Method: Fully Modified Least Squares (FMOLS) Sample (adjusted): 2009Q1 2021Q4			
Explanatory variable	Coefficient	Std. Error	z-Statistic	Prob.
LN(LCI_All)	1.28	0.005	255.99	0.000
LN(Population(-4))	-0.003	0.001	-3.55	0.000
C	-1.980	0.037	-52.83	0.000
R-squared	0.999			
Adjusted R-squared	0.999			

Cycle equation

	Dependent Variable: Residual from trend equation Method: Least Squares Sample (adjusted): 2009Q1 2021Q4			
Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
NetMigration(-2)	0.000	0.000	2.45	0.018
GDPGap(-4)	-0.043	0.014	-3.02	0.004
AR(1)	0.292	0.112	2.61	0.012
R-squared	0.37			
Adjusted R-squared	0.33			

Source: NZIER

Appendix F Categorisation of ANZSIC06 classes

Table 161 Industry and ANZSIC06 mapping

Industry/sector	Value chain	ANZSIC06 code	ANZSIC06 description
Arable	Core Production	A014900	Other Grain Growing
Arable	Core Production	A015900	Other Crop Growing n.e.c.
Arable	Core Processing/Manufacturing	C116100	Grain Mill Product Manufacturing
Arable	Core Processing/Manufacturing	C119200	Prepared Animal and Bird Feed Manufacturing
Arable	Strongly Connected	C116200	Cereal, Pasta and Baking Mix Manufacturing
Arable	Strongly Connected	C117100	Bread Manufacturing (Factory-based)
Arable	Strongly Connected	C117200	Cake and Pastry Manufacturing (Factory-based)
Arable	Strongly Connected	C117300	Biscuit Manufacturing (Factory-based)
Arable	Strongly Connected	C117400	Bakery Product Manufacturing (Non-factory-based)
Arable	Strongly Connected	C118100	Sugar Manufacturing
Arable	Strongly Connected	C121200	Beer Manufacturing

Industry/sector	Value chain	ANZSIC06 code	ANZSIC06 description
Arable	Strongly Connected	C121300	Spirit Manufacturing
Arable	Strongly Connected	F331200	Cereal Grain Wholesaling
Arable	Strongly Connected	I530100	Grain Storage Services
Arable	Relevant	C118200	Confectionery Manufacturing
Dairy	Core Production	A016000	Dairy Cattle Farming
Dairy	Core Processing/Manufacturing	C113100	Milk and Cream Processing
Dairy	Core Processing/Manufacturing	C113200	Ice Cream Manufacturing
Dairy	Core Processing/Manufacturing	C113300	Cheese and Other Dairy Product Manufacturing
Dairy	Strongly Connected	F360300	Dairy Produce Wholesaling
Forestry and wood processing	Core Production	A030100	Forestry
Forestry and wood processing	Core Production	A030200	Logging
Forestry and wood processing	Core Production	A051000	Forestry Support Services
Forestry and wood processing	Core Processing/Manufacturing	C141100	Log Sawmilling
Forestry and wood processing	Core Processing/Manufacturing	C141200	Wood Chipping

Industry/sector	Value chain	ANZSIC06 code	ANZSIC06 description
Forestry and wood processing	Core Processing/Manufacturing	C141300	Timber Resawing and Dressing
Forestry and wood processing	Core Processing/Manufacturing	C149300	Veneer and Plywood Manufacturing
Forestry and wood processing	Core Processing/Manufacturing	C149400	Reconstituted Wood Product Manufacturing
Forestry and wood processing	Core Processing/Manufacturing	C151000	Pulp, Paper and Paperboard Manufacturing
Forestry and wood processing	Strongly Connected	C149200	Wooden Structural Fittings and Components Manufacturing
Forestry and wood processing	Strongly Connected	C149900	Other Wood Product Manufacturing n.e.c.
Forestry and wood processing	Strongly Connected	C152100	Corrugated Paperboard and Paperboard Container Manufacturing
Forestry and wood processing	Strongly Connected	C152200	Paper Bag and Sack Manufacturing
Forestry and wood processing	Strongly Connected	C251100	Wooden Furniture and Upholstered Seat Manufacturing
Forestry and wood processing	Strongly Connected	F333100	Timber Wholesaling

Industry/sector	Value chain	ANZSIC06 code	ANZSIC06 description
Forestry and wood processing	Relevant	C149100	Prefabricated Wooden Building Manufacturing
Forestry and wood processing	Relevant	C152300	Paper Stationery Manufacturing
Forestry and wood processing	Relevant	C152400	Sanitary Paper Product Manufacturing
Forestry and wood processing	Relevant	C152900	Other Converted Paper Product Manufacturing
Viticulture and wine making	Core Production	A013100	Grape Growing
Viticulture and wine making	Core Processing/Manufacturing	C121400	Wine and Other Alcoholic Beverage Manufacturing
Kiwifruit	Core Production	A013200	Kiwifruit Growing
Apple and pear growing	Core Production	A013400	Apple and Pear Growing
Summerfruit	Core Production	A013500	Stone Fruit Growing
Other horticulture	Core Production	A011100	Nursery Production (Under Cover)
Other horticulture	Core Production	A011200	Nursery Production (Outdoors)
Other horticulture	Core Production	A011300	Turf Growing
Other horticulture	Core Production	A011400	Floriculture Production (Under Cover)

Industry/sector	Value chain	ANZSIC06 code	ANZSIC06 description
Other horticulture	Core Production	A011500	Floriculture Production (Outdoors)
Other horticulture	Core Production	A012100	Mushroom Growing
Other horticulture	Core Production	A012200	Vegetable Growing (Under Cover)
Other horticulture	Core Production	A012300	Vegetable Growing (Outdoors)
Other horticulture	Core Production	A013300	Berry Fruit Growing
Other horticulture	Core Production	A013600	Citrus Fruit Growing
Other horticulture	Core Production	A013700	Olive Growing
Other horticulture	Core Production	A013900	Other Fruit and Tree Nut Growing
Other horticulture	Core Production	RSE employed in other ANZSIC	RSE employed in other ANZSIC
Other horticulture	Core Processing/Manufacturing	C114000	Fruit and Vegetable Processing
Other horticulture	Core Processing/Manufacturing	I530900	Other Warehousing and Storage Services
Other horticulture	Core Processing/Manufacturing	N732000	Packaging Services
Other horticulture	Strongly Connected	C119100	Potato Crisps and Corn Chips Manufacturing
Other horticulture	Strongly Connected	F360500	Fruit and Vegetable Wholesaling

Industry/sector	Value chain	ANZSIC06 code	ANZSIC06 description
Other horticulture	Relevant	C121100	Soft Drink, Cordial and Syrup Manufacturing
Pork, Poultry, Bees and Other	Core Production	A017100	Poultry Farming (Meat)
Pork, Poultry, Bees and Other	Core Production	A017200	Poultry Farming (Eggs)
Pork, Poultry, Bees and Other	Core Production	A019100	Horse Farming
Pork, Poultry, Bees and Other	Core Production	A019200	Pig Farming
Pork, Poultry, Bees and Other	Core Production	A019300	Beekeeping
Pork, Poultry, Bees and Other	Core Production	A019900	Other Livestock Farming n.e.c.
Pork, Poultry, Bees and Other	Core Production	A042000	Hunting and Trapping
Pork, Poultry, Bees and Other	Core Processing/Manufacturing	C111200	Poultry Processing
Pork, Poultry, Bees and Other	Strongly Connected	C119900	Other Food Products Manufacturing n.e.c.

Industry/sector	Value chain	ANZSIC06 code	ANZSIC06 description
Pork, Poultry, Bees and Other	Strongly Connected	F331900	Other Agricultural Product Wholesaling
Red Meat	Core Production	A014100	Sheep Farming (Specialised)
Red Meat	Core Production	A014200	Beef Cattle Farming (Specialised)
Red Meat	Core Production	A014400	Sheep-Beef Cattle Farming
Red Meat	Core Production	A014500	Grain-Sheep and Grain-Beef Cattle Farming
Red Meat	Core Production	A018000	Deer Farming
Red Meat	Core Processing/Manufacturing	C111100	Meat Processing
Red Meat	Core Processing/Manufacturing	C132000	Leather Tanning, Fur Dressing and Leather Product Manufacturing
Red Meat	Strongly Connected	C111300	Cured Meat and Smallgoods Manufacturing
Red Meat	Strongly Connected	F360200	Meat, Poultry and Smallgoods Wholesaling
Wool	Core Production	A052200	Shearing Services
Wool	Core Processing/Manufacturing	C131100	Wool Scouring
Wool	Core Processing/Manufacturing	C131200	Natural Fibre Textile Manufacturing

Industry/sector	Value chain	ANZSIC06 code	ANZSIC06 description
Wool	Strongly Connected	C133100	Textile Floor Covering Manufacturing
Wool	Strongly Connected	F331100	Wool Wholesaling
Wool	Relevant	C133300	Cut and Sewn Textile Product Manufacturing
Seafood	Core Production	A020100	Longline and Rack (Offshore) Aquaculture
Seafood	Core Production	A020200	Caged (Offshore) Aquaculture
Seafood	Core Production	A020300	Onshore Aquaculture
Seafood	Core Production	A041100	Rock Lobster and Crab Potting
Seafood	Core Production	A041300	Line Fishing
Seafood	Core Production	A041400	Fish Trawling, Seining and Netting
Seafood	Core Production	A041900	Other Fishing
Seafood	Core Processing/Manufacturing	C112000	Seafood Processing
Seafood	Strongly Connected	F360400	Fish and Seafood Wholesaling
Seafood	Relevant	C239100	Shipbuilding and Repair Services
Seafood	Relevant	C239200	Boatbuilding and Repair Services
Cross Sector	Core Production	A052900	Other Agriculture and

Industry/sector	Value chain	ANZSIC06 code	ANZSIC06 description
			Fishing Support Services
Cross Sector	Strongly Connected	C183100	Fertiliser Manufacturing
Cross Sector	Strongly Connected	C183200	Pesticide Manufacturing
Cross Sector	Strongly Connected	C184200	Veterinary Pharmaceutical and Medicinal Product Manufacturing
Cross Sector	Strongly Connected	C246100	Agricultural Machinery and Equipment Manufacturing
Cross Sector	Strongly Connected	M697000	Veterinary Services
Cross Sector	Relevant	C115000	Oil and Fat Manufacturing
Cross Sector	Relevant	C133200	Rope, Cordage and Twine Manufacturing
Cross Sector	Relevant	C203100	Cement and Lime Manufacturing
Cross Sector	Relevant	F332300	Industrial and Agricultural Chemical Product Wholesaling
Cross Sector	Relevant	F341100	Agricultural and Construction Machinery Wholesaling
Cross Sector	Relevant	I461000	Road Freight Transport

Industry/sector	Value chain	ANZSIC06 code	ANZSIC06 description
Cross Sector	Relevant	I521100	Stevedoring Services
Cross Sector	Relevant	I521200	Port and Water Transport Terminal Operations
Cross Sector	Relevant	M691000	Scientific Research Services
Cross Sector	Relevant	M692300	Engineering Design and Engineering Consulting Services
Cross Sector	Relevant	M692500	Scientific Testing and Analysis Services
Cross Sector	Relevant	M700000	Computer Systems Design and Related Services
Cross Sector	Other	N721200	Labour Supply Services

Source: NZIER, MPI