Primary sector workforce skill projections

Analysis of dairy farming, beef & sheep farming, and the forestry production industries

August 2016

Introduction

The purpose of this report is to show how the skills of workforce in the dairy farming, beef & sheep farming, and forestry production industries are projected to change over time. These projections are compared to targets set out in the Future Capabilities Report in 2014. Note that the scope of the current work is narrower than the Future Capabilities Report which covers all primary sectors and includes production, processing, and support services. In this report, we focus only the production component of the following three industries with ANZSIC codes:

- **Dairy farming:** dairy cattle farming (A016000)
- **Beef & sheep farming:** sheep-beef cattle farming (A014400), beef cattle farming – specialised (A014200), sheep farming – specialised (A014100), grain-sheep and grain-beef cattle farming (A014500) and beef cattle feedlots – specialised (A014300)
- **Forestry production:** forestry (A030100), logging (A030200), and forestry support services (A051000)

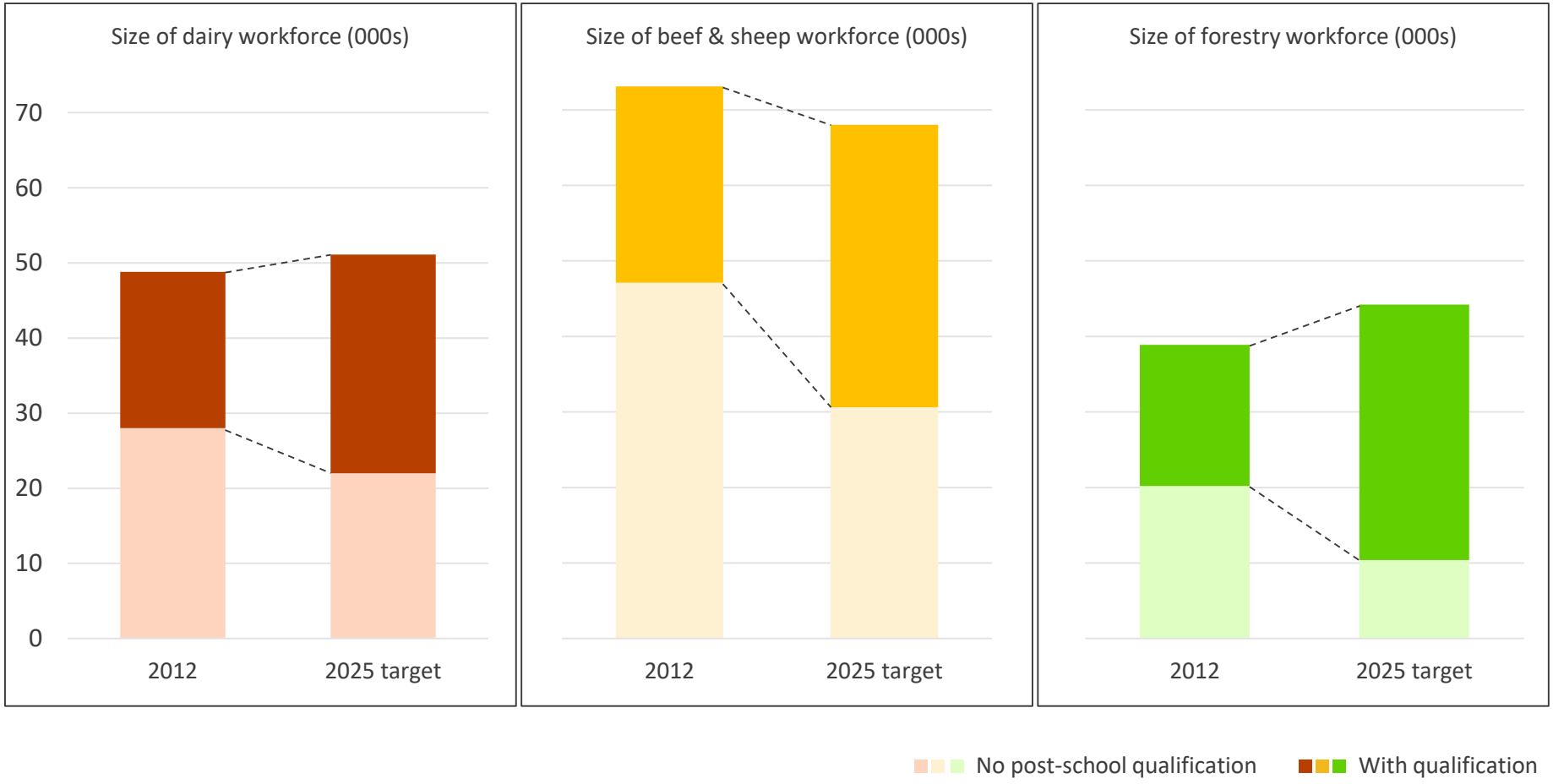
The targets set out in the Future Capabilities Report do not distinguish between sector-specific and general qualifications, of which there are a significant number. We have only considered general qualifications to be valuable to an industry if they are at diploma level or above (L5+).

Scarlatti's Inchworm model was used for the presented predictive analysis. The inputs to the model were calibrated using data extracted from Statistics New Zealand's Integrated Database Infrastructure and the Ministry of Education.

We show that under a 'business as usual' scenario for training and recruitment, the skills of the workforce in scope will not reach the targets set out in the Future Capabilities Report. For the targets to be achieved, a significant increase in sector-specific training is required across the three sectors even when we also model an increase new recruits with L5+ general qualifications. In the dairy farming industry, this requirement translates to about a ~50% increase. In the forestry production industry, a ~threefold increase is required. In beef & sheep farming, the industry needs to increase training volumes by about seven to eight times.

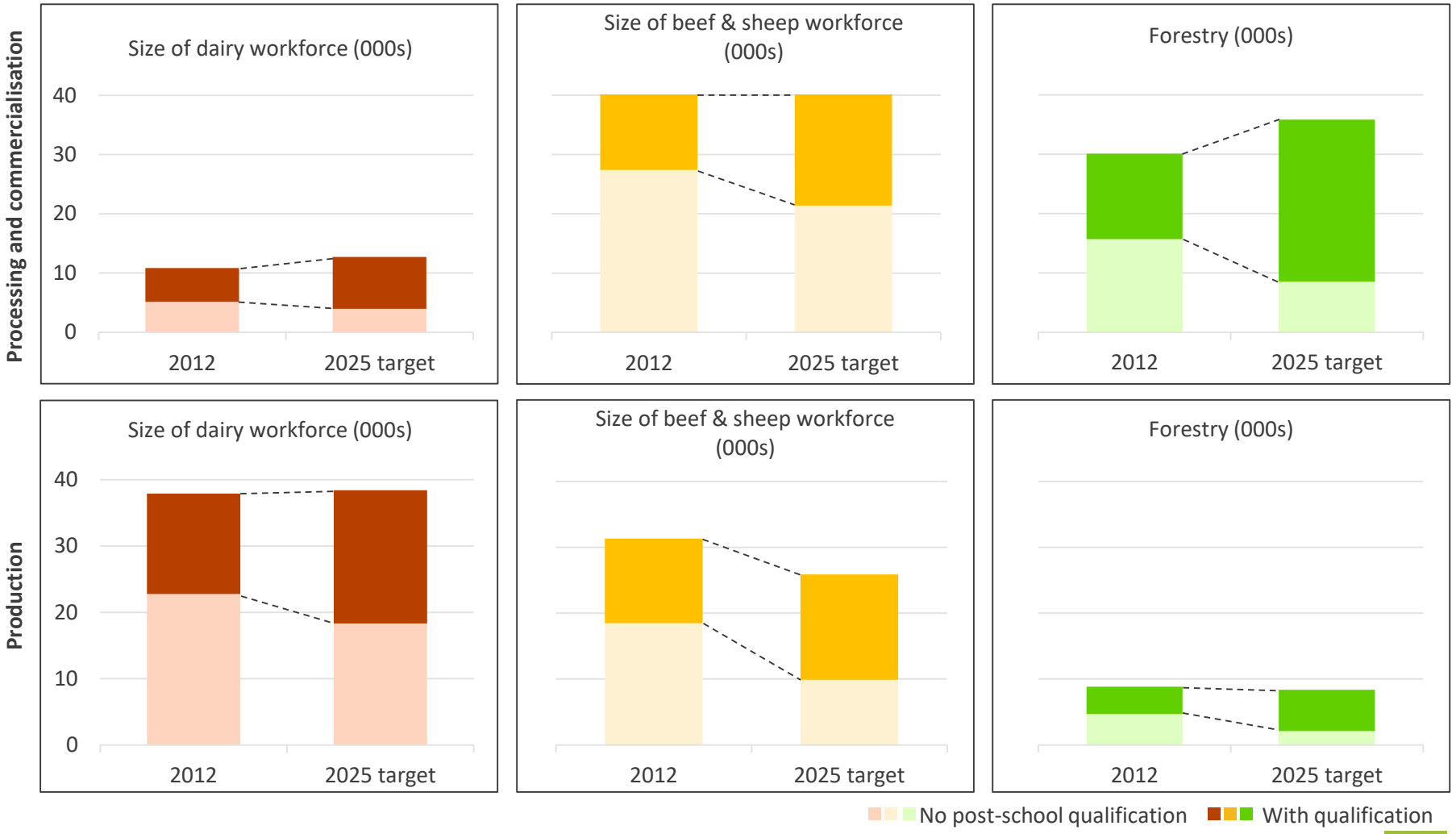
The results presented in this analysis have been calibrated to match the year 2012 current status, and year 2025 targets, from the Future Capabilities Report. The Future Capabilities Report uses a broader scope of the industry (production & processing) then the scope used in this analysis (only production).

Current status and targets from the Future Capabilities Report



Using the qualification data from 'Human capability in primary sector' report (2016) by MPI and workforce size data from Future Capabilities Report, Scarlatti estimated the split of baseline and target for production and processing & commercialisation in the three sectors of interest. For the dairy industry, production is less skilled than processing & commercialisation. In contrast, the beef & sheep farming workforce is more skilled than its processing & commercialisation counterpart. The skills of forestry workforces are similar for production and processing & commercialisation.

Workforce size by qualification - 2012 and 2025 targets broken out



Strategies to meet the Future Capabilities Report targets

The qualified portion of the workforce can be further segmented into two groups, those with a sector-specific qualification that relates to the industry in which they work, and those who hold a general qualification or one from another industry.

With this in mind, there are two strategies to meet the targets set out by the Future Capabilities Report:

1. Increase the number of industry-specific qualifications via training and recruitment
2. Increase the number of general qualifications via recruitment from the general population

Recruits from the general population are likely to improve the industry capability in different amounts. For example, a qualified accountant who took up beef & sheep farming would contribute to the number of qualifications in the dairy industry in the same way a hairdresser would. However, we can argue that the accountant's skills would crossover more readily to farming. As we do not have the data to show what qualification each industry entrant has, we have assumed that qualifications at level 5 and above will be valuable to the industry.

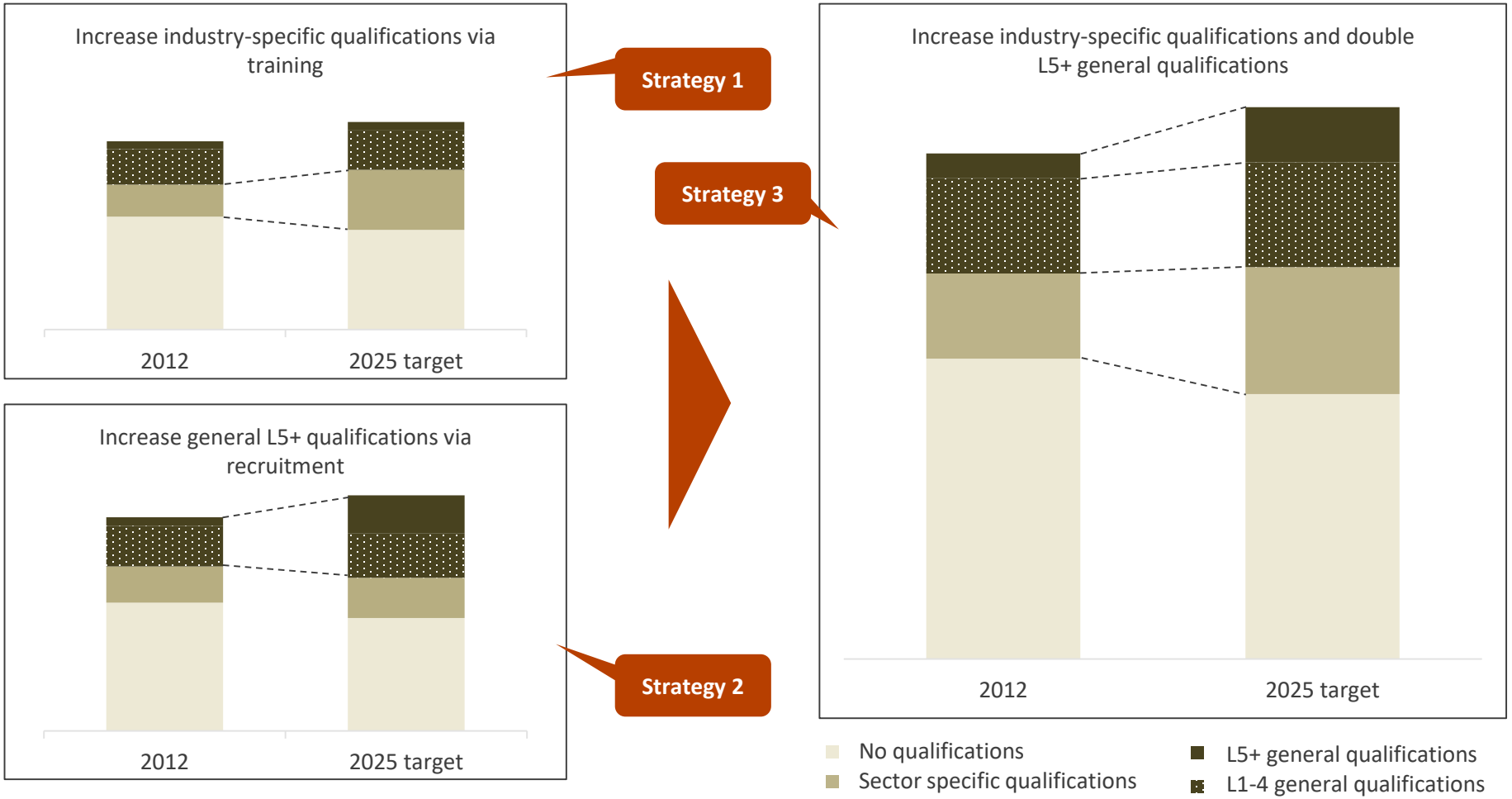
The modelled projections that follow assume that a combination of both strategies is used to meet the 2025 targets. Skills will grow by both:

1. Increasing the number of industry-specific qualifications via training and recruitment, and
2. Increasing the number of level 5+ general qualifications via recruitment from the wider workforce.

The charts below illustrate the different strategies for meeting the 2025 targets as described in the previous slide. The two alternate strategies are shown on the left, and a combination of these strategies is on the right. In the combined example, we assume the proportion of individuals with level 5+ general qualifications doubles, and the rest of the target is met by increasing industry-specific qualifications. Notice that the total size of this illustrative workforce increases between the two time periods, so although the proportion of a category may remain the same, the volumes will change. The analysis reported in this work is based on strategy 3.

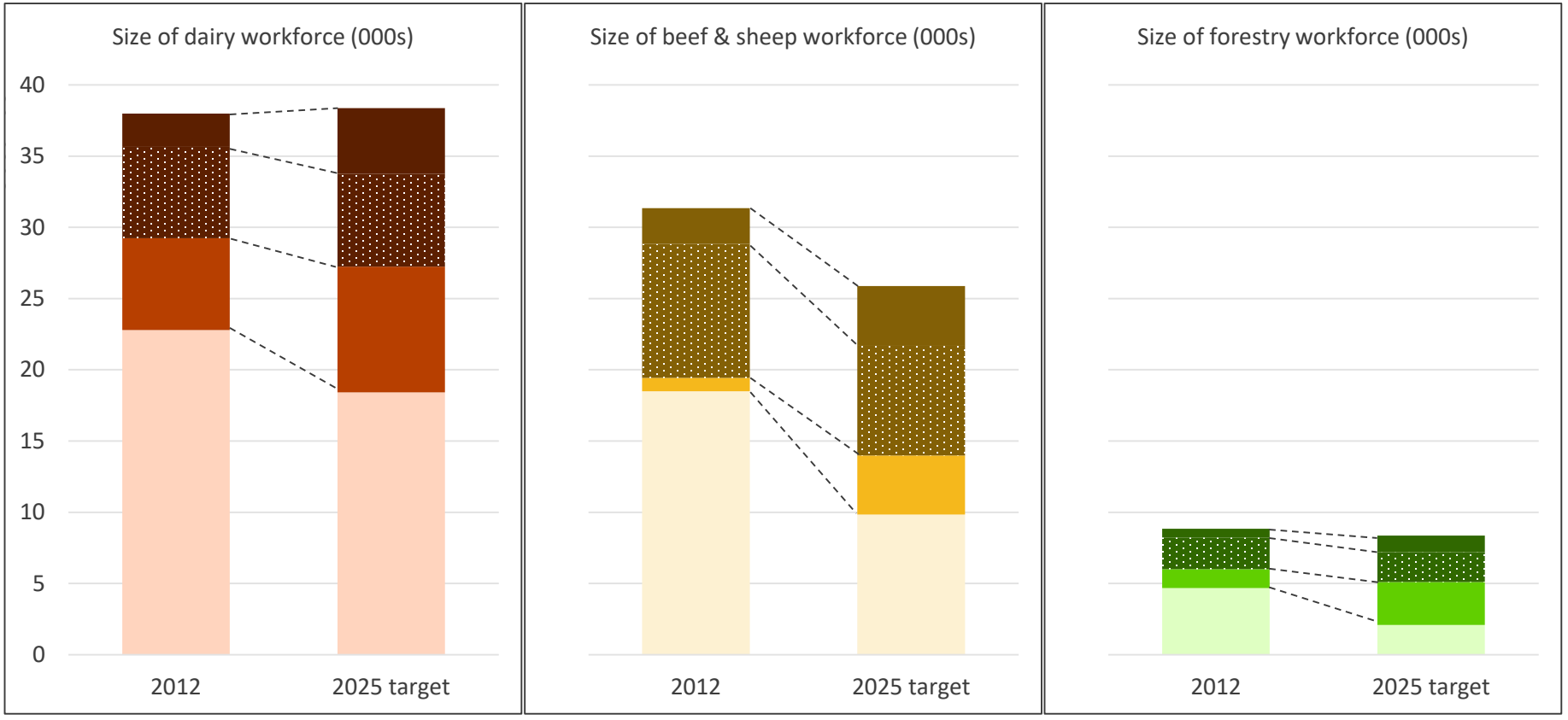
Alternative strategies for meeting the 2025 targets

Illustrative



Below we show the current status (2012) and Future Capabilities Report targets (2025) for the production workers in each industry if we employ two strategies to meet the targets, doubling the number of those with level 5+ non-industry qualifications, and increasing industry-specific qualifications to fill the remaining skills gap to meet the target.

Combined strategies for each industry



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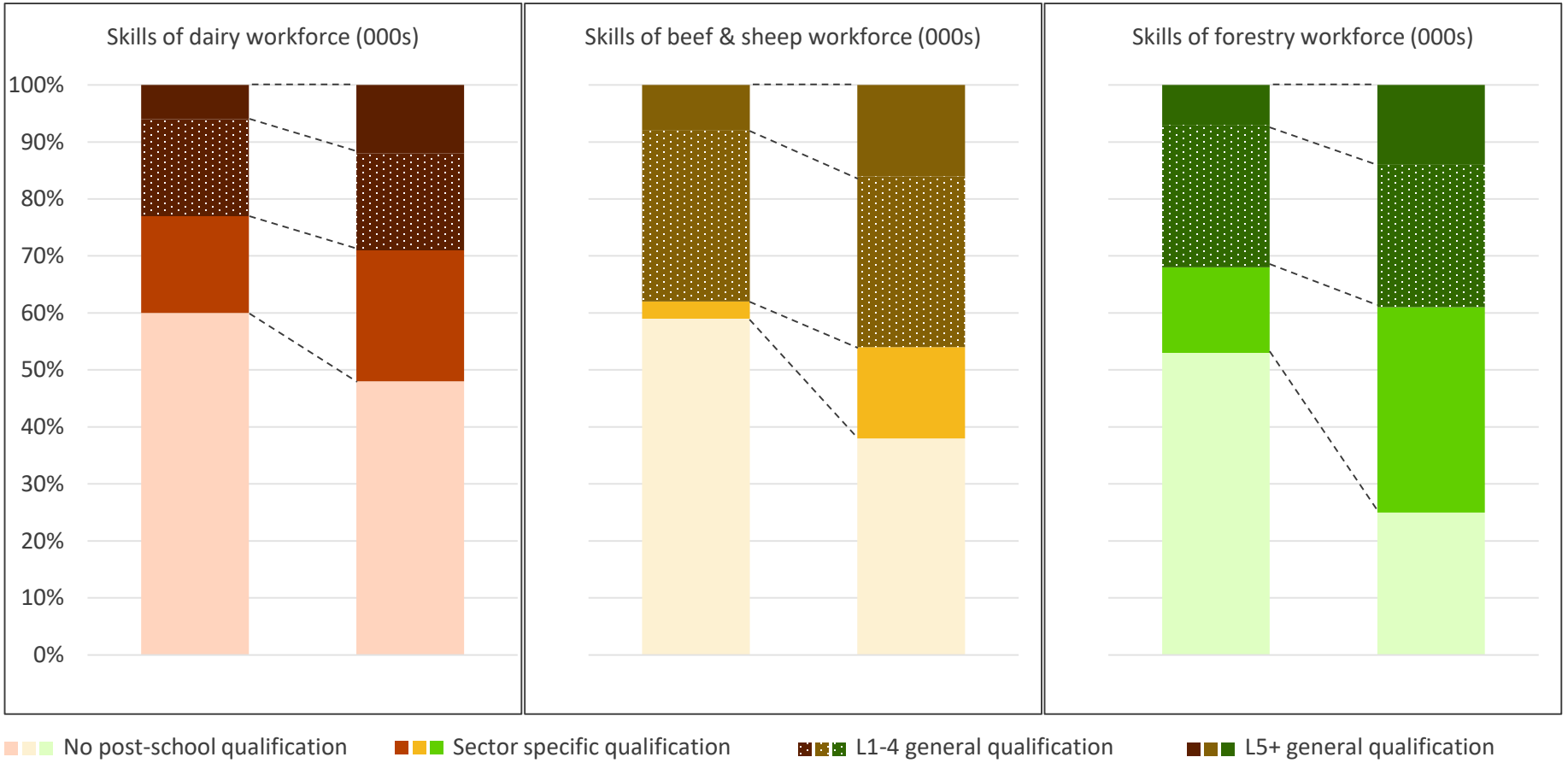

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- Achieving the target

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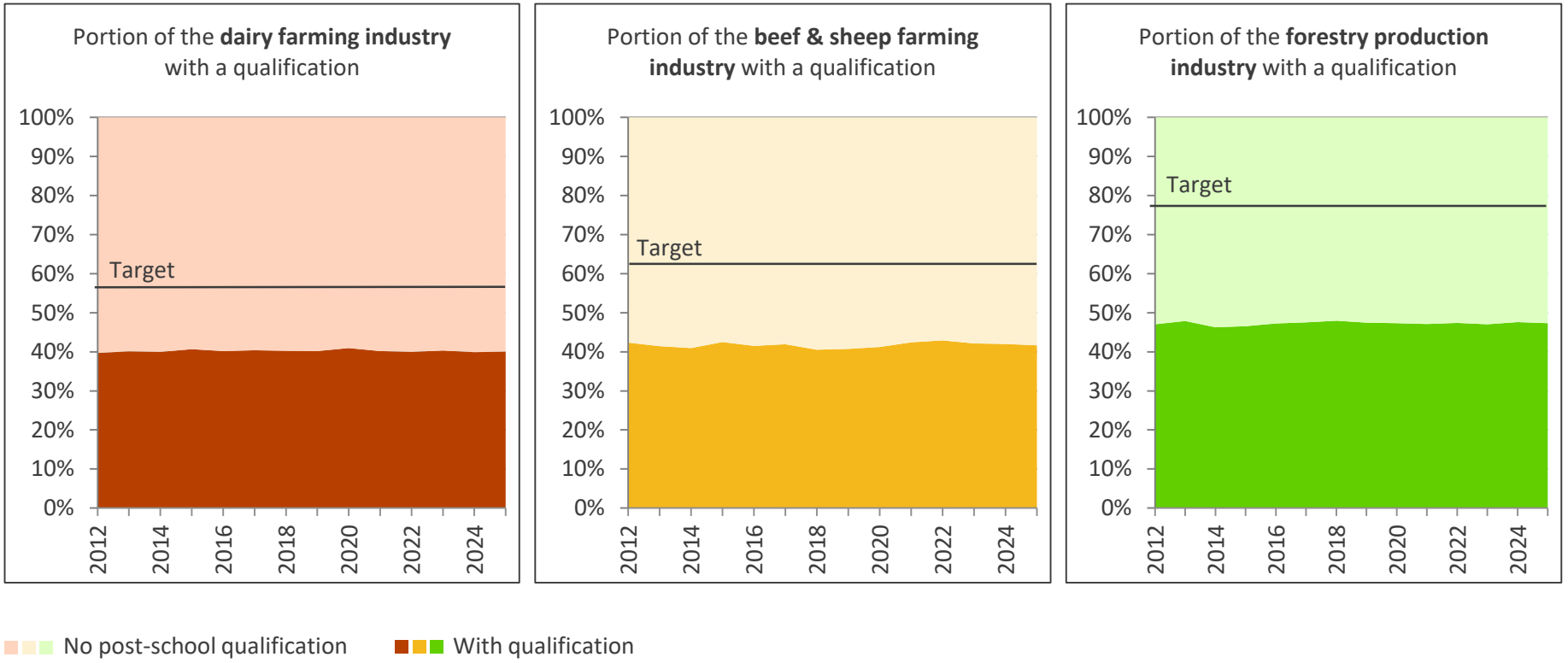
Below is a projection of what would happen in each industry if no changes are made in regards to increasing the volume of sector specific or generally trained individuals e.g. the status quo continues and neither strategy 1,2 or 3 are pursued.

Projected qualification levels under the status quo



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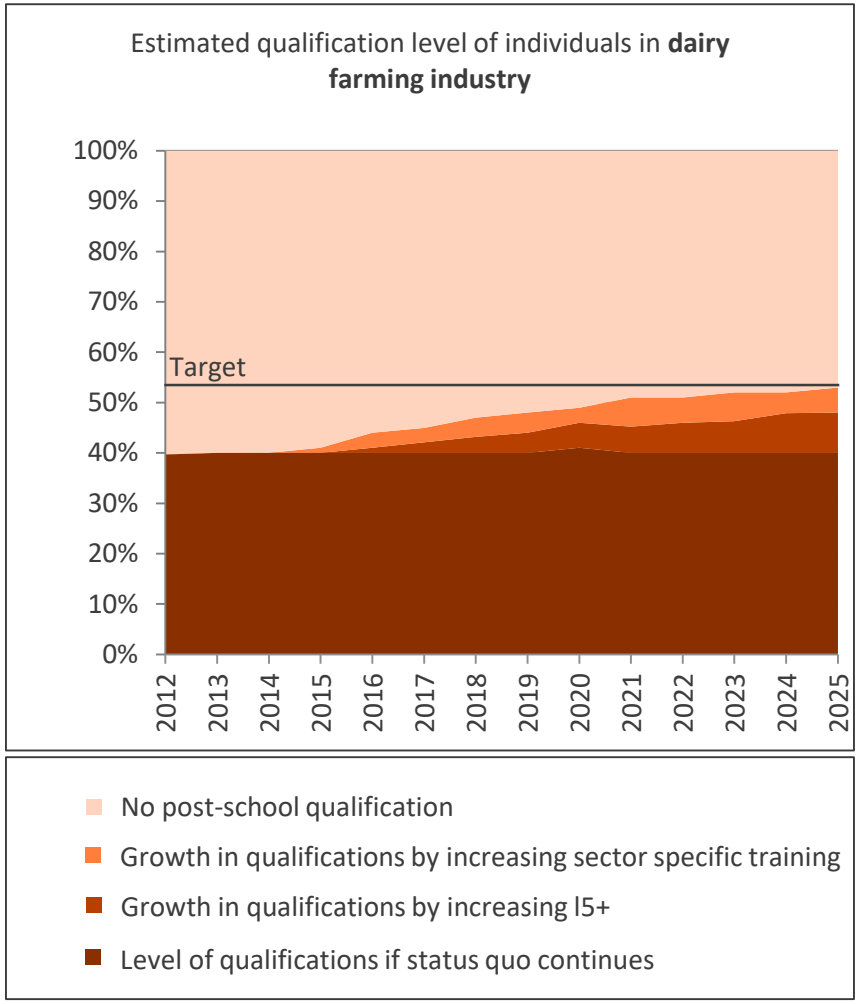
If strategy 3 is pursued and we double the number of individuals in the dairy industry that have a general qualification, we estimate that the dairy farming industry will need to supply about 30% more industry training and recruits in order to achieve the 2025 Future Capabilities Report target. The chart is broken down to show the relative effect that each strategy has on meeting the 2025 target.

What it takes to achieve target – dairy farming

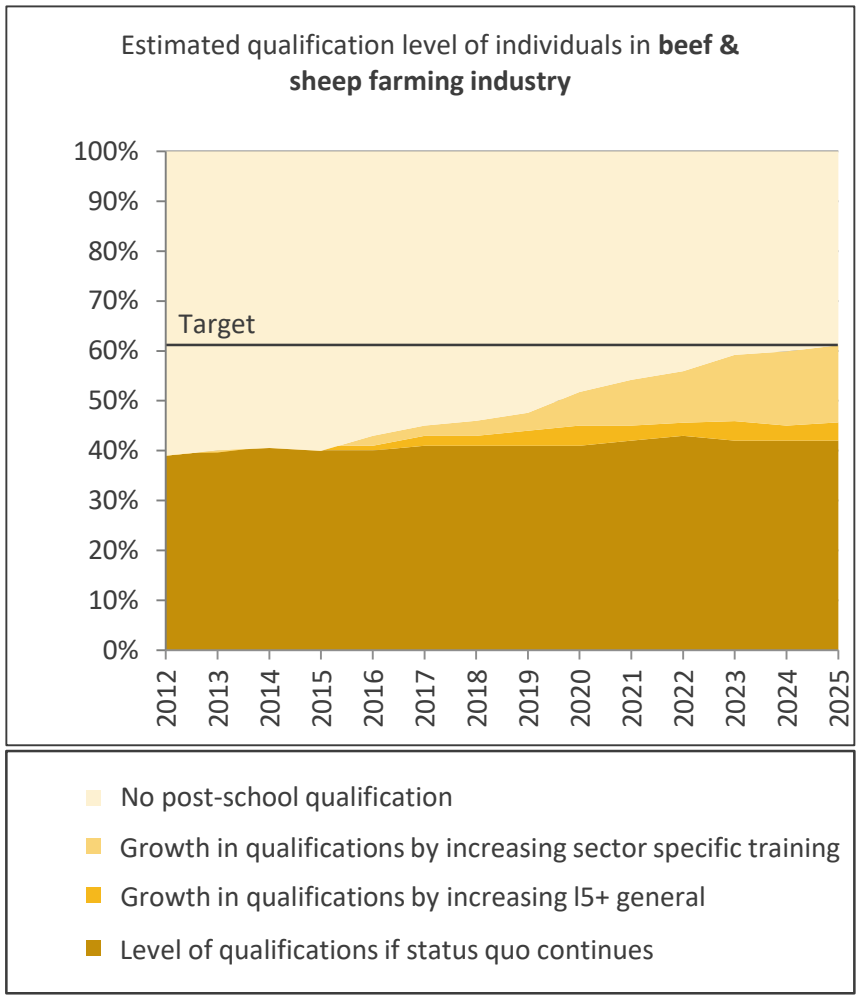
- The number of individuals with general qualifications at level 1-4 remains constant
- By 2025, the number of individuals in the industry with general qualifications at levels 5+ doubles by increasing recruitment efforts by 3-4 times
- The volume of sector specific training increases by ~30%



For the beef & sheep industry, the current supply of industry specific qualifications via training and recruitment from the ITO and SAC providers is far from what it needs to achieve the 2025 target. The industry needs to increase the volume of sector specific qualifications by about six to seven times to achieve the target. The chart is broken down to show the relative effect that each strategy has on meeting the 2025 target.

What it takes to achieve target – beef & sheep farming

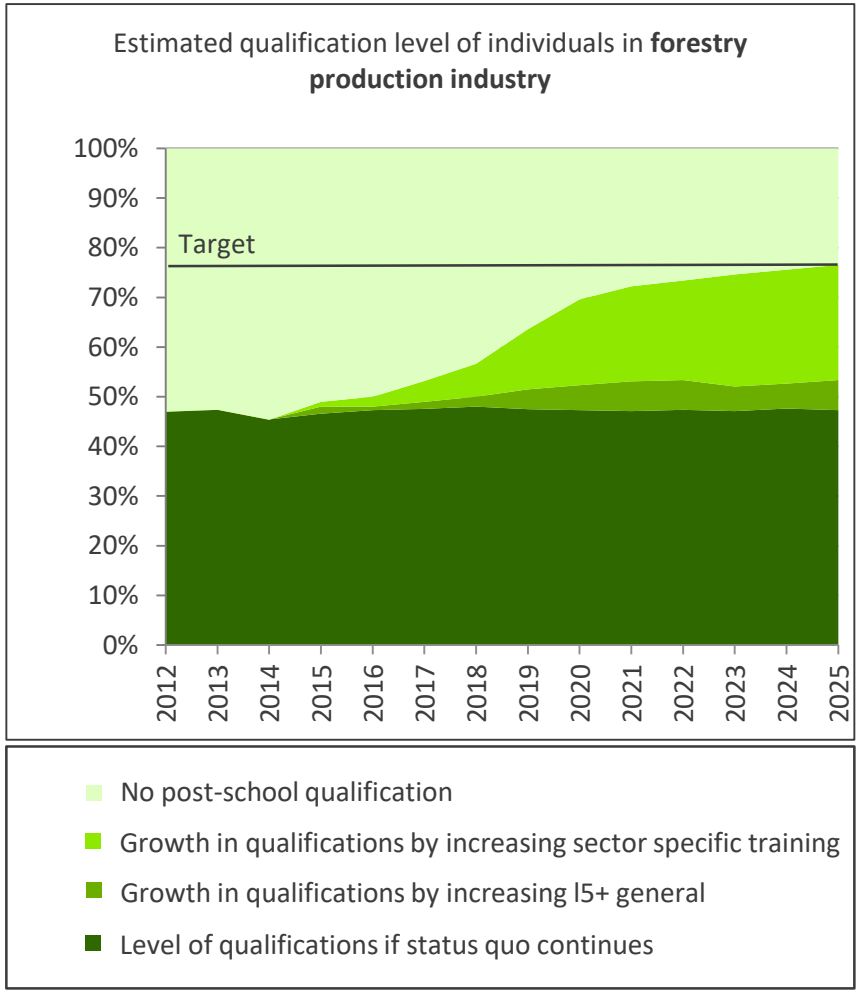
- The number of individuals with general qualifications at level 1-4 remains constant
- By 2025, the number of individuals in the industry with general qualifications at levels 5+ doubles by increasing recruitment efforts by 3-4 times
- The volume of sector specific training increases by ~600-700%



The efforts in recruiting people with general qualifications need to be increased by three to four times in the forestry industry to achieve the target of doubling the stocks of L5+ general qualifications by 2025. Even if these general qualification stocks are doubled, the volume of sector specific qualifications needs to be tripled to reach the 2025 target from the Future Capabilities Report.

What it takes to achieve target – forestry production

- The number of individuals with general qualifications at level 1-4 remains constant
- By 2025, the number of individuals in the industry with general qualifications at levels 5+ doubles by increasing recruitment efforts by 3-4 times
- The volume of sector specific training increases by ~300%



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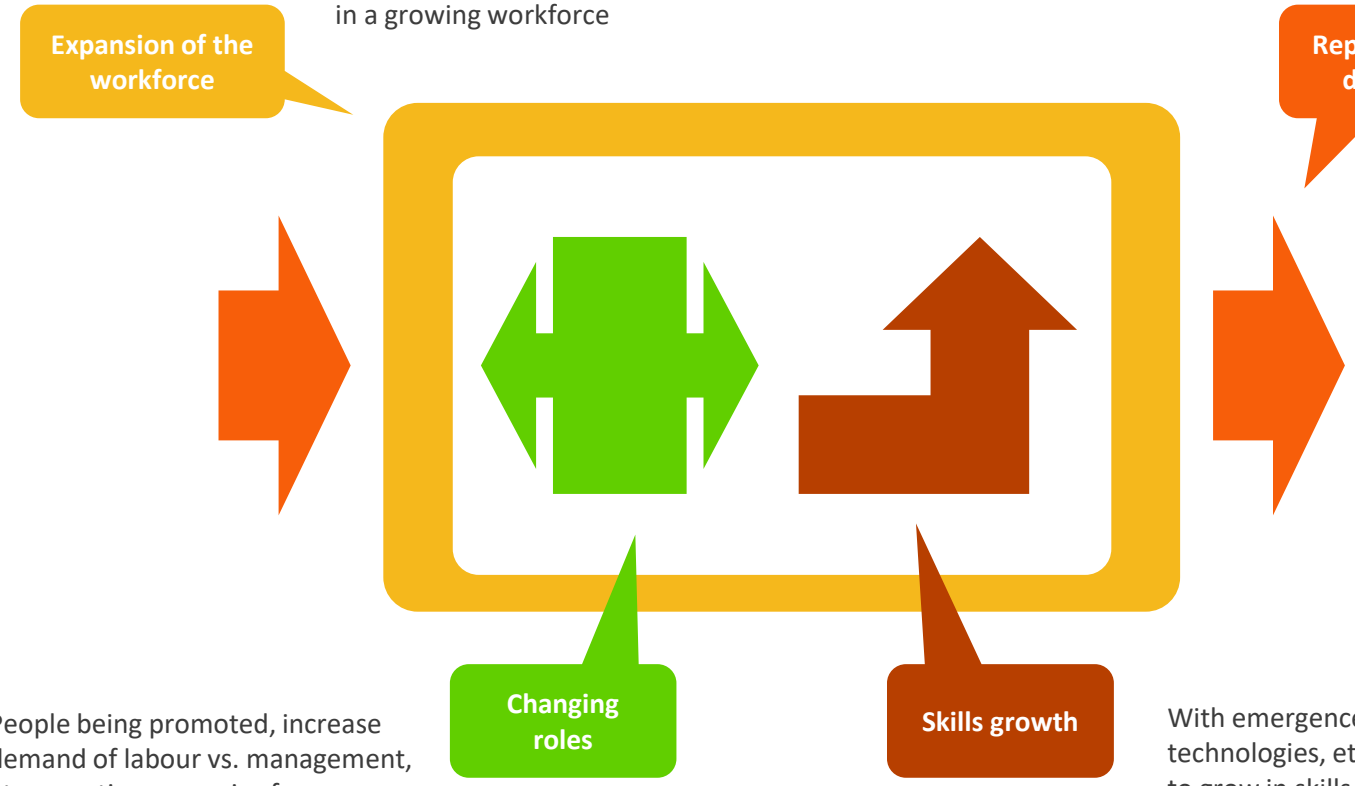
Overview of the modelling approach

A workforce and its skills can be represented as a stock and flow system, which is controlled by supply & demand of workers and skills. These will be elaborated in the next few slides. In order to quantify the supply & demand and their effects on the workforce, we need to understand their complex dynamics and interactions.

We use an agent-based model to manage these complexities. Essentially, we model each individual worker and their propensity to different career pathways within the industry (e.g., being recruited, retire, getting promoted, etc.). Finally, we work bottom-up to evaluate the status of the overall workforce.

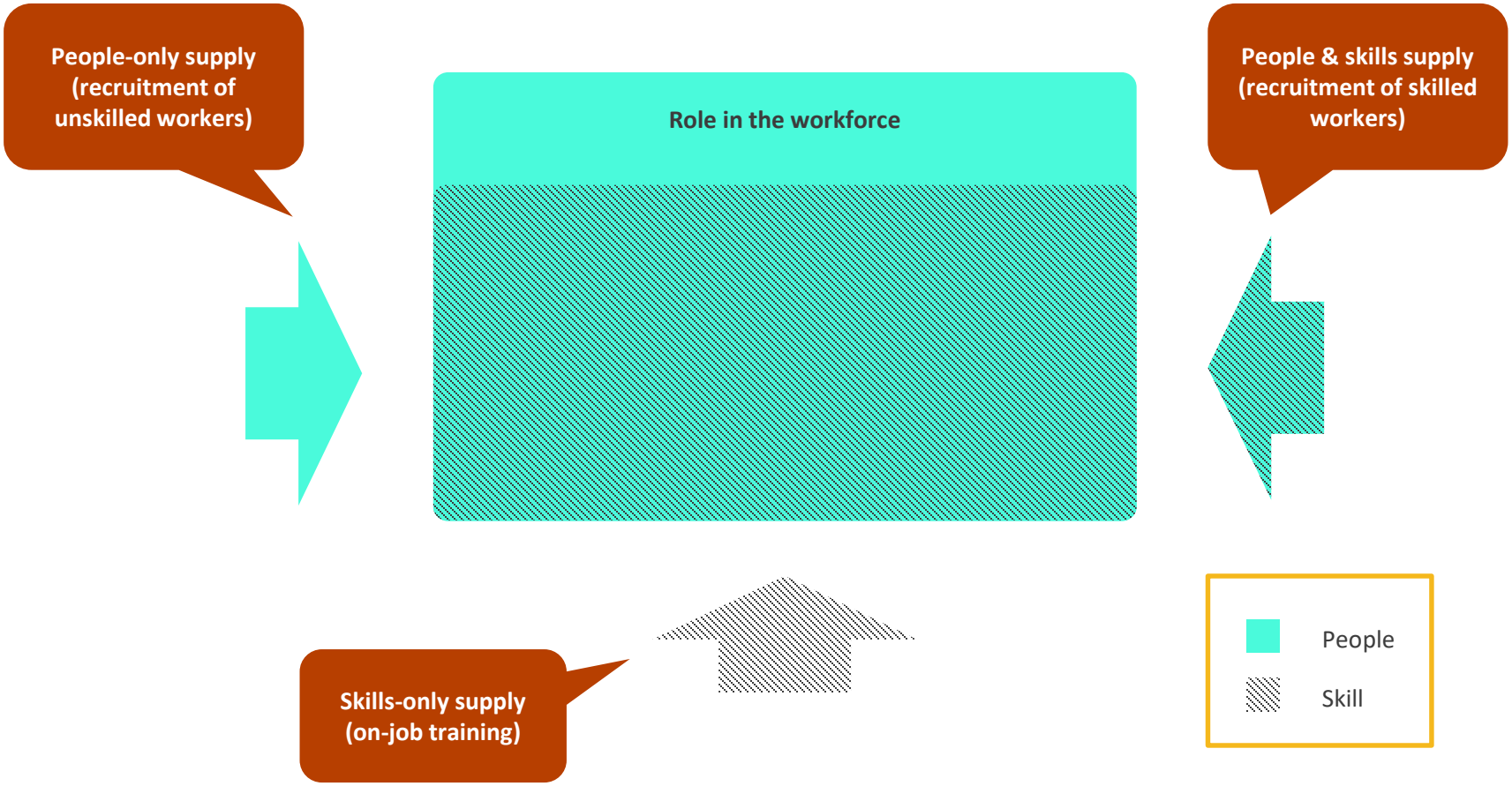
There are two generic types of demand for a workforce: demand for people and for skills. These are generated by any need to increase the number of workers, to replace workers who leave the industry, to fill newly created or vacated job roles and to upskill existing workers.

Sources of workforce demand



On the supply side, we also have two generic types, supply of people and supply of skills. These can come separately (in the case of recruitment of new unskilled individuals or of training for those already in the workforce) or together (in the case of recruitments of new people with appropriate qualifications).

Sources of supply



Our approach to model a workforce is to simulate the work life of each individual in an agent-based situation. Each of these virtual workers has a tendency to take different paths in work – and these tendencies are approximated from looking at their collective statistics available in different databases. The overall workforce characteristics can then be accessed by viewing these virtual individuals collectively, e.g., the workforce skills can be evaluated by looking at how many virtual workers will have the appropriate qualifications in the industry.

Inchworm: overview

Inchworm (Industry Characterisation of Workforce Model) *is a dynamic, agent-based model that characterises important features of an industry workforce. Each agent in the model represents an individual (a virtual worker) characterised by intrinsic career properties. Their virtual careers are shaped by external inputs such as influence of recruitment, promotion, migration and training. The profile of the overall industry workforce is shaped by the collection of these agents.*

Inchworm uses the following approach:

1. The industry to be modelled is characterised by specifying the following: job roles, employer types, regions (incl. employer type by region), qualification levels & workforce size.
2. An initial workforce of 'virtual workers' is created with population statistics matching input data including age, industry tenure & qualification levels.
3. Annual demand for each role in each region is generated based on historic trends and projected for each region.
4. For each year, the model uses turnover rates to determine whether an individual remains in the industry or leaves.
5. The model then attempts to meet forecast demand for job roles by simulating a combination of migration, new graduates, promotion and recruitment from various recruitment pools (school leavers, other primary sector workers, migrants, etc.).
6. Training is supplied to the individuals remaining in the industry. Both the supply of training and the individuals it is directed towards can be adjusted.

Advantages of this modelling approach:

- Ability to examine non-equilibrium effects such as changes in training and skill levels over time.
- Ability to run various training scenarios to assess their impact on industry skills.
- Allows users to experiment with recruitment and training strategies.

The table below describes how the work history of a virtual worker is simulated by our modelling approach.

Inchworm example: dairy farmer A

What the model simulates about dairy farmer A…

Key dates	Born in 1985, first full year in industry was 2005																												
Recruited from	Non-primary sector New Zealand workforce																												
End of year (year 00 = 2000)	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Industry tenure					0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Age					19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Region					Canterbury			Waikato																						
Role					Farm assistant										Herd manager			Farm manager												
Qualification					Level 2, 3 other																									

Which might mean a life story…

Person A grew up the **Canterbury** region. He left school with **NCEA Level 2** at the end of Year 12, and went to work in the hospitality industry. At the **age of 19**, he decides to give the **dairy industry** a go, and gets a job as a **farm assistant** in **2004**. After working at the farm for **3 years**, he decides to see more of the country and moves to the **Waikato** region. In 2011 he gets promoted to **herd manager**, and after a couple of years decides to upskill, successfully completing a **Level 4 Dairy course in 2013**. With his new skills he becomes a variable order sharemilker at the at the age of **29 years old**.

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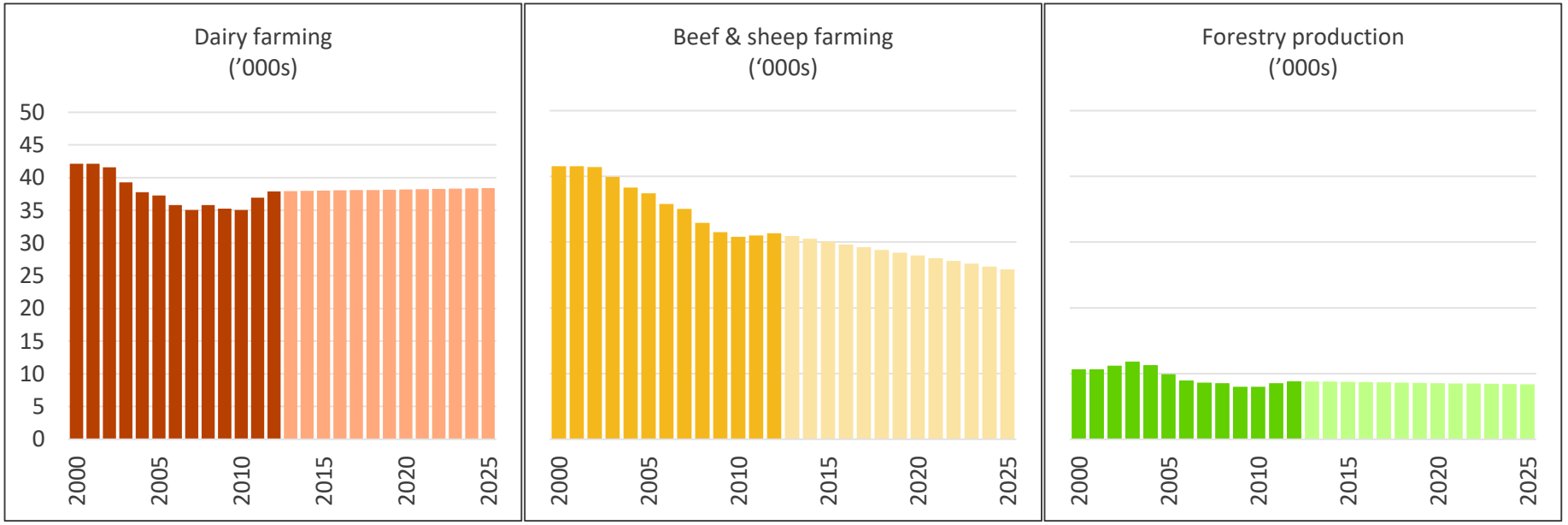
An important input to our model is the workforce size (and its projection). Below are projections of the workforce of the dairy farming, beef & sheep farming and forestry production industries from 2013-2025 as outlined in the Future Capabilities Report, plus the actual fluctuations in workforce sizes from 2000-2012.

Workforce size



Another important input to the model is the workers' probability of leaving. This parameter is derivable from retention statistics, which are approximated from employment histories (accessible from Statistics New Zealand's Integrated Data Infrastructure). One general trend that is visible from the retention profile is the fact that it is sensitive to tenure, changing exceptionally from one-year tenure to two-year.

Retention profile and probability of leaving

One of the advantages of our modelling approach is the capability to assess the supply of different skill levels through training and recruitment (this is not displayed in the main results section to maintain consistency with the Future Capabilities Report). For this purpose, we propose to standardise NZQA qualification levels with the standard roles in the industry. This standardisation process is reflected by the table below.

Qualification level (generalised)

In this work, we redefine and generalise the level of qualification to match the role level in the industry

Level	Description	NZQA level (or equivalent)
R0	No training or elementary/secondary general training	None or Level 1-4 general
R1	Fundamental industry skill training suitable for Role level 1 (new entrants to the industry)	Level 1-2 industry
R2	Intermediate industry skill training suitable for Role level 2	Level 3 industry
R3	Advanced industry skill training suitable for Role level 3	Level 4 industry
	Tertiary general training equivalent to diploma-level certification	Level 5-6 general
R4	Management training suitable for Role level 4	Level 5 production management
R5	Tertiary general training equivalent to graduate-level certification	Level 7 or above general
	Business management training suitable for Role level 5 (business managers/employers)	Level 5-6 business management
	Tertiary industry skill training equivalent to graduate-level certification	Level 7 or above industry

As an example of the standardisation process, we show the example for the dairy industry.

Qualification level (dairy farming example)

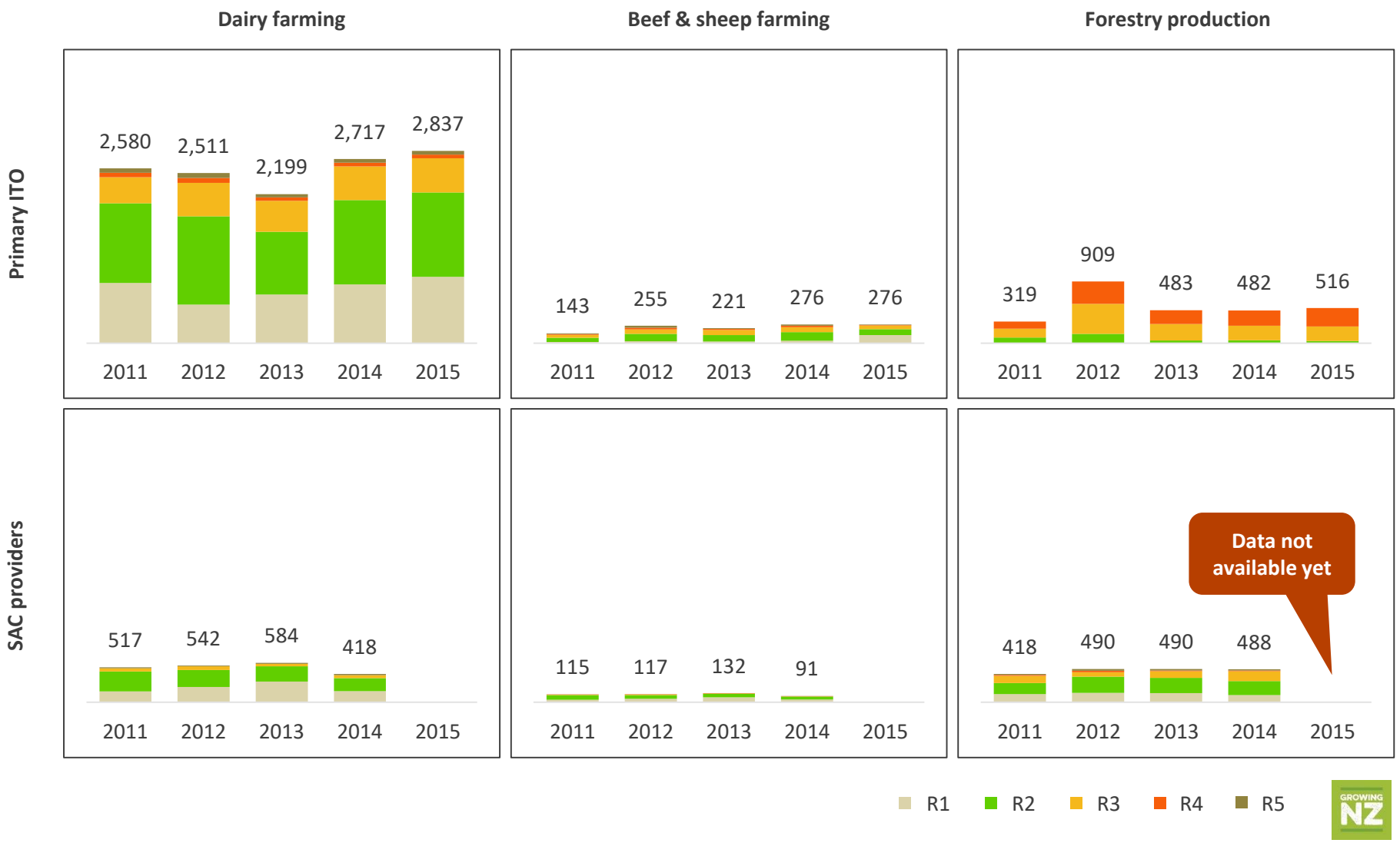
Role level:
Level 1
Level 2
Level 3
Level 4
Level 5

Role level:
Farm assistant
Herd manager
Assistant manager
Farm manager
Business manager

Level	Qualification level	Description	NZQA level (or equivalent)
NA	None	No training or elementary/secondary non-agriculture training	None or Level 1-4 non-agriculture
FAQ	Agriculture foundation	Basic farm skill training	Level 1-2 agriculture
HMQ	Herd management I	Intermediate I farm skill training suitable for herd managers	Level 3 (partial) agriculture
	Herd management II	Intermediate II farm skill training suitable for herd managers	Level 3 (full) agriculture
AMQ	Assistant management	Advanced farm skill training suitable for assistant managers	Level 4 agriculture
	Non-agriculture diploma	Tertiary non-agriculture training equivalent to diploma-level certification	Level 5-6 non-agriculture
FMQ	Farm management	Farm management training suitable for farm managers	Level 5 production management
BMQ	Non-agriculture degree	Tertiary non-agriculture training equivalent to graduate-level certification	Level 7 or above non-agriculture
	Agribusiness management	Farm business management training suitable for business managers	Level 5-6 farm business management
	Advanced management	Advanced farm business management training	Level 7 or above agriculture

The number of qualification completions from tertiary providers is one of the main inputs used to estimate the skills supply to the workforce. The raw completion numbers were processed into flows of trained workers and mapped onto the standardised skill levels. We consider two main supplies: from ITOs which supply most on-job training and from SAC providers which supply skilled (mostly) new workers to the workforce. The different skill levels can be aggregated to compare/calibrate our output to Future Capabilities Report as shown in the result section.

Estimate of trained worker flows (business as usual)



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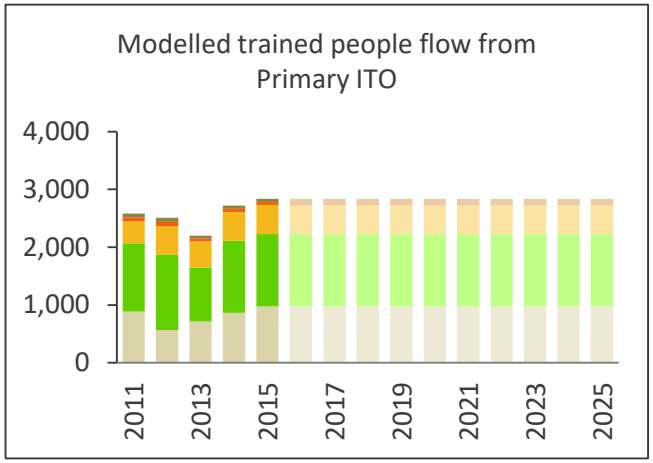
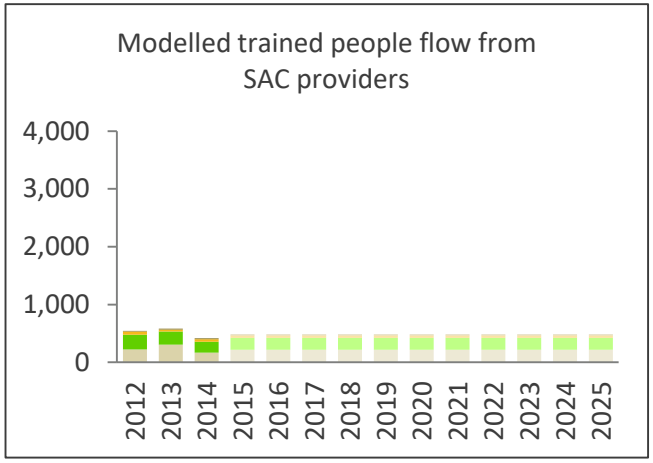
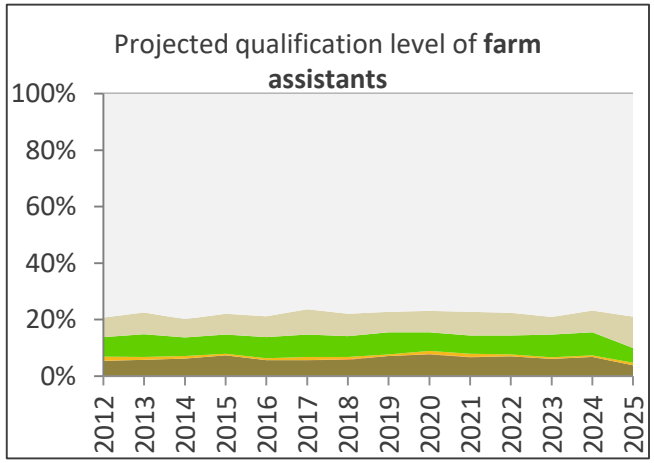
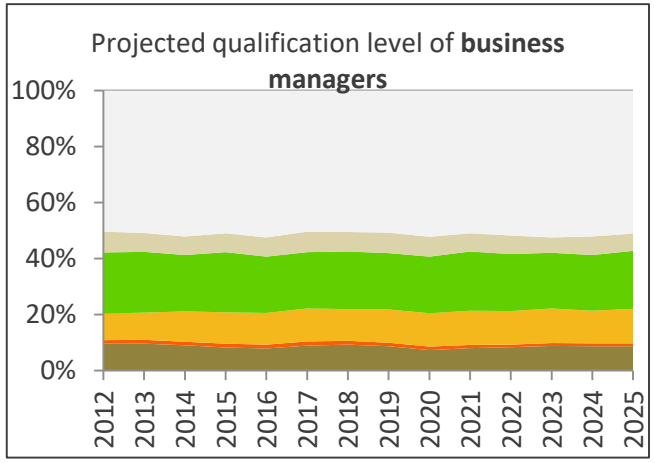
Using the inputs presented in the previous section, we ran simulations using Inchworm to produce the graphics below. Note that Inchworm can be set up not only to show the split between with and without post-school qualifications (as shown in the results section), but also further break results down into different standardised levels and different roles.

Qualification level over time – dairy farming by role









The further breakdown by standardised skill levels can provide more insights into the mix of skills that is required to effectively improve the capability of the industry. In the illustration below, it can be shown that we can meet the 2025 target from the Future Capabilities Report, but still not injecting the right mix of skills into the different roles of dairy farming industry. The business managers here are shown to uptake stock management or equivalent qualifications when they should be getting business management level qualifications.

What it takes to achieve the target – dairy farming by role