Publicly available

Residual biomass fuel projections for New Zealand; 2021 - Indicative availability by region and source

Peter Hall, Scion

Report information sheet

Report title	**Residual biomass fuel projections for New Zealand; 2021** - Indicative availability by region and source
Authors	Peter Hall Scion
Client	MBIE / Te Uru Rakau / EECA
PAD output number	45753044
Signed off by	Paul Bennett
Date	January 2022
Confidentiality requirement	Publicly available
Intellectual property	
Disclaimer	The information and opinions provided in the Report have been prepared for the Client and its specified purposes. Accordingly, any person other than the Client uses the information and opinions in this report entirely at its own risk. The Report has been provided in good faith and on the basis that reasonable endeavours have been made to be accurate and not misleading and to exercise reasonable care, skill and judgment in providing such information and opinions. Neither Scion, nor any of its employees, officers, contractors, agents or other persons acting on its behalf or under its control accepts any responsibility or liability in respect of any information or opinions provided in this Report.

Published by: Scion, Private Bag 3020, Rotorua 3046, New Zealand. www.scionresearch.com

Executive summary

Objective

The goal of this report and the accompanying tables is to describe the woody biomass residue resources in New Zealand by volume, type, energy content and region over time from 2021 to 2050 (30 years). The focus is on existing resources derived from established forests, processing, residue streams etc.

The estimated costs of supply in 2022 are included. These are estimated costs and should be regarded as indicative only. They are not and are not meant to be a price.

This report is an update and expansion of the preceding work done in 2017. This analysis includes more resources; with the addition of port bark and shelter belt turnover. The residues from production thinnings, waste thinnings, pruning residues pulp logs and K grade logs from production plantation forests have also been added. The data on resources that were reported on in 2017 are updated based on the latest available data.

The potential for biomass supply from new forest or crop plantings is not addressed here.

Approach

The various resources; in-forest residues, municipal wood waste, wood processing residues, orchard residues, straws / stover from arable cropping, port bark, shelter belt turnover / harvest residues, production thinnings, waste thinnings, pruning residues and pulp logs are described in terms of gross volumes (green tonnes and energy) and two levels of recoverability. The estimates of recoverable material vary by resource but are intended allow for some material being unsuitable for recovery for quality, financial or environmental reasons. The in-forest residues are assessed as three categories based on the location of the residues, landings, flat to rolling cutovers (suitable for ground-based harvesting) and steep cutovers (cable / hauler harvest).

The characteristics (moisture content, ash content, gross calorific value and typical net calorific value) of the residues are described.

The costs of the various resources including; any fees for accessing the materials, recovery / harvesting, hogging, screening, loading and transport are estimated based off 2022 costs for capital, fuel, labour etc. These costs are an estimate and are not intended to indicate market prices but as an indicator of where prices might start.

Key results

The woody biomass resource in New Zealand is substantial and is summarised below. These figures are for a variable percentage (1st level) recovery of the gross resources estimated to be available. Full details on the percentages and the gross resources are presented in the methods and a set of appendices included at the end the report.

The long run supply of material that could be considered for wood fuels is around 7.6 million green tonnes per annum. If the materials that currently have a market (sawmill chip, pulp logs that are utilised domestically, K grade logs) are excluded the total is around 3.9 million green tonnes per annum.

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
In-forest post-harvest	3,281,411	2,657,097	2,057,579	2,042,674	2,274,610	2,360,950
MWW	171,730	184,827	199,156	214,848	232,047	250,917
Orchard	98,728	100,703	102,717	104,771	106,866	109,004
Straw and stover	480,073	489,675	499,468	509,458	519,647	530,040
Shelter belt	61,440	61,440	61,440	61,440	61,440	61,440
Thin to waste	71,240	131,830	95,764	63,452	90,374	77,777
Production thin residues	23,067	18,650	123,912	212,587	155,894	71,635
Port bark	200,719	220,791	230,827	210,755	200,719	200,719
Prunings	3,523	14,520	12,381	6,078	3,927	3,523
Douglas fir production thinnings	356,031	382,291	82,667	88,154	-	-
Sawmill chip	1,125,398	1,125,398	1,125,398	1,125,398	1,125,398	1,125,398
Pulp log (surplus to domestic demand)	2,127,887	1,856,618	817,321	397,061	843,400	344,871
K grade log	4,579,022	4,405,647	3,030,689	2,728,893	3,072,889	3,548,060
Total	**12,580,270**	**11,649,488**	**8,439,319**	**7,765,568**	**8,687,210**	**8,684,333**

An estimate of current use of these residual woody resources is that around 260,000 green tonnes per annum is being used. However, this figure is likely to increase in the near future as coal burning operations look to low carbon alternatives for their heat supply. This use of the residuals needs to be tracked and publicly reported to give confidence to potential wood fuel users around available supply.

The cost of supply was estimated, and a national level cost supply curve generated.

Further work

The data in this report is based on data available as of 2021. As plantation forestry derived resources are a fundamental component of the woody biomass and as the situation regarding forestry plantings and removals changes over time this data will need updating in the future. The initial analysis and report were done in 2017 and this update is 5 years after that. It is suggested that another update be considered in 4 to 5 years' time.

A further critical issue is the increasing amount of use of some of these resources as boiler fuel replacing coal. Examples are the conversions of the Danone dairy factory near Balclutha from LPG to wood, the conversion Canterbury DHB boilers from coal to wood and the interest from other parties in similar conversion. Tracking the volume and location of this use so that the available volumes are accurately represented is of increasing importance.

Analysis of the potential for new afforestation to provide future supply is possible using GIS based models with input layers such as slope, site productivity, roading network, land prices, carbon prices and log prices (including energy products).

Residual biomass fuel projections for New Zealand; 2021 - Indicative availability by region and source

Table of contents

Introduction

The intent of this report is to present estimates of regional volumes of combustible biomass residues suitable for heat fuel supply and potential feedstock for biofuel production. Assessments are given for every 5-year period out to 2051; for gross supply and estimates of realisable / recoverable supply (green tonnes and energy (GJ)).

The assumptions behind the data are provided to support the findings of the assessment and to allow others to apply their own assumptions to the base data on levels of recoverable biomass.

The resource analysis covers in-forest harvest residues (from landings and cutover), thin to waste volumes from forests, pruning residues, unutilised wood processing residues, municipal wood waste, horticultural wood residues and agricultural (straw & stover) residues, bark from ports and material from shelterbelt turnover. Volumes of pulp logs and K grade logs are also estimated.

In-forest residues were split into categories by site type; – landing / roadside, flat to rolling terrain (ground-based harvest) cutover, steep terrain (hauler harvest) cutover. These residues have differing levels of accessibility, cost of recovery and levels of recoverability (Table 1). There are environmental limits which need to be applied to some resources (e.g. straw and stover and in-forest cutover residues) to maintain soil fertility, biodiversity and potentially mitigate soil erosion.

Estimates of currently surplus quantities available from wood processing facilities are included in the assessment. Wood processing residue estimates do not include that calculated as already being used by the wood processing industry for the production of on-site heat and power.

The availability of pulp logs is based on the amounts that are believed to be available after the demands of the pulp, paper, and fibre board industries are met.

Bark from ports is reported as a potential fuel resource. However, there are issues around this material and its availability in the future;

- most of it is currently used for landscape mulch or composting
- predicting future volumes is difficult given the uncertainty around the impact of both phytosanitary regulations and log export markets / volumes.

Estimates of the amount of greenhouse gases (GHGs) that could be reduced by displacing coal with biomass are made for national level data.

Glossary

g. t.	green tonne = wood with an as received moisture content
odt	oven dry tonne = biomass at 0% moisture content
p. a.	per annum
GJ	Gigajoule
Stover	corn stalk from maize grain harvesting
GHG	greenhouse gas
GCV	gross calorific vale
NEFD	national exotic forest description
NCV	net calorific value
MDF	medium density fibreboard
MWW	municipal wood waste
WPW	wood processing waste

Residuals Assessment: outline of approach and categories

Table 1 - outline of residue data categories and recoverability levels and factors

	Gross volume	**Recoverable level 1**	**Recoverable level 2**
Municipal wood waste	Total estimated at landfill	= Gross x 0.80 (to exclude treated and highly contaminated wood)	= Gross x 0.60 (for losses and sites to remote too use)
Wood processing waste	Gross amount after producer sites own use	= Gross x 0.95 to account for losses	=Gross x 0.90 for small remote sites and lack of participation
Horticultural residues	Gross amount produced	= Gross x 0.80 for losses during gathering and screening etc.	=Gross x 0.65 to account for sites too remote, small or lack of interest in utilisation)
Agricultural residues	Gross amount produced; accounting for 50% retention for soil sustainability	= Gross x 0.80 for losses during gathering and screening etc.	= Gross x 0.60 to account for sites too remote, small or lack of interest in utilisation)
In-forest Landing	Gross amount	= Gross x 0.80 to small / hard to recover	=Gross x 0.65 sites too remote
In forest Cutover **a. Ground-based** **b. Hauler**	Gross amount; a Gross amount; b	a. = Gross x 0.70, rest to small / hard to recover b. = 10% recoverable; rest assumed to be too expensive and risky	a. = Gross x 0.56; allows for sites that are too remote b. = 5% recoverable; rest assumed to be too expensive and risky
Port bark	Gross amount estimated from log volume	= Gross x 0.80 (to allow for losses and sales to other users)	= Gross x 0.70 (to allow for losses and sales to other users)
Shelter belt turnover	Gross amount estimated from mapping of shelter belts	= Gross x 0.80 to small / hard to recover	= Gross x 0.65 sites too remote
Production thinnings	Gross volume of residues (not thinnings volume)	= Gross x 0.80 to small / hard to recover	= Gross x 0.50 sites too remote
Waste thinnings	Gross volume of thinnings	= Gross x 0.80 to small / hard to recover	= Gross x 0.65 sites too remote
Prunings	Gross volumes of prunings	= Gross x 0.50 for flat / rolling terrain only	=Gross x 0.10 close to roadside only
Pulp logs	Volume of pulp logs after existing market demands are met	= Gross x 0.90 to small / hard to recover	= Gross x 0.7 sites too remote
In-forest total	In-forest total	In-forest total	In-forest total
All biomass totals	All biomass Gross totals	All biomass total at recoverability level 1	All biomass total at recoverability level 2

Methods

Fuel characteristics

Fuel characteristics (moisture content, ash content, net and gross calorific values) for the different resources were derived from a range of sources; including Trolove and Garrood (2007), Hall (2000), EECA (2010), van Loo (2008) and a range of unpublished laboratory testing results from bioenergy studies conducted by NZFRI and Scion (Veritec Laboratory reports).

Costs

Indicative delivered costs (including profit margins of 10%) were derived using 2022 cost inputs for capital, fuel, labour and consumables etc. and the transport and harvesting system costing template (Excel spreadsheet) in Riddle (1994). Capital costs were derived from the INFORME harvesting price guide (2020) and a range of sources for items such a fuel, oil, tyres, labour etc.

The same process was used on transport costs. Forest residue transport distances are based on forest industry data for average log hauls (Galbraith, 2007) and estimates of other distances derived from Google maps etc. Standard 44 tonne Gross Vehicle Mass (GVM) trucks were used in the transport cost analysis. Potentially the use of high productivity motor vehicles (HPMVs) may reduce transport costs in the order of 5 to 10%, but these larger units are not able to use all rural roads due to bridge weight limit restrictions.

These indicative costs do not necessarily reflect actual delivered prices as site specifics such as transport distance, limitations on truck size due to access restrictions and scale of demand can have a substantial influence. Costs were derived based on full utilisation of equipment, in reality some idle time will likely occur; increasing operation costs and risks which would be reflected in delivered prices.

However, as technology develops and system productivity improves costs may reduce over time. For example, recent innovations in chipper technology are expected to substantially reduce fuel consumption in this part of the system (where chipping is applicable).

In-forest residues - maximum volumes

Forest harvest potential varies over time due to the uneven age class distribution of the forests and can be estimated using data from the national exotic forest description (MPI, 2021). If we are looking at long term secure supply, we need to consider the long term (out to 2050) volume as the maximum supply, not the peaks that might occur before then. This is of importance, as the in-forest residue resource is the largest resource and its fluctuations have considerable effect on the volumes available.

The low point in forest harvest and therefore in-forest harvest residue supply tends to occur at around 2035 to 2039.

In-forest residues smoothing

Due to the peakiness of the forest plantings (based of the mid 1990s planting boom) the residue calculation based on the forest age class data is also peaky. It is unlikely that the forest harvest will hit the maximum peak of the potential wood available as the required harvesting infrastructure is not likely to be available. Therefore, some smoothing of the harvest is predicted to occur (MPI wood availability forecasts, 2021). In the analysis here, smoothing of the data has been applied by averaging of adjacent periods.

Wood processing residues

Wood processing volumes were derived from a combination of data from Scions wood processing database and the EECA heat plant database; which allows estimates of the volume of wood processing residues produced along with the demand for those residues at an individual processor level.

Municipal wood wastes

Estimates of municipal wood waste were derived from a survey of municipal landfills (Ireland-Blake 2017) conducted as part of the Scion Biofuels Road Map project. Anecdotally there is a further significant amount of wood waste going to non-municipal clean fill sites that has not been captured.

Port Bark

Data on bark produced from a log export port was obtained and related to the volume of logs being exported. This data was used to estimate the volume of bark being produced at other log export ports. The unknown variable going forward is the log export volume. This has been estimated based on domestic processing demand and projected log volumes available.

Horticultural residues

Horticulture and Viticulture residues are principally derived from the removal of old or unwanted trees and vines. Data on this was derived from Saggar et al 2007, which indicates that turnover rates in orchards range from 4% to 12% per annum depending on the crop. The amount of material is adjusted over time allowing for a small expansion of the industry. Not all the estimated gross material will be available for cost / access reasons and recoverability was set at 80% (high) and 65% (low) of the gross.

Agricultural residues (straws and stover)

The amounts of straw and stover residue produced were estimated based on Saggar et al, 2007 and Ministry of Agriculture and Forestry (MAF) 2011. Further, more recent data was obtained from the Foundation for Arable Research. The land area under crops was derived from the land cover database. The total produced amount of material has to be reduced by half to give the gross available, as half the straw is deemed to be needed to be retained on site for soil nutrition and health (Saggar et al, 2007). Straw and stover data are presented in oven dry tonnes (ODT) per annum, as opposed to green tonnes which were used for wood residues. From the gross tonnage we take 50% as the start point; then use two recoverability factors, 80% and 60%, to account for some material being lost during harvest and transport or being inaccessible or sold to other uses such as animal bedding.

Shelter belt residuals

A GIS map layer of shelter belts across New Zealand was used to determine the length of shelter belts present. Google Earth was used as a cross reference for this map layer and as an estimator of shelter belt width. Taking the length of shelter belts by region, an average width 6 metres and assuming a 50-year life for a shelter belt, harvest volume of 650m^3 per ha of shelterbelt and 30% residuals an estimate of the amount of woody biomass from turnover of shelterbelts was derived.

Production thinnings

The volume of material derived from production thinnings was not included in the previous analysis. The volume of residues has been derived from the area by age class of tree crop identified as being planned to have a production thinning in the 2021 NEFD (MPI, 2021). The volume to be extracted was estimated by simulating the size of the trees at production thinning age by region and then taking proportion of that volume as waste generated at landings during stem to log processing.

Waste thinnings

Waste thinnings were not assess in the previous analysis. In this assessment they are included as we have heard that some forestry companies are considering the extraction of this material as market demand for fuel increases. The area of waste thinnings being carried out was estimated from the 2012 NEFD and the volume of material (stem and crown) was derived from a combination of forestry models PradCalc and NuBalM.

Prunings

Prunings are considered an unlikely source of biomass due to the cost of extraction. However, the material exists and there have been enquiries about extracting it. As the analysis of thinnings etc

had identified the areas being pruned (MPI, 2021) and the crown mass of the trees can be estimated using NuBalM the amount of crown mass available from pruning was estimated, based on the assumptions that there would be 2 pruning lifts and that at least 1/3rd of the green crown was left after pruning.

Pulp logs

Pulp logs a have a market in many regions, but not all. Examples of areas with no major adjacent pulp log market are; Gisborne, Wairarapa and Douglas-fir in Southland / Otago and parts of West Coast. Therefore, there are some regions where the pulp logs are potentially available for use as an energy feedstock. Further there are indications that the existing pulp log buyers may be challenged by the energy market as pulp logs sell for below the full cost of production. Our approach with pulp logs is to determine the gross supply from forests, which is reported) and then show the regional availability after the incumbent buyers off-take is allowed for.

Sawmill chip

Sawmill chip also generally has existing outlets, with either pulp and paper, fibre board and chip exports being the main destinations. However, there are already some mills selling chip as fuel. Based on the Scion wood processing database we will estimate the quantity of sawmill chip that is available and report that volume. Information on where the sawmill chip goes is not publicly available in most cases. The amount of chip produced varies slightly from mill to mill but is typically in the order of 25 to 28% of the log volume.

K-grade logs

K grade logs are low grade sawlogs that are a common log product in most radiata pine plantation forests. They make up on average around 24% of the total recoverable volume in a harvest block although this percentage can vary from 17 to 33% depending on the region and regime. The available harvest volume for each region was calculated based on the area of pine forests by regime reported in the NEFD (MPI 2021) and then the proportion of K grade logs by regime and district was estimated using PradCalc (Kimberley, 2014). These calculations allow the approximate volume of K grade logs that are likely to occur now and in the future. The price of K grade logs was derived from a log price database. The prices for logs have been quite volatile over the last 3 years, with significant drops in the months of August to November 2021 so a 3-year monthly log price average was used (Table 2). For K grade logs the gross volume was estimated by forest crop modelling and then recovery rates of 90% and 70% were applied for recoverability levels 1 and 2 respectively.

Table 2 – K grade log prices (average $ per green tonne delivered)

Grade	October 2021	3-year average
K	$100	$116
KS	$99	$114
KI	$91	$106
KIS	$77	$92
Average	**$92**	**$107**

Douglas-fir production thinnings

Douglas-fir generally uses different regimes to radiata pine, and it is common that Douglas-fir stands have thinning that can be a production thinning if there is a suitable market for the logs. Theses logs tend to be small diameter. They are not generally a preferred feedstock for MDF or pulp and paper in New Zealand. A lot of the Douglas fir resources in New Zealand are in Otago and Southland where the key outlets for pulp logs are MDF and export. The volume of Douglas fir produced was derived from areas of Douglas fir by age class reported in the NEFD (MPI, 2012) and estimated yields from production thinning using a conventional regime. The logs produced could be a fuel resource if the price paid is sufficient to cover the costs of logging, transport and chipping with some margin for the grower.

Results

Residual material - fuel characteristics

Typical fuel characteristics for the range of resources assessed are shown in Table 3. The gross calorific values (GCVs) are adjusted for ash content. The net calorific values (NCVs) reflect the effect of moisture content.

It should be noted that the GCVs and NCVs are not absolute values - they are typical averages. Biomass is inherently variable and multiple samples gives a better indication of long-term average energy values than any individual sample.

Woody biomass is by its nature quite variable from site to site as well as piece to piece, and results for individual samples will likely vary from the averages. For example, some Pinus radiata woody biomass has high levels of resin content and this can push the energy content for that sample up as high as 22 to 23 MJ/kg oven dry. However, these levels are not a typical average for softwoods, which is generally accepted as being 18.7 to 18.9 MJ/kg oven dry.

Further, there are variations in ash and moisture content from sample to sample that will change both the GCV and the NCV. Again, the values presented are typical averages. When conducting a site-specific analysis of the opportunities it is important to consider the impact of ash, moisture etc. and get some samples tested. Setting of delivered fuel quality standards is therefore important.

Likely ranges for moisture, ash and NCV are shown in Table 4.

In the tables below; CO = cutover, GB = ground based, MWW = municipal wood waste and WPR = wood processing residues.

Table 3 - summary of fuel properties by residue type

	Moisture Content	Ash Content	GCV	NCV	NCV - 5%	NCV + 5%
Landing stem	**56.5**	1.8	19.8	6.8	**6.5**	**7.2**
Landing mixed	**54.0**	4.5	19.3	7.0	**6.7**	**7.4**
CO GB stem	**51.5**	0.9	20.0	7.7	**7.3**	**8.1**
CO GB mixed	**51.5**	4.8	19.2	7.4	**7.0**	**7.8**
CO Hauler stem	**51.5**	0.9	20.0	7.7	**7.3**	**8.1**
CO Hauler mixed	**51.5**	4.8	19.2	7.4	**7.0**	**7.8**
MWW	**31.5**	4.5	19.3	11.0	**10.5**	**11.6**
Orchard*	**51.5**	1.5	19.9	7.9	**7.5**	**8.3**
Straw	**13.5**	6.8	18.1	14.4	**13.7**	**15.1**
Stover	**20.0**	5.6	17.8	13.8	**13.1**	**14.5**
WPR Wood**	**58.0**	0.5	20.1	7.3	**6.9**	**7.7**
WPR Bark debark	**53.0**	3.0	19.6	7.4	**7.0**	**7.8**
WPR Bark yard	**58.0**	7.5	18.7	6.1	**5.7**	**6.4**

*includes vineyards and kiwifruit orchards as well as pip, stone fruit and citrus orchards.
**includes a mix of residues (sawdust, off-cuts and dry shavings)

In-forest residues can be seasoned, or force dried after hogging or chipping. Fuel treated in this way is likely to have a moisture content of around 35%, with an NCV of around 11 GJ per tonne.

In-forest residues such as waste thinnings and prunings are expected to have propertied similar to ground based cutover residues.

Table 4 - ranges of fuel properties likely to be encountered

	Moisture Content	MC -10%	MC +10%	Ash Content	Ash -10%	Ash +10%	NCV, GJ/tonne	NCV -10%	NCV +10%
Landing stem	56.5	50.9	62.2	1.8	1.6	1.9	6.8	6.1	7.5
Landing mixed	54.0	48.6	59.4	4.5	4.1	5.0	7.0	6.3	7.7
CO GB stem	51.5	46.4	56.7	0.9	0.8	0.9	7.7	6.9	8.5
CO GB mixed	51.5	46.4	56.7	4.8	4.3	5.2	7.4	6.7	8.1
CO Hauler stem	51.5	46.4	56.7	0.9	0.8	0.9	7.7	6.9	8.5
CO Hauler mixed	51.5	46.4	56.7	4.8	4.3	5.2	7.4	6.7	8.1
MWW	31.5	28.4	34.7	4.5	4.1	5.0	11.0	9.9	12.1
Orchard / Vineyard	51.5	46.4	56.7	1.5	1.4	1.7	7.9	7.1	8.7
Straw	13.5	12.2	14.9	6.8	6.1	7.5	14.4	13.0	15.8
Stover	20.0	18.0	22.0	5.6	5.0	6.2	13.8	12.4	15.2
WPR Wood	54.5	49.1	60.0	0.7	0.6	0.7	7.3	6.6	8.0
WPR Bark debark	53.0	47.7	58.3	3.0	2.7	3.3	7.4	6.7	8.1
WPR Bark yard	58.0	52.2	63.8	7.5	6.8	8.3	6.1	5.4	6.7

Straw and stover volumes are substantial in some regions (Canterbury) - and they are included as they are a combustible ligno-cellulosic biomass. However, these materials may not be suited to existing boiler infrastructure and may require purpose-built boilers that are designed for straws. Otherwise densification and co-firing at low percentages (>5%) in coal boilers may be possible. The principal issue is the high ash content and ash composition which can cause fouling of the boiler if combustion conditions are not set correctly. There is potential to co-fire both wood pellets and straw pellets.

Recoverability factors

There is a difference between the gross amount of a biomass resource potentially available and that which can or should be recovered. The recoverability factors used in this analysis are outlined in Table 5. The recoverability factors were set based on industry feedback.

Table 5 – recoverability factors by resource type

Residue type	Recoverability factor 1 (% of gross)	Recoverability factor 2 (% of gross)
In-forest residues - landings	80	65
In-forest residues - cutover	70	55
Wood processing residues	95	90
Municipal wood waste	80	60
Port bark	90	80
Horticultural residues	80	65
Straw and Stover*	80	60
Shelter belt residuals	80	60
Production thinnings residuals	80	65
Waste thinnings	50	25
Prunings	50	25
Pulp log	95	90
Sawmill chip	75	50
K grade logs	75	50
Douglas-fir production thinnings	80	50

*Only half of the total supply of straws is considered to be part of the gross available supply. This is due to the need to retain some of the straw on site to maintain nutrient levels.

Costs

The costs of producing the biomass as a fuel by categories are estimated here. It should be noted that these are estimates of the costs and are not necessarily the same as a market price, which may be higher. Therefore they are only an indicator of price. These costs estimates are presented in Table 6 and are based on operating costs as of January 2022. All prices include a fee paid to the owner of the residual biomass. This fee varies with the type of raw material. The costs also include a transport cost for an assumed transport distance of 90km (residual source to user).

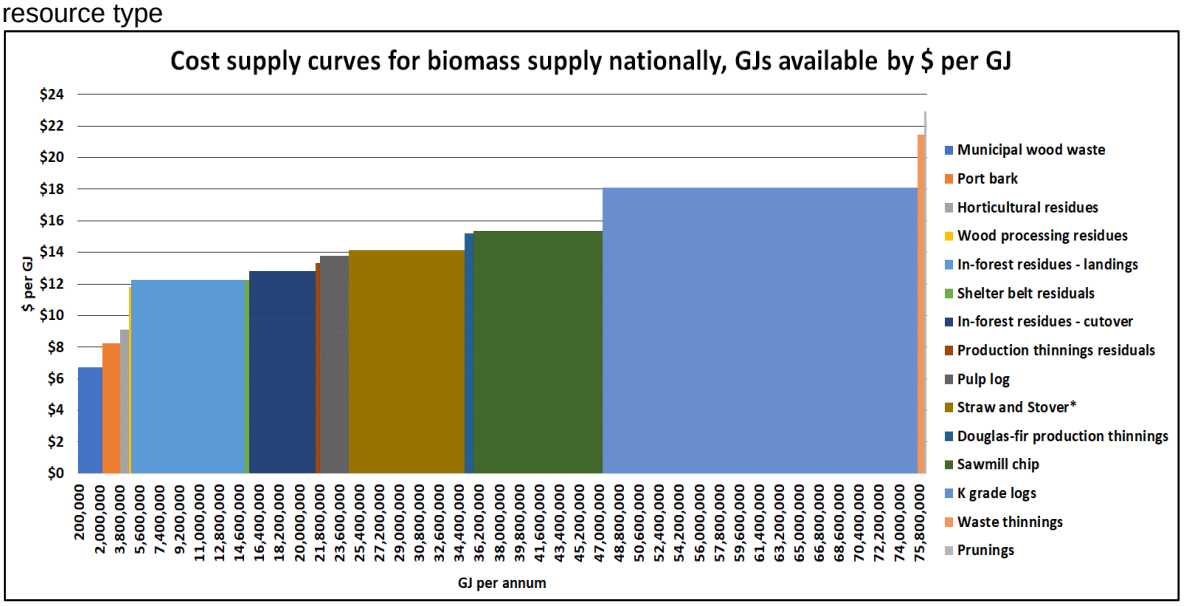
Table 6 – estimated costs for various biomass resources delivered (90km) in fuel form

Residue type	Biomass owners fee ($ per green tonne)	Cost $ per green tonne	Cost $ per GJ
In-forest residues - landings	$20	$84.50	$12.25
In-forest residues - cutover	$20	$88.50	$12.83
Wood processing residues	$15	$81.50	$11.81
Municipal wood waste	$10	$67.00	$6.70
Port bark	$ 5	$57.00	$8.26
Horticultural residues	$10	$63.00	$9.13
Straw and Stover*	$100	$226.00	$14.13
Shelter belt residuals	$20	$84.50	$12.25
Production thinnings residuals	$20	$92.00	$13.33
Waste thinnings	$20	$148.00	$21.45
Prunings	$10	$158.00	$22.90
Pulp log	$55	$95.00	$13.77
Sawmill chip	$80	$106.00	$15.36
K grade logs	$85	$125.00	$18.12
Douglas-fir production thinnings	$65	$105.00	$15.22

*straw is assumed to have a “green” moisture content of 15% wet basis

The national level costs supply curve for biomass by resource type and assuming recoverability level 1 for each resource is shown in Figure 1. The amounts available are based on the long run supply which has a low point around 2036 – 2040. The equivalent graph for tonnages is presented in Appendix R. The data in Figure 1 is deemed to be more useful for comparative purposes as the GJ per tonne varies with fuel type.

Figure 1 – Cost ($ per GJ) supply curve for national amounts (GJ per annum) of biomass by resource type



The data in figure one gives a visual indication of the significance of each resource by the amount of energy available per annum.

Volumes over time by resource type and region

The volumes of material available over time for each resource type are presented in the series of graphs below. The data presented in this section are annual averages and cover the period 2021 to 2050 in 5-year steps. The data behind these graphs is presented in appendices A to Q. Further data is presented in the Appendices; gross volume and energy as well as recoverability levels 1 and 2 for both volume and energy.

In-forest residues

The gross amount of in-forest post-harvest residues available by region over time are shown in Figure 2.

Figure 2 – Gross volume of in forest residues by region

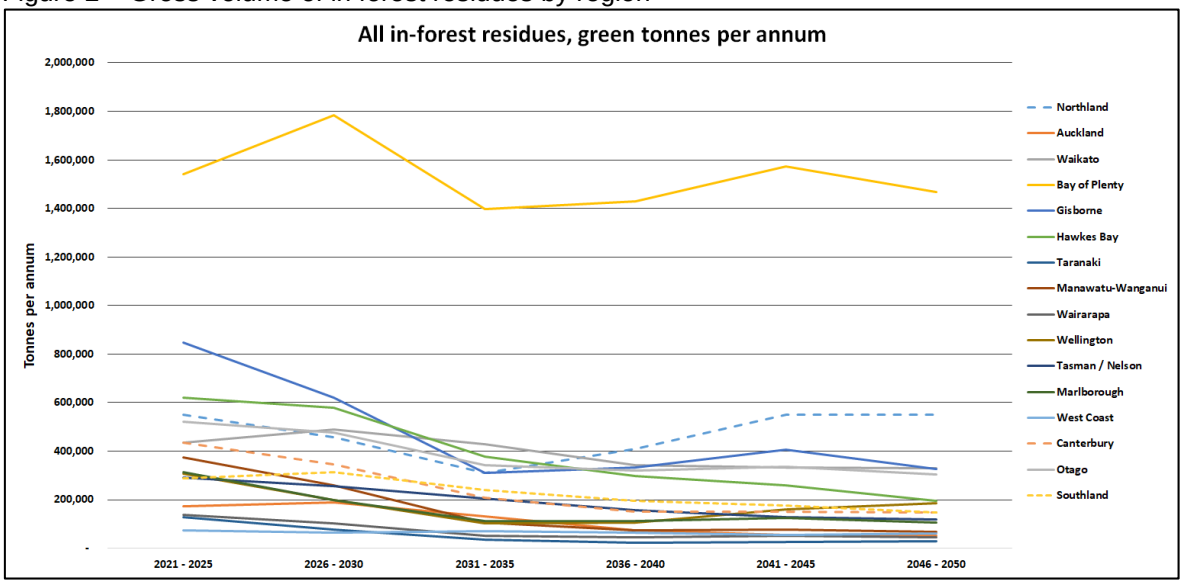
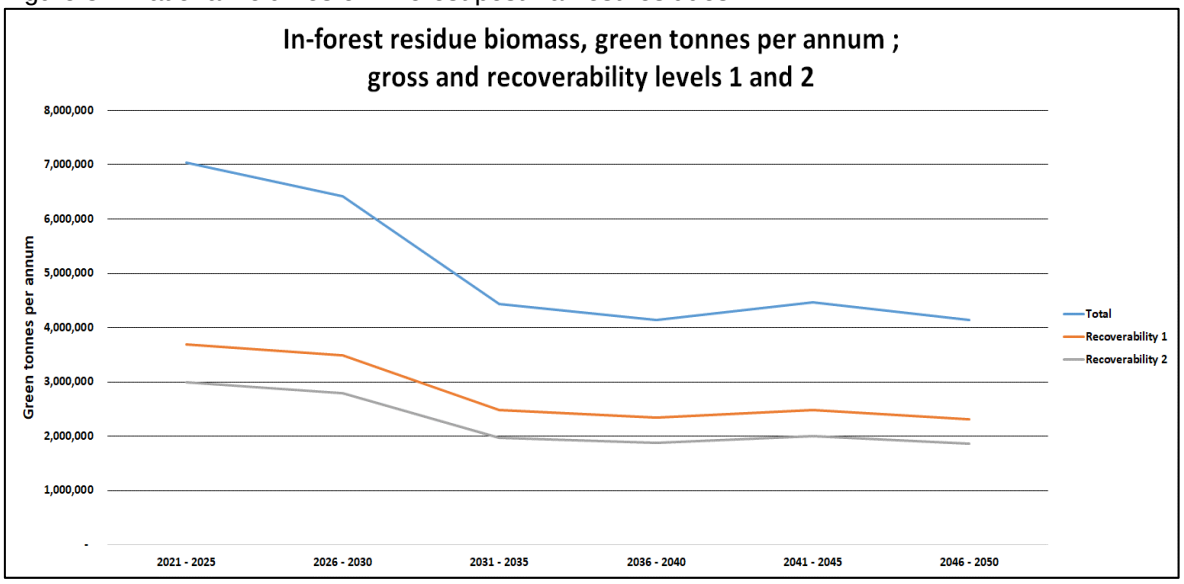


Figure 3 shows the national gross volume of in-forest post-harvest residues and the amounts available assuming recovery rates of 80% and 65%.

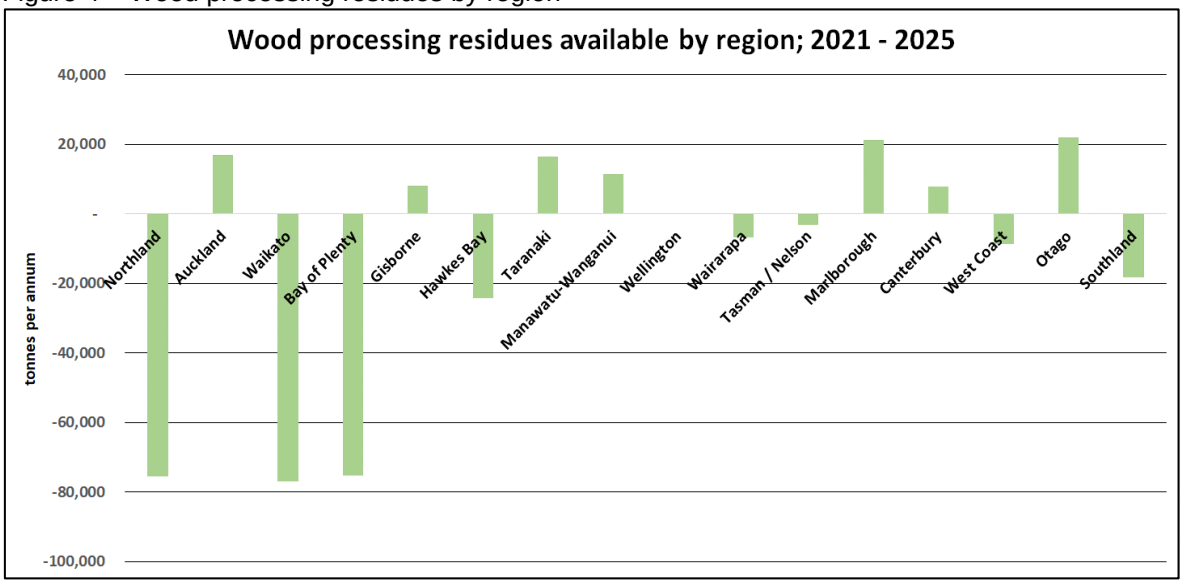
Figure 3 – National volumes of in-forest post-harvest residues



Wood processing residues

The data for wood processing residue production and consumption show that overall these are close to being in balance. Whilst the data in Figure 4 shows pluses and minuses, the overall deficit is around 8% of the total demand. Given the margin of error on the data (which is a calculation not a measured value) it is suggested that there is little wood processing residue available outside the industry once incumbent users demands are met. There is trading between entities and some of this is across regional boundaries (e.g. Waikato and Bay of Plenty). Unless there are major changes to the wood processing infrastructure these volumes are likely to remain relatively stable over time.

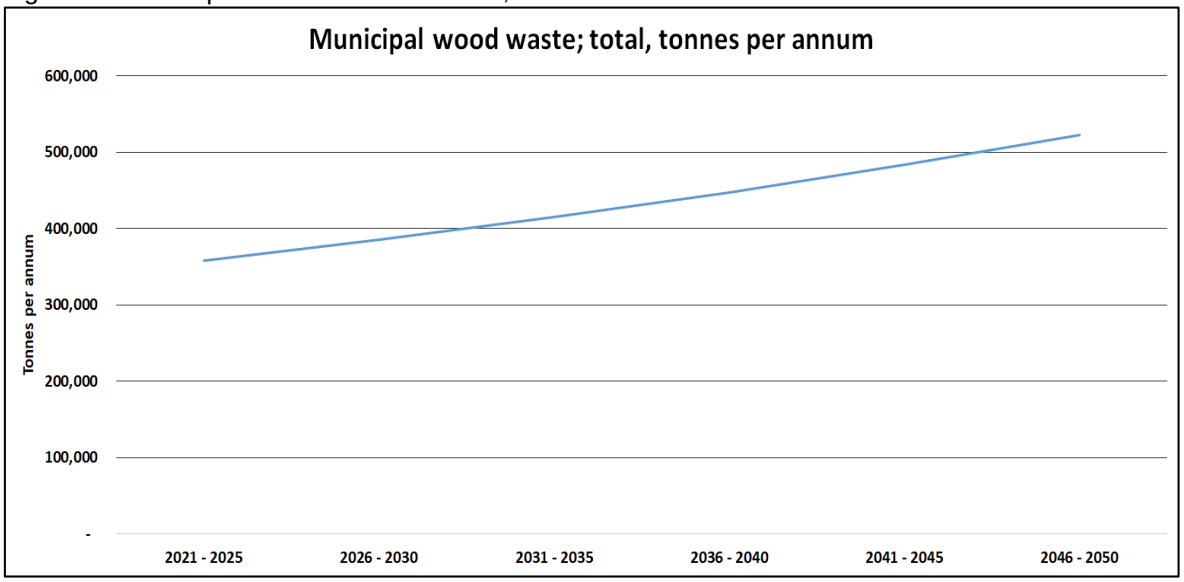
Figure 4 – Wood processing residues by region



Municipal wood wastes

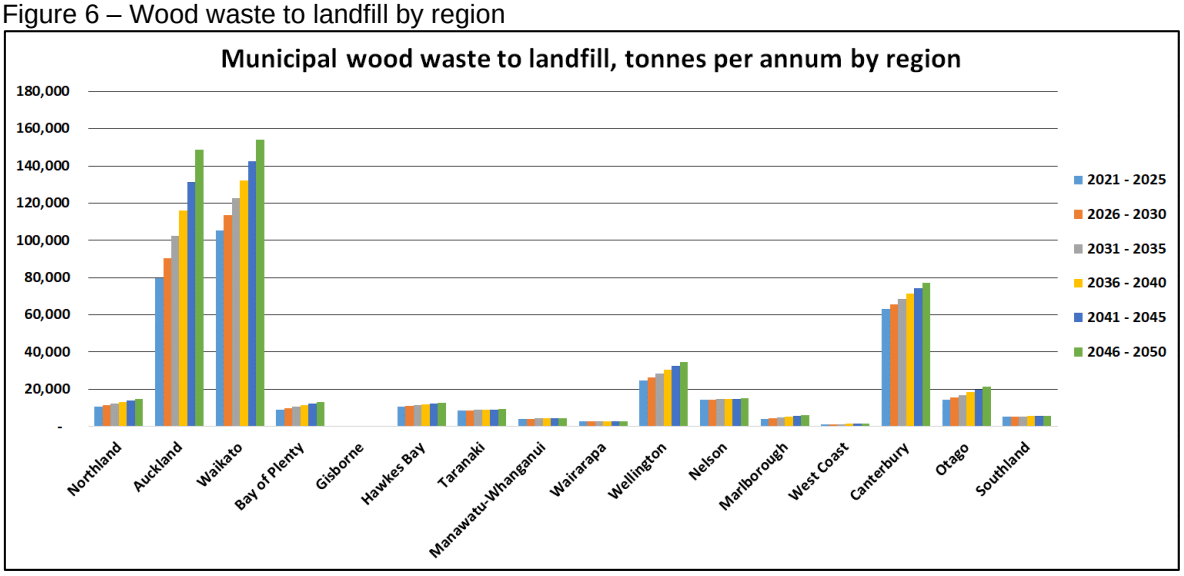
The gross amount of municipal wood waste estimated to be available is shown in Figure 5. Growth in this volume over time is driven by projected population growth.

Figure 5 – Municipal wood waste to landfill, national total



Projections of wood waste to landfills are presented in Figure 6. The increases over time are based on population growth data from census figures, hence some regions have much steeper increases than others.

Figure 6 – Wood waste to landfill by region



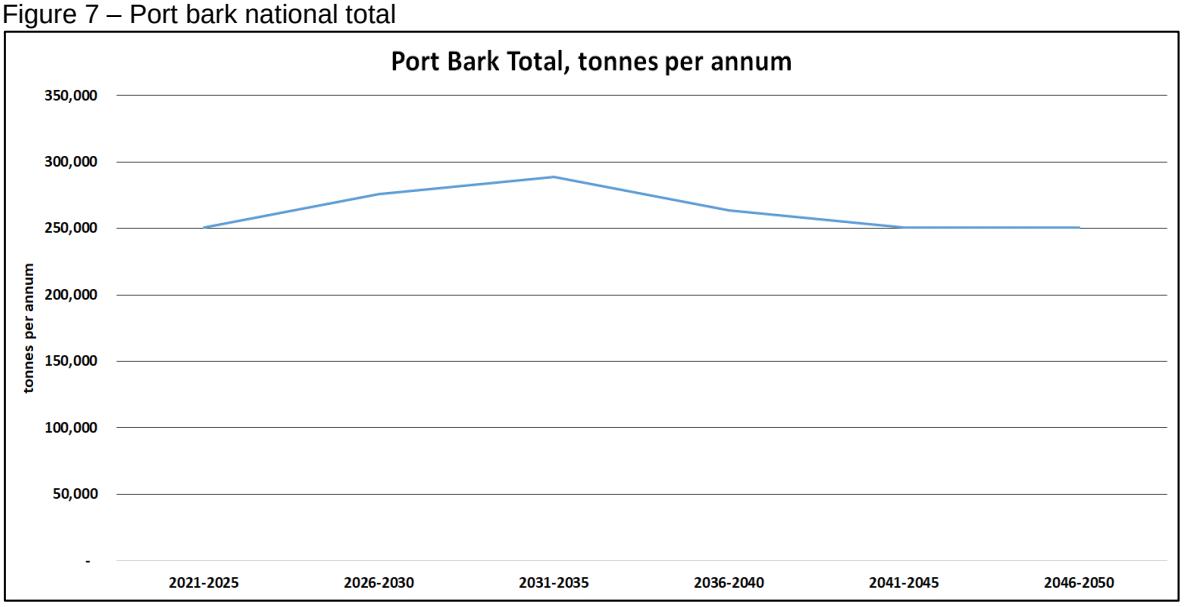
Anecdotally there is a significant amount of wood waste going into “clean-fills” that do not record the amounts of material being dumped. It has been suggested that this amount is equivalent to that which is going into municipal landfills.

More data on the potential resource from the undocumented volume going to clean-fills would be useful but is difficult to find as much of it is not recorded.

Port Bark

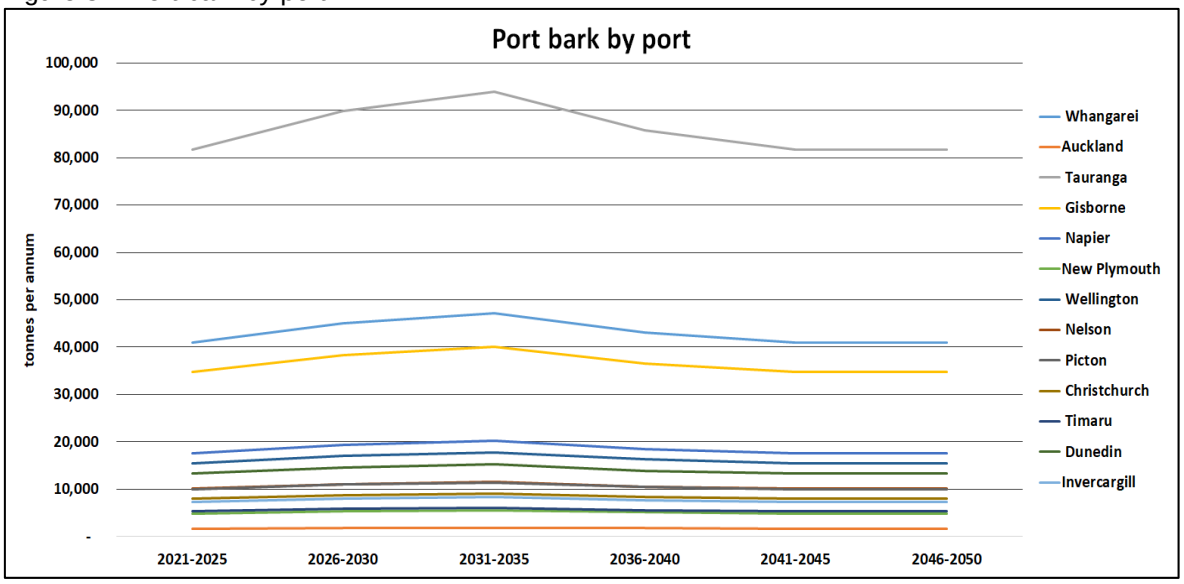
The data in Figure 7 reflects the estimated volume of bark available at log export ports. This bark is that from log yard debris. The decline in volumes post 2035 is due to the expected drop in NZ’s forest harvest and therefore reduced log export volumes.

Figure 7 – Port bark national total



There are 13 ports around New Zealand that export logs. The estimated volume of bark produced for each port is shown in Figure 8. Ports with large volumes of logs passing through them (e.g. Tauranga) have larger volumes of bark.

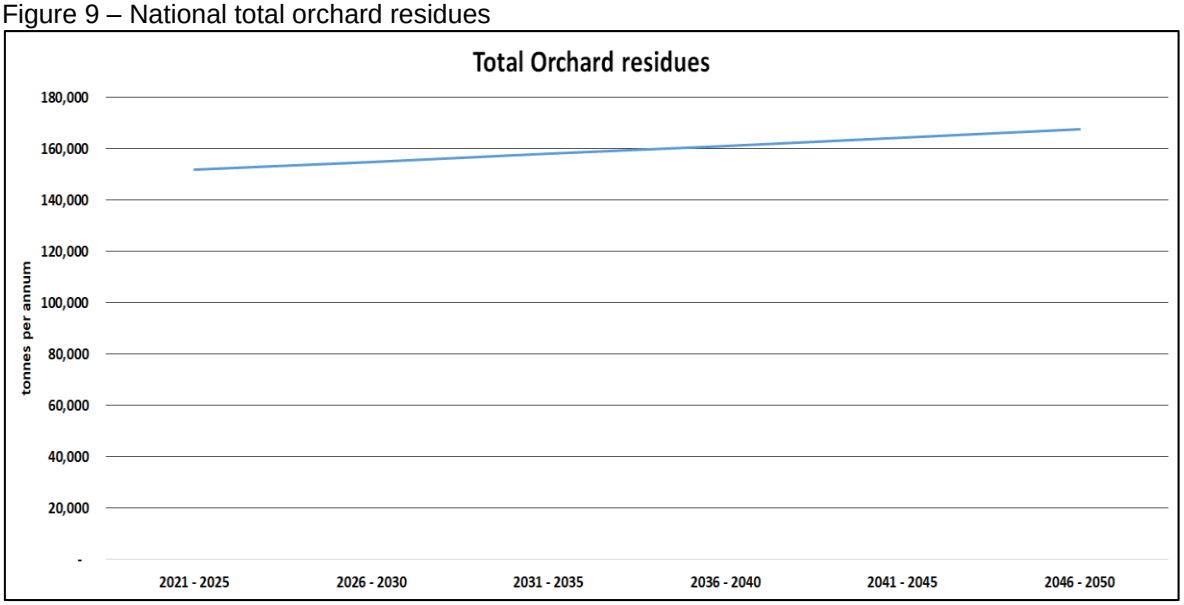
Figure 8 – Port bark by port



Orchard residues

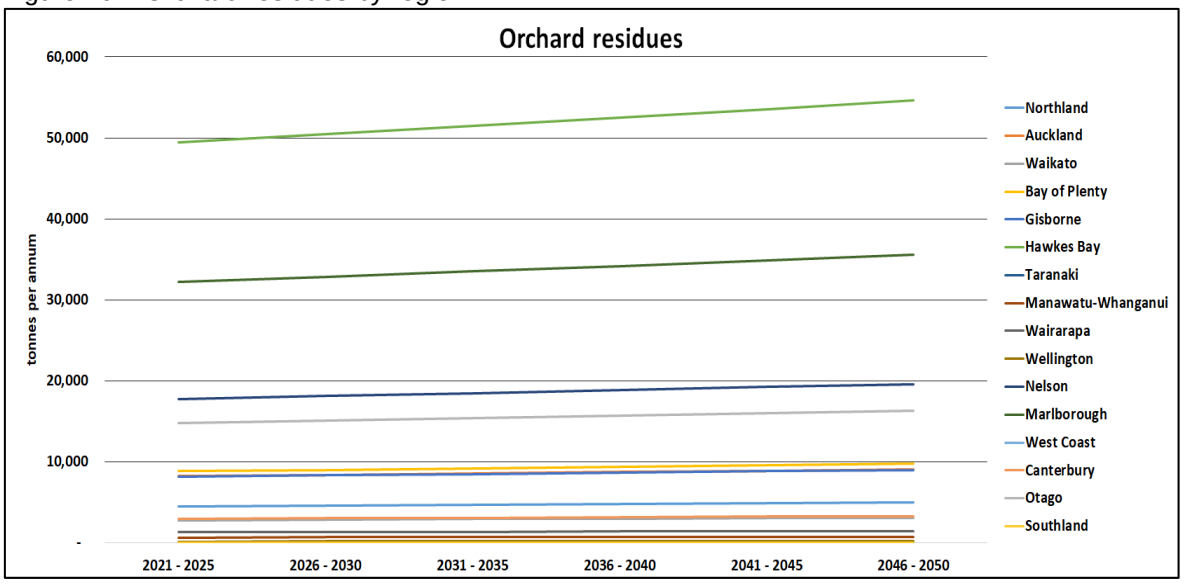
Orchards and vineyards produce woody debris from turn-over of over-mature trees and vines (replacing older plants). Figure 9 shows the volume of this material estimated to be available nationally. The increase in volume over time is due to anticipated increase in area of land used for orchards and vineyards.

Figure 9 – National total orchard residues



The regional availability of orchard residues is shown in Figure 10. Regions with large areas of fruit and grape growing (Hawkes bay, Nelson, Gisborne etc.) have higher volumes than some other regions (West Coast, Southland).

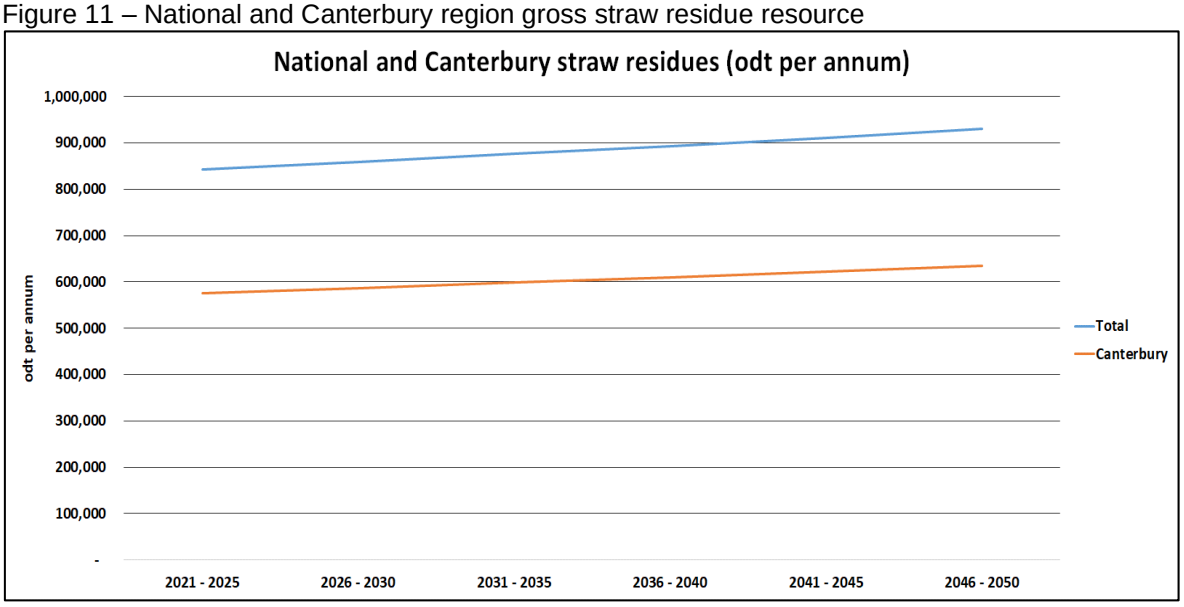
Figure 10 – Orchard residues by region



Agricultural residues (Straws and Stover)

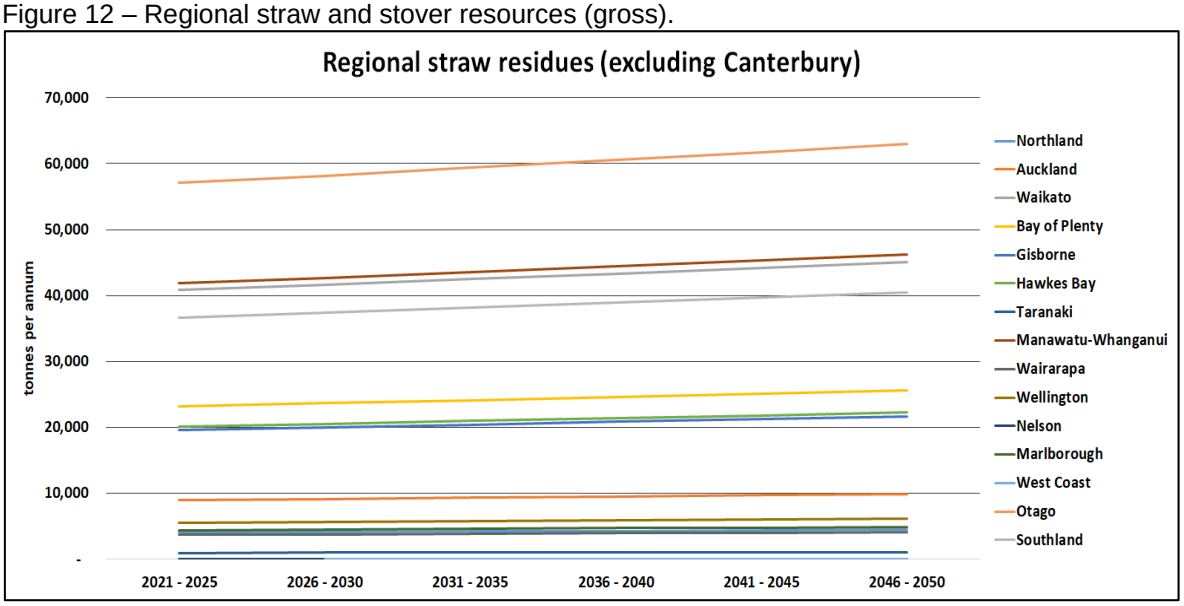
The amount of straw and stover residues potentially available nationally and in Canterbury are shown in Figure 11. Canterbury is included with the national figure as this region has around 70% of the national area under arable crops such as wheat, barley and oats.

Figure 11 – National and Canterbury region gross straw residue resource



The regional availability (excluding Canterbury) of straw and stover residues is shown in Figure 12. In the North Island the resource is skewed towards corn stover, with much less wheat and barley straw. This estimate does not include maize silage, only the stover residue from corn cropping.

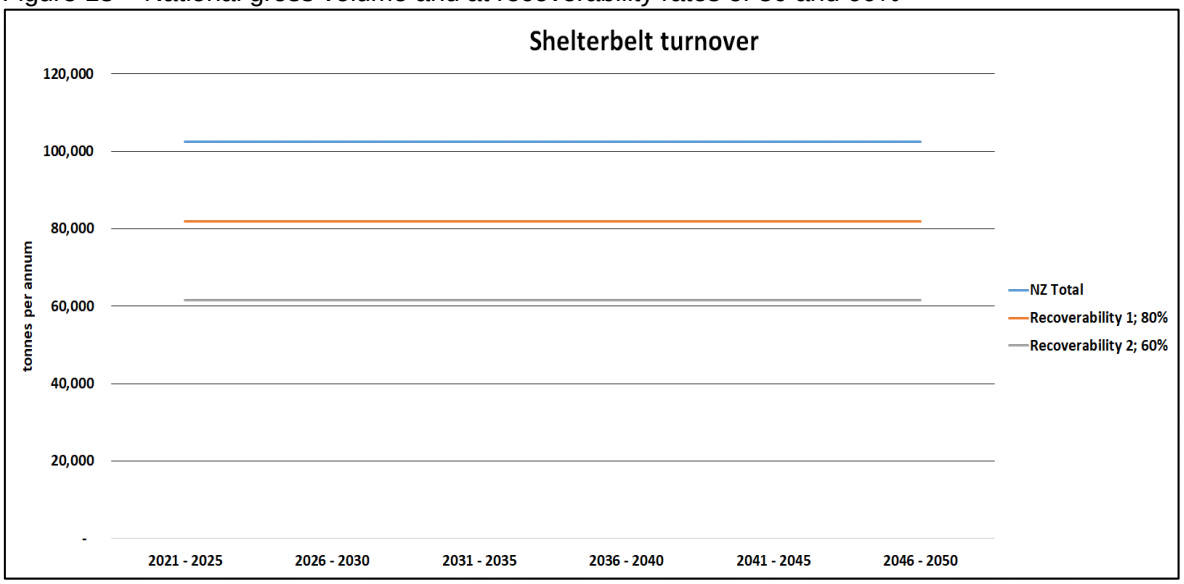
Figure 12 – Regional straw and stover resources (gross).



Shelter belt residuals

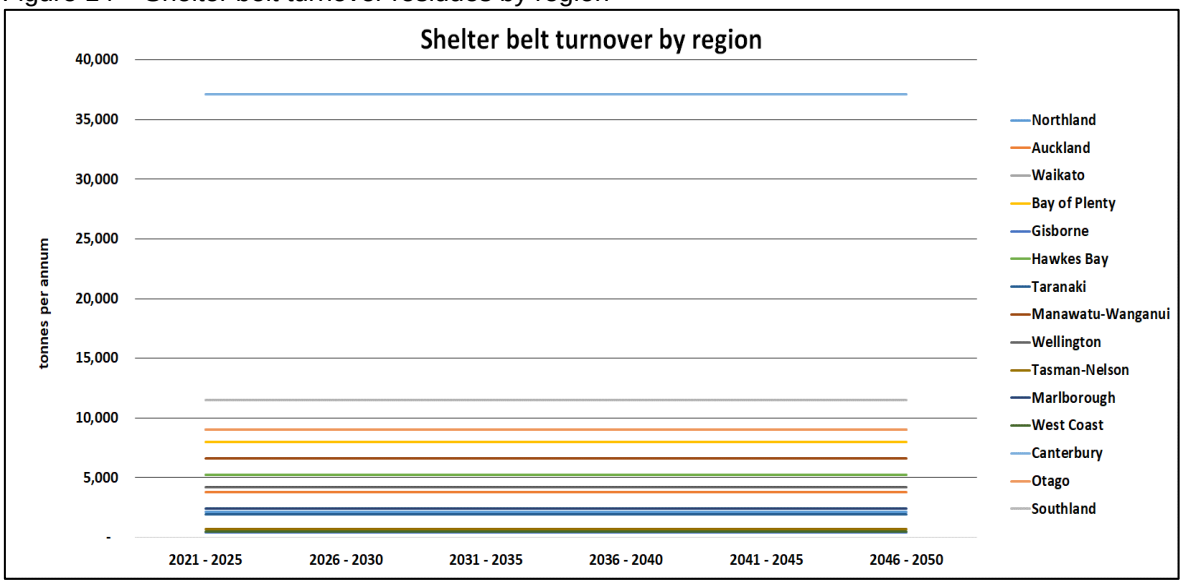
The gross volume of material available from shelterbelt turnover / replacement is shown in Figure 13, along with estimates of the volumes available at recoverability rates of 80 and 60%.

Figure 13 – National gross volume and at recoverability rates of 80 and 60%



The volume of shelter belt turnover residues by region is shown in Figure 14. Canterbury has significantly more of this potential fuel resource than any other region.

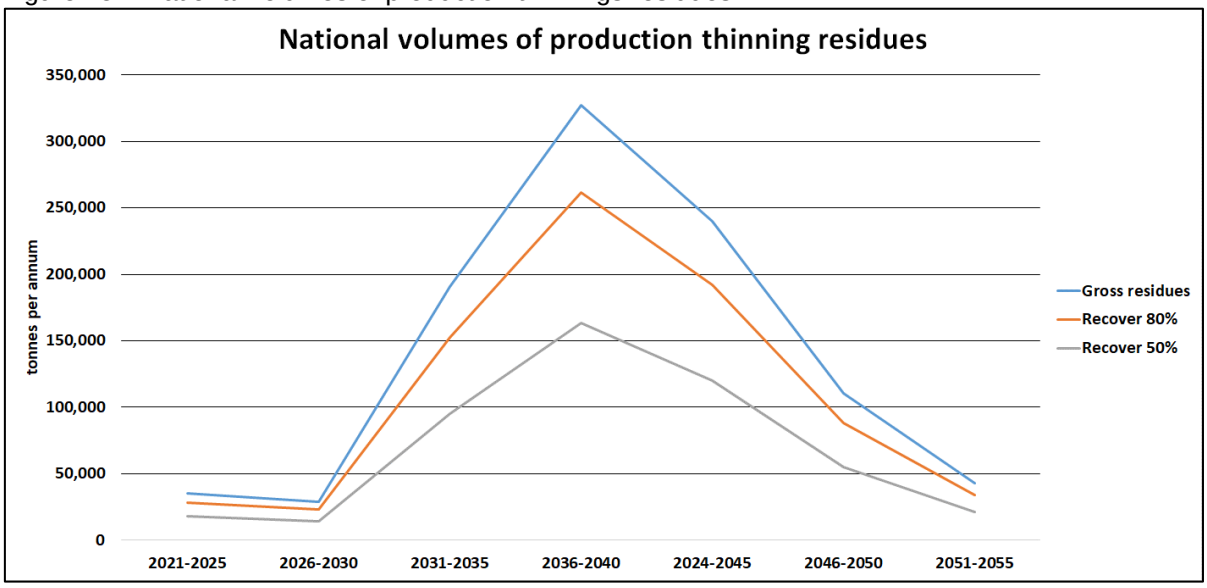
Figure 14 – Shelter belt turnover residues by region



Production thinnings residuals

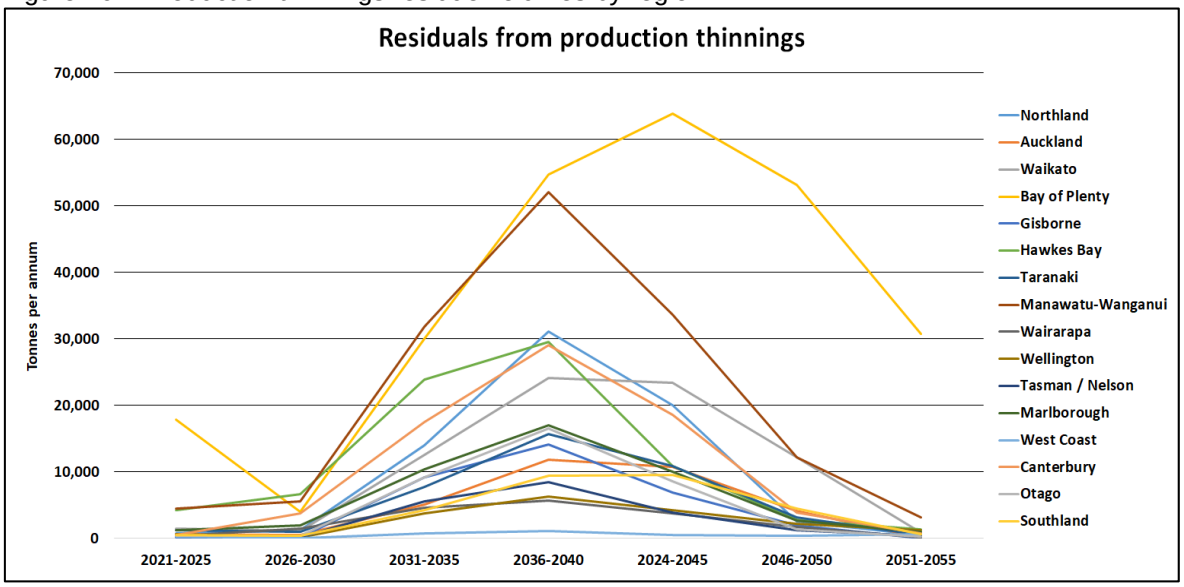
Volumes of residues from production thinnings were not estimated in the previous (2017) report. The volume of residues from this source is peaky due to the age class distribution of the forests and changes in regimes used with less production thinning occurring currently than has been the case historically. We have assumed the same pattern of production thinnings going forward into the future as the changes in production thinning volumes may be dictated by the slope of the land being harvested, with changes to harvests off steeper land on the increase reducing the amount of area viable for production thinning. The ability to smooth the supply from this resource by delaying or bringing forward operations is much more limited than with clear-fell operations. The gross volume of residuals from production thinnings is shown in Figure 15, along with volumes assuming recovery rates of 80 and 50%.

Figure 15 – National volumes of production thinnings residues



The volume of production thinnings by region are shown in Figure 16. The Bay of Plenty region has the largest volume of this material.

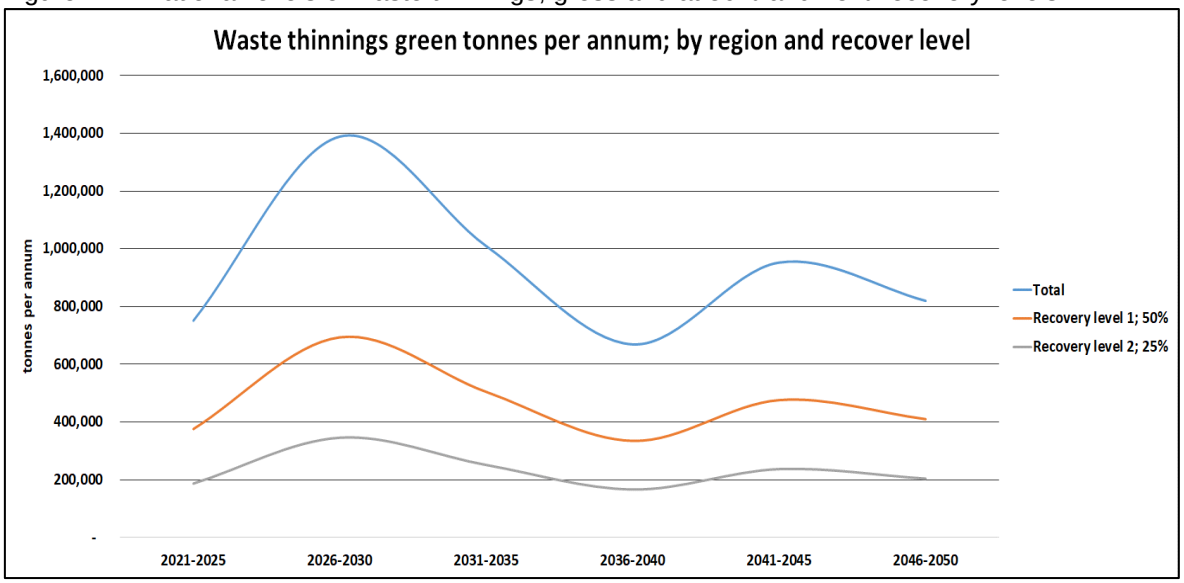
Figure 16 – Production thinnings residue volumes by region



Waste thinnings

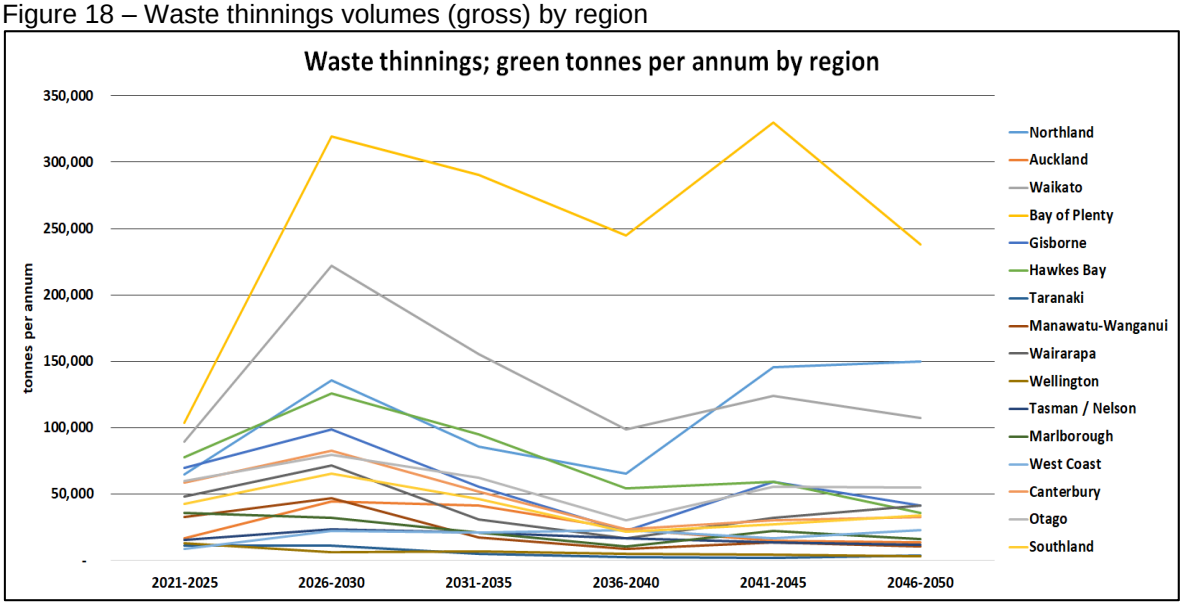
Waste thinnings volumes were estimated in the previous report. Much of this material would be difficult to recover with modest volumes per hectare, spread over a large area. The recovery levels of this material may well be much lower than for other more accessible residues. The estimated gross volume available nationally, along with the volumes from 50% and 25% recovery are shown in Figure 17.

Figure 17 – National levels of waste thinnings, gross and at 50% and 25% recovery levels



The gross amounts of waste thinnings by region are shown in Figure 18. The largest volume is available in the Central North Island (Waikato and Bay of Plenty). The CNI has around 30% of New Zealand's plantation forests by area.

Figure 18 – Waste thinnings volumes (gross) by region



Prunings

The volume of biomass estimated to be available national from pruning of Pinus radiata forests is shown in Figure 19. This material is likely to be difficult to access and expensive to extract in many stands, especially those on steep slopes. The variation in the volume of supply is due to changes in forestry practices, with less are of forest being reported as being planned for a regime that includes pruning (MPI, 2022).

Figure 19 – Pruning residuals, national level

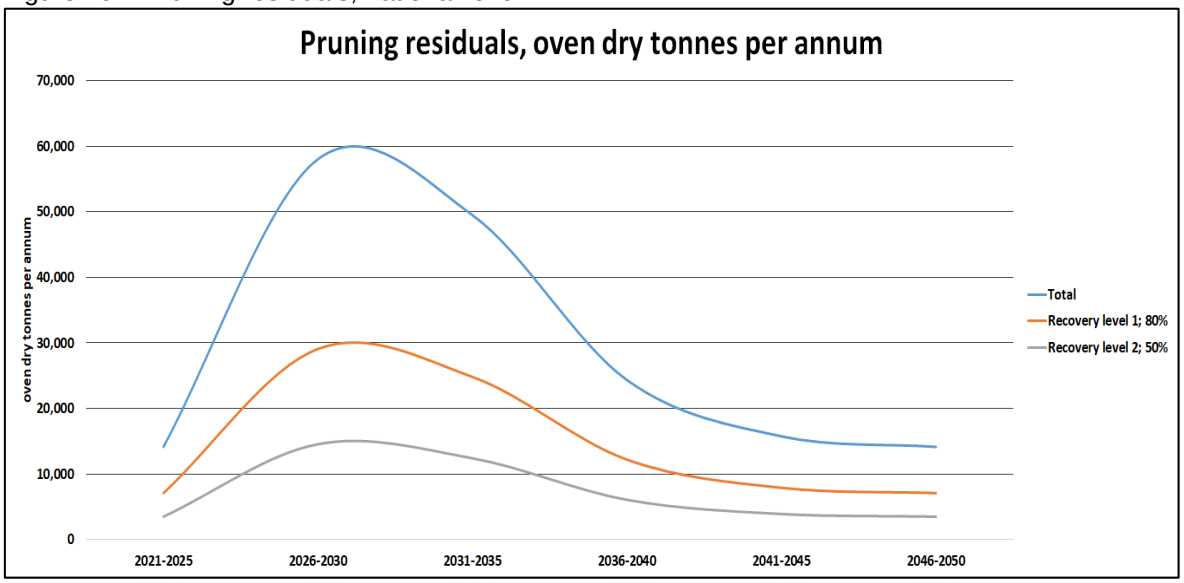
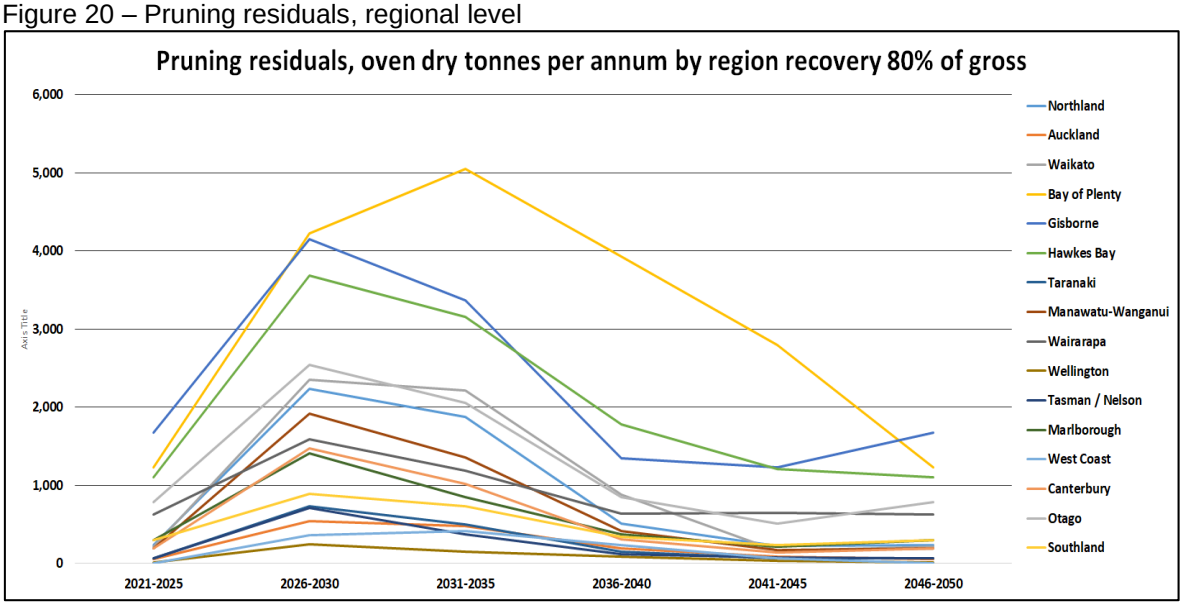


Figure 20 shows the estimated pruning resource by region. This resource has potentially low estimates in the future – but this depends on decisions around pruning that may change in the future.

Figure 20 – Pruning residuals, regional level



Pulp logs

The gross volume of pulp logs produced in New Zealand is shown in Figure 21 (blue line). This volume is for all pulp logs produced and does not allow for the current use of these logs by existing users such as pulp mills and MDF plants. The orange line shows the amount estimated to be available after incumbent users (pulp mills, MDF mills etc.) has been accounted for.

Figure 21 – Gross volume of pulp logs produced in New Zealand

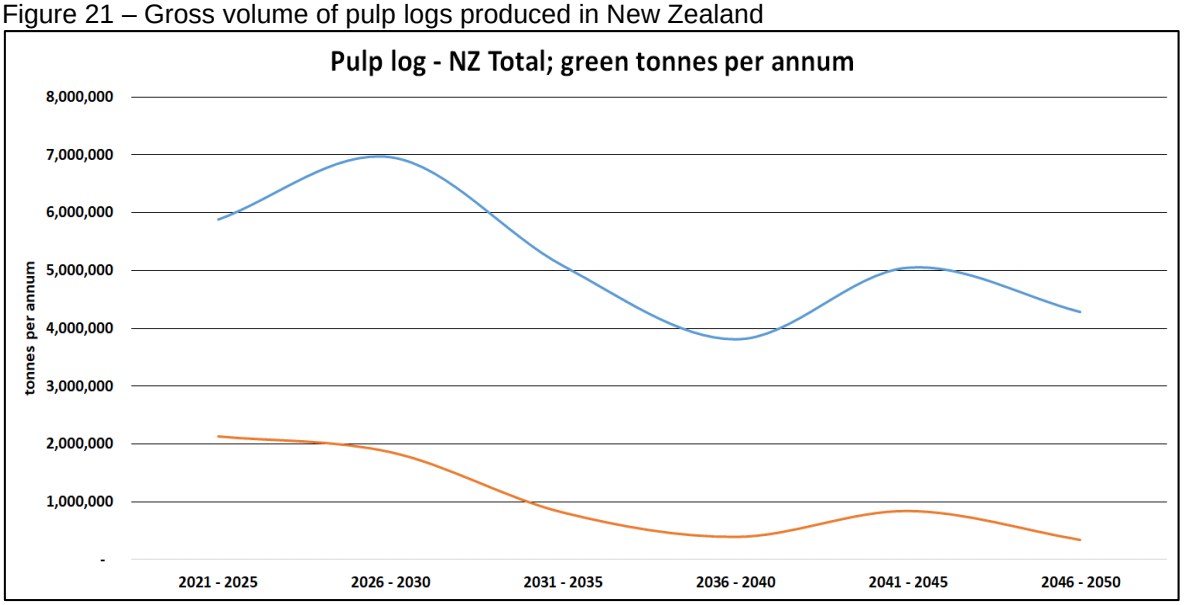
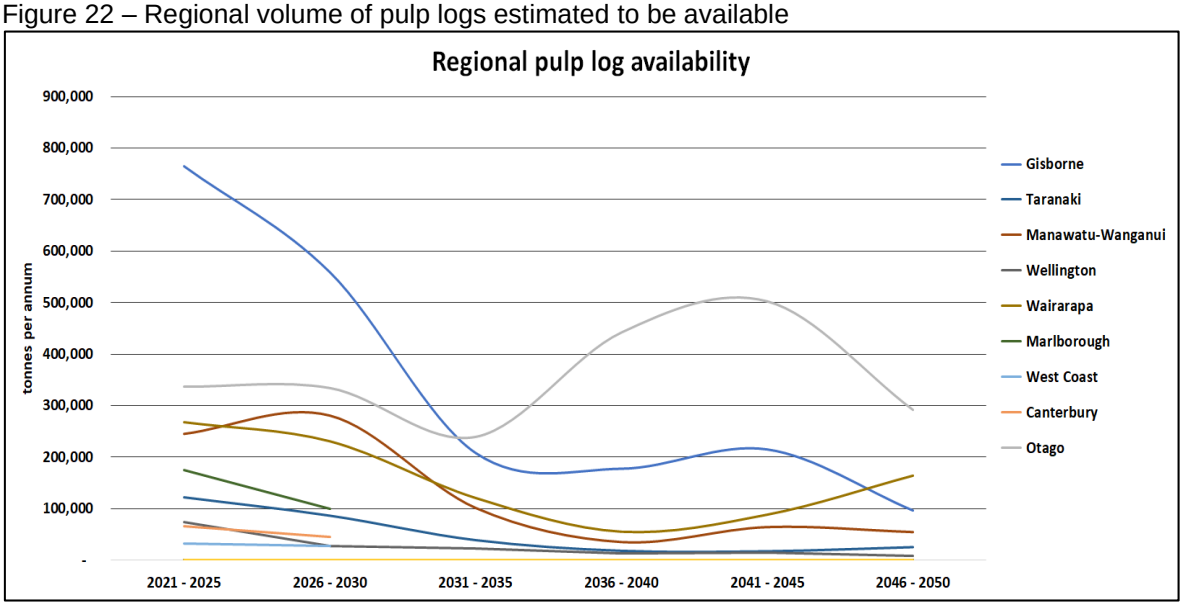


Figure 22 shows the amount of pulp logs available by region after the use by incumbent mills is allowed for.

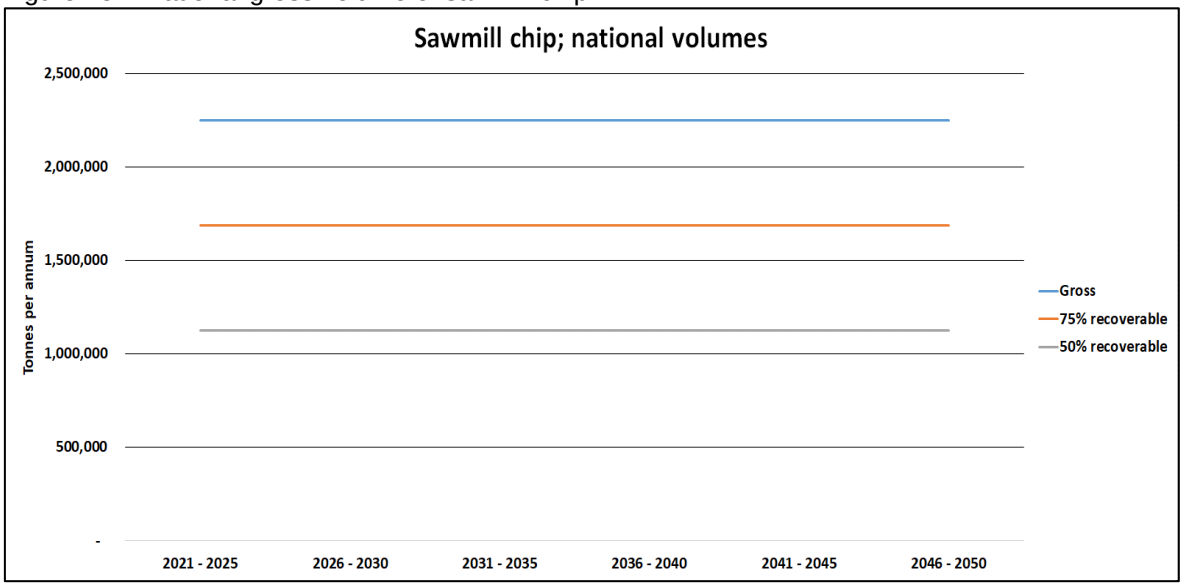
Figure 22 – Regional volume of pulp logs estimated to be available



Sawmill chip

The gross amount of sawmill chip available in New Zealand is shown in Figure 23, along with figures assuming either 75% or 50% being available for purchase. These figures do not allow for the volume going to incumbent users such as pulp mills.

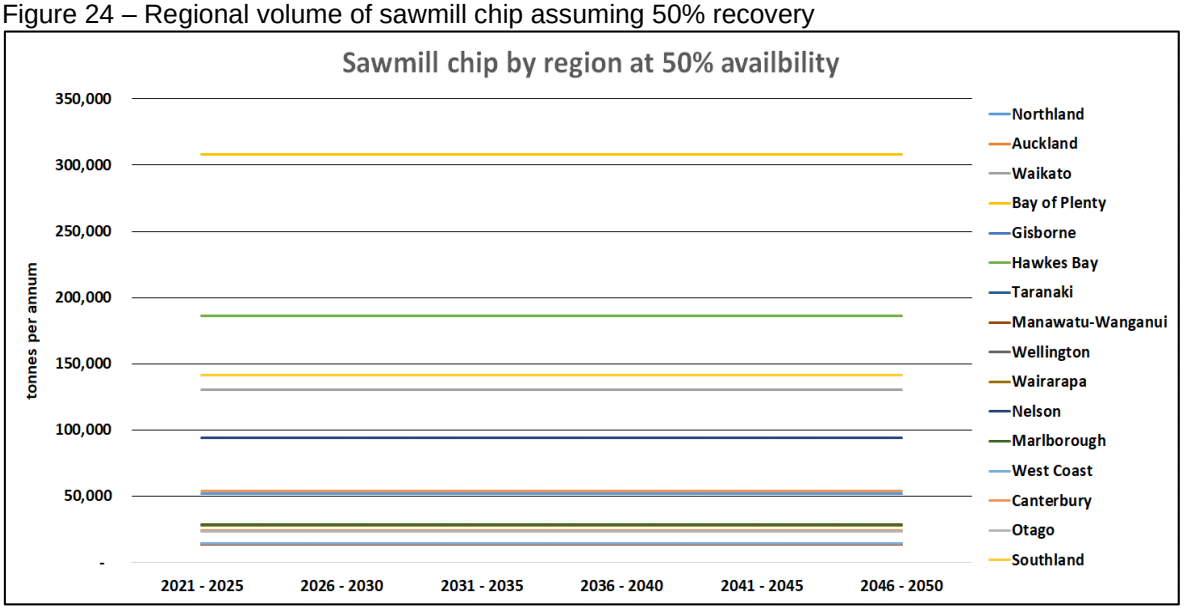
Figure 23 – National gross volume of sawmill chip



The data in Figure 24 shows the volume of sawmill chip available by region, assuming that 50% of the gross is available. Most of the sawmill chip currently produced has a market in either pulp, paper (Central North Island, Hawkes Bay), MDF (Southland, Canterbury & Nelson), particle board (Northland, Central North Island) or as export chip (Northland). However, from a chip producers' point of view the important points is having a market rather than the type pf end-use and there is

anecdotal evidence of fuel users expressing an interest in sawmill chip as a fuel. As carbon process rise this option becomes more viable.

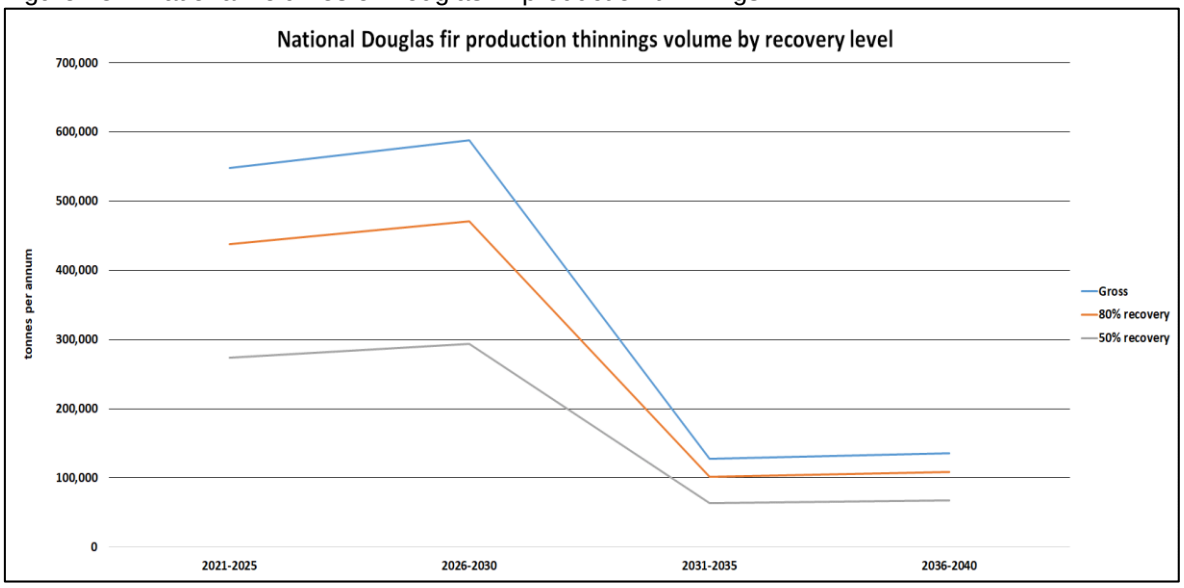
Figure 24 – Regional volume of sawmill chip assuming 50% recovery



Douglas-fir production thinnings

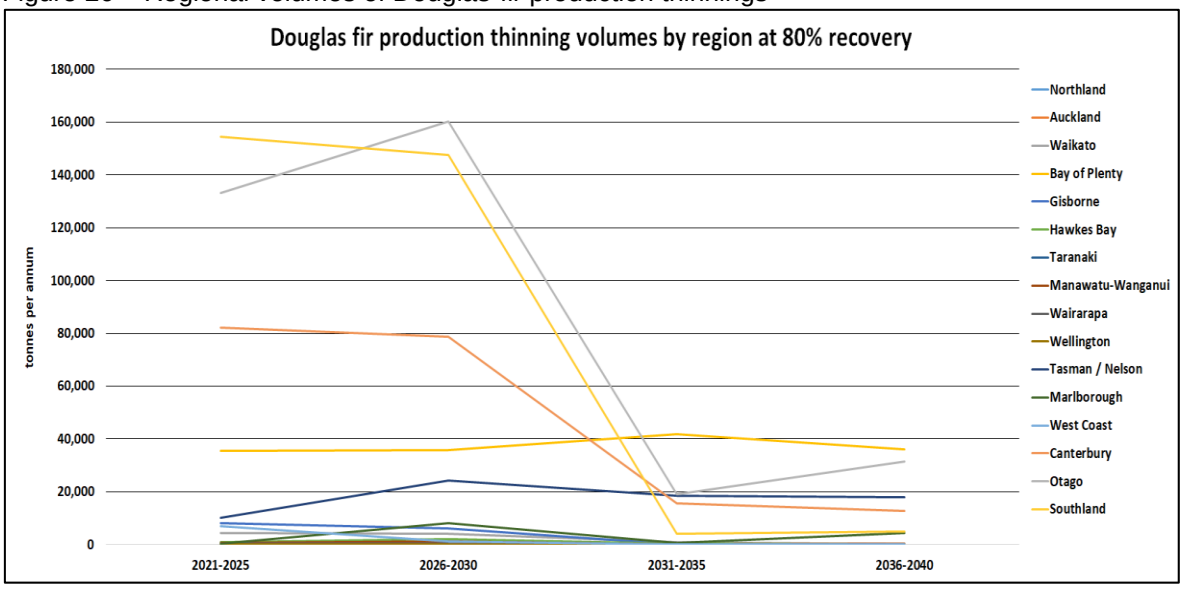
Douglas fir production thinnings were not previously reported. This resource is mostly in the South Island and is likely to be a short-term option as plantings of Douglas fir that had expanded during the 1990's and 200s have declined due to concerns over the spread of wildings. There is a limited market in traditional wood processing for the small logs from the Douglas fir thinnings. They are not a preferred feedstock for MDF. The national level values of this resource are shown in Figure 25.

Figure 25 – National volumes of Douglas-fir production thinnings



The regional volumes of Douglas fir thinnings are shown in Figure 26. The bulk of this resource is in Southland, Otago and Canterbury. The only region in the north Island with a significant amount of Douglas fir is Bay of Plenty.

Figure 26 – Regional volumes of Douglas-fir production thinnings

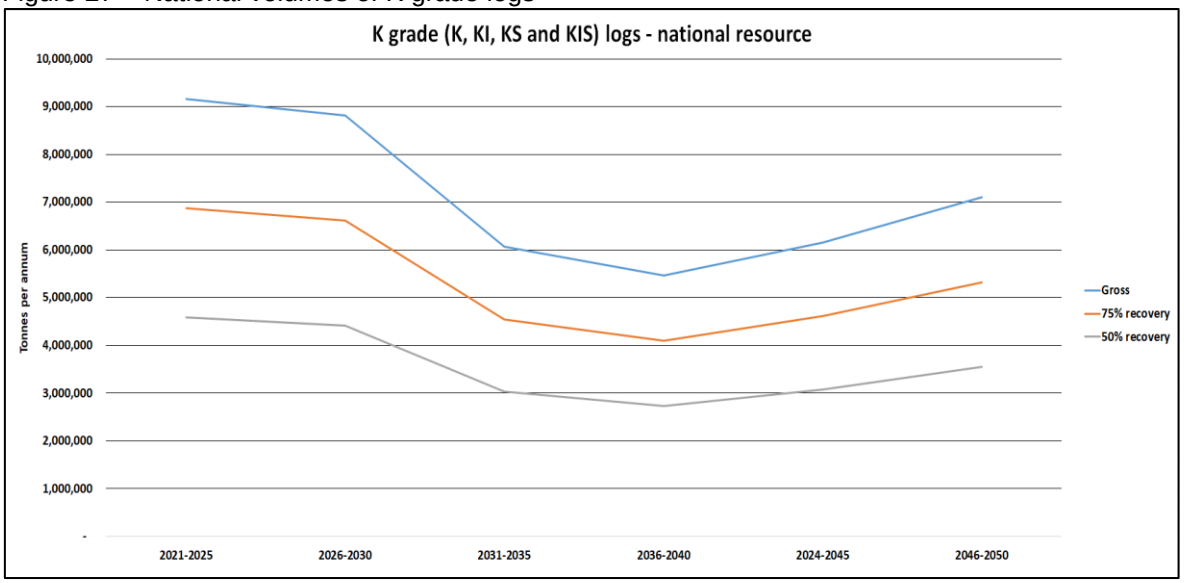


K grade logs (includes K, KI, KS and KIS)

K grade logs are small diameter, short length, knotty logs. They are the lowest value of the sawlog grades (see Table 2). Most of this resource gets exported as raw logs, much of it to China. There are few processors using this material in New Zealand. Potentially this material could be used as a fuel resource depending on the price of the logs and the impact of the price of carbon on coal users.

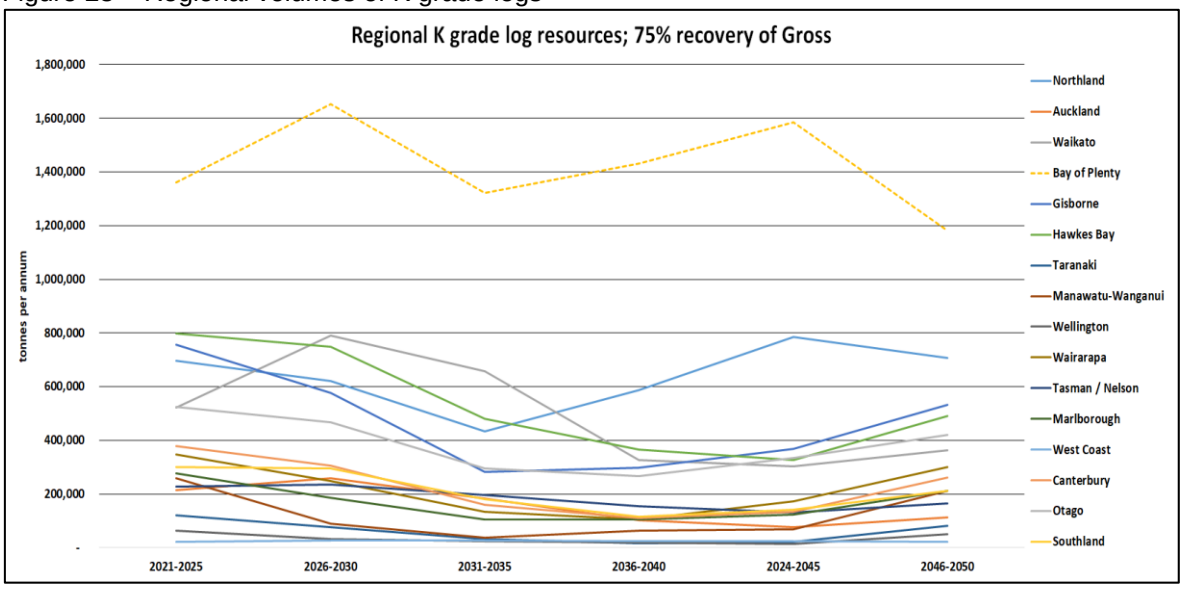
The national volume of K grade logs (combination of the 4 subgrades) potentially available, including availability for purchase levels of 75% and 50% are shown in Figure 27. These volumes are substantial, being several million tonnes per annum, regardless of scenario or timing. The maximum long run volume is around 5.5 million tonnes per annum, with a low point in supply around 2036 to 2040.

Figure 27 – National volumes of K grade logs



The regional volumes of K grade logs likely to be available over time are shown in Figure 28. The largest resource is in the Bay of Plenty (1.2 to 1.4 million tonnes per annum). However, even in many of the regions with smaller volumes the scale of this resource is still in the order of 150,00 to 200,000 hundred thousand green tonnes per annum

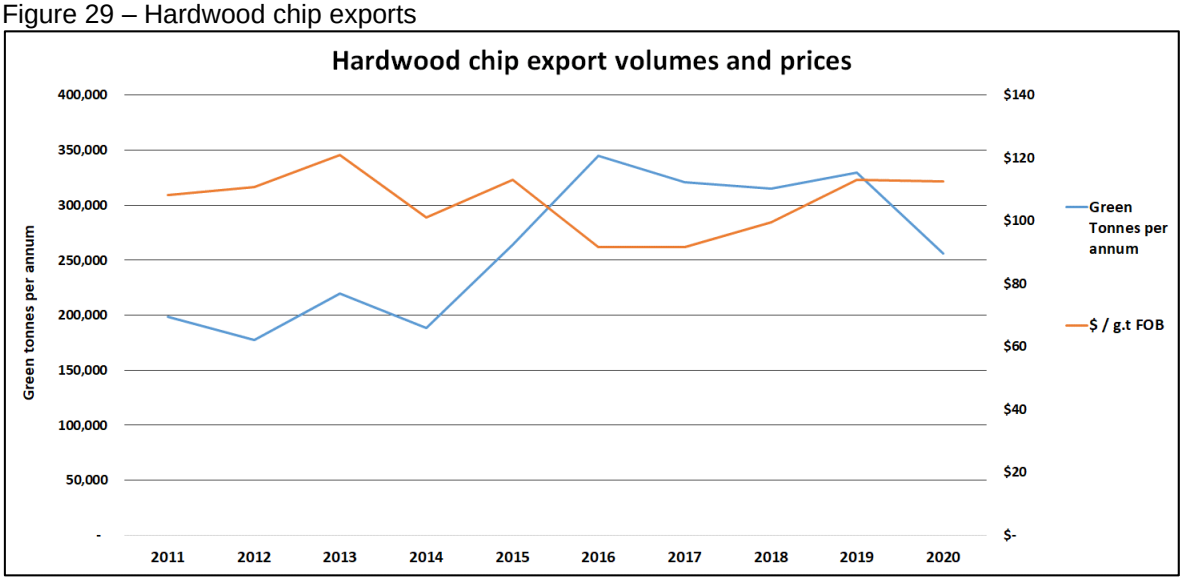
Figure 28 – Regional volumes of K grade logs



Short Rotation Forest (SRF) resources

There is a potential energy resource in Otago and Southland that comes directly from a crop, not as a residual. This is the Eucalyptus nitens resource managed by Southwood Exports. There is around 12,300 ha of this species in Southland and Otago. The trees are grown at high stockings for around 16 to 18 years. The logs produced are chipped at Awarua and exported via the port at Bluff. Data available from MPI on export volumes presented in Figure 29 and prices are currently around $110 per green tonne having ranged from $92 to $120 over the last 5 years. The chip mill has a single shift capacity of 320,000 green tonnes per annum. This material could also potentially be available as a wood fuel resource if circumstances (demand and price) change.

Figure 29 – Hardwood chip exports



Source; https://www.mpi.govt.nz/forestry/new-zealand-forests-forest-industry/forestry/wood-product-markets/ - Quarterly trade data exports

In theory this resource represents a wood energy resource of around 300,000 green tonnes (2PJ of energy) per annum at around $14 to $15 per GJ.

New short rotation forests are not included here but could be used to expand the supply of biomass for bioenergy. Modelling of the potential for SRF forests and future supply based on them is possible using GIS based models.

Discussion

Outside of the residual, sawmill chip and log resources covered above there is potential to grow biomass for fuel from non-traditional forestry regimes. These approaches include short rotation coppice of willow and poplar. There are no commercial areas of this type of material in New Zealand, but there have been trials. Short rotation forestry without coppicing is also an option.

Current wood fuel for large scale (<1MWth) heat.

There are a number of heat plant around New Zealand that have made a change in the recent past to using wood as fuel. Generally the displaced fuel has been a fossil fuel, and many have been coal boilers.

Based on information that is publicly available (industry newsletters, company announcements, published case studies etc.) a list of know users of wood fuels is presented (Table 7). It indicates around 260,000 green tonnes per annum (at least) of wood residuals being used as fuel. This list is not believed to be complete and further work on expanding this dataset is planned.

Table 7 – current known wood fuel users (non-wood processing) greater than 1MWth

Region	Location	Boiler size; MWth	Wood fuel type	Wood fuel demand; GJ p. a.	Wood fuel demand; t pellets p. a.	Wood fuel demand; chip, p. a.	Forest residues Wood fuel demand; g.t. hog, p. a.	MWW Wood fuel demand; g.t. hog, p. a.
Northland	Dargaville	1.5	Wood pellets	38,956	2,292	-	-	-
Auckland				-	-	-	-	-
Waikato	Te Awamutu	40	Wood pellets	680,000	40,000.0	-	-	-
Bay of Plenty				-	-	-	-	-
Gisborne				-	-	-	-	-
Hawkes Bay				-	-	-	-	-
Taranaki				-	-	-	-	-
Manawatu-Wanganui				-	-	-	-	-
Wairarapa				-	-	-	-	-
Wellington				-	-	-	-	-
Tasman / Nelson	Brightwater	7	Hog fuel	36,359	-	-	5,269	-
Marlborough				-	-	-	-	-
West Coast				-	-	-	-	-
Canterbury	Christchuch City	15	Hog fuel	335,000	-	-	48,500	-
Canterbury	Burwood	6	Hog fuel	134,000	-	-	19,000	-
Canterbury	Belfast	2.25	MMW hog	80,000	-	-	-	**8,607**
Otago	Clutha	13	Hog fuel	290,000	-	-	42,029	-
Otago	Clutha	11	Hog fuel	245,000	-	-	35,507	-
Otago	Clutha	8.5	Hog fuel	189,000	-	-	27,391	-
Otago	Dunedin	4	Hog fuel	104,000	-	-	15,000	-
Southland	Invercargill	3.4	Chip	63,000	-	9,140	-	-
Southland	Invercargill	0.675	Chip	71,500	-	6,805	-	-
Total		**112.325**		**2,266,815**	**42,292**	**15,945**	**192,697**	**8,607**

The Table 7 list excludes the wood processing industry. Wood processors around New Zealand are the largest users of wood fuels and an estimate of this is that around 2.6 million green tonnes of wood fuels are used per annum at around 100 sites in 106 boilers with around 400MWth total installed capacity. This material is typically sawdust, shavings, bark, sander dust, trim etc. This use of wood indicates that the use of wood as fuel is well established and has been used extensively by the wood processing industry for decades.

Conclusions

There are many sources of residual woody biomass that could provide a low carbon fuel; in-forest post-harvest residues, shelterbelt replacement, orchard turnover, municipal wood waste, straws, bark, wood processing residues, waste thinnings and prunings from plantation forests etc. Further there are other resources such as sawmill chip, pulp logs and K grade logs which are typically used or exported but which based on current pricing could reasonably be used as wood fuels.

Residuals based on plantation forests are the largest source of residual material.

K grade logs are potentially a very large source of wood fuel.

Straws are a substantial potential fuel source in Canterbury. Operations and studies overseas and in New Zealand indicate that specialist straw boilers are likely to be required.

Orchard residues are potentially significant in regions with large horticulture and viticulture industries (Hawkes Bay, Gisborne, Marlborough, Tasman).

In the long run a mid-range (recoverability level 1) estimate of woody biomass supply is up to 7.6 million green tonnes per annum. If pulp logs, K grade logs and sawmill chip is excluded then the supply potential drops to around 3.5 million green tonnes per annum. The national level of biomass supply by resource and over time (2021 to 2050) is shown in Table 8.

Table 8 – national potential supply of woody biomass fuels; green tonnes per annum.

	2021 - 2025	**2026 - 2030**	**2031 - 2035**	**2036 - 2040**	**2041 - 2045**	**2046 - 2050**
In-forest post-harvest residues	3,281,411	2,657,097	2,057,579	2,042,674	2,274,610	2,360,950
MWW	171,730	184,827	199,156	214,848	232,047	250,917
Orchard	98,728	100,703	102,717	104,771	106,866	109,004
Straw and stover	480,073	489,675	499,468	509,458	519,647	530,040
Shelter belt	61,440	61,440	61,440	61,440	61,440	61,440
Thin to waste	71,240	131,830	95,764	63,452	90,374	77,777
Production thin residues	23,067	18,650	123,912	212,587	155,894	71,635
Port bark	200,719	220,791	230,827	210,755	200,719	200,719
Prunings	3,523	14,520	12,381	6,078	3,927	3,523
Douglas fir production thinnings	356,031	382,291	82,667	88,154	-	-
Sawmill chip	1,125,398	1,125,398	1,125,398	1,125,398	1,125,398	1,125,398
Pulp log	2,127,887	1,856,618	817,321	397,061	843,400	344,871
K grade log	4,579,022	4,405,647	3,030,689	2,728,893	3,072,889	3,548,060
Total	**12,580,270**	**11,649,488**	**8,439,319**	**7,765,568**	**8,687,210**	**8,684,333**

A set of 17 appendices (A to Q) show the gross and recoverable tonnages (levels 1 and 2) and energy content by resource, region and time for all the different resources assessed above.

These resources are based on current forest area and age class data, as well as crop residues. Establishment of new forests, especially short rotation energy forests could expand the bioenergy supply available in the future.

Acknowledgements

Scion wishes to acknowledge the Ministry on Business, Innovation and Employment and the Strategic Science Investment Funding that enabled this data summary and report.

References

https://www.eecabusiness.govt.nz/tools/wood-energy-calculators/

EECA (2010). Good practice guide. Production of wood fuel from forest landings. Technical Guide 9.0

NZ Forest Owners Association; Galbraith J (2007). NZFOA submission to MOT / Transit Heavy Vehicle VDM concessions project.

Hall P. (1999). Logging Residue Distribution. LIRO Report, Vol. 24, No. 9.

Hall P. (1994). Waste wood at logging landings. LIRO report Vol 19 No. 15.

Hall P. (2000). Effects of storage on fuel parameters of piled and comminuted logging residues. LIRO Report, Volume 25, No. 5.

Hall P and Gifford J. (2007). Bioenergy options for New Zealand. A situation analysis of biomass resources and conversion technologies. Editor; Margaret Richardson. Scion Energy Group.
ISBN 0-478-11019-7.

Hall P. (2017). Residual biomass fuel projections for New Zealand – Indicative availability by region and source. Scion contract report for BANZ & EECA. SCION SIDNEY No. 59041.

Handbook of Biomass Combustion and Co-Firing, Sjaak van Loo and Jaap Koppejan (eds.) (Twente University Press 2002)

INFORME (2020). Harvesting 2020. (Forestry equipment and cost price guide).

http://www.nzwine.com/about-new-zealand-winegrowers/

Ireland-Blake M. (2017). Municipal solid waste and wood waste annual disposal to landfill in New Zealand. Scion Internal report. Sidney No. 23067

Kimberley M. O. (2014). Radiata pine calculator version 4. Developed for Future Forest Research based on the calculator produced for the NZ Farm Forestry Association by Leith Knowles.

Ministry of Agriculture and Forestry 2010. Horticulture and arable overview.

Ministry of Agriculture and Forestry 2011. Horticulture and arable overview.

Ministry of Business, Innovation and Employment (2016). Energy in New Zealand 16. 2015 Calendar Year Edition.

Ministry of Business, Innovation and Employment (2021). Energy in New Zealand 21. 2020 Calendar Year Edition.

Ministry of Primary Industries (2021). A national exotic forest description 1 April 2020.

Saggar S., Giltrap D., Forgie V. and Renquist R. (2007). Bioenergy Options report: Review of Agricultural resources. LandCare Research Contract Report; LC0708/016

Trolove H. and Garrood M. (2007). Bioenergy feedstock combustion and handling properties - biomass gasification. CRL Ref. 07-115442B.

Riddle A. (1994) Business management or Logging. LIRO Handbook.

Statistics New Zealand (accessed June 2017). Agricultural production statistics. http://www.stats.govt.nz/browse_for_stats/industry_sectors/agriculture-horticulture-forestry/AgriculturalProduction_final_HOTPJun16final.aspx

Appendix A – All in-forest residues

Gross supply all in-forest residues; m^3 per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	550,349	458,320	310,713	410,915	549,101	549,723
Auckland	172,235	189,518	132,000	73,304	55,209	51,998
Waikato	434,965	489,488	428,753	343,434	332,087	330,299
Bay of Plenty	1,542,020	1,784,910	1,397,097	1,428,603	1,572,921	1,468,060
Gisborne	846,784	619,649	311,084	332,403	405,772	327,443
Hawkes Bay	621,980	577,593	377,084	297,088	260,889	196,626
Taranaki	129,922	78,444	34,936	22,711	26,511	30,128
Manawatu-Wanganui	374,665	259,142	107,078	74,076	78,183	67,672
Wellington	138,294	102,119	52,604	45,435	51,461	44,641
Wairarapa	306,233	199,220	101,776	106,349	161,110	187,233
Tasman-Nelson	289,784	255,903	205,465	157,925	128,447	119,759
Marlborough	314,215	199,148	111,304	112,144	126,489	105,488
West Coast	74,370	65,985	72,005	63,915	55,548	62,779
Canterbury	435,053	346,634	206,705	151,657	151,129	146,804
Otago	522,038	475,300	342,801	320,099	334,660	302,742
Southland	289,002	314,608	240,301	196,283	175,313	147,216
NZ Total	**7,043,932**	**6,418,007**	**4,433,739**	**4,138,380**	**4,466,873**	**4,140,658**

Gross supply all in-forest residues; GJ per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	3,797,407	3,162,410	2,143,920	2,835,313	3,788,800	3,793,088
Auckland	1,188,423	1,307,671	910,803	505,798	380,944	358,783
Waikato	3,001,255	3,377,465	2,958,399	2,369,694	2,291,397	2,279,064
Bay of Plenty	10,639,938	12,315,882	9,639,972	9,857,364	10,853,156	10,129,616
Gisborne	5,842,809	4,275,577	2,146,477	2,293,584	2,799,826	2,259,357
Hawkes Bay	4,291,663	3,985,390	2,601,880	2,049,908	1,800,136	1,356,721
Taranaki	896,463	541,262	241,061	156,706	182,923	207,883
Manawatu-Wanganui	2,585,190	1,788,078	738,836	511,124	539,464	466,937
Wellington	954,229	704,619	362,967	313,503	355,078	308,025
Wairarapa	2,113,005	1,374,615	702,254	733,810	1,111,662	1,291,910
Tasman-Nelson	1,999,511	1,765,731	1,417,712	1,089,679	886,281	826,340
Marlborough	2,168,085	1,374,119	767,994	773,793	872,774	727,870
West Coast	513,150	455,300	496,834	441,015	383,281	433,175
Canterbury	3,001,869	2,391,772	1,426,262	1,046,431	1,042,791	1,012,945
Otago	3,602,061	3,279,571	2,365,328	2,208,686	2,309,155	2,088,919
Southland	1,994,115	2,170,797	1,658,080	1,354,354	1,209,661	1,015,792
NZ Total	**48,603,128**	**44,284,250**	**30,592,802**	**28,554,822**	**30,821,422**	**28,570,537**

All in-forest residues, m^3 per annum at recoverability level 1 (landings 80%, GB cutover 70%, hauler cutover 10%)

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	342,912	287,645	200,089	262,876	347,255	345,486
Auckland	102,842	114,892	81,066	45,588	34,129	32,077
Waikato	265,306	304,231	267,017	212,600	206,375	206,778
Bay of Plenty	900,303	1,039,247	806,056	820,106	892,129	833,561
Gisborne	382,481	288,250	149,137	150,417	184,084	156,292
Hawkes Bay	310,356	291,398	191,331	147,527	129,972	103,054
Taranaki	57,522	36,655	16,746	9,983	11,314	13,181
Manawatu-Wanganui	190,238	136,811	59,236	40,512	42,388	37,162
Wellington	67,458	50,269	26,163	22,605	25,728	23,001
Wairarapa	138,696	92,889	48,205	49,378	73,977	86,115
Tasman-Nelson	119,413	117,096	99,010	80,010	63,397	56,961
Marlborough	117,624	78,493	46,043	46,055	52,857	47,556
West Coast	45,052	39,658	43,447	39,912	34,951	38,858
Canterbury	235,823	192,379	123,381	94,063	90,013	85,589
Otago	239,137	218,964	173,498	173,727	170,607	151,233
Southland	180,677	193,206	156,567	138,823	120,568	98,169
NZ Total	**3,697,459**	**3,483,705**	**2,488,618**	**2,335,811**	**2,481,380**	**2,316,709**

All in-forest residues, GJ per annum at recoverability level 1 (landings 80%, GB cutover 70%, hauler cutover 10%)

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	2,366,091	1,984,751	1,380,615	1,813,845	2,396,061	2,383,854
Auckland	709,608	792,753	559,354	314,555	235,489	221,332
Waikato	1,830,610	2,099,195	1,842,416	1,466,943	1,423,991	1,426,766
Bay of Plenty	6,212,094	7,170,803	5,561,788	5,658,730	6,155,690	5,751,569
Gisborne	2,639,119	1,988,925	1,029,045	1,037,880	1,270,180	1,078,415
Hawkes Bay	2,141,460	2,010,647	1,320,183	1,017,937	896,810	711,076
Taranaki	396,905	252,918	115,544	68,881	78,069	90,949
Manawatu-Wanganui	1,312,640	943,999	408,725	279,533	292,478	256,415
Wellington	465,463	346,853	180,525	155,972	177,520	158,706
Wairarapa	957,006	640,933	332,616	340,707	510,443	594,197
Tasman-Nelson	823,946	807,961	683,168	552,070	437,442	393,032
Marlborough	811,604	541,605	317,694	317,776	364,714	328,135
West Coast	1,627,180	1,327,418	851,330	649,038	621,093	590,567
Canterbury	310,862	273,638	299,784	275,390	241,160	268,119
Otago	1,650,044	1,510,848	1,197,139	1,198,713	1,177,188	1,043,508
Southland	1,246,672	1,333,125	1,080,316	957,876	831,918	677,364
NZ Total	**25,512,468**	**24,037,563**	**17,171,462**	**16,117,093**	**17,121,520**	**15,985,293**

All in-forest residues, m^3 per annum at recoverability level 2 (landings 65%, GB cutover 56%, hauler cutover 5%)

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	276,048	230,936	159,777	212,582	281,053	278,606
Auckland	83,418	92,588	64,747	36,098	27,306	25,794
Waikato	213,455	242,788	213,470	171,432	166,070	165,677
Bay of Plenty	733,642	848,063	654,863	668,916	728,506	677,554
Gisborne	311,174	227,667	114,011	121,714	148,956	120,939
Hawkes Bay	252,391	232,396	150,671	116,861	103,624	80,196
Taranaki	46,972	28,480	12,849	8,055	9,405	10,800
Manawatu-Wanganui	151,154	103,755	42,363	30,054	32,357	27,733
Wellington	56,585	42,154	21,959	18,982	21,631	19,280
Wairarapa	116,011	76,081	38,648	40,833	61,901	71,919
Tasman-Nelson	90,346	85,383	72,519	57,205	45,147	41,237
Marlborough	98,841	63,511	36,375	36,966	40,993	34,167
West Coast	36,096	31,762	34,781	31,905	28,031	31,379
Canterbury	189,763	152,032	96,225	74,769	72,437	68,685
Otago	196,442	176,780	138,229	140,989	139,405	122,380
Southland	146,023	155,063	124,977	111,646	97,317	78,987
NZ Total	**2,999,675**	**2,790,756**	**1,977,786**	**1,880,332**	**2,005,467**	**1,856,661**

All in-forest residues, GJ per annum at recoverability level 2 (landings 65%, GB cutover 56%, hauler cutover 5%)

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	1,904,732	1,593,459	1,102,461	1,466,814	1,939,267	1,922,384
Auckland	575,585	638,856	446,754	249,080	188,413	177,977
Waikato	1,472,839	1,675,236	1,472,945	1,182,880	1,145,883	1,143,171
Bay of Plenty	5,062,129	5,851,632	4,518,551	4,615,524	5,026,693	4,675,121
Gisborne	2,147,101	1,570,902	786,675	839,823	1,027,798	834,482
Hawkes Bay	1,741,497	1,603,532	1,039,630	806,341	715,003	553,349
Taranaki	324,107	196,515	88,662	55,580	64,897	74,523
Manawatu-Wanganui	1,042,963	715,910	292,303	207,374	223,262	191,357
Wellington	390,433	290,861	151,514	130,978	149,253	133,030
Wairarapa	800,479	524,959	266,673	281,749	427,114	496,238
Tasman-Nelson	623,387	589,143	500,383	394,717	311,514	284,533
Marlborough	682,001	438,224	250,986	255,068	282,854	235,755
West Coast	1,309,363	1,049,021	663,955	515,903	499,813	473,926
Canterbury	249,064	219,159	239,987	220,142	193,415	216,515
Otago	1,355,448	1,219,781	953,780	972,823	961,895	844,420
Southland	1,007,556	1,069,935	862,344	770,357	671,488	545,007
NZ Total	20,697,756	19,256,218	13,646,720	12,974,290	13,837,721	12,810,960

Appendix B – Municipal Wood Wastes

Wood waste to landfill; gross tonnage, tonnes per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	10,558	11,307	12,108	12,967	13,886	14,871
Auckland	79,860	90,442	102,427	115,999	131,370	148,778
Waikato	105,118	113,465	122,474	132,199	142,696	154,027
Bay of Plenty	8,964	9,685	10,464	11,306	12,216	13,199
Gisborne	105	116	129	143	158	175
Hawkes Bay	10,540	10,958	11,392	11,843	12,312	12,800
Taranaki	8,483	8,654	8,828	9,006	9,187	9,372
Manawatu-Wanganui	4,119	4,185	4,253	4,321	4,391	4,461
Wellington	2,758	2,802	2,847	2,893	2,939	2,986
Wairarapa	24,827	26,562	28,418	30,403	32,528	34,801
Tasman-Nelson	14,254	14,432	14,612	14,794	14,979	15,166
Marlborough	4,018	4,376	4,765	5,190	5,652	6,155
West Coast	1,103	1,211	1,329	1,459	1,601	1,757
Canterbury	63,198	65,768	68,442	71,225	74,121	77,135
Otago	14,482	15,663	16,940	18,321	19,814	21,430
Southland	5,384	5,433	5,482	5,531	5,581	5,631
NZ Total	**357,771**	**385,057**	**414,909**	**447,600**	**483,432**	**522,744**

Wood waste to landfill; gross energy, GJ per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	95,360	102,121	109,362	117,116	125,420	134,313
Auckland	721,296	816,875	925,119	1,047,706	,186,538	1,343,767
Waikato	949,426	1,024,814	1,106,188	1,194,024	1,288,834	1,391,172
Bay of Plenty	80,963	87,476	94,514	102,118	110,334	119,210
Gisborne	948	1,050	1,163	1,288	1,426	1,579
Hawkes Bay	95,197	98,969	102,889	106,965	111,202	115,608
Taranaki	76,618	78,161	79,735	81,340	82,978	84,649
Manawatu-Wanganui	37,203	37,802	38,410	39,029	39,657	40,296
Wellington	24,910	25,309	25,714	26,125	26,543	26,968
Wairarapa	224,237	239,906	256,669	274,604	293,792	314,321
Tasman-Nelson	128,742	130,349	131,976	133,624	135,292	136,981
Marlborough	36,291	39,522	43,040	46,872	51,045	55,590
West Coast	9,962	10,935	12,002	13,173	14,459	15,870
Canterbury	570,804	594,014	618,168	643,304	669,462	696,684
Otago	130,801	141,466	152,999	165,473	178,965	193,556
Southland	48,628	49,067	49,510	49,957	50,408	50,863
NZ Total	3,233,405	3,479,857	3,749,487	4,044,751	4,368,392	4,723,467

Wood waste to landfill, tonnes per annum, recovery level 1, 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	6,757	7,236	7,749	8,299	8,887	9,517
Auckland	51,110	57,883	65,553	74,240	84,077	95,218
Waikato	67,276	72,617	78,384	84,608	91,326	98,577
Bay of Plenty	5,737	6,199	6,697	7,236	7,818	8,447
Gisborne	67	74	82	91	101	112
Hawkes Bay	6,746	7,013	7,291	7,579	7,880	8,192
Taranaki	5,429	5,538	5,650	5,764	5,880	5,998
Manawatu-Wanganui	2,636	2,679	2,722	2,766	2,810	2,855
Wellington	1,765	1,793	1,822	1,851	1,881	1,911
Wairarapa	15,889	17,000	18,187	19,458	20,818	22,272
Tasman-Nelson	9,123	9,236	9,352	9,468	9,587	9,706
Marlborough	2,572	2,800	3,050	3,321	3,617	3,939
West Coast	706	775	850	933	1,025	1,125
Canterbury	40,447	42,091	43,803	45,584	47,438	49,366
Otago	9,268	10,024	10,841	11,725	12,681	13,715
Southland	3,446	3,477	3,508	3,540	3,572	3,604
NZ Total	228,973	246,437	265,542	286,464	309,396	334,556

Wood Waste to landfill, GJ per annum, recovery level 1, 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	61,030	65,358	69,992	74,954	80,269	85,960
Auckland	461,629	522,800	592,076	670,532	759,385	860,011
Waikato	607,632	655,881	707,960	764,175	824,854	890,350
Bay of Plenty	51,816	55,985	60,489	65,355	70,613	76,294
Gisborne	607	672	744	824	913	1,011
Hawkes Bay	60,926	63,340	65,849	68,458	71,170	73,989
Taranaki	49,036	50,023	51,030	52,058	53,106	54,175
Manawatu-Wanganui	23,810	24,193	24,583	24,978	25,381	25,789
Wellington	15,943	16,198	16,457	16,720	16,988	17,259
Wairarapa	143,512	153,540	164,268	175,747	188,027	201,165
Tasman-Nelson	82,395	83,423	84,465	85,519	86,587	87,668
Marlborough	23,226	25,294	27,546	29,998	32,669	35,578
West Coast	6,376	6,998	7,681	8,431	9,254	10,157
Canterbury	365,315	380,169	395,628	411,715	428,456	445,878
Otago	83,713	90,538	97,920	105,903	114,537	123,876
Southland	31,122	31,403	31,686	31,972	32,261	32,552
NZ Total	**2,068,088**	**2,225,815**	**2,398,374**	**2,587,340**	**2,794,467**	**3,021,712**

Wood waste to landfill, tonnes per annum, recovery level 2, 60%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	5,068	5,427	5,812	6,224	6,665	7,138
Auckland	38,333	43,412	49,165	55,680	63,058	71,414
Waikato	50,457	54,463	58,788	63,456	68,494	73,933
Bay of Plenty	4,303	4,649	5,023	5,427	5,864	6,335
Gisborne	50	56	62	68	76	84
Hawkes Bay	5,059	5,260	5,468	5,685	5,910	6,144
Taranaki	4,072	4,154	4,237	4,323	4,410	4,499
Manawatu-Wanganui	1,977	2,009	2,041	2,074	2,108	2,141
Wellington	1,324	1,345	1,367	1,388	1,411	1,433
Wairarapa	11,917	12,750	13,641	14,594	15,613	16,704
Tasman-Nelson	6,842	6,927	7,014	7,101	7,190	7,280
Marlborough	1,929	2,100	2,287	2,491	2,713	2,954
West Coast	529	581	638	700	768	843
Canterbury	30,335	31,569	32,852	34,188	35,578	37,025
Otago	6,951	7,518	8,131	8,794	9,511	10,286
Southland	2,584	2,608	2,631	2,655	2,679	2,703
NZ Total	**171,730**	**184,827**	**199,156**	**214,848**	**232,047**	**250,917**

Wood Waste to landfill, GJ per annum, recovery level 2, 60%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	45,773	49,018	52,494	56,216	60,202	64,470
Auckland	346,222	392,100	444,057	502,899	569,538	645,008
Waikato	455,724	491,911	530,970	573,131	618,640	667,763
Bay of Plenty	38,862	41,989	45,367	49,017	52,960	57,221
Gisborne	455	504	558	618	684	758
Hawkes Bay	45,695	47,505	49,387	51,343	53,377	55,492
Taranaki	36,777	37,517	38,273	39,043	39,829	40,631
Manawatu-Wanganui	17,857	18,145	18,437	18,734	19,035	19,342
Wellington	11,957	12,148	12,343	12,540	12,741	12,945
Wairarapa	107,634	115,155	123,201	131,810	141,020	150,874
Tasman-Nelson	61,796	62,568	63,349	64,139	64,940	65,751
Marlborough	17,419	18,970	20,659	22,499	24,502	26,683
West Coast	4,782	5,249	5,761	6,323	6,940	7,618
Canterbury	273,986	285,127	296,721	308,786	321,342	334,408
Otago	62,785	67,904	73,440	79,427	85,903	92,907
Southland	23,342	23,552	23,765	23,979	24,196	24,414
NZ Total	**1,551,066**	**1,669,361**	**1,798,781**	**1,940,505**	**2,095,851**	**2,266,284**

Appendix C – Orchard / viticulture Residues

Orchard / viticulture residues, gross tonnage per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	4,479	4,568	4,660	4,753	4,848	4,945
Auckland	8,219	8,383	8,551	8,722	8,897	9,074
Waikato	2,788	2,844	2,901	2,959	3,018	3,078
Bay of Plenty	8,832	9,009	9,189	9,373	9,560	9,752
Gisborne	8,161	8,324	8,491	8,661	8,834	9,011
Hawkes Bay	49,465	50,454	51,463	52,492	53,542	54,613
Taranaki	127	130	132	135	138	140
Manawatu-Wanganui	678	692	706	720	734	749
Wellington	1,300	1,326	1,353	1,380	1,407	1,435
Wairarapa	143	146	149	152	155	158
Tasman-Nelson	17,768	18,123	18,485	18,855	19,232	19,617
Marlborough	32,201	32,845	33,502	34,172	34,855	35,553
West Coast	-	-	-	-	-	-
Canterbury	2,980	3,040	3,101	3,163	3,226	3,291
Otago	14,748	15,043	15,344	15,651	15,964	16,283
Southland	-	-	-	-	-	-
NZ Total	**151,889**	**154,927**	**158,026**	**161,186**	**164,410**	**167,698**

Orchard / viticulture residues, gross energy (GJ) per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	32,964	33,623	34,296	34,982	35,681	36,395
Auckland	60,492	61,702	62,936	64,195	65,478	66,788
Waikato	20,520	20,930	21,349	21,776	22,212	22,656
Bay of Plenty	65,006	66,306	67,632	68,984	70,364	71,771
Gisborne	60,066	61,268	62,493	63,743	65,018	66,318
Hawkes Bay	364,059	371,340	378,767	386,343	394,069	401,951
Taranaki	936	955	974	993	1,013	1,033
Manawatu-Wanganui	4,992	5,092	5,194	5,298	5,404	5,512
Wellington	9,568	9,759	9,955	10,154	10,357	10,564
Wairarapa	1,052	1,074	1,095	1,117	1,139	1,162
Tasman-Nelson	130,769	133,384	136,052	138,773	141,548	144,379
Marlborough	237,000	241,740	246,575	251,506	256,536	261,667
West Coast	-	-	-	-	-	-
Canterbury	21,936	22,375	22,822	23,279	23,744	24,219
Otago	108,545	110,716	112,930	115,189	117,492	119,842
Southland	-	-	-	-	-	-
NZ Total	**1,117,905**	**1,140,263**	**1,163,068**	**1,186,330**	**1,210,056**	**1,234,257**

Orchard / viticulture residues, green tonnes per annum, recoverability level 1, 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	3,583	3,655	3,728	3,802	3,878	3,956
Auckland	6,575	6,707	6,841	6,978	7,117	7,260
Waikato	2,230	2,275	2,321	2,367	2,414	2,463
Bay of Plenty	7,066	7,207	7,351	7,498	7,648	7,801
Gisborne	6,529	6,660	6,793	6,929	7,067	7,208
Hawkes Bay	39,572	40,363	41,170	41,994	42,834	43,690
Taranaki	102	104	106	108	110	112
Manawatu-Wanganui	543	553	565	576	587	599
Wellington	1,040	1,061	1,082	1,104	1,126	1,148
Wairarapa	114	117	119	121	124	126
Tasman-Nelson	14,214	14,498	14,788	15,084	15,386	15,693
Marlborough	25,761	26,276	26,802	27,338	27,884	28,442
West Coast	-	-	-	-	-	-
Canterbury	2,384	2,432	2,481	2,530	2,581	2,633
Otago	11,798	12,034	12,275	12,521	12,771	13,026
Southland	-	-	-	-	-	-
NZ Total	**121,511**	**123,942**	**126,420**	**128,949**	**131,528**	**134,158**

Orchard / viticulture residues, energy (GJ) per annum, recoverability level 1, 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	26,371	26,899	27,437	27,985	28,545	29,116
Auckland	48,394	49,361	50,349	51,356	52,383	53,430
Waikato	16,416	16,744	17,079	17,421	17,769	18,125
Bay of Plenty	52,004	53,045	54,105	55,188	56,291	57,417
Gisborne	48,053	49,014	49,994	50,994	52,014	53,055
Hawkes Bay	291,247	297,072	303,014	309,074	315,256	321,561
Taranaki	749	764	779	795	811	827
Manawatu-Wanganui	3,994	4,073	4,155	4,238	4,323	4,409
Wellington	7,654	7,807	7,964	8,123	8,285	8,451
Wairarapa	842	859	876	894	911	930
Tasman-Nelson	104,615	106,707	108,841	111,018	113,239	115,503
Marlborough	189,600	193,392	197,260	201,205	205,229	209,334
West Coast	-	-	-	-	-	-
Canterbury	17,549	17,900	18,258	18,623	18,995	19,375
Otago	86,836	88,573	90,344	92,151	93,994	95,874
Southland	-	-	-	-	-	-
NZ Total	**894,324**	**912,210**	**930,455**	**949,064**	**968,045**	**987,406**

Orchard / viticulture residues, green tonnes per annum, recoverability level 2, 60%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	2,911	2,969	3,029	3,089	3,151	3,214
Auckland	5,342	5,449	5,558	5,669	5,783	5,898
Waikato	1,812	1,848	1,885	1,923	1,962	2,001
Bay of Plenty	5,741	5,856	5,973	6,092	6,214	6,339
Gisborne	5,305	5,411	5,519	5,629	5,742	5,857
Hawkes Bay	32,152	32,795	33,451	34,120	34,802	35,498
Taranaki	83	84	86	88	89	91
Manawatu-Wanganui	441	450	459	468	477	487
Wellington	845	862	879	897	915	933
Wairarapa	93	95	97	99	101	103
Tasman-Nelson	11,549	11,780	12,015	12,256	12,501	12,751
Marlborough	20,931	21,349	21,776	22,212	22,656	23,109
West Coast	-	-	-	-	-	-
Canterbury	1,937	1,976	2,016	2,056	2,097	2,139
Otago	9,586	9,778	9,973	10,173	10,376	10,584
Southland	-	-	-	-	-	-
NZ Total	98,728	100,703	102,717	104,771	106,866	109,004

Orchard / viticulture residues, energy (GJ) per annum, recoverability level 2, 60%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	21,427	21,855	22,292	22,738	23,193	23,657
Auckland	39,320	40,106	40,908	41,726	42,561	43,412
Waikato	13,338	13,605	13,877	14,154	14,437	14,726
Bay of Plenty	42,254	43,099	43,961	44,840	45,737	46,651
Gisborne	39,043	39,824	40,621	41,433	42,262	43,107
Hawkes Bay	236,638	241,371	246,199	251,123	256,145	261,268
Taranaki	608	621	633	646	659	672
Manawatu-Wanganui	3,245	3,310	3,376	3,443	3,512	3,583
Wellington	6,219	6,344	6,470	6,600	6,732	6,866
Wairarapa	684	698	712	726	741	755
Tasman-Nelson	85,000	86,700	88,434	90,202	92,006	93,847
Marlborough	154,050	157,131	160,274	163,479	166,749	170,084
West Coast	-	-	-	-	-	-
Canterbury	14,258	14,544	14,834	15,131	15,434	15,742
Otago	70,554	71,965	73,405	74,873	76,370	77,897
Southland	-	-	-	-	-	-
NZ Total	726,638	741,171	755,994	771,114	786,536	802,267

Appendix D – Straw and Stover residues

Straw residues, sustainable tonnage, per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	2,035	2,076	2,117	2,160	2,203	2,247
Auckland	4,481	4,570	4,662	4,755	4,850	4,947
Waikato	20,406	20,814	21,230	21,654	22,088	22,529
Bay of Plenty	11,592	11,824	12,060	12,302	12,548	12,799
Gisborne	9,820	10,016	10,217	10,421	10,629	10,842
Hawkes Bay	10,075	10,277	10,482	10,692	10,906	11,124
Taranaki	489	498	508	518	529	539
Manawatu-Wanganui	20,920	21,338	21,765	22,200	22,644	23,097
Wellington	1,862	1,899	1,937	1,976	2,015	2,056
Wairarapa	2,794	2,849	2,906	2,964	3,024	3,084
Tasman-Nelson	-	-	-	-	-	-
Marlborough	2,217	2,261	2,306	2,352	2,399	2,447
West Coast	-	-	-	-	-	-
Canterbury	287,572	293,323	299,189	305,173	311,277	317,502
Otago	28,527	29,098	29,679	30,273	30,879	31,496
Southland	18,330	18,697	19,071	19,452	19,841	20,238
NZ Total	**421,117**	**429,539**	**438,130**	**446,893**	**455,831**	**464,947**

Straw residues, sustainable energy, (GJ) per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	36,223	36,947	37,686	38,440	39,209	39,993
Auckland	79,753	81,348	82,975	84,634	86,327	88,054
Waikato	363,218	370,482	377,892	385,450	393,159	401,022
Bay of Plenty	206,338	210,464	214,674	218,967	223,346	227,813
Gisborne	174,796	178,292	181,858	185,495	189,205	192,989
Hawkes Bay	179,335	182,922	186,580	190,312	194,118	198,000
Taranaki	8,695	8,869	9,047	9,228	9,412	9,600
Manawatu-Wanganui	372,376	379,824	387,420	395,168	403,072	411,133
Wellington	33,144	33,806	34,483	35,172	35,876	36,593
Wairarapa	49,724	50,719	51,733	52,768	53,823	54,900
Tasman-Nelson	-	-	-	-	-	-
Marlborough	39,454	40,243	41,048	41,869	42,706	43,560
West Coast	-	-	-	-	-	-
Canterbury	5,118,773	5,221,148	5,325,571	5,432,083	5,540,724	5,651,539
Otago	507,781	517,936	528,295	538,861	549,638	560,631
Southland	326,274	332,799	339,455	346,245	353,169	360,233
NZ Total	7,495,883	7,645,800	7,798,716	7,954,691	8,113,784	8,276,060

Straw residues, tonnage per annum recoverability level 1, 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	1,628	1,661	1,694	1,728	1,762	1,797
Auckland	3,584	3,656	3,729	3,804	3,880	3,957
Waikato	16,324	16,651	16,984	17,324	17,670	18,023
Bay of Plenty	9,274	9,459	9,648	9,841	10,038	10,239
Gisborne	7,856	8,013	8,173	8,337	8,504	8,674
Hawkes Bay	8,060	8,221	8,386	8,553	8,724	8,899
Taranaki	391	399	407	415	423	431
Manawatu-Wanganui	16,736	17,071	17,412	17,760	18,116	18,478
Wellington	1,490	1,519	1,550	1,581	1,612	1,645
Wairarapa	2,235	2,279	2,325	2,372	2,419	2,467
Tasman-Nelson	-	-	-	-	-	-
Marlborough	1,773	1,809	1,845	1,882	1,919	1,958
West Coast	-	-	-	-	-	-
Canterbury	230,057	234,658	239,352	244,139	249,021	254,002
Otago	22,822	23,278	23,744	24,218	24,703	25,197
Southland	14,664	14,957	15,256	15,562	15,873	16,190
NZ Total	336,894	343,631	350,504	357,514	364,664	371,958

Straw residues, energy (GJ) per annum. recoverability level 1, 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	28,978	29,558	30,149	30,752	31,367	31,994
Auckland	63,802	65,078	66,380	67,708	69,062	70,443
Waikato	290,574	296,386	302,314	308,360	314,527	320,818
Bay of Plenty	165,070	168,371	171,739	175,174	178,677	182,251
Gisborne	139,837	142,634	145,486	148,396	151,364	154,391
Hawkes Bay	143,468	146,337	149,264	152,249	155,294	158,400
Taranaki	6,956	7,095	7,237	7,382	7,530	7,680
Manawatu-Wanganui	297,901	303,859	309,936	316,135	322,457	328,907
Wellington						
Wairarapa	39,779	40,575	41,387	42,214	43,059	43,920
Tasman-Nelson	-	-	-	-	-	-
Marlborough	31,563	32,194	32,838	33,495	34,165	34,848
West Coast	-	-	-	-	-	-
Canterbury	4,095,018	4,176,919	4,260,457	4,345,666	4,432,579	4,521,231
Otago	406,224	414,349	422,636	431,089	439,710	448,505
Southland	261,019	266,240	271,564	276,996	282,536	288,186
NZ Total	5,996,706	6,116,640	6,238,973	6,363,752	6,491,028	6,620,848

Straw residues, tonnage per annum recoverability level 2, 60%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	1,221	1,245	1,270	1,296	1,322	1,348
Auckland	2,688	2,742	2,797	2,853	2,910	2,968
Waikato	12,243	12,488	12,738	12,993	13,253	13,518
Bay of Plenty	6,955	7,094	7,236	7,381	7,529	7,679
Gisborne	5,892	6,010	6,130	6,253	6,378	6,505
Hawkes Bay	6,045	6,166	6,289	6,415	6,543	6,674
Taranaki	293	299	305	311	317	324
Manawatu-Wanganui	12,552	12,803	13,059	13,320	13,587	13,858
Wellington	1,117	1,140	1,162	1,186	1,209	1,233
Wairarapa	1,676	1,710	1,744	1,779	1,814	1,851
Tasman-Nelson	-	-	-	-	-	-
Marlborough	1,330	1,356	1,384	1,411	1,440	1,468
West Coast	-	-	-	-	-	-
Canterbury	172,543	175,994	179,514	183,104	186,766	190,501
Otago	17,116	17,459	17,808	18,164	18,527	18,898
Southland	10,998	11,218	11,442	11,671	11,905	12,143
NZ Total	252,670	257,724	262,878	268,136	273,498	278,968

Straw residues, energy (GJ) per annum. recoverability level 2, 60%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	21,734	22,168	22,612	23,064	23,525	23,996
Auckland	47,852	48,809	49,785	50,781	51,796	52,832
Waikato	217,931	222,289	226,735	231,270	235,895	240,613
Bay of Plenty	123,803	126,279	128,804	131,380	134,008	136,688
Gisborne	104,878	106,975	109,115	111,297	113,523	115,793
Hawkes Bay	107,601	109,753	111,948	114,187	116,471	118,800
Taranaki	5,217	5,322	5,428	5,537	5,647	5,760
Manawatu-Wanganui	223,426	227,894	232,452	237,101	241,843	246,680
Wellington						
Wairarapa	29,835	30,431	31,040	31,661	32,294	32,940
Tasman-Nelson	-	-	-	-	-	-
Marlborough	23,672	24,146	24,629	25,121	25,624	26,136
West Coast	-	-	-	-	-	-
Canterbury	3,071,264	3,132,689	3,195,343	3,259,250	3,324,435	3,390,923
Otago	304,668	310,762	316,977	323,317	329,783	336,378
Southland	195,764	199,680	203,673	207,747	211,902	216,140
NZ Total	4,497,530	4,587,480	4,679,230	4,772,814	4,868,271	4,965,636

Appendix E – Wood processing residues

Gross wood processing residues (after incumbent use) green tonnes per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	-79,356	-79,356	-79,356	-79,356	-79,356	-79,356
Auckland	17,858	17,858	17,858	17,858	17,858	17,858
Waikato	-80,919	-80,919	-80,919	-80,919	-80,919	-80,919
Bay of Plenty	-79,096	-79,096	-79,096	-79,096	-79,096	-79,096
Gisborne	8,573	8,573	8,573	8,573	8,573	8,573
Hawkes Bay	-25,516	-25,516	-25,516	-25,516	-25,516	-25,516
Taranaki	17,408	17,408	17,408	17,408	17,408	17,408
Manawatu-Wanganui	12,018	12,018	12,018	12,018	12,018	12,018
Wellington	-	-	-	-	-	-
Wairarapa	-7,037	-7,037	-7,037	-7,037	-7,037	-7,037
Tasman-Nelson	-3,321	-3,321	-3,321	-3,321	-3,321	-3,321
Marlborough	22,419	22,419	22,419	22,419	22,419	22,419
West Coast	8,245	8,245	8,245	8,245	8,245	8,245
Canterbury	-9,052	-9,052	-9,052	-9,052	-9,052	-9,052
Otago	23,228	23,228	23,228	23,228	23,228	23,228
Southland	-19,122	-19,122	-19,122	-19,122	-19,122	-19,122
NZ Total	-193,669	-193,669	-193,669	-193,669	-193,669	-193,669

The gross wood energy use for heat within the wood processing industry is 23,868,000 GJ (23.868 PJ) per annum. The apparent deficit after incumbent use is 8% and given margin of error in calculations it can basically be assumed to be in balance with some site exceptions. The wood processing industry is largely in balance and provides much of its own heat energy demand from internally generated residues.

Gross wood processing residues (after incumbent use) energy (GJ) per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	-547,556	-547,556	-547,556	-547,556	-547,556	-547,556
Auckland	123,220	123,220	123,220	123,220	123,220	123,220
Waikato	-558,341	-558,341	-558,341	-558,341	-558,341	-558,341
Bay of Plenty	-545,762	-545,762	-545,762	-545,762	-545,762	-545,762
Gisborne	59,154	59,154	59,154	59,154	59,154	59,154
Hawkes Bay	-176,060	-176,060	-176,060	-176,060	-176,060	-176,060
Taranaki	120,116	120,116	120,116	120,116	120,116	120,116
Manawatu-Wanganui	82,927	82,927	82,927	82,927	82,927	82,927
Wellington	-	-	-	-	-	-
Wairarapa	-48,555	-48,555	-48,555	-48,555	-48,555	-48,555
Tasman-Nelson	-22,915	-22,915	-22,915	-22,915	-22,915	-22,915
Marlborough	154,693	154,693	154,693	154,693	154,693	154,693
West Coast	56,891	56,891	56,891	56,891	56,891	56,891
Canterbury	-62,460	-62,460	-62,460	-62,460	-62,460	-62,460
Otago	160,274	160,274	160,274	160,274	160,274	160,274
Southland	-131,939	-131,939	-131,939	-131,939	-131,939	-131,939
NZ Total	-1,336,315	-1,336,315	-1,336,315	-1,336,315	-1,336,315	-1,336,315

Wood processing residues, green tonnes per annum, recovery level 1, 95%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	-75,388	-75,388	-75,388	-75,388	-75,388	-75,388
Auckland	16,965	16,965	16,965	16,965	16,965	16,965
Waikato	-76,873	-76,873	-76,873	-76,873	-76,873	-76,873
Bay of Plenty	-75,141	-75,141	-75,141	-75,141	-75,141	-75,141
Gisborne	8,144	8,144	8,144	8,144	8,144	8,144
Hawkes Bay	-24,240	-24,240	-24,240	-24,240	-24,240	-24,240
Taranaki	16,538	16,538	16,538	16,538	16,538	16,538
Manawatu-Wanganui	11,417	11,417	11,417	11,417	11,417	11,417
Wellington	-	-	-	-	-	-
Wairarapa	-6,685	-6,685	-6,685	-6,685	-6,685	-6,685
Tasman-Nelson	-3,155	-3,155	-3,155	-3,155	-3,155	-3,155
Marlborough	21,298	21,298	21,298	21,298	21,298	21,298
West Coast	7,833	7,833	7,833	7,833	7,833	7,833
Canterbury	-8,600	-8,600	-8,600	-8,600	-8,600	-8,600
Otago	22,067	22,067	22,067	22,067	22,067	22,067
Southland	-18,165	-18,165	-18,165	-18,165	-18,165	-18,165
NZ Total	**-183,985**	**-183,985**	**-183,985**	**-183,985**	**-183,985**	**-183,985**

Wood processing residues, energy (GJ) per annum, recovery level 1, 95%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	-520,179	-520,179	-520,179	-520,179	-520,179	-520,179
Auckland	117,059	117,059	117,059	117,059	117,059	117,059
Waikato	-530,424	-530,424	-530,424	-530,424	-530,424	-530,424
Bay of Plenty	-518,474	-518,474	-518,474	-518,474	-518,474	-518,474
Gisborne	56,196	56,196	56,196	56,196	56,196	56,196
Hawkes Bay	-167,257	-167,257	-167,257	-167,257	-167,257	-167,257
Taranaki	114,110	114,110	114,110	114,110	114,110	114,110
Manawatu-Wanganui	78,781	78,781	78,781	78,781	78,781	78,781
Wellington	-	-	-	-	-	-
Wairarapa	-46,128	-46,128	-46,128	-46,128	-46,128	-46,128
Tasman-Nelson	-21,769	-21,769	-21,769	-21,769	-21,769	-21,769
Marlborough	146,958	146,958	146,958	146,958	146,958	146,958
West Coast	54,046	54,046	54,046	54,046	54,046	54,046
Canterbury	-59,337	-59,337	-59,337	-59,337	-59,337	-59,337
Otago	152,260	152,260	152,260	152,260	152,260	152,260
Southland	-125,342	-125,342	-125,342	-125,342	-125,342	-125,342
NZ Total	**-1,269,499**	**-1,269,499**	**-1,269,499**	**-1,269,499**	**-1,269,499**	**-1,269,499**

Wood processing residues, green tonnes per annum, recovery level 2, 90%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	-71,420	-71,420	-71,420	-71,420	-71,420	-71,420
Auckland	16,072	16,072	16,072	16,072	16,072	16,072
Waikato	-72,827	-72,827	-72,827	-72,827	-72,827	-72,827
Bay of Plenty	-71,186	-71,186	-71,186	-71,186	-71,186	-71,186
Gisborne	7,716	7,716	7,716	7,716	7,716	7,716
Hawkes Bay	-22,964	-22,964	-22,964	-22,964	-22,964	-22,964
Taranaki	15,667	15,667	15,667	15,667	15,667	15,667
Manawatu-Wanganui	10,817	10,817	10,817	10,817	10,817	10,817
Wellington	-	-	-	-	-	-
Wairarapa	-6,333	-6,333	-6,333	-6,333	-6,333	-6,333
Tasman-Nelson	-2,989	-2,989	-2,989	-2,989	-2,989	-2,989
Marlborough	20,177	20,177	20,177	20,177	20,177	20,177
West Coast	7,421	7,421	7,421	7,421	7,421	7,421
Canterbury	-8,147	-8,147	-8,147	-8,147	-8,147	-8,147
Otago	20,905	20,905	20,905	20,905	20,905	20,905
Southland	-17,209	-17,209	-17,209	-17,209	-17,209	-17,209
NZ Total	**-174,302**	**-174,302**	**-174,302**	**-174,302**	**-174,302**	**-174,302**

Wood processing residues, energy (GJ) per annum, recovery level 2, 90%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	-492,801	-492,801	-492,801	-492,801	-492,801	-492,801
Auckland	110,898	110,898	110,898	110,898	110,898	110,898
Waikato	-502,507	-502,507	-502,507	-502,507	-502,507	-502,507
Bay of Plenty	-491,186	-491,186	-491,186	-491,186	-491,186	-491,186
Gisborne	53,238	53,238	53,238	53,238	53,238	53,238
Hawkes Bay	-158,454	-158,454	-158,454	-158,454	-158,454	-158,454
Taranaki	108,104	108,104	108,104	108,104	108,104	108,104
Manawatu-Wanganui	74,634	74,634	74,634	74,634	74,634	74,634
Wellington	-	-	-	-	-	-
Wairarapa	-43,700	-43,700	-43,700	-43,700	-43,700	-43,700
Tasman-Nelson	-20,623	-20,623	-20,623	-20,623	-20,623	-20,623
Marlborough	139,223	139,223	139,223	139,223	139,223	139,223
West Coast	51,201	51,201	51,201	51,201	51,201	51,201
Canterbury	-56,214	-56,214	-56,214	-56,214	-56,214	-56,214
Otago	144,246	144,246	144,246	144,246	144,246	144,246
Southland	-118,745	-118,745	-118,745	-118,745	-118,745	-118,745
NZ Total	**-1,202,684**	**-1,202,684**	**-1,202,684**	**-1,202,684**	**-1,202,684**	**-1,202,684**

Appendix F - Port bark

Gross bark supply at ports (no debarking) tonnes per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland Marsden Point	41,025	45,128	47,179	43,076	41,025	41,025
Auckland	1,651	1,816	1,898	1,733	1,651	1,651
Waikato	-	-	-	-	-	-
Bay of Plenty Tauranga	67,627	74,390	77,771	71,009	67,627	67,627
Gisborne	34,107	37,517	39,223	35,812	34,107	34,107
Hawkes Bay Napier	9,471	10,418	10,892	9,945	9,471	9,471
Taranaki New Plymouth	30,100	33,110	34,615	31,605	30,100	30,100
Manawatu-Wanganui	-	-	-	-	-	-
Wairarapa	-	-	-	-	-	-
Wellington	15,512	17,064	17,839	16,288	15,512	15,512
Tasman-Nelson Nelson	10,071	11,078	11,582	10,574	10,071	10,071
Marlborough Shakespeare Bay	9,968	10,965	11,464	10,467	9,968	9,968
West Coast	-	-	-	-	-	-
Canterbury Lyttleton	7,945	8,739	9,136	8,342	7,945	7,945
Canterbury Timaru	5,282	5,810	6,074	5,546	5,282	5,282
Otago Port Chalmers	13,261	14,587	15,250	13,924	13,261	13,261
Southland Bluff	7,233	7,956	8,318	7,594	7,233	7,233
NZ Total	**253,253**	**278,579**	**291,241**	**265,916**	**253,253**	**253,253**

Gross bark supply at ports (no debarking) energy (GJ) per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland Marsden Point	283,074	311,381	325,535	297,227	283,074	283,074
Auckland	11,390	12,529	13,099	11,960	11,390	11,390
Waikato	-	-	-	-	-	-
Bay of Plenty Tauranga	466,627	513,290	536,622	489,959	466,627	466,627
Gisborne	235,335	258,869	270,635	247,102	235,335	235,335
Hawkes Bay Napier	65,352	71,887	75,155	68,620	65,352	65,352
Taranaki New Plymouth	207,692	228,461	238,845	218,076	207,692	207,692
Manawatu-Wanganui	-	-	-	-	-	-
Wairarapa	-	-	-	-	-	-
Wellington	107,036	117,739	123,091	112,387	107,036	107,036
Tasman-Nelson Nelson	69,489	76,438	79,913	72,964	69,489	69,489
Marlborough Shakespeare Bay	68,782	75,660	79,099	72,221	68,782	68,782
West Coast	-	-	-	-	-	-
Canterbury Lyttleton	54,818	60,300	63,040	57,559	54,818	54,818
Canterbury Timaru	36,445	40,090	41,912	38,268	36,445	36,445
Otago Port Chalmers	91,502	100,652	105,227	96,077	91,502	91,502
Southland Bluff	49,906	54,896	57,392	52,401	49,906	49,906
NZ Total	**1,747,448**	**1,922,193**	**2,009,565**	**1,834,821**	**1,747,448**	**1,747,448**

Bark supply at ports, tonnes per annum, recovery level 1, 90%

	2021 - 2025	**2026 - 2030**	**2031 - 2035**	**2036 - 2040**	**2041 - 2045**	**2046 - 2050**
Northland Marsden Point	36,923	40,615	42,461	38,769	36,923	36,923
Auckland	1,486	1,634	1,709	1,560	1,486	1,486
Waikato						
Bay of Plenty Tauranga	60,864	66,951	69,994	63,908	60,864	60,864
Gisborne	30,696	33,765	35,300	32,231	30,696	30,696
Hawkes Bay Napier	8,524	9,377	9,803	8,950	8,524	8,524
Taranaki New Plymouth	27,090	29,799	31,154	28,445	27,090	27,090
Manawatu-Wanganui						
Wairarapa						
Wellington	13,961	15,357	16,055	14,659	13,961	13,961
Tasman-Nelson Nelson	9,064	9,970	10,423	9,517	9,064	9,064
Marlborough Shakespeare Bay	8,972	9,869	10,317	9,420	8,972	8,972
West Coast						
Canterbury Lyttleton	7,150	7,865	8,223	7,508	7,150	7,150
Canterbury Timaru	4,754	5,229	5,467	4,991	4,754	4,754
Otago Port Chalmers	11,935	13,129	13,725	12,532	11,935	11,935
Southland Bluff	6,509	7,160	7,486	6,835	6,509	6,509
NZ Total	**227,928**	**250,721**	**262,117**	**239,324**	**227,928**	**227,928**

Bark supply at ports, energy (GJ) per annum, recovery level 1, 90%

	2021 - 2025	**2026 - 2030**	**2031 - 2035**	**2036 - 2040**	**2041 - 2045**	**2046 - 2050**
Northland Marsden Point	254,766	280,243	292,981	267,505	254,766	254,766
Auckland	10,251	11,276	11,789	10,764	10,251	10,251
Waikato	-	-	-	-	-	-
Bay of Plenty Tauranga	419,965	461,961	482,959	440,963	419,965	419,965
Gisborne	211,802	232,982	243,572	222,392	211,802	211,802
Hawkes Bay Napier	58,817	64,699	67,639	61,758	58,817	58,817
Taranaki New Plymouth	186,923	205,615	214,961	196,269	186,923	186,923
Manawatu-Wanganui	-	-	-	-	-	-
Wairarapa	-	-	-	-	-	-
Wellington	96,332	105,965	110,782	101,149	96,332	96,332
Tasman-Nelson Nelson	62,540	68,794	71,921	65,667	62,540	62,540
Marlborough Shakespeare Bay	61,904	68,094	71,189	64,999	61,904	61,904
West Coast	-	-	-	-	-	-
Canterbury Lyttleton	49,336	54,270	56,736	51,803	49,336	49,336
Canterbury Timaru	32,801	36,081	37,721	34,441	32,801	32,801
Otago Port Chalmers	82,352	90,587	94,705	86,469	82,352	82,352
Southland Bluff	44,915	49,407	51,653	47,161	44,915	44,915
NZ Total	**1,572,703**	**1,729,974**	**1,808,609**	**1,651,339**	**1,572,703**	**1,572,703**

Bark supply at ports, tonnes per annum, recovery level 2, 80%

	2021 - 2025	**2026 - 2030**	**2031 - 2035**	**2036 - 2040**	**2041 - 2045**	**2046 - 2050**
Northland Marsden Point	32,820	36,102	37,743	34,461	32,820	32,820
Auckland	1,321	1,453	1,519	1,387	1,321	1,321
Waikato						
Bay of Plenty Tauranga	54,102	59,512	62,217	56,807	54,102	54,102
Gisborne	27,285	30,014	31,378	28,650	27,285	27,285
Hawkes Bay Napier	7,577	8,335	8,714	7,956	7,577	7,577
Taranaki New Plymouth	24,080	26,488	27,692	25,284	24,080	24,080
Manawatu-Wanganui						
Wairarapa						
Wellington	12,410	13,651	14,271	13,030	12,410	12,410
Tasman-Nelson Nelson	8,057	8,862	9,265	8,460	8,057	8,057
Marlborough Shakespeare Bay	7,975	8,772	9,171	8,373	7,975	7,975
West Coast						
Canterbury Lyttleton	6,356	6,991	7,309	6,673	6,356	6,356
Canterbury Timaru	4,226	4,648	4,859	4,437	4,226	4,226
Otago Port Chalmers	10,609	11,670	12,200	11,139	10,609	10,609
Southland Bluff	5,786	6,365	6,654	6,075	5,786	5,786
NZ Total	**202,603**	**222,863**	**232,993**	**212,733**	**202,603**	**202,603**

Bark supply at ports, energy (GJ) per annum, recovery level 2, 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland Marsden Point	226,459	249,105	260,428	237,782	226,459	226,459
Auckland	9,112	10,023	10,479	9,568	9,112	9,112
Waikato	-	-	-	-	-	-
Bay of Plenty Tauranga	373,302	410,632	429,297	391,967	373,302	373,302
Gisborne	188,268	207,095	216,508	197,682	188,268	188,268
Hawkes Bay Napier	52,282	57,510	60,124	54,896	52,282	52,282
Taranaki New Plymouth	166,153	182,769	191,076	174,461	166,153	166,153
Manawatu-Wanganui	-	-	-	-	-	-
Wairarapa	-	-	-	-	-	-
Wellington	85,628	94,191	98,473	89,910	85,628	85,628
Tasman-Nelson Nelson	55,591	61,151	63,930	58,371	55,591	55,591
Marlborough Shakespeare Bay	55,026	60,528	63,279	57,777	55,026	55,026
West Coast	-	-	-	-	-	-
Canterbury Lyttleton	43,854	48,240	50,432	46,047	43,854	43,854
Canterbury Timaru	29,156	32,072	33,530	30,614	29,156	29,156
Otago Port Chalmers	73,202	80,522	84,182	76,862	73,202	73,202
Southland Bluff	39,925	43,917	45,913	41,921	39,925	39,925
NZ Total	**1,397,959**	**1,537,754**	**1,607,652**	**1,467,856**	**1,397,959**	**1,397,959**

Appendix G – Shelterbelt turnover residuals

Shelter belt turnover residuals, Gross Volume; m^3 per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	2,100	2,100	2,100	2,100	2,100	2,100
Auckland	3,800	3,800	3,800	3,800	3,800	3,800
Waikato	9,000	9,000	9,000	9,000	9,000	9,000
Bay of Plenty	8,000	8,000	8,000	8,000	8,000	8,000
Gisborne	400	400	400	400	400	400
Hawkes Bay	5,200	5,200	5,200	5,200	5,200	5,200
Taranaki	1,900	1,900	1,900	1,900	1,900	1,900
Manawatu-Wanganui	6,600	6,600	6,600	6,600	6,600	6,600
Wellington	200	200	200	200	200	200
Wairarapa	4,000	4,000	4,000	4,000	4,000	4,000
Tasman-Nelson	700	700	700	700	700	700
Marlborough	2,400	2,400	2,400	2,400	2,400	2,400
West Coast	500	500	500	500	500	500
Canterbury	37,100	37,100	37,100	37,100	37,100	37,100
Otago	9,000	9,000	9,000	9,000	9,000	9,000
Southland	11,500	11,500	11,500	11,500	11,500	11,500
NZ Total	**102,400**	**102,400**	**102,400**	**102,400**	**102,400**	**102,400**

Shelter belt turnover residuals, Gross energy (GJ per annum)

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	14,490	14,490	14,490	14,490	14,490	14,490
Auckland	26,220	26,220	26,220	26,220	26,220	26,220
Waikato	62,100	62,100	62,100	62,100	62,100	62,100
Bay of Plenty	55,200	55,200	55,200	55,200	55,200	55,200
Gisborne	2,760	2,760	2,760	2,760	2,760	2,760
Hawkes Bay	35,880	35,880	35,880	35,880	35,880	35,880
Taranaki	13,110	13,110	13,110	13,110	13,110	13,110
Manawatu-Wanganui	45,540	45,540	45,540	45,540	45,540	45,540
Wellington	1,380	1,380	1,380	1,380	1,380	1,380
Wairarapa	27,600	27,600	27,600	27,600	27,600	27,600
Tasman-Nelson	4,830	4,830	4,830	4,830	4,830	4,830
Marlborough	16,560	16,560	16,560	16,560	16,560	16,560
West Coast	3,450	3,450	3,450	3,450	3,450	3,450
Canterbury	255,990	255,990	255,990	255,990	255,990	255,990
Otago	62,100	62,100	62,100	62,100	62,100	62,100
Southland	79,350	79,350	79,350	79,350	79,350	79,350
NZ Total	**706,560**	**706,560**	**706,560**	**706,560**	**706,560**	**706,560**

Shelter belt turnover residuals, Volume (m^3 p.a.) Recoverability Level 1 = 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	1,680	1,680	1,680	1,680	1,680	1,680
Auckland	3,040	3,040	3,040	3,040	3,040	3,040
Waikato	7,200	7,200	7,200	7,200	7,200	7,200
Bay of Plenty	6,400	6,400	6,400	6,400	6,400	6,400
Gisborne	320	320	320	320	320	320
Hawkes Bay	4,160	4,160	4,160	4,160	4,160	4,160
Taranaki	1,520	1,520	1,520	1,520	1,520	1,520
Manawatu-Wanganui	5,280	5,280	5,280	5,280	5,280	5,280
Wellington	160	160	160	160	160	160
Wairarapa	3,200	3,200	3,200	3,200	3,200	3,200
Tasman-Nelson	560	560	560	560	560	560
Marlborough	1,920	1,920	1,920	1,920	1,920	1,920
West Coast	400	400	400	400	400	400
Canterbury	29,680	29,680	29,680	29,680	29,680	29,680
Otago	7,200	7,200	7,200	7,200	7,200	7,200
Southland	9,200	9,200	9,200	9,200	9,200	9,200
NZ Total	**81,920**	**81,920**	**81,920**	**81,920**	**81,920**	**81,920**

Shelter belt turnover residuals, Energy (GJ p.a.) Recoverability Level 1 = 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	11,592	11,592	11,592	11,592	11,592	11,592
Auckland	20,976	20,976	20,976	20,976	20,976	20,976
Waikato	49,680	49,680	49,680	49,680	49,680	49,680
Bay of Plenty	44,160	44,160	44,160	44,160	44,160	44,160
Gisborne	2,208	2,208	2,208	2,208	2,208	2,208
Hawkes Bay	28,704	28,704	28,704	28,704	28,704	28,704
Taranaki	10,488	10,488	10,488	10,488	10,488	10,488
Manawatu-Wanganui	36,432	36,432	36,432	36,432	36,432	36,432
Wellington	1,104	1,104	1,104	1,104	1,104	1,104
Wairarapa	22,080	22,080	22,080	22,080	22,080	22,080
Tasman-Nelson	3,864	3,864	3,864	3,864	3,864	3,864
Marlborough	13,248	13,248	13,248	13,248	13,248	13,248
West Coast	2,760	2,760	2,760	2,760	2,760	2,760
Canterbury	204,792	204,792	204,792	204,792	204,792	204,792
Otago	49,680	49,680	49,680	49,680	49,680	49,680
Southland	63,480	63,480	63,480	63,480	63,480	63,480
NZ Total	**565,248**	**565,248**	**565,248**	**565,248**	**565,248**	**565,248**

Shelter belt turnover residuals, Volume (m^3 p.a.) Recoverability Level 2 = 60%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	1,260	1,260	1,260	1,260	1,260	1,260
Auckland	2,280	2,280	2,280	2,280	2,280	2,280
Waikato	5,400	5,400	5,400	5,400	5,400	5,400
Bay of Plenty	4,800	4,800	4,800	4,800	4,800	4,800
Gisborne	240	240	240	240	240	240
Hawkes Bay	3,120	3,120	3,120	3,120	3,120	3,120
Taranaki	1,140	1,140	1,140	1,140	1,140	1,140
Manawatu-Wanganui	3,960	3,960	3,960	3,960	3,960	3,960
Wellington	120	120	120	120	120	120
Wairarapa	2,400	2,400	2,400	2,400	2,400	2,400
Tasman-Nelson	420	420	420	420	420	420
Marlborough	1,440	1,440	1,440	1,440	1,440	1,440
West Coast	300	300	300	300	300	300
Canterbury	22,260	22,260	22,260	22,260	22,260	22,260
Otago	5,400	5,400	5,400	5,400	5,400	5,400
Southland	6,900	6,900	6,900	6,900	6,900	6,900
NZ Total	**61,440**	**61,440**	**61,440**	**61,440**	**61,440**	**61,440**

Shelter belt turnover residuals, Energy (GJ p.a.) Recoverability Level 2 = 60%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	8,694	8,694	8,694	8,694	8,694	8,694
Auckland	15,732	15,732	15,732	15,732	15,732	15,732
Waikato	37,260	37,260	37,260	37,260	37,260	37,260
Bay of Plenty	33,120	33,120	33,120	33,120	33,120	33,120
Gisborne	1,656	1,656	1,656	1,656	1,656	1,656
Hawkes Bay	21,528	21,528	21,528	21,528	21,528	21,528
Taranaki	7,866	7,866	7,866	7,866	7,866	7,866
Manawatu-Wanganui	27,324	27,324	27,324	27,324	27,324	27,324
Wellington	828	828	828	828	828	828
Wairarapa	16,560	16,560	16,560	16,560	16,560	16,560
Tasman-Nelson	2,898	2,898	2,898	2,898	2,898	2,898
Marlborough	9,936	9,936	9,936	9,936	9,936	9,936
West Coast	2,070	2,070	2,070	2,070	2,070	2,070
Canterbury	153,594	153,594	153,594	153,594	153,594	153,594
Otago	37,260	37,260	37,260	37,260	37,260	37,260
Southland	47,610	47,610	47,610	47,610	47,610	47,610
NZ Total	**423,936**	**423,936**	**423,936**	**423,936**	**423,936**	**423,936**

Appendix H – Pulp logs

Gross pulp log supply; m^3 per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	526,973	585,417	368,024	298,736	605,457	605,534
Auckland	136,921	210,909	186,203	95,045	63,704	57,991
Waikato	666,095	1,129,488	788,032	463,986	580,760	528,044
Bay of Plenty	904,502	1,593,470	1,563,852	1,271,414	1,653,081	1,467,628
Gisborne	848,493	761,767	416,129	172,084	455,225	314,689
Hawkes Bay	553,391	637,921	458,386	251,514	296,634	187,722
Taranaki	129,184	91,333	40,719	18,739	17,785	26,290
Manawatu-Wanganui	258,554	296,183	106,836	36,944	67,626	57,280
Wellington	281,919	243,016	127,443	58,709	93,434	172,976
Wairarapa	78,844	29,158	24,064	14,472	14,812	9,063
Tasman-Nelson	236,301	256,105	230,935	193,773	142,315	120,145
Marlborough	318,365	219,188	129,815	76,640	135,403	96,776
West Coast	34,364	28,811	23,808	40,752	40,691	53,151
Canterbury	314,289	292,025	184,363	174,529	177,435	138,940
Otago	376,728	370,221	268,377	348,068	396,700	277,881
Southland	217,840	221,528	162,851	286,736	304,730	163,108
NZ Total	5,882,763	6,966,540	5,079,834	3,802,139	5,045,792	4,277,220

Gross pulp log energy supply; GJ per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	3,636,111	4,039,376	2,539,367	2,061,276	4,177,654	4,178,188
Auckland	944,756	1,455,275	1,284,798	655,808	439,556	400,140
Waikato	4,596,056	7,793,466	5,437,418	3,201,507	4,007,247	3,643,507
Bay of Plenty	6,241,064	10,994,940	10,790,579	8,772,755	11,406,262	10,126,635
Gisborne	5,854,601	5,256,190	2,871,289	1,187,380	3,141,049	2,171,352
Hawkes Bay	3,818,400	4,401,655	3,162,863	1,735,446	2,046,773	1,295,283
Taranaki	891,366	630,197	280,961	129,302	122,714	181,400
Manawatu-Wanganui	1,784,020	2,043,661	737,167	254,913	466,620	395,233
Wellington	1,945,244	1,676,812	879,354	405,089	644,693	1,193,537
Wairarapa	544,026	201,191	166,041	99,854	102,200	62,537
Tasman-Nelson	1,630,474	1,767,124	1,593,450	1,337,031	981,975	829,004
Marlborough	2,196,716	1,512,395	895,723	528,813	934,278	667,753
West Coast	237,114	198,797	164,272	281,188	280,768	366,744
Canterbury	2,168,593	2,014,973	1,272,102	1,204,253	1,224,303	958,684
Otago	2,599,425	2,554,527	1,851,801	2,401,669	2,737,232	1,917,381
Southland	1,503,098	1,528,547	1,123,673	1,978,476	2,102,640	1,125,443
NZ Total	40,591,064	48,069,125	35,050,858	26,234,761	34,815,963	29,512,819

Pulp log availability after incumbents' users supplied; m^3 per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	-	-	-	-	-	-
Auckland	-	-	-	-	-	-
Waikato	-	-	-	-	-	-
Bay of Plenty	-	-	-	-	-	-
Gisborne	848,493	761,767	416,129	23,598	351,858	102,411
Hawkes Bay	-	-	-	-	-	-
Taranaki	129,184	91,333	40,719	18,739	17,785	26,290
Manawatu-Wanganui	258,554	296,183	106,836	36,944	67,626	57,280
Wellington	281,919	243,016	127,443	58,709	93,434	172,976
Wairarapa	78,844	29,158	24,064	14,472	14,812	9,063
Tasman-Nelson	-	-	-	-	-	-
Marlborough	184,665	105,293	-9,250	-99,588	-92,282	-153,079
West Coast	34,364	28,811	-36,830	-29,719	-26,874	-52,909
Canterbury	69,289	47,025	-60,637	-70,471	-67,565	-106,060
Otago	354,569	351,750	251,866	465,274	528,995	307,049
Southland	-	-	-	-	-	-
NZ Total	2,239,881	1,954,335	860,338	417,959	887,789	363,022

Pulp log energy availability after incumbents' users supplied; GJ per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	-	-	-	-	-	-
Auckland	-	-	-	-	-	-
Waikato	-	-	-	-	-	-
Bay of Plenty	-	-	-	-	-	-
Gisborne	5,854,601	5,256,190	2,871,289	162,826	2,427,822	706,635
Hawkes Bay	-	-	-	-	-	-
Taranaki	891,366	630,197	280,961	129,302	122,714	181,400
Manawatu-Wanganui	1,784,020	2,043,661	737,167	254,913	466,620	395,233
Wellington	1,945,244	1,676,812	879,354	405,089	644,693	1,193,537
Wairarapa	544,026	201,191	166,041	99,854	102,200	62,537
Tasman-Nelson	-	-	-	-	-	-
Marlborough	1,274,189	726,519	-63,828	-687,157	-636,747	-1,056,244
West Coast	237,114	198,797	-254,126	-205,058	-185,429	-365,072
Canterbury	478,093	324,473	-418,398	-486,247	-466,197	-731,816
Otago	2,446,523	2,427,073	1,737,872	3,210,392	3,650,069	2,118,640
Southland	-	-	-	-	-	-
NZ Total	15,455,177	13,484,913	5,936,333	2,883,915	6,125,745	2,504,849

Pulp log availability after incumbent supply; recoverability level 95%; m^3 per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	-	-	-	-	-	-
Auckland	-	-	-	-	-	-
Waikato	-	-	-	-	-	-
Bay of Plenty	-	-	-	-	-	-
Gisborne	806,068	723,678	395,322	22,418	334,265	97,290
Hawkes Bay	-	-	-	-	-	-
Taranaki	122,724	86,766	38,683	17,803	16,895	24,975
Manawatu-Wanganui	245,626	281,374	101,494	35,097	64,245	54,416
Wellington	267,824	230,865	121,070	55,773	88,762	164,328
Wairarapa	74,902	27,700	22,861	13,748	14,071	8,610
Tasman-Nelson	-	-	-	-	-	-
Marlborough	175,432	100,028	-8,788	-94,609	-87,668	-145,425
West Coast	32,646	27,371	-34,988	-28,233	-25,530	-50,264
Canterbury	65,824	44,674	-57,606	-66,947	-64,186	-100,757
Otago	336,840	334,162	239,272	442,010	502,546	291,697
Southland	-	-	-	-	-	-
NZ Total	2,127,887	1,856,618	817,321	397,061	843,400	344,871

Energy from pulp log availability after incumbent supply; recoverability level 95%; GJ per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	-	-	-	-	-	-
Auckland	-	-	-	-	-	-
Waikato	-	-	-	-	-	-
Bay of Plenty	-	-	-	-	-	-
Gisborne	5,561,871	4,993,380	2,727,725	154,685	2,306,431	671,303
Hawkes Bay	-	-	-	-	-	-
Taranaki	846,798	598,687	266,913	122,837	116,579	172,330
Manawatu-Wanganui	1,694,819	1,941,478	700,309	242,168	443,289	375,472
Wellington	1,847,982	1,592,971	835,386	384,834	612,458	1,133,860
Wairarapa	516,825	191,132	157,739	94,861	97,090	59,410
Tasman-Nelson	-	-	-	-	-	-
Marlborough	1,210,480	690,193	-60,636	-652,799	-604,910	-1,003,431
West Coast	225,258	188,858	-241,420	-194,805	-176,158	-346,819
Canterbury	454,188	308,249	-397,478	-461,934	-442,887	-695,226
Otago	2,324,197	2,305,720	1,650,979	3,049,872	3,467,565	2,012,708
Southland	-	-	-	-	-	-
NZ Total	14,682,418	12,810,667	5,639,516	2,739,719	5,819,458	2,379,607

Pulp log availability after incumbent supply; recoverability level 90%; m^3 per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	-	-	-	-	-	-
Auckland	-	-	-	-	-	-
Waikato	-	-	-	-	-	-
Bay of Plenty	-	-	-	-	-	-
Gisborne	763,644	685,590	374,516	21,238	316,672	92,170
Hawkes Bay	-	-	-	-	-	-
Taranaki	116,265	82,200	36,647	16,866	16,006	23,661
Manawatu-Wanganui	232,698	266,564	96,152	33,250	60,864	51,552
Wellington	253,728	218,715	114,698	52,838	84,090	155,679
Wairarapa	70,960	26,242	21,658	13,024	13,330	8,157
Tasman-Nelson	-	-	-	-	-	-
Marlborough	166,199	94,763	-8,325	-89,629	-83,054	-137,771
West Coast	30,928	25,930	-33,147	-26,747	-24,186	-47,618
Canterbury	62,360	42,323	-54,574	-63,423	-60,808	-95,454
Otago	319,112	316,575	226,679	418,747	476,096	276,344
Southland	-	-	-	-	-	-
NZ Total	2,015,893	1,758,902	774,304	376,163	799,010	326,719

Energy from pulp log availability after incumbent supply; recoverability level 90%; GJ per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	-	-	-	-	-	-
Auckland	-	-	-	-	-	-
Waikato	-	-	-	-	-	-
Bay of Plenty	-	-	-	-	-	-
Gisborne	5,269,141	4,730,571	2,584,160	146,544	2,185,039	635,972
Hawkes Bay	-	-	-	-	-	-
Taranaki	802,230	567,178	252,865	116,372	110,443	163,260
Manawatu-Wanganui	1,605,618	1,839,295	663,450	229,422	419,958	355,710
Wellington	1,750,720	1,509,131	791,418	364,580	580,223	1,074,183
Wairarapa	489,624	181,072	149,437	89,868	91,980	56,283
Tasman-Nelson	-	-	-	-	-	-
Marlborough	1,146,770	653,867	-57,445	-618,441	-573,072	-950,619
West Coast	213,402	178,918	-228,713	-184,552	-166,886	-328,565
Canterbury	430,284	292,026	-376,558	-437,622	-419,577	-658,635
Otago	2,201,871	2,184,366	1,564,085	2,889,352	3,285,062	1,906,776
Southland	-	-	-	-	-	-
NZ Total	13,909,659	12,136,422	5,342,699	2,595,523	5,513,171	2,254,364

Appendix I – Production thinnings

Gross residues from production thinnings, m^3 per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	16,264	10,329	16,256	33,777	28,989	17,403
Auckland	603	504	7,798	15,633	12,058	4,322
Waikato	2,052	1,267	14,604	27,772	26,190	13,807
Bay of Plenty	41,974	98,214	109,022	66,036	72,874	59,621
Gisborne	2,990	3,104	10,825	16,919	8,327	2,119
Hawkes Bay	5,150	7,835	26,104	32,849	12,371	2,941
Taranaki	1,241	1,058	7,945	16,024	11,114	3,218
Manawatu-Wanganui	7,904	7,168	34,114	58,490	41,311	17,671
Wellington	1,050	1,957	5,459	7,086	5,854	3,319
Wairarapa	692	183	3,970	6,493	4,328	2,315
Tasman-Nelson	506	594	6,935	10,529	6,128	2,445
Marlborough	1,413	2,041	11,754	19,019	10,956	3,064
West Coast	318	71	713	1,122	535	373
Canterbury	1,296	4,282	20,495	34,991	23,243	5,760
Otago	1,941	460	9,648	17,544	12,465	6,050
Southland	1,282	427	4,814	10,605	10,917	5,981
NZ Total	**86,675**	**139,493**	**290,458**	**374,889**	**287,658**	**150,409**

Gross energy from production thinnings, GJ per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	112,221	71,268	112,165	233,059	200,021	120,080
Auckland	4,163	3,478	53,809	107,870	83,197	29,821
Waikato	14,161	8,744	100,768	191,628	180,710	95,267
Bay of Plenty	289,618	677,675	752,255	455,647	502,832	411,382
Gisborne	20,631	21,417	74,692	116,740	57,458	14,624
Hawkes Bay	35,536	54,061	180,120	226,659	85,358	20,294
Taranaki	8,561	7,298	54,819	110,565	76,685	22,203
Manawatu-Wanganui	54,538	49,458	235,388	403,579	285,043	121,933
Wellington	7,242	13,501	37,669	48,897	40,392	22,904
Wairarapa	4,772	1,263	27,396	44,798	29,866	15,971
Tasman-Nelson	3,489	4,101	47,855	72,651	42,281	16,873
Marlborough	9,752	14,083	81,103	131,228	75,596	21,140
West Coast	2,191	487	4,917	7,745	3,694	2,571
Canterbury	8,941	29,548	141,415	241,440	160,375	39,742
Otago	13,395	3,176	66,573	121,056	86,009	41,745
Southland	8,845	2,946	33,218	73,172	75,327	41,272
NZ Total	**598,054**	**962,502**	**2,004,161**	**2,586,734**	**1,984,843**	**1,037,822**

Residues from production thinnings, m^3 per annum, recoverability level 1, 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	13,011	8,263	13,005	27,021	23,191	13,922
Auckland	483	403	6,239	12,507	9,646	3,457
Waikato	1,642	1,014	11,683	22,218	20,952	11,045
Bay of Plenty	33,579	78,571	87,218	52,829	58,299	47,696
Gisborne	2,392	2,483	8,660	13,535	6,662	1,696
Hawkes Bay	4,120	6,268	20,883	26,279	9,897	2,353
Taranaki	993	846	6,356	12,819	8,891	2,574
Manawatu-Wanganui	6,323	5,734	27,291	46,792	33,048	14,137
Wellington	840	1,565	4,367	5,669	4,683	2,656
Wairarapa	553	146	3,176	5,194	3,463	1,852
Tasman-Nelson	405	475	5,548	8,423	4,902	1,956
Marlborough	1,131	1,633	9,403	15,215	8,765	2,451
West Coast	254	56	570	898	428	298
Canterbury	1,037	3,426	16,396	27,993	18,594	4,608
Otago	1,553	368	7,719	14,035	9,972	4,840
Southland	1,025	342	3,851	8,484	8,734	4,785
NZ Total	**69,340**	**111,594**	**232,367**	**299,911**	**230,127**	**120,327**

Residues from production thinnings, energy (GJ) per annum, recoverability level 1 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	89,777	57,014	89,732	186,447	160,017	96,064
Auckland	3,330	2,782	43,047	86,296	66,558	23,857
Waikato	11,329	6,995	80,615	153,303	144,568	76,213
Bay of Plenty	231,694	542,140	601,804	364,518	402,265	329,106
Gisborne	16,505	17,133	59,754	93,392	45,966	11,699
Hawkes Bay	28,428	43,249	144,096	181,327	68,287	16,235
Taranaki	6,849	5,838	43,855	88,452	61,348	17,762
Manawatu-Wanganui	43,631	39,566	188,311	322,863	228,034	97,546
Wellington	5,793	10,801	30,135	39,117	32,313	18,324
Wairarapa	3,817	1,010	21,916	35,839	23,893	12,777
Tasman-Nelson	2,791	3,280	38,284	58,121	33,825	13,499
Marlborough	7,801	11,266	64,883	104,983	60,477	16,912
West Coast	1,753	389	3,934	6,196	2,956	2,057
Canterbury	7,153	23,639	113,132	193,152	128,300	31,794
Otago	10,716	2,540	53,258	96,845	68,807	33,396
Southland	7,076	2,356	26,575	58,538	60,261	33,018
NZ Total	**478,443**	**770,002**	**1,603,329**	**2,069,387**	**1,587,874**	**830,258**

Residues from production thinnings, m^3 per annum, recoverability level 2, 50%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	7,807	4,958	7,803	16,213	13,915	8,353
Auckland	290	242	3,743	7,504	5,788	2,074
Waikato	985	608	7,010	13,331	12,571	6,627
Bay of Plenty	20,147	47,143	52,331	31,697	34,980	28,618
Gisborne	1,435	1,490	5,196	8,121	3,997	1,017
Hawkes Bay	2,472	3,761	12,530	15,768	5,938	1,412
Taranaki	596	508	3,814	7,691	5,335	1,545
Manawatu-Wanganui	3,794	3,441	16,375	28,075	19,829	8,482
Wellington	504	939	2,620	3,401	2,810	1,593
Wairarapa	332	88	1,906	3,116	2,078	1,111
Tasman-Nelson	243	285	3,329	5,054	2,941	1,174
Marlborough	678	980	5,642	9,129	5,259	1,471
West Coast	152	34	342	539	257	179
Canterbury	622	2,056	9,838	16,796	11,157	2,765
Otago	932	221	4,631	8,421	5,983	2,904
Southland	615	205	2,311	5,090	5,240	2,871
NZ Total	**41,604**	**66,957**	**139,420**	**179,947**	**138,076**	**72,196**

Residues from production thinnings, energy (GJ) per annum, recoverability level 2, 50%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	53,866	34,208	53,839	111,868	96,010	57,638
Auckland	1,998	1,669	25,828	51,778	39,935	14,314
Waikato	6,797	4,197	48,369	91,982	86,741	45,728
Bay of Plenty	139,017	325,284	361,082	218,711	241,359	197,463
Gisborne	9,903	10,280	35,852	56,035	27,580	7,020
Hawkes Bay	17,057	25,949	86,458	108,796	40,972	9,741
Taranaki	4,109	3,503	26,313	53,071	36,809	10,657
Manawatu-Wanganui	26,178	23,740	112,986	193,718	136,821	58,528
Wellington	3,476	6,481	18,081	23,470	19,388	10,994
Wairarapa	2,290	606	13,150	21,503	14,336	7,666
Tasman-Nelson	1,675	1,968	22,970	34,873	20,295	8,099
Marlborough	4,681	6,760	38,930	62,990	36,286	10,147
West Coast	1,052	234	2,360	3,718	1,773	1,234
Canterbury	4,292	14,183	67,879	115,891	76,980	19,076
Otago	6,429	1,524	31,955	58,107	41,284	20,038
Southland	4,245	1,414	15,945	35,123	36,157	19,811
NZ Total	**287,066**	**462,001**	**961,997**	**1,241,632**	**952,724**	**498,155**

Appendix J – Waste thinnings

Gross waste thinnings biomass, odt per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	24,572	51,562	32,671	24,978	55,211	57,013
Auckland	6,366	16,828	15,781	8,851	5,670	5,197
Waikato	33,920	84,344	59,148	37,445	47,205	40,873
Bay of Plenty	39,493	121,348	110,433	93,104	125,282	90,357
Gisborne	26,542	37,626	21,075	8,524	22,655	15,843
Hawkes Bay	29,633	47,884	36,179	20,567	22,581	13,673
Taranaki	4,342	4,231	1,883	896	784	1,531
Manawatu-Wanganui	12,554	17,952	6,532	3,370	5,133	4,151
Wellington	18,348	27,194	11,820	6,330	12,218	15,693
Wairarapa	5,000	2,297	2,651	1,993	1,597	1,287
Tasman-Nelson	5,992	8,893	7,923	6,333	5,101	4,484
Marlborough	13,606	12,237	8,038	4,125	8,536	6,066
West Coast	3,273	8,481	7,949	8,636	6,453	8,606
Canterbury	22,247	31,326	19,613	8,908	11,469	12,418
Otago	22,847	30,284	23,654	11,480	21,155	20,871
Southland	16,226	24,835	17,707	8,269	10,449	13,048
NZ Total	**284,960**	**527,322**	**383,057**	**253,809**	**361,497**	**311,110**

Gross waste thinnings energy (GJ) per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	464,408	974,517	617,487	472,083	1,043,479	1,077,549
Auckland	120,309	318,042	298,256	167,276	107,159	98,216
Waikato	641,084	1,594,103	1,117,895	707,709	892,167	772,497
Bay of Plenty	746,416	2,293,477	2,087,178	1,759,661	2,367,825	1,707,748
Gisborne	501,647	711,130	398,321	161,105	428,180	299,428
Hawkes Bay	560,069	905,013	683,777	388,723	426,781	258,418
Taranaki	82,057	79,963	35,590	16,930	14,814	28,945
Manawatu-Wanganui	237,273	339,287	123,448	63,687	97,006	78,446
Wellington	346,779	513,975	223,392	119,628	230,915	296,593
Wairarapa	94,494	43,406	50,112	37,676	30,177	24,325
Tasman-Nelson	113,244	168,079	149,742	119,689	96,415	84,738
Marlborough	257,162	231,285	151,926	77,971	161,339	114,656
West Coast	61,859	160,290	150,228	163,221	121,967	162,652
Canterbury	420,475	592,071	370,681	168,364	216,757	234,706
Otago	431,803	572,369	447,067	216,973	399,829	394,460
Southland	306,671	469,376	334,669	156,293	197,478	246,601
NZ Total	**5,385,748**	**9,966,383**	**7,239,769**	**4,796,988**	**6,832,288**	**5,879,978**

Waste thinnings biomass, recoverability level 1, 50%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	12,286	25,781	16,336	12,489	27,605	28,507
Auckland	3,183	8,414	7,890	4,425	2,835	2,598
Waikato	16,960	42,172	29,574	18,722	23,602	20,436
Bay of Plenty	19,746	60,674	55,216	46,552	62,641	45,179
Gisborne	13,271	18,813	10,538	4,262	11,328	7,921
Hawkes Bay	14,817	23,942	18,089	10,284	11,291	6,836
Taranaki	2,171	2,115	942	448	392	766
Manawatu-Wanganui	6,277	8,976	3,266	1,685	2,566	2,075
Wellington	9,174	13,597	5,910	3,165	6,109	7,846
Wairarapa	2,500	1,148	1,326	997	798	644
Tasman-Nelson	2,996	4,447	3,961	3,166	2,551	2,242
Marlborough	6,803	6,119	4,019	2,063	4,268	3,033
West Coast	1,636	4,240	3,974	4,318	3,227	4,303
Canterbury	11,124	15,663	9,806	4,454	5,734	6,209
Otago	11,423	15,142	11,827	5,740	10,577	10,435
Southland	8,113	12,417	8,854	4,135	5,224	6,524
NZ Total	**142,480**	**263,661**	**191,528**	**126,904**	**180,748**	**155,555**

Waste thinnings energy (GJ) per annum, recoverability level 1, 50%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	232,204	487,258	308,744	236,042	521,739	538,774
Auckland	60,155	159,021	149,128	83,638	53,579	49,108
Waikato	320,542	797,052	558,948	353,855	446,084	386,248
Bay of Plenty	373,208	1,146,739	1,043,589	879,831	1,183,912	853,874
Gisborne	250,823	355,565	199,160	80,552	214,090	149,714
Hawkes Bay	280,035	452,506	341,889	194,361	213,391	129,209
Taranaki	41,028	39,982	17,795	8,465	7,407	14,473
Manawatu-Wanganui	118,636	169,643	61,724	31,843	48,503	39,223
Wellington	173,389	256,987	111,696	59,814	115,458	148,297
Wairarapa	47,247	21,703	25,056	18,838	15,089	12,162
Tasman-Nelson	56,622	84,040	74,871	59,845	48,207	42,369
Marlborough	128,581	115,642	75,963	38,986	80,670	57,328
West Coast	30,929	80,145	75,114	81,610	60,984	81,326
Canterbury	210,238	296,035	185,340	84,182	108,378	117,353
Otago	215,902	286,185	223,533	108,486	199,915	197,230
Southland	153,335	234,688	167,334	78,147	98,739	123,300
NZ Total	**2,692,874**	**4,983,192**	**3,619,885**	**2,398,494**	**3,416,144**	**2,939,989**

Waste thinnings biomass, recoverability level 2, 25%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	6,143	12,890	8,168	6,244	13,803	14,253
Auckland	1,591	4,207	3,945	2,213	1,417	1,299
Waikato	8,480	21,086	14,787	9,361	11,801	10,218
Bay of Plenty	9,873	30,337	27,608	23,276	31,320	22,589
Gisborne	6,636	9,406	5,269	2,131	5,664	3,961
Hawkes Bay	7,408	11,971	9,045	5,142	5,645	3,418
Taranaki	1,085	1,058	471	224	196	383
Manawatu-Wanganui	3,139	4,488	1,633	842	1,283	1,038
Wellington	4,587	6,799	2,955	1,582	3,054	3,923
Wairarapa	1,250	574	663	498	399	322
Tasman-Nelson	1,498	2,223	1,981	1,583	1,275	1,121
Marlborough	3,402	3,059	2,010	1,031	2,134	1,517
West Coast	818	2,120	1,987	2,159	1,613	2,151
Canterbury	5,562	7,832	4,903	2,227	2,867	3,105
Otago	5,712	7,571	5,914	2,870	5,289	5,218
Southland	4,056	6,209	4,427	2,067	2,612	3,262
NZ Total	**71,240**	**131,830**	**95,764**	**63,452**	**90,374**	**77,777**

Waste thinnings energy (GJ) per annum, recoverability level 2, 25%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	116,102	243,629	154,372	118,021	260,870	269,387
Auckland	30,077	79,511	74,564	41,819	26,790	24,554
Waikato	160,271	398,526	279,474	176,927	223,042	193,124
Bay of Plenty	186,604	573,369	521,794	439,915	591,956	426,937
Gisborne	125,412	177,782	99,580	40,276	107,045	74,857
Hawkes Bay	140,017	226,253	170,944	97,181	106,695	64,605
Taranaki	20,514	19,991	8,897	4,233	3,703	7,236
Manawatu-Wanganui	59,318	84,822	30,862	15,922	24,251	19,611
Wellington	86,695	128,494	55,848	29,907	57,729	74,148
Wairarapa	23,623	10,852	12,528	9,419	7,544	6,081
Tasman-Nelson	28,311	42,020	37,436	29,922	24,104	21,185
Marlborough	64,290	57,821	37,981	19,493	40,335	28,664
West Coast	15,465	40,072	37,557	40,805	30,492	40,663
Canterbury	105,119	148,018	92,670	42,091	54,189	58,676
Otago	107,951	143,092	111,767	54,243	99,957	98,615
Southland	76,668	117,344	83,667	39,073	49,369	61,650
NZ Total	**1,346,437**	**2,491,596**	**1,809,942**	**1,199,247**	**1,708,072**	**1,469,994**

Appendix K – Pruning residues

Gross pruning biomass, odt per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	477	4,476	3,751	1,024	453	477
Auckland	106	1,087	950	378	163	106
Waikato	419	4,704	4,422	1,760	321	419
Bay of Plenty	2,450	8,438	10,095	7,855	5,598	2,450
Gisborne	3,341	8,307	6,725	2,700	2,462	3,341
Hawkes Bay	2,200	7,365	6,319	3,560	2,415	2,200
Taranaki	121	1,460	996	307	129	121
Manawatu-Wanganui	395	3,825	2,703	822	342	395
Wellington	1,247	3,168	2,367	1,280	1,288	1,247
Wairarapa	28	485	294	178	64	28
Tasman-Nelson	135	1,414	745	235	152	135
Marlborough	607	2,820	1,695	737	422	607
West Coast	8	724	833	478	132	8
Canterbury	377	2,942	2,044	617	271	377
Otago	1,573	5,082	4,112	1,707	1,021	1,573
Southland	607	1,784	1,472	674	473	607
NZ Total	**14,091**	**58,079**	**49,524**	**24,310**	**15,706**	**14,091**

Gross Prunings, energy (GJ) per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	9,015	84,587	70,901	19,348	8,564	9,015
Auckland	2,002	20,538	17,961	7,141	3,085	2,002
Waikato	7,918	88,900	83,569	33,255	6,068	7,918
Bay of Plenty	46,314	159,472	190,802	148,460	105,796	46,314
Gisborne	63,153	157,005	127,103	51,034	46,525	63,153
Hawkes Bay	41,583	139,200	119,432	67,278	45,647	41,583
Taranaki	2,283	27,597	18,821	5,797	2,431	2,283
Manawatu-Wanganui	7,466	72,289	51,084	15,531	6,468	7,466
Wellington	23,564	59,882	44,738	24,183	24,351	23,564
Wairarapa	532	9,163	5,564	3,369	1,204	532
Tasman-Nelson	2,549	26,723	14,083	4,445	2,876	2,549
Marlborough	11,469	53,292	32,036	13,929	7,982	11,469
West Coast	160	13,681	15,746	9,027	2,504	160
Canterbury	7,118	55,595	38,633	11,669	5,115	7,118
Otago	29,723	96,057	77,714	32,260	19,299	29,723
Southland	11,463	33,712	27,812	12,740	8,933	11,463
NZ Total	**266,314**	**1,097,692**	**936,000**	**459,465**	**296,849**	**266,314**

Pruning biomass residues, odt per annum, recovery level 1, 50%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	238	2,238	1,876	512	227	238
Auckland	53	543	475	189	82	53
Waikato	209	2,352	2,211	880	161	209
Bay of Plenty	1,225	4,219	5,048	3,928	2,799	1,225
Gisborne	1,671	4,154	3,363	1,350	1,231	1,671
Hawkes Bay	1,100	3,683	3,160	1,780	1,208	1,100
Taranaki	60	730	498	153	64	60
Manawatu-Wanganui	198	1,912	1,351	411	171	198
Wellington	623	1,584	1,184	640	644	623
Wairarapa	14	242	147	89	32	14
Tasman-Nelson	67	707	373	118	76	67
Marlborough	303	1,410	848	368	211	303
West Coast	4	362	417	239	66	4
Canterbury	188	1,471	1,022	309	135	188
Otago	786	2,541	2,056	853	511	786
Southland	303	892	736	337	236	303
NZ Total	7,045	29,039	24,762	12,155	7,853	7,045

Pruning biomass energy (GJ) per annum, recovery level 1, 50%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	4,507	42,294	35,450	9,674	4,282	4,507
Auckland	1,001	10,269	8,981	3,570	1,543	1,001
Waikato	3,959	44,450	41,784	16,628	3,034	3,959
Bay of Plenty	23,157	79,736	95,401	74,230	52,898	23,157
Gisborne	31,577	78,503	63,551	25,517	23,263	31,577
Hawkes Bay	20,792	69,600	59,716	33,639	22,824	20,792
Taranaki	1,142	13,799	9,411	2,899	1,216	1,142
Manawatu-Wanganui	3,733	36,144	25,542	7,766	3,234	3,733
Wellington	11,782	29,941	22,369	12,092	12,175	11,782
Wairarapa	266	4,581	2,782	1,684	602	266
Tasman-Nelson	1,275	13,362	7,041	2,223	1,438	1,275
Marlborough	5,735	26,646	16,018	6,964	3,991	5,735
West Coast	80	6,840	7,873	4,513	1,252	80
Canterbury	3,559	27,797	19,316	5,834	2,558	3,559
Otago	14,861	48,029	38,857	16,130	9,650	14,861
Southland	5,732	16,856	13,906	6,370	4,466	5,732
NZ Total	133,157	548,846	468,000	229,733	148,425	133,157

Pruning biomass residues, odt per annum, recovery level 2, 25%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	119	1,119	938	256	113	119
Auckland	26	272	238	94	41	26
Waikato	105	1,176	1,105	440	80	105
Bay of Plenty	613	2,109	2,524	1,964	1,399	613
Gisborne	835	2,077	1,681	675	615	835
Hawkes Bay	550	1,841	1,580	890	604	550
Taranaki	30	365	249	77	32	30
Manawatu-Wanganui	99	956	676	205	86	99
Wellington	312	792	592	320	322	312
Wairarapa	7	121	74	45	16	7
Tasman-Nelson	34	353	186	59	38	34
Marlborough	152	705	424	184	106	152
West Coast	2	181	208	119	33	2
Canterbury	94	735	511	154	68	94
Otago	393	1,271	1,028	427	255	393
Southland	152	446	368	169	118	152
NZ Total	3,523	14,520	12,381	6,078	3,927	3,523

Pruning biomass energy (GJ) per annum, recovery level 2, 25%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	2,254	21,147	17,725	4,837	2,141	2,254
Auckland	500	5,134	4,490	1,785	771	500
Waikato	1,980	22,225	20,892	8,314	1,517	1,980
Bay of Plenty	11,579	39,868	47,701	37,115	26,449	11,579
Gisborne	15,788	39,251	31,776	12,759	11,631	15,788
Hawkes Bay	10,396	34,800	29,858	16,819	11,412	10,396
Taranaki	571	6,899	4,705	1,449	608	571
Manawatu-Wanganui	1,867	18,072	12,771	3,883	1,617	1,867
Wellington	5,891	14,970	11,185	6,046	6,088	5,891
Wairarapa	133	2,291	1,391	842	301	133
Tasman-Nelson	637	6,681	3,521	1,111	719	637
Marlborough	2,867	13,323	8,009	3,482	1,996	2,867
West Coast	40	3,420	3,936	2,257	626	40
Canterbury	1,780	13,899	9,658	2,917	1,279	1,780
Otago	7,431	24,014	19,428	8,065	4,825	7,431
Southland	2,866	8,428	6,953	3,185	2,233	2,866
NZ Total	66,578	274,423	234,000	114,866	74,212	66,578

Appendix L - In-forest residues by sub-category – Landing residues

Gross supply – in-forests residues, landings, m^3 per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	210,789	234,167	147,210	119,494	242,183	242,214
Auckland	54,768	84,364	74,481	38,018	25,482	23,197
Waikato	169,280	212,866	225,541	162,541	154,782	153,031
Bay of Plenty	458,959	876,317	715,213	531,620	738,754	645,238
Gisborne	339,397	304,707	166,452	68,834	182,090	125,875
Hawkes Bay	221,357	255,168	183,354	100,606	118,653	75,089
Taranaki	51,673	36,533	16,288	7,496	7,114	10,516
Manawatu-Wanganui	133,893	129,829	52,278	20,558	32,975	26,537
Wellington	49,325	46,314	25,744	12,050	20,824	17,077
Wairarapa	119,060	99,774	45,060	28,632	48,395	70,517
Tasman-Nelson	94,520	102,442	92,374	77,509	56,926	48,058
Marlborough	127,346	87,675	51,926	30,656	54,161	38,710
West Coast	13,746	11,524	9,523	16,301	16,276	21,261
Canterbury	125,716	116,810	73,745	69,812	70,974	55,576
Otago	150,691	148,089	107,351	139,227	158,680	111,152
Southland	87,136	88,611	65,140	114,694	121,892	65,243
NZ Total	**2,409,676**	**2,837,216**	**2,053,709**	**1,540,080**	**2,052,201**	**1,731,336**

Gross supply - in-forest residues, landings, energy (GJ) per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	1,454,444	1,615,750	1,015,747	824,510	1,671,061	1,671,275
Auckland	377,902	582,110	513,919	262,323	175,822	160,056
Waikato	1,168,034	1,468,774	1,556,232	1,121,530	1,067,999	1,055,914
Bay of Plenty	3,166,814	6,046,589	4,934,967	3,668,175	5,097,405	4,452,143
Gisborne	2,341,840	2,102,476	1,148,516	474,952	1,256,420	868,541
Hawkes Bay	1,527,360	1,760,662	1,265,145	694,179	818,709	518,113
Taranaki	356,547	252,079	112,384	51,721	49,086	72,560
Manawatu-Wanganui	923,864	895,823	360,718	141,847	227,528	183,108
Wellington	340,341	319,569	177,632	83,143	143,683	117,832
Wairarapa	821,514	688,443	310,913	197,560	333,922	486,565
Tasman-Nelson	652,189	706,850	637,380	534,812	392,790	331,601
Marlborough	878,686	604,958	358,289	211,525	373,711	267,101
West Coast	94,845	79,519	65,709	112,475	112,307	146,698
Canterbury	867,437	805,989	508,841	481,701	489,721	383,473
Otago	1,039,770	1,021,811	740,721	960,668	1,094,893	766,952
Southland	601,239	611,419	449,469	791,390	841,056	450,177
NZ Total	**16,626,766**	**19,576,792**	**14,170,589**	**10,626,554**	**14,160,189**	**11,946,220**

In-forest landing residues, volume (m^3) per annum), recoverability level 1, 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	168,631	187,333	117,768	95,595	193,746	193,771
Auckland	43,815	67,491	59,585	30,414	20,385	18,557
Waikato	135,424	170,293	180,433	130,032	123,826	122,425
Bay of Plenty	367,167	701,054	572,170	425,296	591,003	516,190
Gisborne	271,518	243,765	133,161	55,067	145,672	100,700
Hawkes Bay	177,085	204,135	146,684	80,484	94,923	60,071
Taranaki	41,339	29,227	13,030	5,997	5,691	8,413
Manawatu-Wanganui	107,115	103,864	41,822	16,446	26,380	21,230
Wellington	39,460	37,052	20,595	9,640	16,659	13,662
Wairarapa	95,248	79,819	36,048	22,906	38,716	56,413
Tasman-Nelson	75,616	81,954	73,899	62,007	45,541	38,447
Marlborough	101,877	70,140	41,541	24,525	43,329	30,968
West Coast	10,997	9,220	7,618	13,041	13,021	17,008
Canterbury	100,572	93,448	58,996	55,849	56,779	44,461
Otago	120,553	118,471	85,881	111,382	126,944	88,922
Southland	69,709	70,889	52,112	91,755	97,514	52,194
NZ Total	**1,927,741**	**2,269,773**	**1,642,967**	**1,232,064**	**1,641,761**	**1,385,069**

In-forest landing residues, energy (GJ) per annum, recoverability level 1, 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	1,163,556	1,292,600	812,597	659,608	1,336,849	1,337,020
Auckland	302,322	465,688	411,135	209,859	140,658	128,045
Waikato	934,427	1,175,019	1,244,986	897,224	854,399	844,731
Bay of Plenty	2,533,451	4,837,271	3,947,973	2,934,540	4,077,924	3,561,714
Gisborne	1,873,472	1,681,981	918,813	379,962	1,005,136	694,833
Hawkes Bay	1,221,888	1,408,530	1,012,116	555,343	654,967	414,491
Taranaki	285,237	201,663	89,908	41,377	39,269	58,048
Manawatu-Wanganui	739,091	716,658	288,575	113,477	182,023	146,486
Wellington	272,273	255,656	142,106	66,514	114,946	94,266
Wairarapa	657,212	550,754	248,731	158,048	267,138	389,252
Tasman-Nelson	521,752	565,480	509,904	427,850	314,232	265,281
Marlborough	702,949	483,966	286,631	169,220	298,969	213,681
West Coast	75,876	63,615	52,567	89,980	89,846	117,358
Canterbury	693,950	644,791	407,073	385,361	391,777	306,779
Otago	831,816	817,449	592,576	768,534	875,914	613,562
Southland	480,991	489,135	359,575	633,112	672,845	360,142
NZ Total	**13,301,413**	**15,661,434**	**11,336,471**	**8,501,243**	**11,328,152**	**9,556,976**

In-forest landing residues, volume (m^3) per annum), recoverability level 2, 65%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	137,013	152,208	95,686	77,671	157,419	157,439
Auckland	35,600	54,836	48,413	24,712	16,563	15,078
Waikato	110,032	138,363	146,602	105,651	100,609	99,470
Bay of Plenty	298,323	569,606	464,888	345,553	480,190	419,405
Gisborne	220,608	198,059	108,194	44,742	118,358	81,819
Hawkes Bay	143,882	165,859	119,180	65,394	77,125	48,808
Taranaki	33,588	23,747	10,587	4,872	4,624	6,835
Manawatu-Wanganui	87,031	84,389	33,981	13,362	21,434	17,249
Wellington	32,061	30,104	16,733	7,832	13,535	11,100
Wairarapa	77,389	64,853	29,289	18,611	31,456	45,836
Tasman-Nelson	61,438	66,587	60,043	50,381	37,002	31,238
Marlborough	82,775	56,989	33,752	19,926	35,205	25,162
West Coast	8,935	7,491	6,190	10,596	10,580	13,819
Canterbury	81,715	75,927	47,934	45,378	46,133	36,124
Otago	97,949	96,258	69,778	90,498	103,142	72,249
Southland	56,638	57,597	42,341	74,551	79,230	42,408
NZ Total	**1,566,290**	**1,844,191**	**1,334,911**	**1,001,052**	**1,333,931**	**1,125,369**

In-forest landing residues, energy (GJ) per annum, recoverability level 2, 65%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	945,389	1,050,238	660,235	535,932	1,086,190	1,086,329
Auckland	245,637	378,372	334,047	170,510	114,285	104,036
Waikato	759,222	954,703	1,011,551	728,994	694,199	686,344
Bay of Plenty	2,058,429	3,930,283	3,207,728	2,384,314	3,313,313	2,893,893
Gisborne	1,522,196	1,366,609	746,535	308,719	816,673	564,551
Hawkes Bay	992,784	1,144,430	822,344	451,216	532,161	336,774
Taranaki	231,755	163,851	73,050	33,619	31,906	47,164
Manawatu-Wanganui	600,511	582,285	234,467	92,200	147,893	119,020
Wellington	221,222	207,720	115,461	54,043	93,394	76,591
Wairarapa	533,984	447,488	202,094	128,414	217,050	316,267
Tasman-Nelson	423,923	459,452	414,297	347,628	255,313	215,541
Marlborough	571,146	393,223	232,888	137,491	242,912	173,616
West Coast	61,650	51,687	42,711	73,109	73,000	95,353
Canterbury	563,834	523,893	330,746	313,106	318,319	249,258
Otago	675,851	664,177	481,468	624,434	711,680	498,519
Southland	390,805	397,422	292,155	514,404	546,686	292,615
NZ Total	**10,807,398**	**12,724,915**	**9,210,883**	**6,907,260**	**9,204,123**	**7,765,043**

Appendix M - In-forest residues by sub-category – Cutover residues – ground-based harvest

Gross supply – in-forests residues, ground-based cutover, m^3 per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	225,558	225,595	141,492	110,391	217,189	207,435
Auckland	54,613	75,060	63,993	31,683	20,802	18,188
Waikato	138,299	163,909	176,450	120,053	111,568	112,438
Bay of Plenty	373,892	629,866	473,500	353,787	494,739	425,506
Gisborne	157,171	139,315	77,693	31,605	85,322	56,945
Hawkes Bay	143,435	163,759	118,435	64,423	77,651	49,629
Taranaki	31,497	23,460	10,705	4,854	5,093	5,852
Manawatu-Wanganui	111,319	97,716	44,110	15,334	25,021	16,523
Wellington	43,045	39,222	21,289	10,046	16,812	13,336
Wairarapa	76,361	61,088	27,813	17,096	31,562	39,700
Tasman-Nelson	35,098	30,659	24,804	19,436	15,774	12,576
Marlborough	43,316	29,718	16,059	7,608	15,585	11,111
West Coast	52,535	44,706	42,151	49,745	24,513	30,360
Canterbury	190,224	183,314	120,740	47,194	50,649	54,900
Otago	146,170	170,324	129,218	55,549	84,105	79,512
Southland	117,522	191,687	173,832	57,588	63,416	63,686
NZ Total	**1,940,056**	**2,269,397**	**1,662,283**	**996,391**	**1,339,799**	**1,197,699**

Gross supply – in-forest residues, ground-based cutover, energy (GJ) per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	1,556,349	1,556,604	976,295	761,699	1,498,601	1,431,303
Auckland	376,832	517,915	441,550	218,610	143,531	125,499
Waikato	954,260	1,130,972	1,217,502	828,365	769,820	775,823
Bay of Plenty	2,579,854	4,346,072	3,267,148	2,441,128	3,413,702	2,935,990
Gisborne	1,084,477	961,272	536,084	218,076	588,718	392,921
Hawkes Bay	989,702	1,129,936	817,205	444,517	535,794	342,441
Taranaki	217,330	161,872	73,865	33,496	35,141	40,379
Manawatu-Wanganui	768,100	674,243	304,360	105,806	172,647	114,010
Wellington	297,008	270,633	146,894	69,315	115,999	92,018
Wairarapa	526,893	421,505	191,913	117,964	217,777	273,928
Tasman-Nelson	242,178	211,546	171,149	134,107	108,843	86,774
Marlborough	298,882	205,054	110,806	52,496	107,534	76,668
West Coast	362,495	308,474	290,842	343,238	169,139	209,486
Canterbury	1,312,548	1,264,869	833,105	325,638	349,479	378,813
Otago	1,008,574	1,175,235	891,601	383,288	580,322	548,633
Southland	810,903	1,322,637	1,199,438	397,355	437,567	439,434
NZ Total	**13,386,385**	**15,658,839**	**11,469,755**	**6,875,097**	**9,244,614**	**8,264,120**

In-forests residues, ground-based cutover, m^3 per annum, recoverability level 1, 70%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	157,891	157,916	99,044	77,274	152,032	145,205
Auckland	38,229	52,542	44,795	22,178	14,561	12,732
Waikato	96,809	114,736	123,515	84,037	78,098	78,707
Bay of Plenty	261,724	440,906	331,450	247,651	346,318	297,854
Gisborne	110,019	97,520	54,385	22,124	59,725	39,862
Hawkes Bay	100,405	114,631	82,905	45,096	54,356	34,740
Taranaki	22,048	16,422	7,494	3,398	3,565	4,096
Manawatu-Wanganui	77,923	68,401	30,877	10,734	17,515	11,566
Wellington	30,131	27,456	14,902	7,032	11,768	9,335
Wairarapa	53,453	42,761	19,469	11,967	22,093	27,790
Tasman-Nelson	24,569	21,461	17,363	13,605	11,042	8,803
Marlborough	30,321	20,803	11,241	5,326	10,909	7,778
West Coast	36,775	31,294	29,506	34,821	17,159	21,252
Canterbury	133,157	128,320	84,518	33,036	35,454	38,430
Otago	102,319	119,227	90,452	38,884	58,873	55,658
Southland	82,266	134,181	121,682	40,311	44,391	44,580
NZ Total	1,358,039	1,588,578	1,163,598	697,474	937,859	838,389

In-forests residues, ground-based cutover, energy (GJ) per annum, recoverability level 1, 70%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	1,089,445	1,089,623	683,406	533,189	1,049,021	1,001,912
Auckland	263,782	362,540	309,085	153,027	100,472	87,849
Waikato	667,982	791,680	852,252	579,856	538,874	543,076
Bay of Plenty	1,805,898	3,042,250	2,287,003	1,708,790	2,389,591	2,055,193
Gisborne	759,134	672,890	375,258	152,653	412,103	275,045
Hawkes Bay	692,792	790,955	572,043	311,162	375,056	239,709
Taranaki	152,131	113,310	51,705	23,447	24,599	28,265
Manawatu-Wanganui	537,670	471,970	213,052	74,064	120,853	79,807
Wellington	207,906	189,443	102,826	48,520	81,200	64,413
Wairarapa	368,825	295,053	134,339	82,575	152,444	191,750
Tasman-Nelson	169,525	148,083	119,804	93,875	76,190	60,742
Marlborough	209,217	143,538	77,564	36,747	75,274	53,667
West Coast	253,746	215,932	203,589	240,267	118,397	146,640
Canterbury	918,784	885,409	583,174	227,947	244,636	265,169
Otago	706,002	822,664	624,121	268,302	406,225	384,043
Southland	567,632	925,846	839,606	278,148	306,297	307,604
NZ Total	9,370,470	10,961,187	8,028,828	4,812,568	6,471,230	5,784,884

In-forests residues, ground-based cutover, m^3 per annum, recoverability level 2, 55%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	145,972	103,918	74,293	68,068	124,925	123,380
Auckland	37,435	39,222	31,427	16,192	9,965	10,815
Waikato	100,394	127,492	105,343	74,567	57,298	69,058
Bay of Plenty	198,914	313,160	221,888	187,076	271,422	226,762
Gisborne	96,275	70,621	36,035	19,594	47,901	34,952
Hawkes Bay	95,542	80,368	62,125	36,983	39,790	44,441
Taranaki	21,616	9,623	4,969	2,498	3,185	4,786
Manawatu-Wanganui	71,762	53,670	20,836	7,572	20,330	13,051
Wellington	264,230	182,249	81,095	47,524	71,594	82,482
Wairarapa	97,296	66,733	30,586	20,406	29,064	35,474
Tasman-Nelson	24,370	19,590	20,073	20,058	14,660	13,971
Marlborough	31,949	17,079	9,760	7,155	15,045	13,198
West Coast	33,988	23,196	24,114	22,643	13,642	17,092
Canterbury	123,492	91,286	58,030	23,439	26,698	26,040
Otago	95,032	97,195	53,644	28,122	43,816	46,874
Southland	86,626	116,018	71,851	29,603	39,328	37,997
NZ Total	**1,524,894**	**1,411,419**	**906,068**	**611,500**	**828,664**	**800,374**

In-forests residues, ground-based cutover, energy (GJ) per annum, recoverability level 2, 55%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	1,007,207	717,034	512,624	469,667	861,982	851,322
Auckland	258,300	270,631	216,843	111,722	68,760	74,622
Waikato	692,719	879,698	726,868	514,516	395,357	476,499
Bay of Plenty	1,372,510	2,160,804	1,531,029	1,290,826	1,872,812	1,564,660
Gisborne	664,297	487,284	248,643	135,200	330,515	241,172
Hawkes Bay	659,242	554,538	428,662	255,182	274,551	306,640
Taranaki	149,149	66,402	34,283	17,237	21,973	33,024
Manawatu-Wanganui	495,155	370,321	143,770	52,250	140,280	90,054
Wellington	1,823,186	1,257,518	559,556	327,912	493,996	569,126
Wairarapa	671,341	460,456	211,045	140,800	200,545	244,773
Tasman-Nelson	168,155	135,168	138,506	138,397	101,154	96,399
Marlborough	220,450	117,845	67,342	49,370	103,811	91,064
West Coast	234,517	160,050	166,384	156,240	94,133	117,935
Canterbury	852,092	629,876	400,405	161,733	184,219	179,679
Otago	655,724	670,643	370,142	194,040	302,330	323,430
Southland	597,722	800,523	495,770	204,260	271,363	262,179
NZ Total	**10,521,766**	**9,738,792**	**6,251,871**	**4,219,350**	**5,717,783**	**5,522,578**

Appendix N - In-forest residues by sub-category – Cutover residues – hauler / cable harvest

Gross supply – in-forests residues, hauler cutover, m^3 per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	95,786	108,803	59,375	43,464	89,109	100,074
Auckland	31,867	43,798	37,340	18,487	12,138	10,613
Waikato	87,888	97,688	102,522	70,400	67,523	64,830
Bay of Plenty	296,139	448,868	426,058	294,018	444,288	397,316
Gisborne	399,164	353,815	197,316	80,267	216,690	144,622
Hawkes Bay	209,127	251,114	183,355	103,996	128,848	71,908
Taranaki	67,130	49,551	20,351	10,179	10,686	13,760
Manawatu-Wanganui	140,532	136,040	58,310	23,566	30,698	24,611
Wellington	52,598	46,084	25,584	10,495	20,645	14,228
Wairarapa	144,445	111,736	52,968	31,983	55,031	77,017
Tasman-Nelson	170,360	146,490	115,037	81,771	64,433	59,125
Marlborough	205,282	135,094	77,824	38,534	77,744	55,667
West Coast	14,983	11,244	12,822	13,468	7,528	11,158
Canterbury	126,450	127,592	71,065	30,853	33,831	36,327
Otago	208,596	220,206	175,413	78,844	123,794	112,077
Southland	35,576	57,472	52,475	16,874	18,102	18,287
NZ Total	**2,285,924**	**2,345,594**	**1,667,815**	**947,201**	**1,401,088**	**1,211,623**

Gross supply – in-forests residues, hauler cutover, energy (GJ) per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	660,927	750,739	409,684	299,904	614,849	690,510
Auckland	219,882	302,204	257,645	127,559	83,751	73,229
Waikato	606,426	674,045	707,405	485,763	465,912	447,328
Bay of Plenty	2,043,358	3,097,190	2,939,800	2,028,728	3,065,590	2,741,483
Gisborne	2,754,228	2,441,325	1,361,482	553,844	1,495,158	997,895
Hawkes Bay	1,442,978	1,732,687	1,265,146	717,569	889,048	496,167
Taranaki	463,198	341,901	140,423	70,233	73,737	94,944
Manawatu-Wanganui	969,674	938,676	402,336	162,606	211,816	169,819
Wellington	362,929	317,977	176,532	72,419	142,448	98,176
Wairarapa	996,674	770,980	365,476	220,681	379,715	531,417
Tasman-Nelson	1,175,481	1,010,778	793,758	564,217	444,590	407,965
Marlborough	1,416,444	932,147	536,985	265,888	536,433	384,101
West Coast	103,385	77,582	88,474	92,930	51,940	76,991
Canterbury	872,506	880,388	490,352	212,886	233,435	250,659
Otago	1,439,310	1,519,422	1,210,353	544,025	854,176	773,334
Southland	245,475	396,557	362,075	116,433	124,907	126,181
NZ Total	**15,772,873**	**16,184,601**	**11,507,925**	**6,535,685**	**9,667,505**	**8,360,197**

In-forests residues, hauler cutover, m^3 per annum, recoverability level 1, 10%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	9,579	10,880	5,937	4,346	8,911	10,007
Auckland	3,187	4,380	3,734	1,849	1,214	1,061
Waikato	8,789	9,769	10,252	7,040	6,752	6,483
Bay of Plenty	29,614	44,887	42,606	29,402	44,429	39,732
Gisborne	39,916	35,382	19,732	8,027	21,669	14,462
Hawkes Bay	20,913	25,111	18,335	10,400	12,885	7,191
Taranaki	6,713	4,955	2,035	1,018	1,069	1,376
Manawatu-Wanganui	14,053	13,604	5,831	2,357	3,070	2,461
Wellington	5,260	4,608	2,558	1,050	2,064	1,423
Wairarapa	14,445	11,174	5,297	3,198	5,503	7,702
Tasman-Nelson	17,036	14,649	11,504	8,177	6,443	5,913
Marlborough	20,528	13,509	7,782	3,853	7,774	5,567
West Coast	1,498	1,124	1,282	1,347	753	1,116
Canterbury	12,645	12,759	7,107	3,085	3,383	3,633
Otago	20,860	22,021	17,541	7,884	12,379	11,208
Southland	3,558	5,747	5,247	1,687	1,810	1,829
NZ Total	**228,592**	**234,559**	**166,782**	**94,720**	**140,109**	**121,162**

In-forests residues, hauler cutover, energy (GJ) per annum, recoverability level 1, 10%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	66,093	75,074	40,968	29,990	61,485	69,051
Auckland	21,988	30,220	25,764	12,756	8,375	7,323
Waikato	60,643	67,405	70,741	48,576	46,591	44,733
Bay of Plenty	204,336	309,719	293,980	202,873	306,559	274,148
Gisborne	275,423	244,132	136,148	55,384	149,516	99,790
Hawkes Bay	144,298	173,269	126,515	71,757	88,905	49,617
Taranaki	46,320	34,190	14,042	7,023	7,374	9,494
Manawatu-Wanganui	96,967	93,868	40,234	16,261	21,182	16,982
Wellington	36,293	31,798	17,653	7,242	14,245	9,818
Wairarapa	99,667	77,098	36,548	22,068	37,972	53,142
Tasman-Nelson	117,548	101,078	79,376	56,422	44,459	40,796
Marlborough	141,644	93,215	53,698	26,589	53,643	38,410
West Coast	10,339	7,758	8,847	9,293	5,194	7,699
Canterbury	87,251	88,039	49,035	21,289	23,344	25,066
Otago	143,931	151,942	121,035	54,403	85,418	77,333
Southland	24,547	39,656	36,207	11,643	12,491	12,618
NZ Total	**1,577,287**	**1,618,460**	**1,150,792**	**653,569**	**966,750**	**836,020**

In-forests residues, hauler cutover, m^3 per annum, recoverability level 2, 5%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	4,789	5,440	2,969	2,173	4,455	5,004
Auckland	1,593	2,190	1,867	924	607	531
Waikato	4,394	4,884	5,126	3,520	3,376	3,242
Bay of Plenty	14,807	22,443	21,303	14,701	22,214	19,866
Gisborne	19,958	17,691	9,866	4,013	10,834	7,231
Hawkes Bay	10,456	12,556	9,168	5,200	6,442	3,595
Taranaki	3,357	2,478	1,018	509	534	688
Manawatu-Wanganui	7,027	6,802	2,915	1,178	1,535	1,231
Wellington	2,630	2,304	1,279	525	1,032	711
Wairarapa	7,222	5,587	2,648	1,599	2,752	3,851
Tasman-Nelson	8,518	7,324	5,752	4,089	3,222	2,956
Marlborough	10,264	6,755	3,891	1,927	3,887	2,783
West Coast	749	562	641	673	376	558
Canterbury	6,323	6,380	3,553	1,543	1,692	1,816
Otago	10,430	11,010	8,771	3,942	6,190	5,604
Southland	1,779	2,874	2,624	844	905	914
NZ Total	**114,296**	**117,280**	**83,391**	**47,360**	**70,054**	**60,581**

In-forests residues, hauler cutover, energy (GJ) per annum, recoverability level 2, 5%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	33,046	37,537	20,484	14,995	30,742	34,526
Auckland	10,994	15,110	12,882	6,378	4,188	3,661
Waikato	30,321	33,702	35,370	24,288	23,296	22,366
Bay of Plenty	102,168	154,860	146,990	101,436	153,280	137,074
Gisborne	137,711	122,066	68,074	27,692	74,758	49,895
Hawkes Bay	72,149	86,634	63,257	35,878	44,452	24,808
Taranaki	23,160	17,095	7,021	3,512	3,687	4,747
Manawatu-Wanganui	48,484	46,934	20,117	8,130	10,591	8,491
Wellington	18,146	15,899	8,827	3,621	7,122	4,909
Wairarapa	49,834	38,549	18,274	11,034	18,986	26,571
Tasman-Nelson	58,774	50,539	39,688	28,211	22,229	20,398
Marlborough	70,822	46,607	26,849	13,294	26,822	19,205
West Coast	5,169	3,879	4,424	4,647	2,597	3,850
Canterbury	43,625	44,019	24,518	10,644	11,672	12,533
Otago	71,965	75,971	60,518	27,201	42,709	38,667
Southland	12,274	19,828	18,104	5,822	6,245	6,309
NZ Total	**788,644**	**809,230**	**575,396**	**326,784**	**483,375**	**418,010**

Appendix O – Sawmill chip

Sawmill chip is a by-product of the production of sawn lumber and is generally regarded as a by-product not a residue. The sale of chip is a small but important part of a sawmill's income. Typically, this material is sold to other wood processing industries; pulp, paper, MDF, particle board etc. The price is estimated at $70 per green tonne ex- the sawmill. Some sawmill chip is sold for fuel and other uses and so it could be considered as a potential fuel feedstock at the current price.

Gross supply of sawmill chip, green tonnes per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	103,740	103,740	103,740	103,740	103,740	103,740
Auckland	48,750	48,750	48,750	48,750	48,750	48,750
Waikato	260,420	260,420	260,420	260,420	260,420	260,420
Bay of Plenty	615,740	615,740	615,740	615,740	615,740	615,740
Gisborne	27,520	27,520	27,520	27,520	27,520	27,520
Hawkes Bay	372,080	372,080	372,080	372,080	372,080	372,080
Taranaki	29,170	29,170	29,170	29,170	29,170	29,170
Manawatu-Wanganui	27,170	27,170	27,170	27,170	27,170	27,170
Wellington						
Wairarapa	56,350	56,350	56,350	56,350	56,350	56,350
Tasman-Nelson	187,920	187,920	187,920	187,920	187,920	187,920
Marlborough	56,790	56,790	56,790	56,790	56,790	56,790
West Coast	28,200	28,200	28,200	28,200	28,200	28,200
Canterbury	107,625	107,625	107,625	107,625	107,625	107,625
Otago	46,860	46,860	46,860	46,860	46,860	46,860
Southland	282,460	282,460	282,460	282,460	282,460	282,460
NZ Total	**2,250,795**	**2,250,795**	**2,250,795**	**2,250,795**	**2,250,795**	**2,250,795**

Sawmill chip, gross energy (GJ per annum)

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	715,806	715,806	715,806	715,806	715,806	715,806
Auckland	336,375	336,375	336,375	336,375	336,375	336,375
Waikato	1,796,898	1,796,898	1,796,898	1,796,898	1,796,898	1,796,898
Bay of Plenty	4,248,606	4,248,606	4,248,606	4,248,606	4,248,606	4,248,606
Gisborne	189,888	189,888	189,888	189,888	189,888	189,888
Hawkes Bay	2,567,352	2,567,352	2,567,352	2,567,352	2,567,352	2,567,352
Taranaki	201,273	201,273	201,273	201,273	201,273	201,273
Manawatu-Wanganui	187,473	187,473	187,473	187,473	187,473	187,473
Wellington	-	-	-	-	-	-
Wairarapa	388,815	388,815	388,815	388,815	388,815	388,815
Tasman-Nelson	1,296,648	1,296,648	1,296,648	1,296,648	1,296,648	1,296,648
Marlborough	391,851	391,851	391,851	391,851	391,851	391,851
West Coast	194,580	194,580	194,580	194,580	194,580	194,580
Canterbury	742,613	742,613	742,613	742,613	742,613	742,613
Otago	323,334	323,334	323,334	323,334	323,334	323,334
Southland	1,948,974	1,948,974	1,948,974	1,948,974	1,948,974	1,948,974
NZ Total	**15,530,486**	**15,530,486**	**15,530,486**	**15,530,486**	**15,530,486**	**15,530,486**

Sawmill chip volume (tonnes per annum) recovery level 1, 75%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	77,805	77,805	77,805	77,805	77,805	77,805
Auckland	36,563	36,563	36,563	36,563	36,563	36,563
Waikato	195,315	195,315	195,315	195,315	195,315	195,315
Bay of Plenty	461,805	461,805	461,805	461,805	461,805	461,805
Gisborne	20,640	20,640	20,640	20,640	20,640	20,640
Hawkes Bay	279,060	279,060	279,060	279,060	279,060	279,060
Taranaki	21,878	21,878	21,878	21,878	21,878	21,878
Manawatu-Wanganui	20,378	20,378	20,378	20,378	20,378	20,378
Wellington	-	-	-	-	-	-
Wairarapa	42,263	42,263	42,263	42,263	42,263	42,263
Tasman-Nelson	140,940	140,940	140,940	140,940	140,940	140,940
Marlborough	42,593	42,593	42,593	42,593	42,593	42,593
West Coast	21,150	21,150	21,150	21,150	21,150	21,150
Canterbury	80,719	80,719	80,719	80,719	80,719	80,719
Otago	35,145	35,145	35,145	35,145	35,145	35,145
Southland	211,845	211,845	211,845	211,845	211,845	211,845
NZ Total	**1,688,096**	**1,688,096**	**1,688,096**	**1,688,096**	**,688,096**	**1,688,096**

Sawmill chip, energy (GJ per annum) recovery level 1, 75%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	536,855	536,855	536,855	536,855	536,855	536,855
Auckland	252,281	252,281	252,281	252,281	252,281	252,281
Waikato	1,347,674	1,347,674	1,347,674	1,347,674	1,347,674	1,347,674
Bay of Plenty	3,186,455	3,186,455	3,186,455	3,186,455	3,186,455	3,186,455
Gisborne	142,416	142,416	142,416	142,416	142,416	142,416
Hawkes Bay	1,925,514	1,925,514	1,925,514	1,925,514	1,925,514	1,925,514
Taranaki	150,955	150,955	150,955	150,955	150,955	150,955
Manawatu-Wanganui	140,605	140,605	140,605	140,605	140,605	140,605
Wellington	-	-	-	-	-	-
Wairarapa	291,611	291,611	291,611	291,611	291,611	291,611
Tasman-Nelson	972,486	972,486	972,486	972,486	972,486	972,486
Marlborough	293,888	293,888	293,888	293,888	293,888	293,888
West Coast	145,935	145,935	145,935	145,935	145,935	145,935
Canterbury	556,959	556,959	556,959	556,959	556,959	556,959
Otago	242,501	242,501	242,501	242,501	242,501	242,501
Southland	1,461,731	1,461,731	1,461,731	1,461,731	1,461,731	1,461,731
NZ Total	**11,647,864**	**11,647,864**	**11,647,864**	**11,647,864**	**11,647,864**	**11,647,864**

Sawmill chip volume (tonnes per annum) recovery level 2, 50%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	51,870	51,870	51,870	51,870	51,870	51,870
Auckland	24,375	24,375	24,375	24,375	24,375	24,375
Waikato	130,210	130,210	130,210	130,210	130,210	130,210
Bay of Plenty	307,870	307,870	307,870	307,870	307,870	307,870
Gisborne	13,760	13,760	13,760	13,760	13,760	13,760
Hawkes Bay	186,040	186,040	186,040	186,040	186,040	186,040
Taranaki	14,585	14,585	14,585	14,585	14,585	14,585
Manawatu-Wanganui	13,585	13,585	13,585	13,585	13,585	13,585
Wellington	-	-	-	-	-	-
Wairarapa	28,175	28,175	28,175	28,175	28,175	28,175
Tasman-Nelson	93,960	93,960	93,960	93,960	93,960	93,960
Marlborough	28,395	28,395	28,395	28,395	28,395	28,395
West Coast	14,100	14,100	14,100	14,100	14,100	14,100
Canterbury	53,813	53,813	53,813	53,813	53,813	53,813
Otago	23,430	23,430	23,430	23,430	23,430	23,430
Southland	141,230	141,230	141,230	141,230	141,230	141,230
NZ Total	**1,125,398**	**1,125,398**	**1,125,398**	**1,125,398**	**,125,398**	**1,125,398**

Sawmill chip, energy (GJ per annum) recovery level 2, 50%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	357,903	357,903	357,903	357,903	357,903	357,903
Auckland	168,188	168,188	168,188	168,188	168,188	168,188
Waikato	898,449	898,449	898,449	898,449	898,449	898,449
Bay of Plenty	2,124,303	2,124,303	2,124,303	2,124,303	2,124,303	2,124,303
Gisborne	94,944	94,944	94,944	94,944	94,944	94,944
Hawkes Bay	1,283,676	1,283,676	1,283,676	1,283,676	1,283,676	1,283,676
Taranaki	100,637	100,637	100,637	100,637	100,637	100,637
Manawatu-Wanganui	93,737	93,737	93,737	93,737	93,737	93,737
Wellington	-	-	-	-	-	-
Wairarapa	194,408	194,408	194,408	194,408	194,408	194,408
Tasman-Nelson	648,324	648,324	648,324	648,324	648,324	648,324
Marlborough	195,926	195,926	195,926	195,926	195,926	195,926
West Coast	97,290	97,290	97,290	97,290	97,290	97,290
Canterbury	371,306	371,306	371,306	371,306	371,306	371,306
Otago	161,667	161,667	161,667	161,667	161,667	161,667
Southland	974,487	974,487	974,487	974,487	974,487	974,487
NZ Total	**7,765,243**	**7,765,243**	**7,765,243**	**7,765,243**	**7,765,243**	**7,765,243**

Appendix P – K grade logs

Gross supply of K grade logs, green tonnes per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	929,461	827,362	576,494	781,876	1,045,179	941,897
Auckland	285,172	345,714	244,873	137,258	103,031	150,103
Waikato	695,483	1,054,480	876,461	436,311	402,771	483,925
Bay of Plenty	1,813,038	2,205,038	1,761,837	1,909,069	2,113,802	1,574,569
Gisborne	1,007,315	768,180	376,315	395,748	489,527	709,229
Hawkes Bay	1,065,838	998,389	640,652	488,861	434,230	653,470
Taranaki	159,750	100,200	41,269	23,295	30,597	108,121
Manawatu-Wanganui	344,091	119,507	51,282	84,772	92,552	283,645
Wellington	84,342	43,860	31,746	23,956	19,458	67,730
Wairarapa	463,960	331,775	177,817	140,053	230,737	400,686
Tasman-Nelson	304,934	313,895	262,530	206,448	173,347	220,468
Marlborough	368,113	247,291	138,661	141,757	163,758	281,485
West Coast	28,430	34,566	35,134	32,333	32,086	28,751
Canterbury	506,324	406,482	214,396	147,223	179,727	346,742
Otago	699,860	622,265	392,091	354,093	446,219	561,812
Southland	401,934	392,290	239,819	154,732	188,756	283,487
NZ Total	**9,158,045**	**8,811,295**	**6,061,377**	**5,457,785**	**6,145,778**	**7,096,119**

K grade logs, gross energy (GJ per annum)

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	6,413,284	5,708,796	3,977,811	5,394,944	7,211,735	6,499,088
Auckland	1,967,685	2,385,430	1,689,622	947,082	710,916	1,035,712
Waikato	4,798,835	7,275,910	6,047,578	3,010,543	2,779,122	3,339,082
Bay of Plenty	12,509,959	15,214,764	12,156,676	13,172,577	14,585,235	10,864,529
Gisborne	6,950,474	5,300,445	2,596,577	2,730,661	3,377,737	4,893,682
Hawkes Bay	7,354,283	6,888,884	4,420,500	3,373,142	2,996,189	4,508,945
Taranaki	1,102,273	691,380	284,756	160,737	211,119	746,032
Manawatu-Wanganui	2,374,227	824,601	353,845	584,926	638,608	1,957,153
Wellington	581,958	302,636	219,048	165,298	134,261	467,334
Wairarapa	3,201,325	2,289,247	1,226,937	966,364	1,592,085	2,764,735
Tasman-Nelson	2,104,048	2,165,875	1,811,457	1,424,493	1,196,093	1,521,229
Marlborough	2,539,978	1,706,306	956,763	978,121	1,129,929	1,942,244
West Coast	196,168	238,507	242,421	223,096	221,396	198,382
Canterbury	3,493,637	2,804,727	1,479,333	1,015,839	1,240,113	2,392,517
Otago	4,829,031	4,293,627	2,705,426	2,443,242	3,078,911	3,876,500
Southland	2,773,342	2,706,798	1,654,752	1,067,654	1,302,417	1,956,059
NZ Total	**63,190,508**	**60,797,934**	**41,823,502**	**37,658,719**	**42,405,866**	**48,963,223**

K grade logs volume (tonnes per annum) recovery level 1, 75%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	697,096	620,521	432,371	586,407	783,884	706,423
Auckland	213,879	259,286	183,655	102,944	77,274	112,577
Waikato	521,613	790,860	657,345	327,233	302,078	362,944
Bay of Plenty	1,359,778	1,653,779	1,321,378	1,431,802	1,585,352	1,180,927
Gisborne	755,486	576,135	282,237	296,811	367,145	531,922
Hawkes Bay	799,379	748,792	480,489	366,646	325,673	490,103
Taranaki	119,812	75,150	30,952	17,471	22,948	81,090
Manawatu-Wanganui	258,068	89,631	38,461	63,579	69,414	212,734
Wellington	63,256	32,895	23,810	17,967	14,594	50,797
Wairarapa	347,970	248,831	133,363	105,040	173,053	300,515
Tasman-Nelson	228,701	235,421	196,897	154,836	130,010	165,351
Marlborough	276,085	185,468	103,996	106,317	122,818	211,113
West Coast	21,323	25,925	26,350	24,250	24,065	21,563
Canterbury	379,743	304,862	160,797	110,417	134,795	260,056
Otago	524,895	466,699	294,068	265,570	334,664	421,359
Southland	301,450	294,217	179,864	116,049	141,567	212,615
NZ Total	**6,868,534**	**6,608,471**	**4,546,033**	**4,093,339**	**4,609,333**	**5,322,089**

K grade logs, energy (GJ per annum) recovery level 1, 75%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	4,809,963	4,281,597	2,983,358	4,046,208	5,408,801	4,874,316
Auckland	1,475,764	1,789,072	1,267,217	710,312	533,187	776,784
Waikato	3,599,126	5,456,932	4,535,683	2,257,907	2,084,341	2,504,312
Bay of Plenty	9,382,470	11,411,073	9,117,507	9,879,433	10,938,926	8,148,397
Gisborne	5,212,856	3,975,333	1,947,432	2,047,996	2,533,303	3,670,261
Hawkes Bay	5,515,712	5,166,663	3,315,375	2,529,856	2,247,142	3,381,709
Taranaki	826,704	518,535	213,567	120,553	158,340	559,524
Manawatu-Wanganui	1,780,671	618,451	265,384	438,694	478,956	1,467,865
Wellington	436,469	226,977	164,286	123,973	100,696	350,501
Wairarapa	2,400,994	1,716,936	920,203	724,773	1,194,063	2,073,551
Tasman-Nelson	1,578,036	1,624,407	1,358,592	1,068,370	897,070	1,140,922
Marlborough	1,904,984	1,279,729	717,572	733,591	847,447	1,456,683
West Coast	147,126	178,880	181,816	167,322	166,047	148,786
Canterbury	2,620,228	2,103,545	1,109,500	761,879	930,085	1,794,388
Otago	3,621,773	3,220,220	2,029,070	1,832,431	2,309,183	2,907,375
Southland	2,080,007	2,030,099	1,241,064	800,740	976,813	1,467,044
NZ Total	**47,392,881**	**45,598,451**	**31,367,626**	**28,244,039**	**31,804,399**	**36,722,417**

K grade logs volume (tonnes per annum) recovery level 2, 50%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	464,731	413,681	288,247	390,938	522,589	470,948
Auckland	142,586	172,857	122,436	68,629	51,516	75,052
Waikato	347,742	527,240	438,230	218,155	201,386	241,962
Bay of Plenty	906,519	1,102,519	880,919	954,535	1,056,901	787,285
Gisborne	503,658	384,090	188,158	197,874	244,764	354,615
Hawkes Bay	532,919	499,195	320,326	244,431	217,115	326,735
Taranaki	79,875	50,100	20,635	11,648	15,299	54,060
Manawatu-Wanganui	172,045	59,754	25,641	42,386	46,276	141,823
Wellington	42,171	21,930	15,873	11,978	9,729	33,865
Wairarapa	231,980	165,887	88,908	70,026	115,368	200,343
Tasman-Nelson	152,467	156,947	131,265	103,224	86,673	110,234
Marlborough	184,056	123,645	69,331	70,878	81,879	140,742
West Coast	14,215	17,283	17,567	16,166	16,043	14,375
Canterbury	253,162	203,241	107,198	73,612	89,863	173,371
Otago	349,930	311,132	196,045	177,047	223,109	280,906
Southland	200,967	196,145	119,910	77,366	94,378	141,743
NZ Total	**4,579,022**	**4,405,647**	**3,030,689**	**2,728,893**	**3,072,889**	**3,548,060**

K grade logs, energy (GJ per annum) recovery level 2, 50%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	2046 - 2050
Northland	3,206,642	2,854,398	1,988,905	2,697,472	3,605,867	3,249,544
Auckland	983,843	1,192,715	844,811	473,541	355,458	517,856
Waikato	2,399,418	3,637,955	3,023,789	1,505,271	1,389,561	1,669,541
Bay of Plenty	6,254,980	7,607,382	6,078,338	6,586,288	7,292,617	5,432,264
Gisborne	3,475,237	2,650,222	1,298,288	1,365,331	1,688,868	2,446,841
Hawkes Bay	3,677,141	3,444,442	2,210,250	1,686,571	1,498,095	2,254,473
Taranaki	551,136	345,690	142,378	80,369	105,560	373,016
Manawatu-Wanganui	1,187,114	412,301	176,922	292,463	319,304	978,576
Wellington	290,979	151,318	109,524	82,649	67,131	233,667
Wairarapa	1,600,662	1,144,624	613,469	483,182	796,042	1,382,368
Tasman-Nelson	1,052,024	1,082,938	905,728	712,247	598,047	760,615
Marlborough	1,269,989	853,153	478,382	489,060	564,965	971,122
West Coast	98,084	119,254	121,211	111,548	110,698	99,191
Canterbury	1,746,818	1,402,364	739,666	507,919	620,057	1,196,259
Otago	2,414,516	2,146,813	1,352,713	1,221,621	1,539,455	1,938,250
Southland	1,386,671	1,353,399	827,376	533,827	651,209	978,030
NZ Total	**31,595,254**	**30,398,967**	**20,911,751**	**18,829,359**	**21,202,933**	**24,481,612**

Appendix Q – Douglas-fir production thinnings

Gross supply of Douglas-fir production thinnings, green tonnes per annum

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040
Northland	0	0	40	0
Auckland	0	0	120	0
Waikato	5,580	5,280	1,300	40
Bay of Plenty	44,400	44,720	52,460	45,020
Gisborne	10,380	7,600	20	20
Hawkes Bay	1,260	2,780	500	200
Taranaki	40	0	0	0
Manawatu-Wanganui	960	1,680	240	380
Wairarapa	640	640	80	20
Wellington	160	120	20	60
Tasman-Nelson	12,600	30,360	23,220	22,320
Marlborough	640	10,340	760	5,520
West Coast	8,820	1,460	160	40
Canterbury	102,700	98,340	19,420	16,112
Otago	166,320	200,300	23,800	39,430
Southland	193,240	184,540	5,040	6,120
NZ Total	**547,740**	**588,140**	**127,180**	**135,622**

Douglas-fir production thinnings, gross energy (GJ per annum)

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040
Northland	0	0	276	0
Auckland	0	0	828	0
Waikato	38,502	36,432	8,970	276
Bay of Plenty	306,360	308,568	361,974	310,638
Gisborne	71,622	52,440	138	138
Hawkes Bay	8,694	19,182	3,450	1,380
Taranaki	276	0	0	0
Manawatu-Wanganui	6,624	11,592	1,656	2,622
Wairarapa	4,416	4,416	552	138
Wellington	1,104	828	138	414
Tasman-Nelson	86,940	209,484	160,218	154,008
Marlborough	4,416	71,346	5,244	38,088
West Coast	60,858	10,074	1,104	276
Canterbury	708,630	678,546	133,998	111,173
Otago	1,147,608	1,382,070	164,220	272,067
Southland	1,333,356	1,273,326	34,776	42,228
NZ Total	**3,779,406**	**4,058,166**	**877,542**	**935,792**

Douglas-fir production thinnings volume (tonnes per annum) recovery level 1, 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040
Northland	-	-	34	-
Auckland	-	-	102	-
Waikato	4,743	4,488	1,105	34
Bay of Plenty	37,740	38,012	44,591	38,267
Gisborne	8,823	6,460	17	17
Hawkes Bay	1,071	2,363	425	170
Taranaki	34	-	-	-
Manawatu-Wanganui	816	1,428	204	323
Wairarapa	544	544	68	17
Wellington	136	102	17	51
Tasman-Nelson	10,710	25,806	19,737	18,972
Marlborough	544	8,789	646	4,692
West Coast	7,497	1,241	136	34
Canterbury	87,295	83,589	16,507	13,695
Otago	141,372	170,255	20,230	33,516
Southland	164,254	156,859	4,284	5,202
NZ Total	**465,579**	**499,919**	**108,103**	**115,279**

Douglas-fir production thinnings, energy (GJ per annum) recovery level 1, 80%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040
Northland	-	-	235	-
Auckland	-	-	704	-
Waikato	32,727	30,967	7,625	235
Bay of Plenty	260,406	262,283	307,678	264,042
Gisborne	60,879	44,574	117	117
Hawkes Bay	7,390	16,305	2,933	1,173
Taranaki	235	-	-	-
Manawatu-Wanganui	5,630	9,853	1,408	2,229
Wairarapa	3,754	3,754	469	117
Wellington	938	704	117	352
Tasman-Nelson	73,899	178,061	136,185	130,907
Marlborough	3,754	60,644	4,457	32,375
West Coast	51,729	8,563	938	235
Canterbury	602,336	576,764	113,898	94,497
Otago	975,467	1,174,760	139,587	231,257
Southland	1,133,353	1,082,327	29,560	35,894
NZ Total	**3,212,495**	**3,449,441**	**745,911**	**795,423**

Douglas-fir production thinnings volume (tonnes per annum) recovery level 2, 50%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040
Northland	0	0	20	0
Auckland	0	0	60	0
Waikato	2,790	2,640	650	20
Bay of Plenty	22,200	22,360	26,230	22,510
Gisborne	5,190	3,800	10	10
Hawkes Bay	630	1,390	250	100
Taranaki	20	0	0	0
Manawatu-Wanganui	480	840	120	190
Wairarapa	320	320	40	10
Wellington	80	60	10	30
Tasman-Nelson	6,300	15,180	11,610	11,160
Marlborough	320	5,170	380	2,760
West Coast	4,410	730	80	20
Canterbury	51,350	49,170	9,710	8,056
Otago	83,160	100,150	11,900	19,715
Southland	96,620	92,270	2,520	3,060
NZ Total	**273,870**	**294,070**	**63,590**	**67,811**

Douglas-fir production thinnings, energy (GJ per annum) recovery level 2, 50%

	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040
Northland	0	0	138	0
Auckland	0	0	414	0
Waikato	19,251	18,216	4,485	138
Bay of Plenty	153,180	154,284	180,987	155,319
Gisborne	35,811	26,220	69	69
Hawkes Bay	4,347	9,591	1,725	690
Taranaki	138	0	0	0
Manawatu-Wanganui	3,312	5,796	828	1,311
Wairarapa	2,208	2,208	276	69
Wellington	552	414	69	207
Tasman-Nelson	43,470	104,742	80,109	77,004
Marlborough	2,208	35,673	2,622	19,044
West Coast	30,429	5,037	552	138
Canterbury	354,315	339,273	66,999	55,586
Otago	573,804	691,035	82,110	136,034
Southland	666,678	636,663	17,388	21,114
NZ Total	**1,889,703**	**2,029,083**	**438,771**	**467,896**

Appendix R – National level cost supply curve ($s per tonne and tonnage per annum)