

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

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## Report information sheet

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# 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 2017 to 2042 (25 years). The estimated costs of supply are included.

## Approach

The 5 key resources; in-forest residues, municipal wood waste, wood processing residues, orchard residues and straws / stover from arable cropping are described in terms of gross volumes (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, landing, flat to rolling cutover and steep cutover.

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 2017 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.

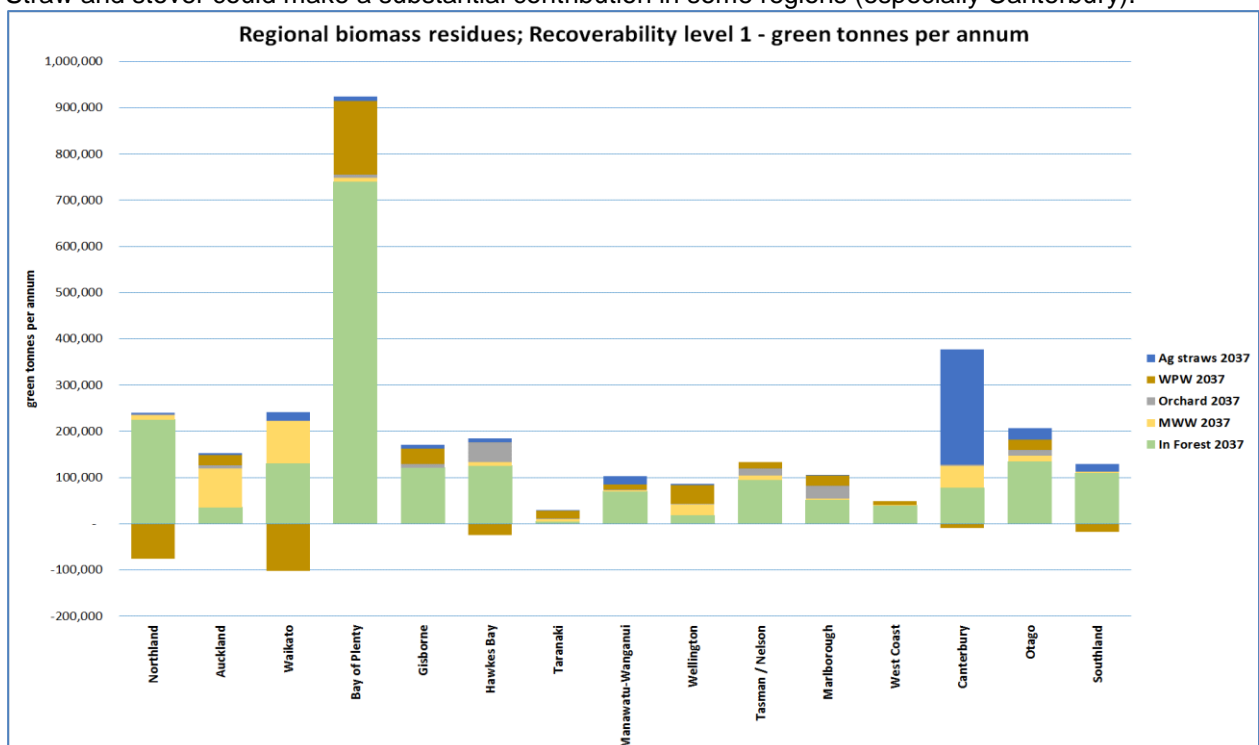
## Key results

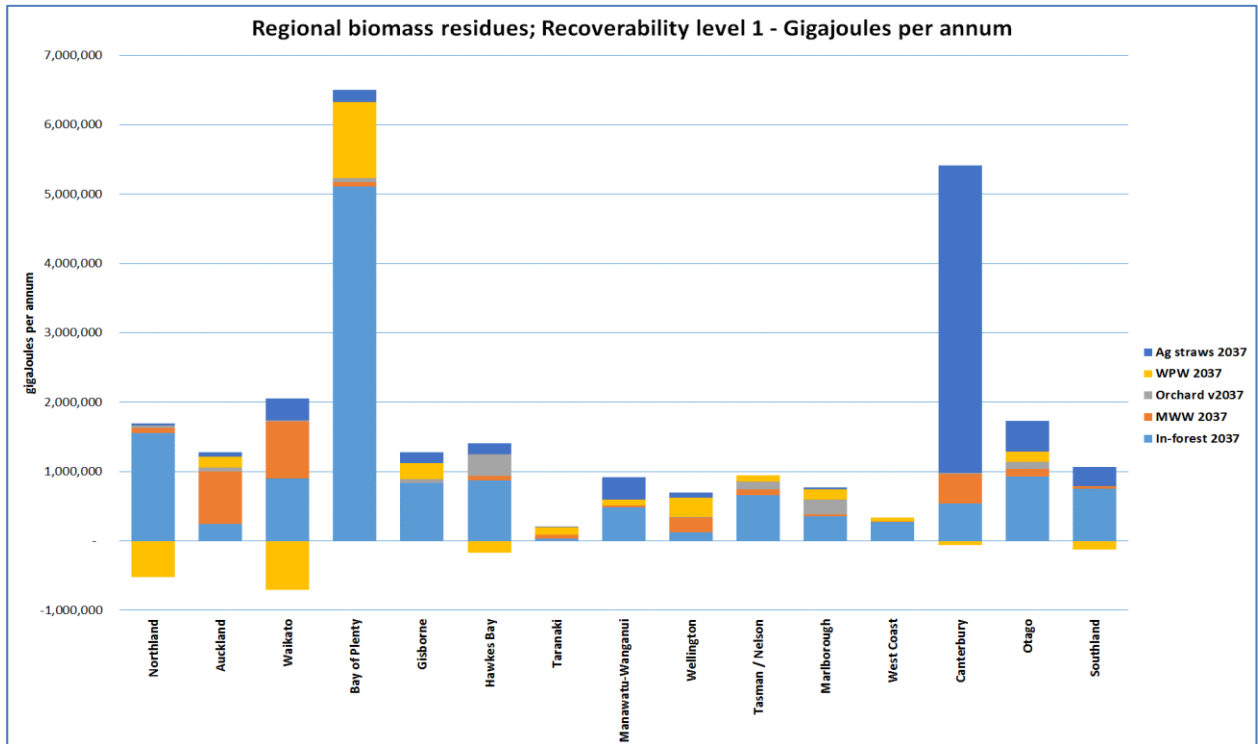
In-forest residues make up the bulk of the biomass residue supply. The in-forest residues are split into three categories based on accessibility and the cost of recovery.

The cheapest resource is municipal wood waste which currently attracts a gate fee averaging ~\$140 per tonne.

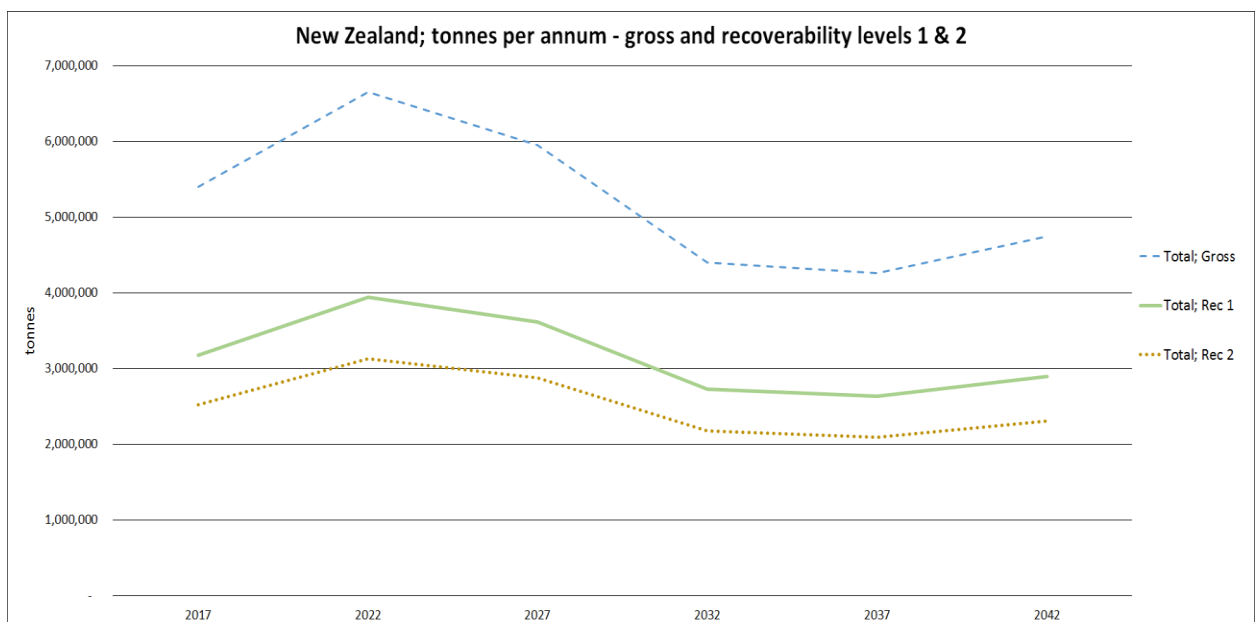
The best quality fuel (low ash) is likely to come from wood processing operations as it generally has low levels of contamination. This is a small resource as most of the wood processing residues are already used for energy by the wood processing operation or sold as other products (animal bedding, mulch etc.)

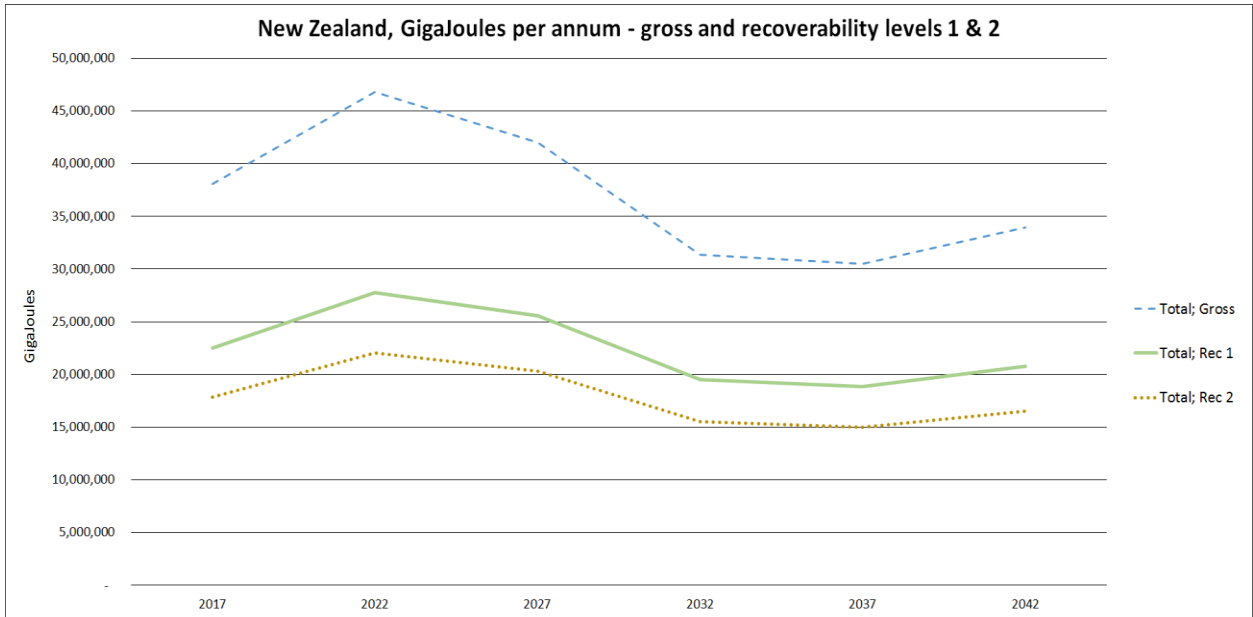
Straw and stover could make a substantial contribution in some regions (especially Canterbury).





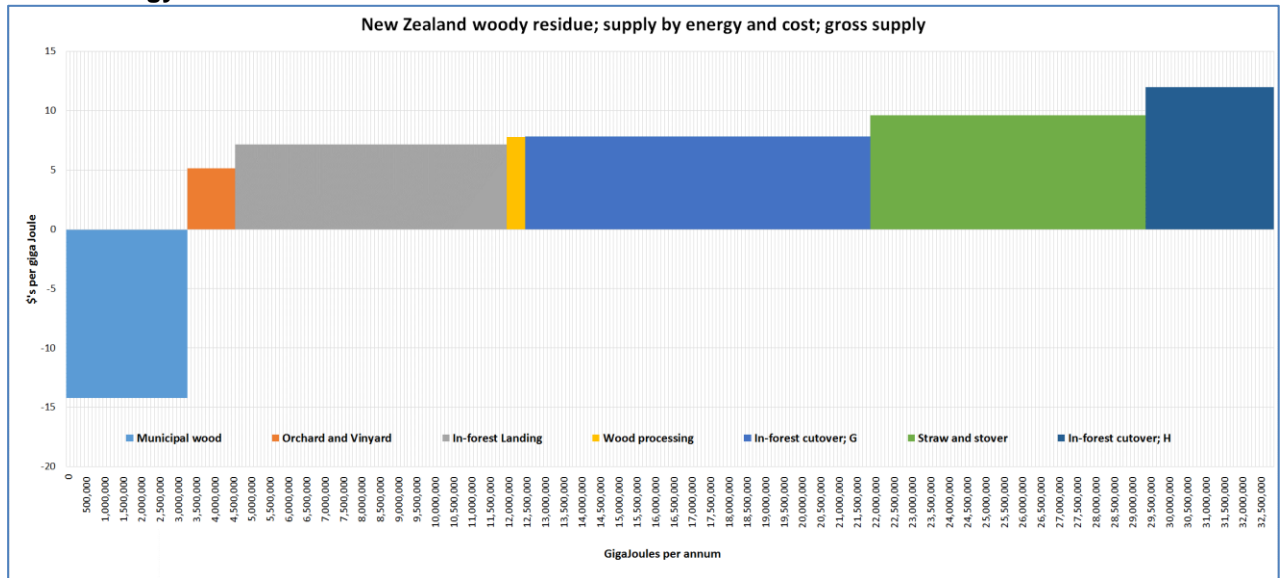
The two graphs below show the national volume of woody residues in tonnes and Gigajoules; for the gross amount and the two recoverability levels.





The three graphs below show the national level cost supply curves for the gross GigaJoules potentially available from the various resources and the estimated GigaJoules available at two levels of recoverability. It should be noted that the costs are indicative only - delivered price will vary by site, driven variables such as transport distance, truck size limitations and scale of demand.

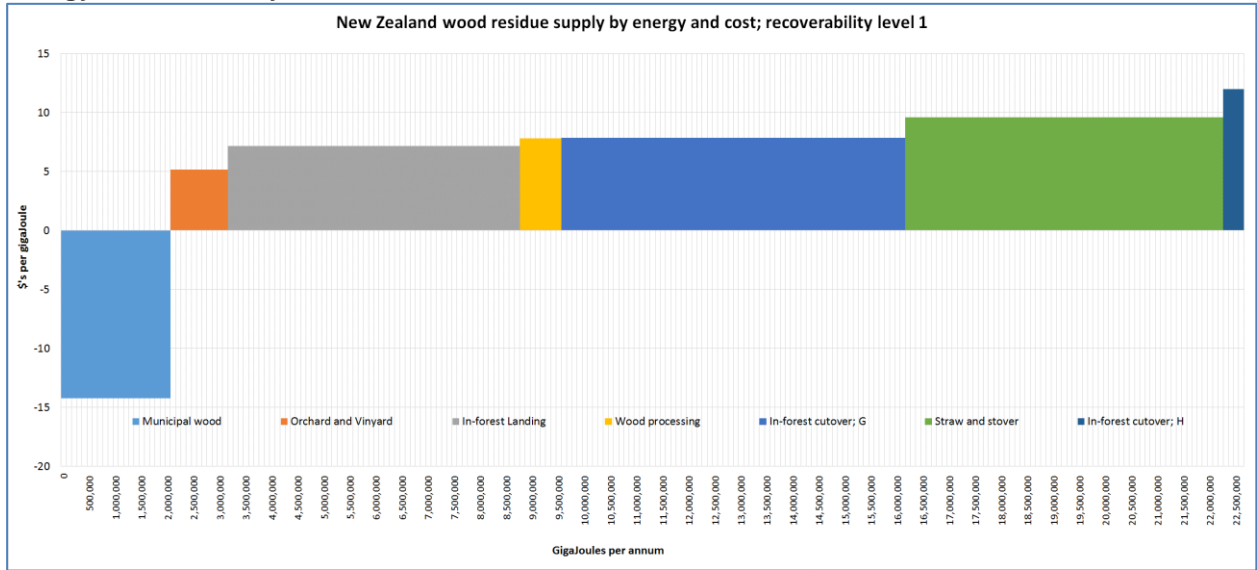
### Gross energy



The gross energy potentially available is in the order of 32 PJ per annum, with a cost of up to \$12 per GJ. This energy is derived from approximately 4 million green tonnes of gross biomass supply.

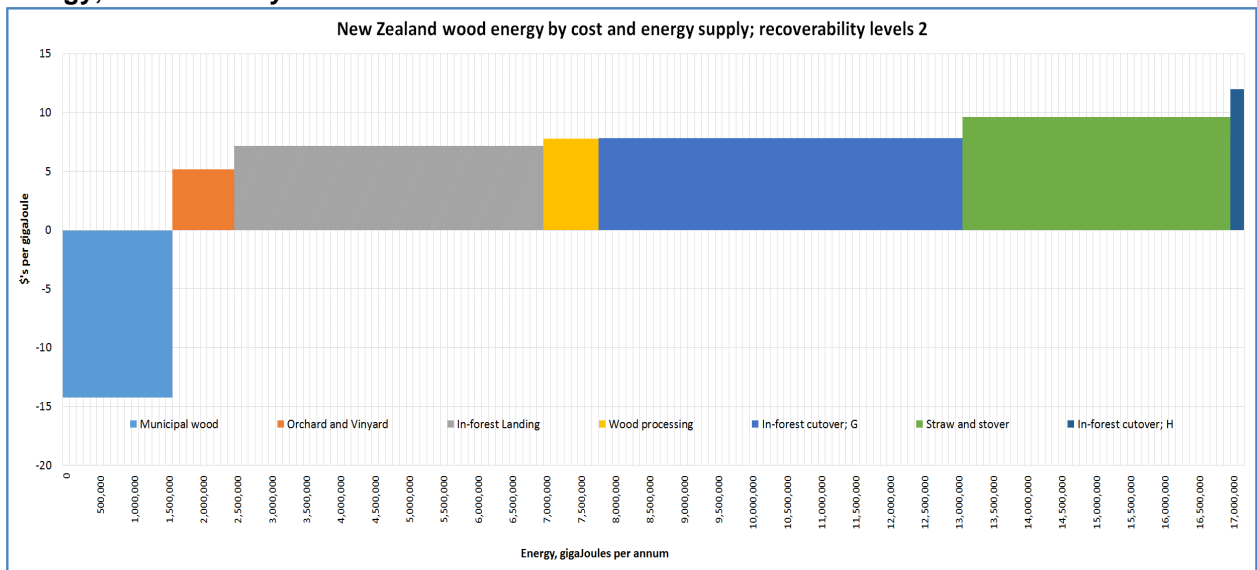
Not all the gross biomass will be available, especially not at the typical costs estimated. Two levels of recoverability were estimated for each resource, with the levels of recoverability varying by resource.

## Energy; recoverability level 1



If the first level of recoverability is applied to all resources the amount of energy estimated to be available reduces to around 22 PJ or ~2.6 million green tonnes.

## Energy; recoverability level 2



If the second level of recoverability is applied the gross amount of energy available reduces to around 17 PJ or 2.0 million tonnes.

Regional totals for tonnes and energy over time are presented.

Data tables for each resource by region over time for tonnes and energy content are provided in the appendices.

## Further work

More up-to-date information on straws and stover location and area of arable cropping are required as the data in the current assessment is based on information circa 2007. The orchard residue data is more recent (2016) for the material derived from vineyards and kiwi fruit orchards. However the data on the residues from other fruit crops should be updated if possible. There may be value in breaking down the wood processing residues into that comprised of wood and bark, but this may present some challenges as it would involve getting detailed information from individual wood processors.

# Residual biomass fuel projections for New Zealand - indicative availability by region and source.

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# Introduction

The intent of this report is to present estimates of regional combustible biomass residues suitable for heat fuel supply for 2017 and periods of 5, 10, 15, 20 and 25 years into the future (out to 2042); for gross supply and estimates of realisable / recoverable supply (tonnes and energy).

The assumptions behind the data are provided to support 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, wood processing residues, municipal wood waste, horticultural wood residues and agricultural (straw & stover) residues.

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 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.

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

Bark from ports is a potential fuel resource. However, there are complicating issues around this material and its availability now and 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.

## 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 value

NCV = net calorific value

MWW = municipal wood waste

WPW = wood processing waste



## Residuals Assessment: outline of approach and categories

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

	<b>Gross</b>	<b>Recoverable level 1</b>	<b>Recoverable level 2</b>
<b>Municipal wood waste</b>	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)
<b>Wood processing waste</b>	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
<b>Horticultural residues</b>	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)
<b>Agricultural residues</b>	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)
<b>In-forest Landing</b>	Gross amount	= Gross x 0.80 to small / hard to recover	=Gross x 0.65 sites too remote
<b>In forest Cutover</b>			
a. GB	Gross amount; a	a. = Gross x 0.70, rest to small / hard to recover	a. = Gross x 0.56; allows for sites that are too remote
b. Hauler	Gross amount; b	b. = 10% recoverable; rest assumed to be too expensive and risky	b. = 5% recoverable; rest assumed to be too expensive and risky
<b>In-forest total</b>	In-forest total	In-forest total	In-forest total
<b>All biomass totals</b>	<b>All biomass Gross totals</b>	<b>All biomass total at recoverability level 1</b>	<b>All biomass total at recoverability level 2</b>

# 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 Garrod (2007), Hall (2000), EECA (2010), van Loo (2008) and a range of 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 2017 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 (2016) and a range of sources for items such as 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 GVM trucks were used in the transport cost analysis. Potentially the use of HPMVs may reduce transport costs in the order of 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 specific factors 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 costs.

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, 2016). If we are looking at long term secure supply we need to consider the long term (out to 2045) 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 on 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, 2014). 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.

# Results

## Residual material - fuel characteristics

Typical fuel characteristics for the range of resources assessed are shown in Table 2. 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 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 wood, 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 3. In the tables below; CO = cutover, GB = ground-based, MWW = municipal wood waste and WPR = wood processing residues.

Table 2 - summary of fuel properties by residue type

	<b>Moisture Content</b>	<b>Ash Content</b>	<b>GCV</b>	<b>NCV</b>	<b>NCV - 5%</b>	<b>NCV + 5%</b>
<b>Landing stem</b>	<b>56.5</b>	1.8	19.8	6.8	<b>6.5</b>	<b>7.2</b>
<b>Landing mixed</b>	<b>54.0</b>	4.5	19.3	7.0	<b>6.7</b>	<b>7.4</b>
<b>CO GB stem</b>	<b>51.5</b>	0.9	20.0	7.7	<b>7.3</b>	<b>8.1</b>
<b>CO GB mixed</b>	<b>51.5</b>	4.8	19.2	7.4	<b>7.0</b>	<b>7.8</b>
<b>CO Hauler stem</b>	<b>51.5</b>	0.9	20.0	7.7	<b>7.3</b>	<b>8.1</b>
<b>CO Hauler mixed</b>	<b>51.5</b>	4.8	19.2	7.4	<b>7.0</b>	<b>7.8</b>
<b>MWW</b>	<b>31.5</b>	4.5	19.3	11.0	<b>10.5</b>	<b>11.6</b>
<b>Orchard*</b>	<b>51.5</b>	1.5	19.9	7.9	<b>7.5</b>	<b>8.3</b>
<b>Straw</b>	<b>13.5</b>	6.8	18.1	14.4	<b>13.7</b>	<b>15.1</b>
<b>Stover</b>	<b>20.0</b>	5.6	17.8	13.8	<b>13.1</b>	<b>14.5</b>
<b>WPR Wood</b>	<b>54.5</b>	0.7	20.1	7.3	<b>6.9</b>	<b>7.7</b>
<b>WPR Bark debark</b>	<b>53.0</b>	3.0	19.6	7.4	<b>7.0</b>	<b>7.8</b>
<b>WPR Bark yard</b>	<b>58.0</b>	7.5	18.7	6.1	<b>5.7</b>	<b>6.4</b>

\*includes vineyards and kiwifruit orchards as well as pip, stone fruit and citrus orchards.

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.

Table 3 - 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 - 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.

### **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 explained here.

#### **In-forest landing residues**

There is no environmental limit on the amount of these residues that can be recovered. However, what is economically and physically feasible to recoverable is a consideration. The highest level considered to be realistic is 80% of the gross volume, this is on a landing by landing basis. Picking up every piece is considered to be financially unfeasible as some of the pieces will be very small, buried in dirt or out of easy reach. The second level of recoverability is 65%, this allows for the fact that not all landings are going to be viable for residue recovery, being too isolated, too small or difficult to access.

#### **In-forest cutover residues - ground based logging**

Not all the cutover residues should be removed for soil nutrition and fertility reasons. The highest level of recoverability is suggested as being 70%, with the focus being on the larger stem sections, with fine branches and branches with needles attached being left behind. For reasons of cost and

practicality, it is possible that only a proportion of the ground-based cutover would be accessed for residue recovery; if 20% is not accessed then the recoverable proportion becomes 80% of the 70% (56%).

### **In-forest residues - hauler logging**

The vast majority of hauler logged cutover (steep terrain) will be inaccessible due to both cost and environmental reasons. Harvesting residues from steep terrain could cost up to \$90 per tonne (excluding hogging and transport), and removing residues such as branches from steep slopes may cause more sediment to reach water ways in heavy rainfall events, as it removes multiple small water and debris barriers. However, removal of slash piles from gully bottoms, streams and stream margins may be beneficial on some sites. Recovery levels were set at 10% of gross (high) and 5% of gross (low).

### **Municipal wood waste**

Municipal wood waste comes in two broad categories, construction and demolition (C&D) waste and green waste. Some of both categories will be un-useable. Some of the C&D waste will be contaminated with treatment chemicals (e.g. CCA) and will be unsuitable for use as fuel. Recovery of the total useable fraction was estimated at 80% (high) and 60% (low), as some landfills are small, remote and collection and use may not be viable.

### **Horticulture and Viticulture wastes**

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.

### **Straw and stover residuals**

Amounts of straw and stover residue produced were estimated based on Saggar et al, 2007 and Ministry of Agriculture and Forestry (MAF) 2011. These data (land area under crops, MAF 2011) need to be updated at some point, but this data gives indicative numbers. 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 is 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.

### **Wood Processing residues**

Whilst most wood processing residues (saw dust, bark, shavings etc.) are already consumed for heat production there are some sites with excess supply. Recoverability of this material is expected to be high; level 1 is assumed to be 95% and level 2 90%.

## **Costs**

The costs of providing the biomass from the various resources were estimated (Table 4). The rationale for the cost components in Table 4 are as outlined in the box below.

Table 4 - estimates of costs for delivered biomass

Resource	Resource fee, \$/green tonne	Harvesting: \$/green tonne	Hogging: \$/green tonne	Screening: \$/green tonne	Loading: \$/green tonne	Transport distance, km	Bulk density, t per m <sup>3</sup>	Transport cost, \$/green tonne	Total cost, green tonne	Moisture content	basic density	Total cost; odt	Total Cost; \$/GJ	t per m <sup>3</sup>	Potential load, t per truck load	Actual Load (t) in 100 m <sup>3</sup> truck
Municipal wood waste	\$ -140	\$ -	\$ 15	\$ 5	\$ 3	65	0.37	\$ 17.00	\$ 100.00	0.35	0.661	\$ 250	\$ 13.81	0.245	24.457	24.5
Orchard and Vineyard residues	\$ 5	\$ -	\$ 15	\$ 3	\$ 3	65	0.37	\$ 15.60	\$ 41.60	0.45	0.781	\$ 104	\$ 5.56	0.289	28.897	28.8
In-forest Landing residues	\$ 10	\$ 5	\$ 15	\$ 3	\$ 3	85	0.37	\$ 18.70	\$ 54.70	0.56	0.977	\$ 137	\$ 7.56	0.361	36.149	29.5
Straw and stover residues	\$ 5	\$ 21	\$ -	\$ -	\$ 3	75	0.32	\$ 28.50	\$ 57.50	0.20	0.537	\$ 133	\$ 7.48	0.172	17.184	17.1
Wood processing residues	\$ 25	\$ -	\$ 15	\$ 3	\$ 3	65	0.37	\$ 14.30	\$ 60.30	0.53	0.915	\$ 151	\$ 8.19	0.339	33.855	29.5
In-forest cutover; G	\$ 10	\$ 15	\$ 15	\$ 3	\$ 3	85	0.37	\$ 18.70	\$ 64.70	0.56	0.977	\$ 162	\$ 8.94	0.361	36.149	29.5
In-forest cutover; H	\$ 5	\$ 45	\$ 15	\$ 3	\$ 3	85	0.37	\$ 18.70	\$ 89.70	0.56	0.977	\$ 224	\$ 12.39	0.361	36.149	29.5

### Resource fee

The owners of the biomass will likely want at least a nominal fee for the right to access the residual biomass. The precedent has been set for this with the recovery of bin wood and hog fuel in some CNI forests. The exception is the municipal wood waste - where the site receiving the material will likely be paid to dispose of it.

### Harvesting

The materials in most cases need to be collected into a useful volume, in some cases being retrieved from forest cutover or from orchards and paddocks. The systems used to do this vary widely from baling of straws to forwarders traversing forest cutover.

### Hogging /chipping

A hogger or chipper will need to be medium to large to handle the larger pieces of wood residues, and so have though-puts in the order of 30 tonnes per hour. Typically the hoggers do not have an operator, but are driven by remote control by the loader driver.

### Screening

Most of the residual material will require screening to remove dirt, stones and fines. Municipal wood waste will also require removal of metals (magnets) and so has a higher cost. The straw and stover residues will not require screening as it should be clean. Some of the wood processing residues will require screening, particularly bark, to remove dirt. Other residues may require screening for size.

### Loading

After preparation all the materials will require loading onto a truck. The most common form is hog fuel, with the exception of the straws which come as large bales, and therefore have a lower handling cost. The loading cost is based off a costing of a rubber-tyred front end loader and industry derived production rates.

### Transport

Transport costs vary from product to product. This is based on variations in basic density, moisture content and bulk density. The truck costs were based on a truck and trailer unit with a maximum volume of 100 cubic metres and a maximum payload of 29.5 tonnes. Some products (straw and stover, municipal wood waste) reach the volume limit before they reach the trucks payload (weight) limit, increasing the cost of transport per tonne or GJ delivered.

Transport distances for the different resources were derived from a range of sources. In-forest residues used average log transport distances (Galbraith / NZFOA, 2007). Other distances were derived from interpretation and analysis of maps for point sources such as municipal landfills and wood processing sites. Land use maps were used for area based resources such as orchard residues and crop residues.

A further impact on costs is local completion for supply; increasing demand within a region will push up costs, with first movers getting the better and cheaper resource.

These costs should be regarded as indicative only, and represent a low start point. There are numerous factors affecting system productivity which will affect the delivered cost. For example if a hogger is not fully utilised for logistics / demand reasons the costs might rise by \$2 to 4 per tonne, depending on the level of unutilised capacity.

## Regional biomass - volumes and energy value

The following section is a set of graphs (Figures 1 to 31) which present the biomass supply by tonnage and energy for each region; with the gross supply and the two levels of recoverability.

These graphs are for the total woody biomass supply.

Many of the graphs have increases from 2017 to ~2027 and low points at or from ~2032. These variations are largely driven by the variations in wood available to harvest from plantation forests (MPI, 2016). These forests have an uneven age class distribution due to a planting boom in the mid-1990's. Wood from in forest harvest residues is the dominant resource across most regions (Figures 32 and 33).

Figure 1 - Northland; tonnes per annum

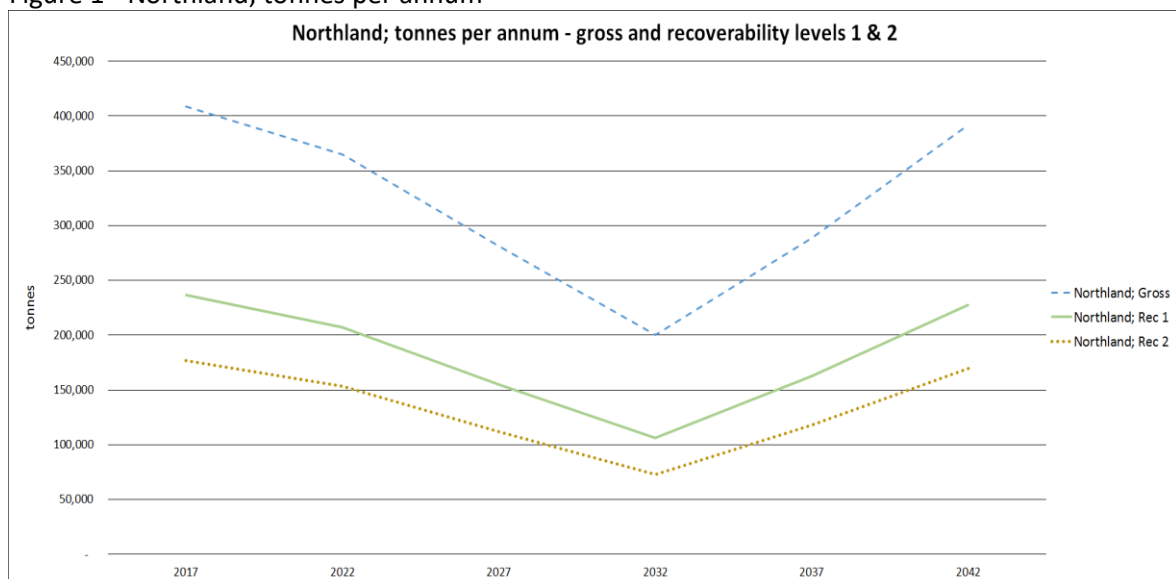


Figure 2 - Northland; Gigajoules per annum

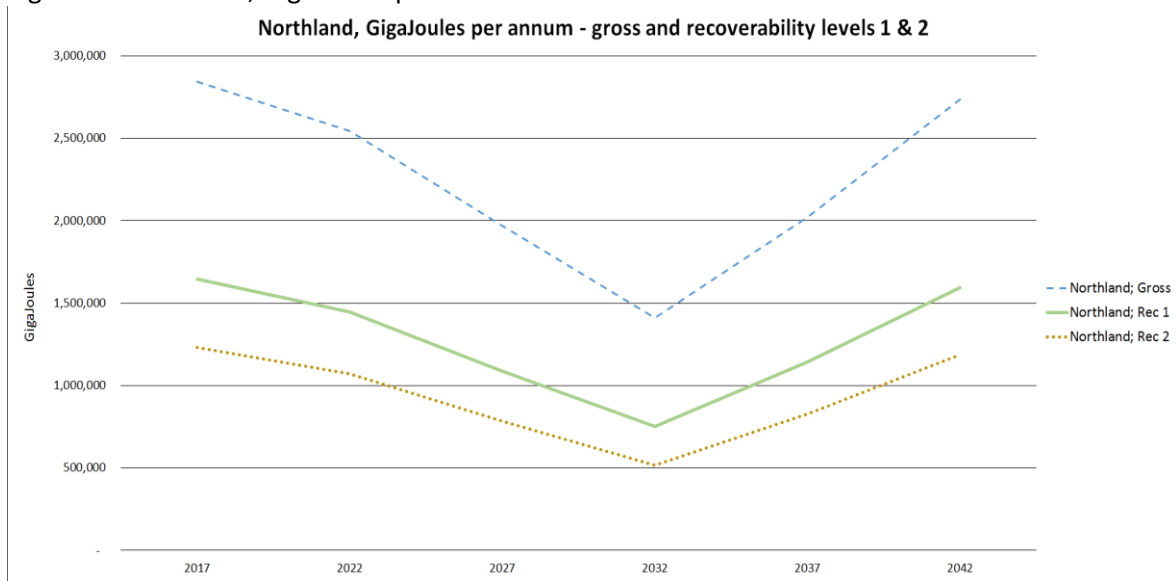


Figure 3 - Auckland; tonnes per annum

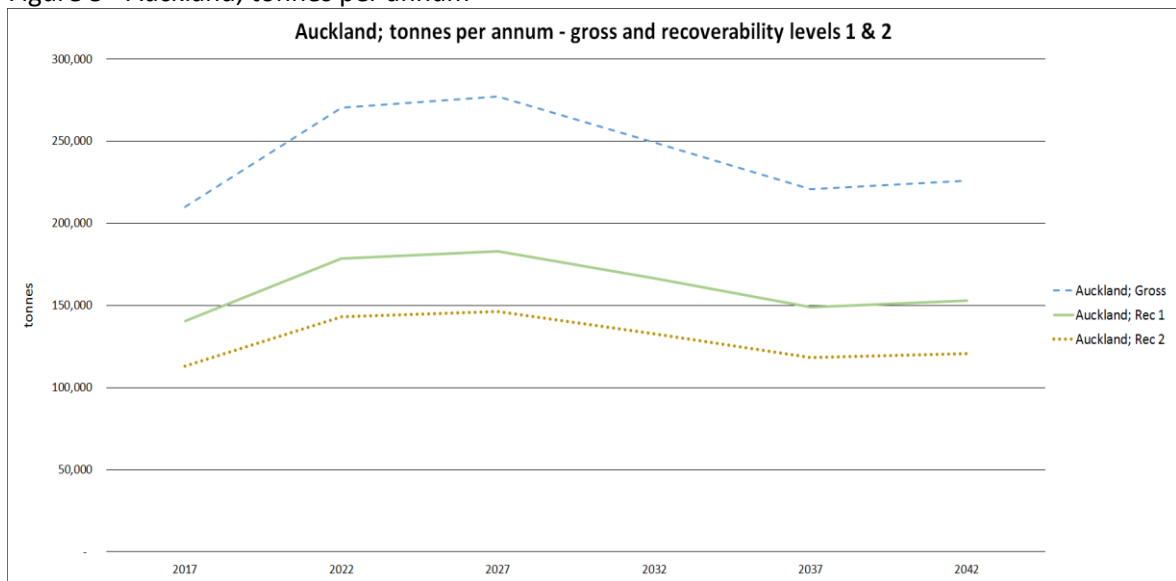




Figure 4 - Auckland; GigaJoules per annum

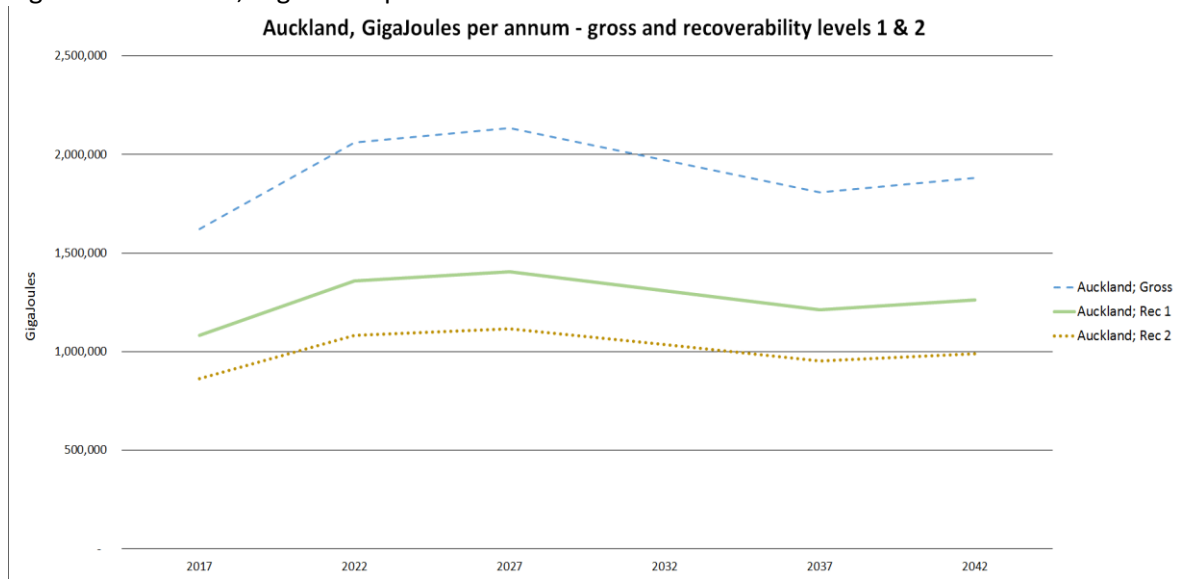


Figure 4 - Waikato; tonnes per annum

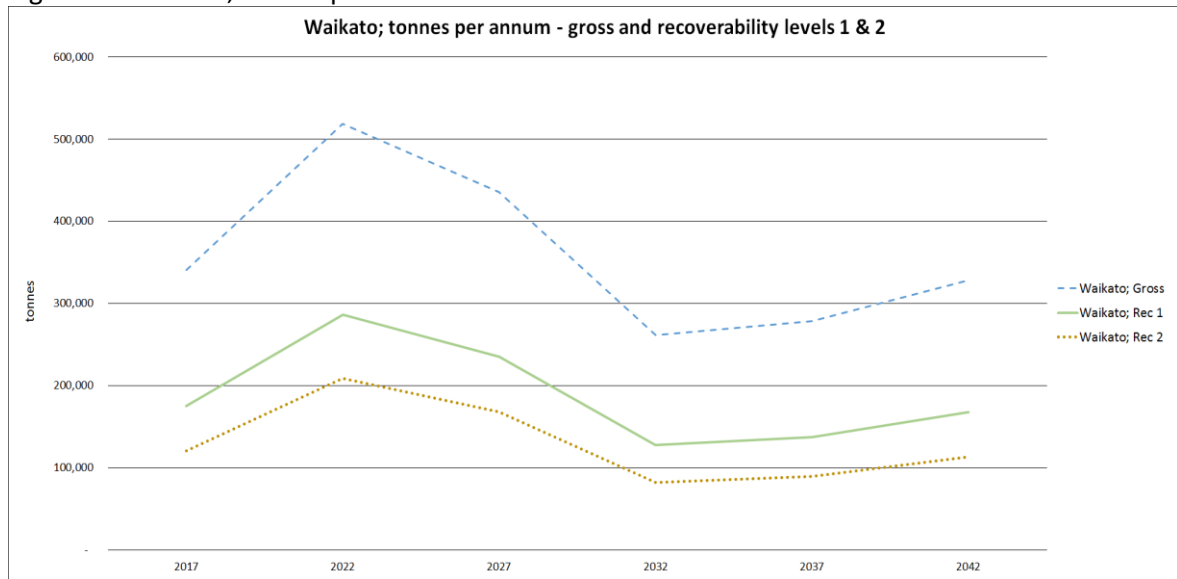


Figure 5 - Waikato; GigaJoules per annum

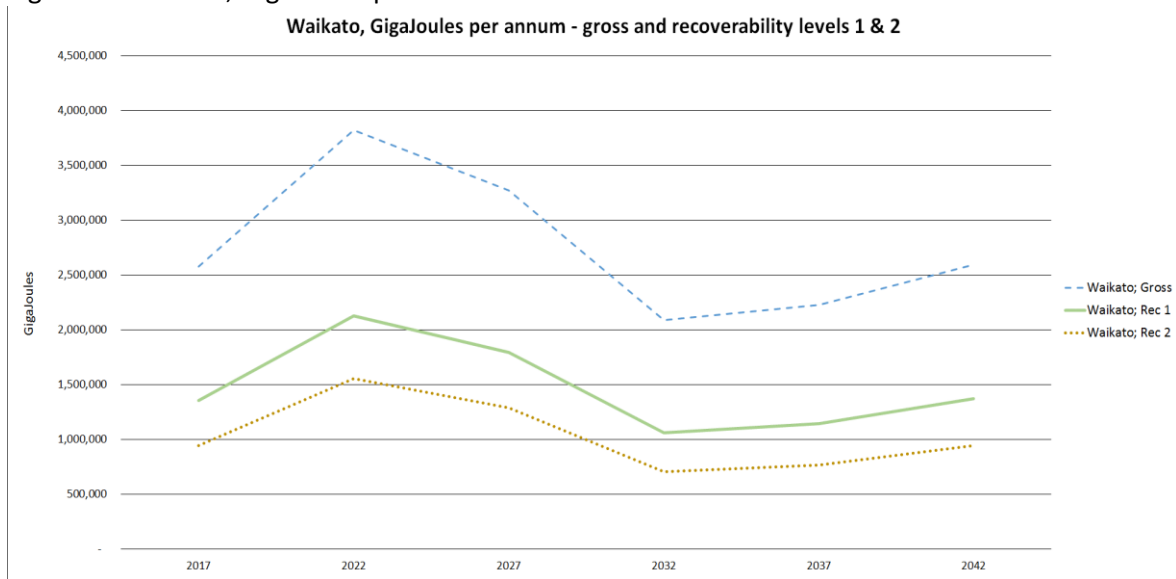


Figure 6 - Bay of Plenty; tonnes per annum

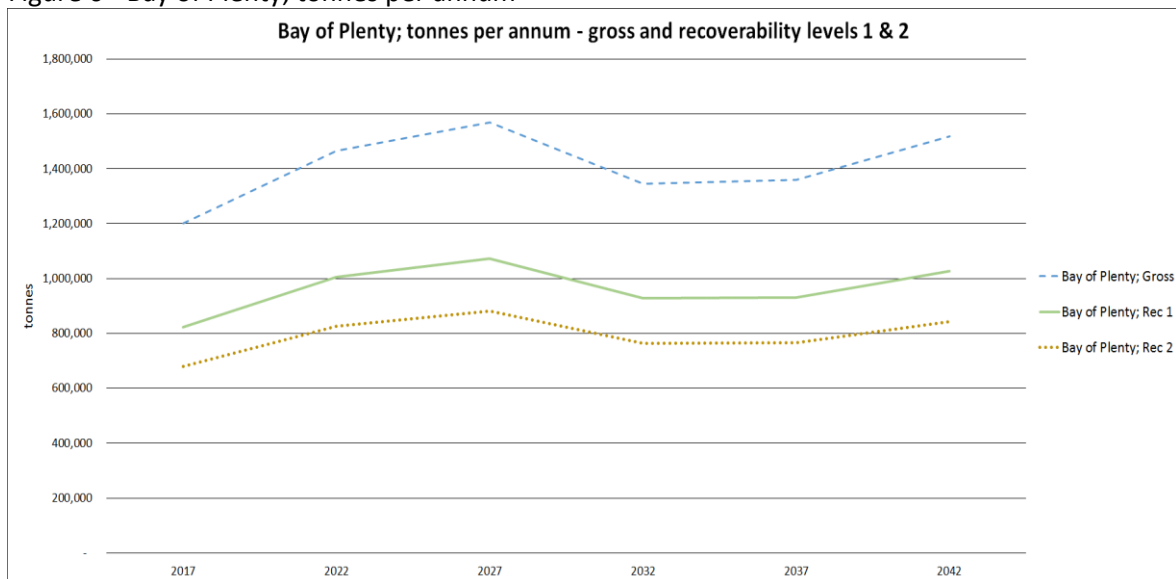


Figure 7 - Bay of Plenty; GigaJoules per annum

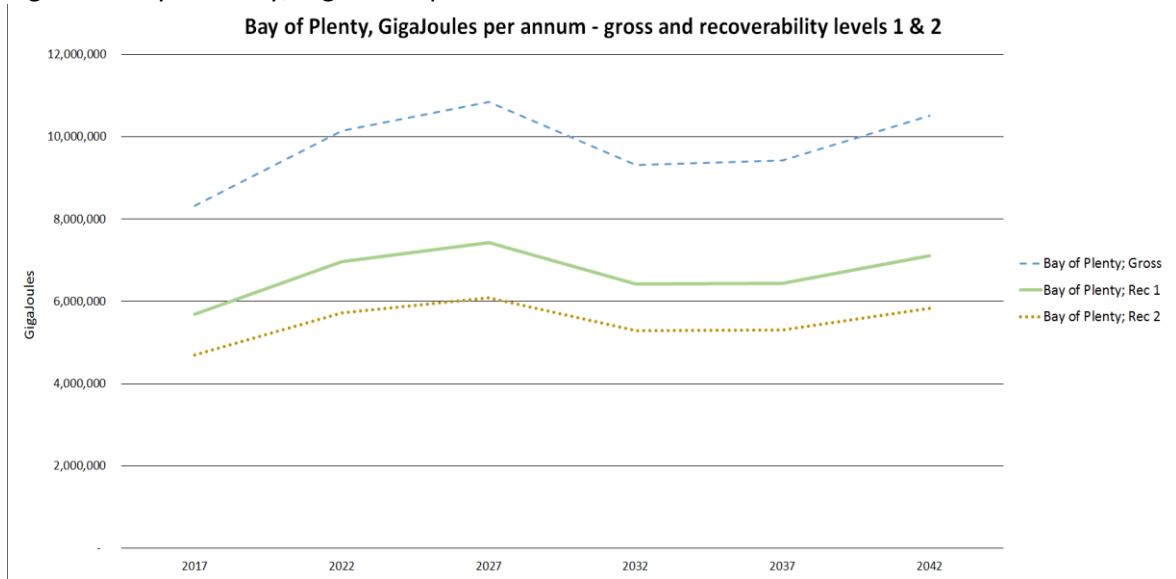


Figure 8 - Gisborne; tonnes per annum

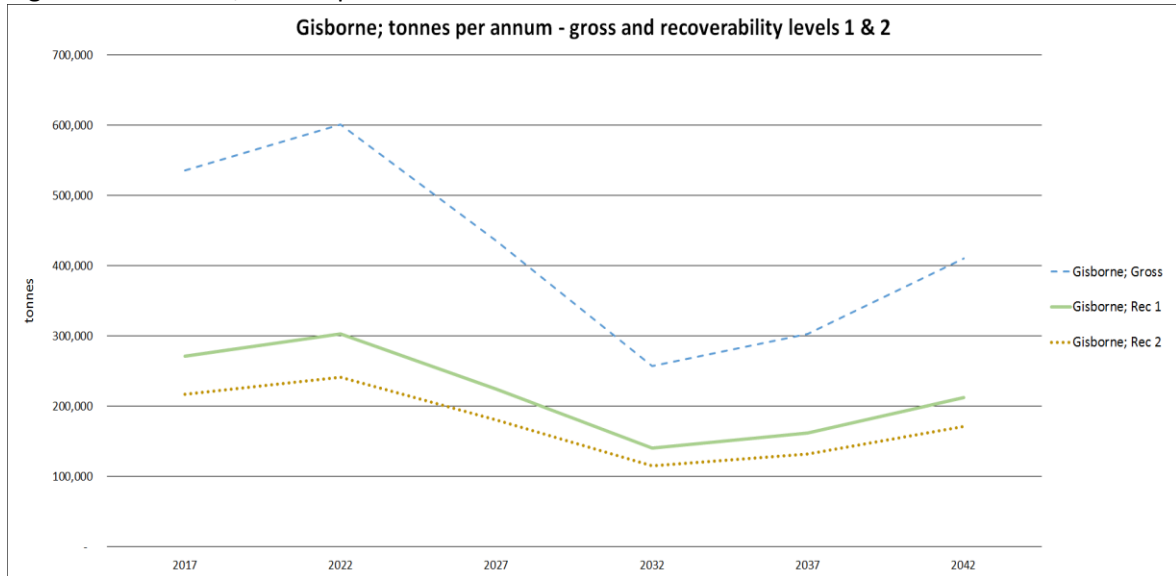


Figure 9 - Gisborne; GigaJoules per annum

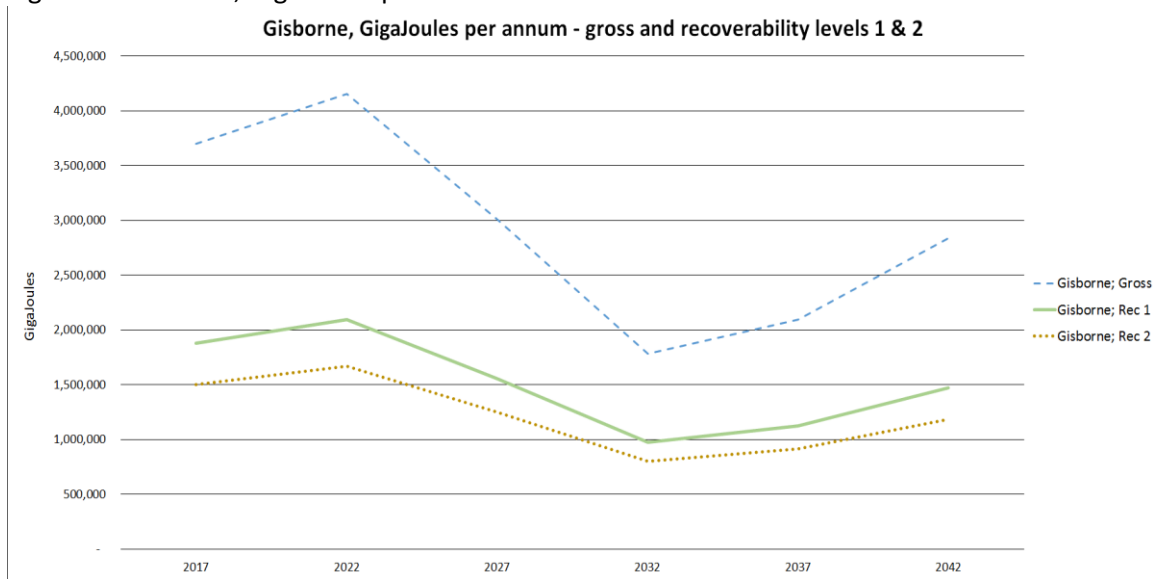


Figure 10 - Hawkes Bay; Tonnes per annum

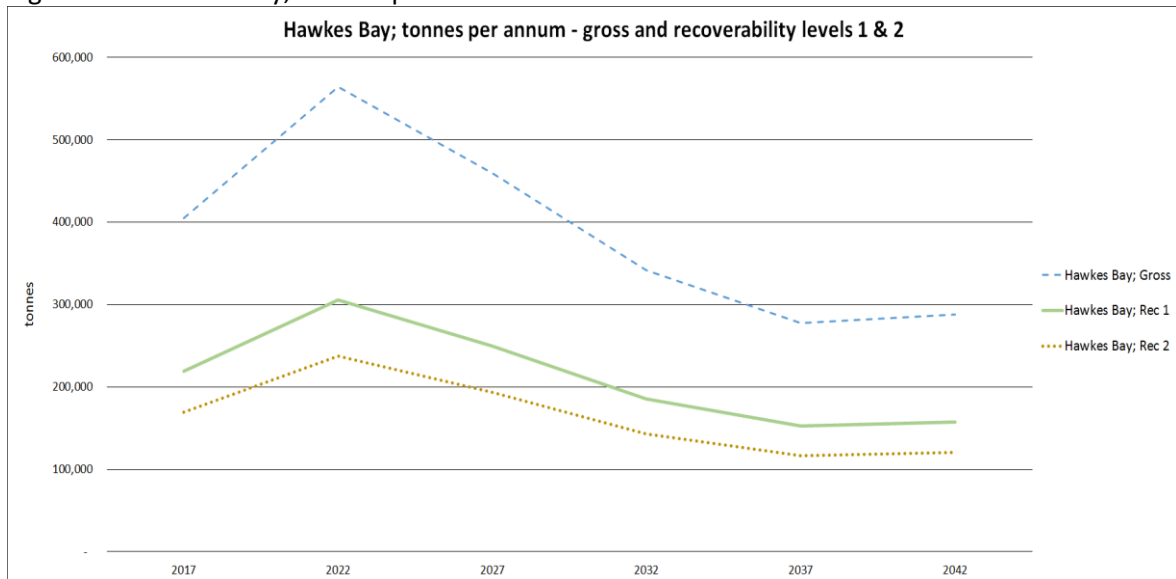


Figure 11 - Hawkes Bay; GigaJoules per annum

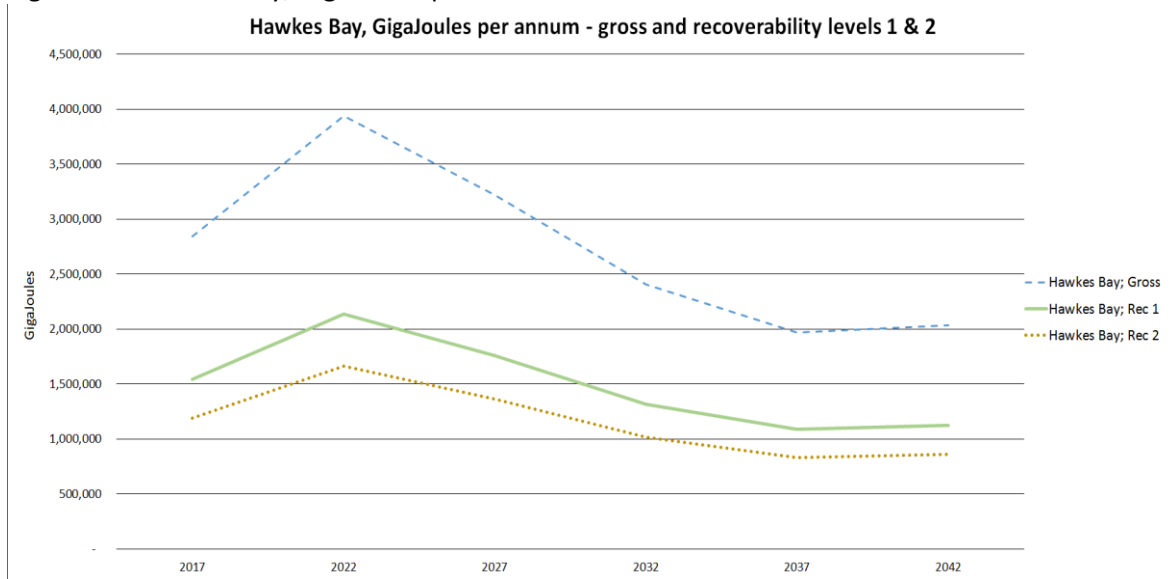


Figure 12 - Taranaki; tonnes per annum

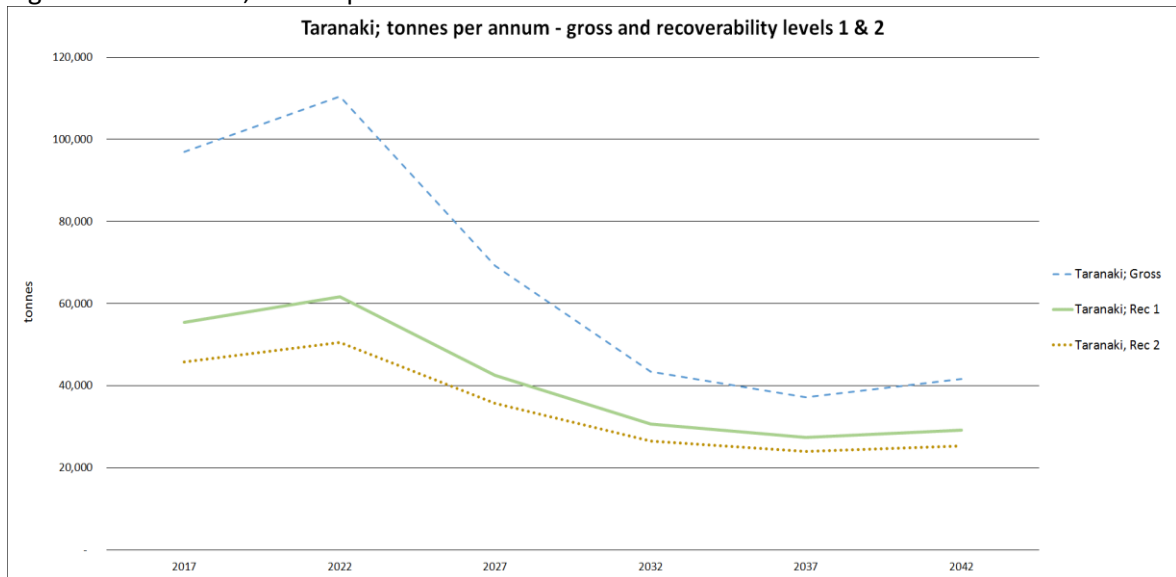


Figure 13 - Taranaki; GigaJoules per annum

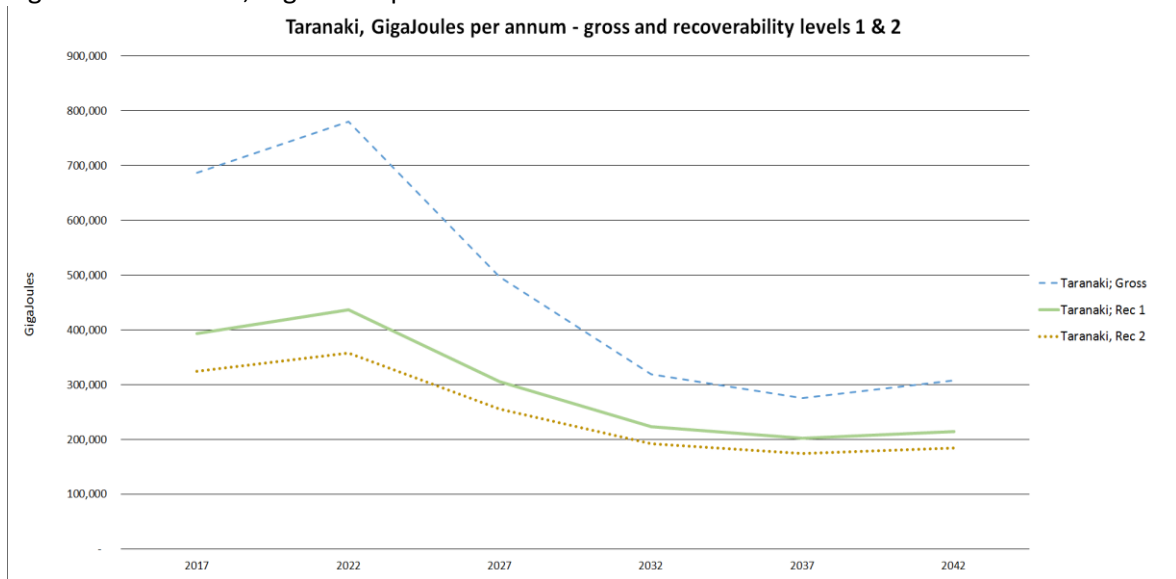


Figure 14 - Manawatu-Wanganui; tonnes per annum

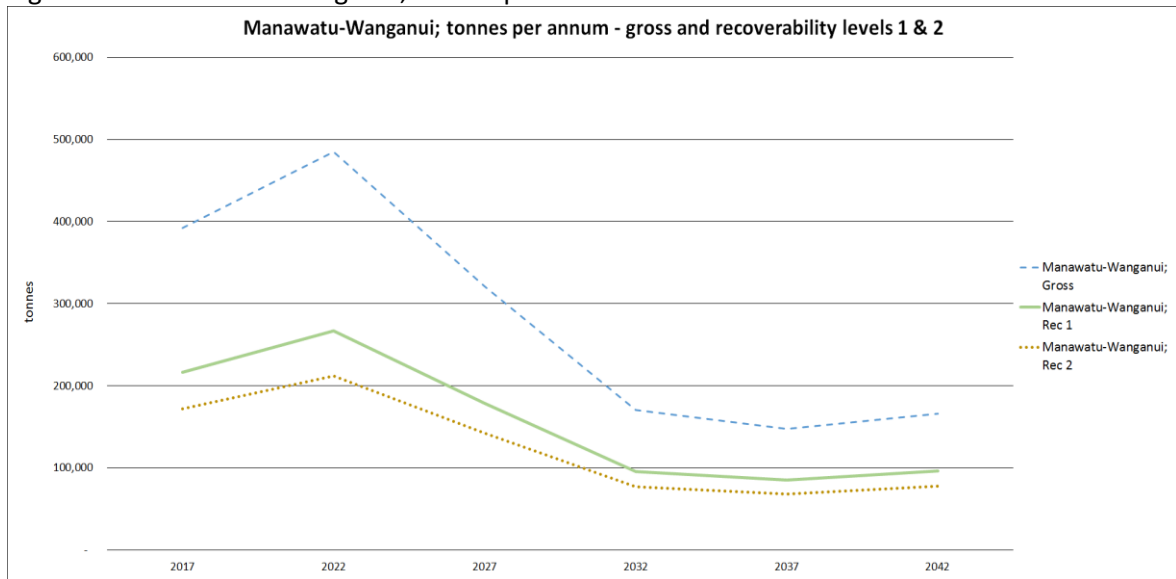


Figure 15 - Manawatu-Wanganui; GigaJoules per annum

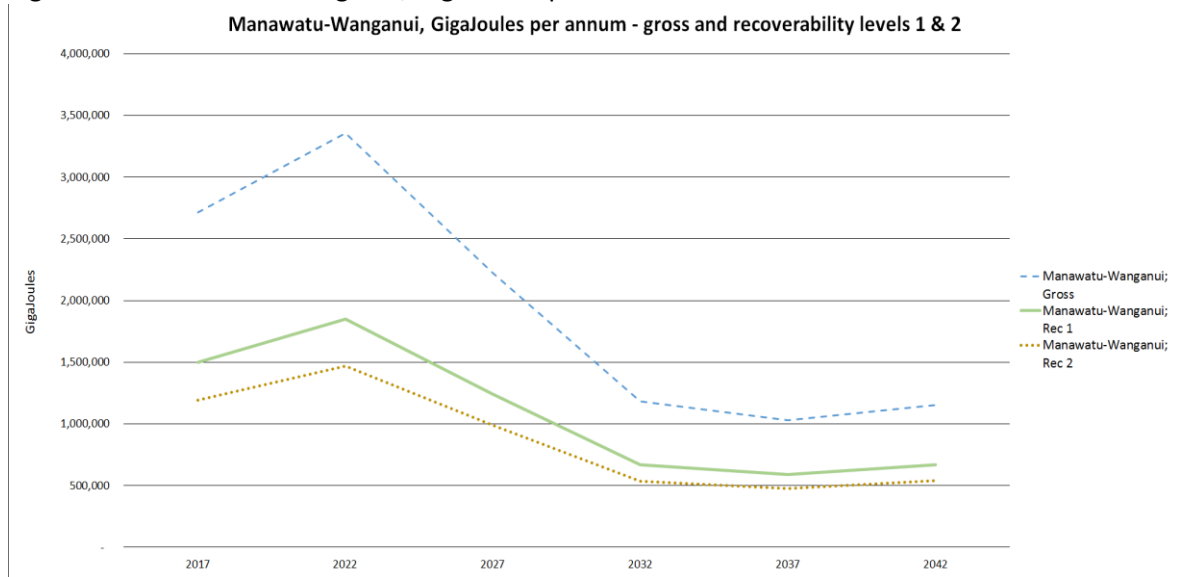


Figure 16 - Wellington; tonnes per annum

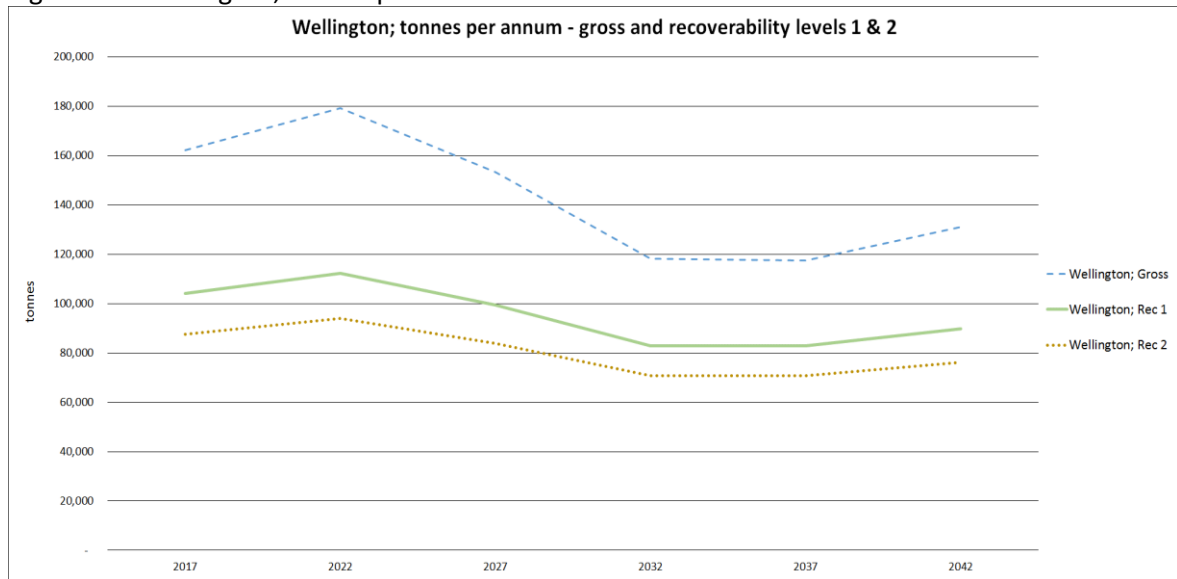


Figure 17 - Wellington; Gigajoules per annum

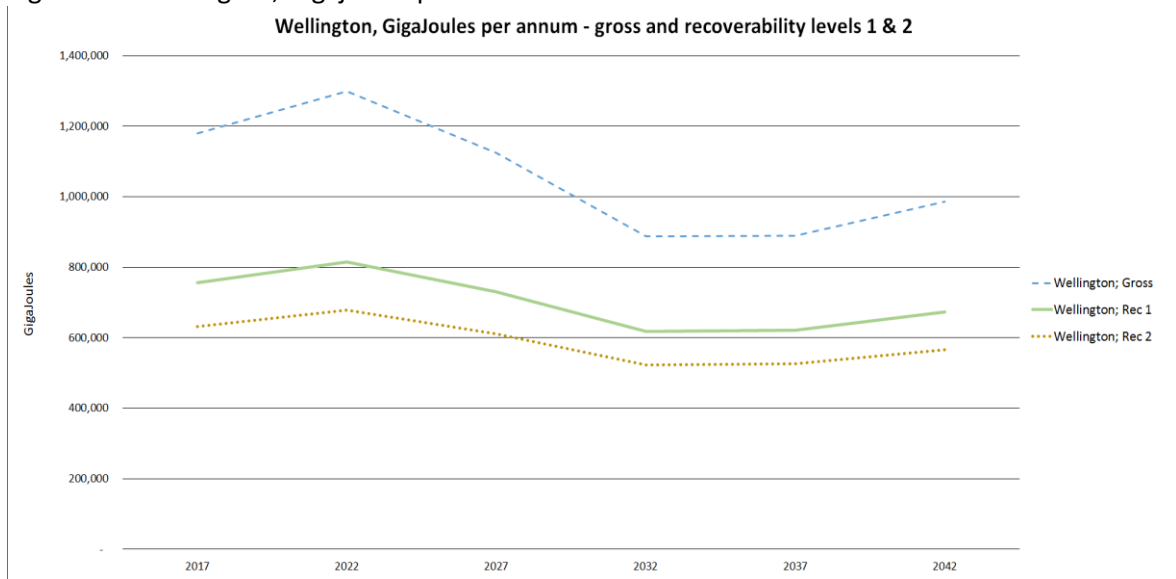


Figure 18 - Tasman-Nelson; tonnes per annum

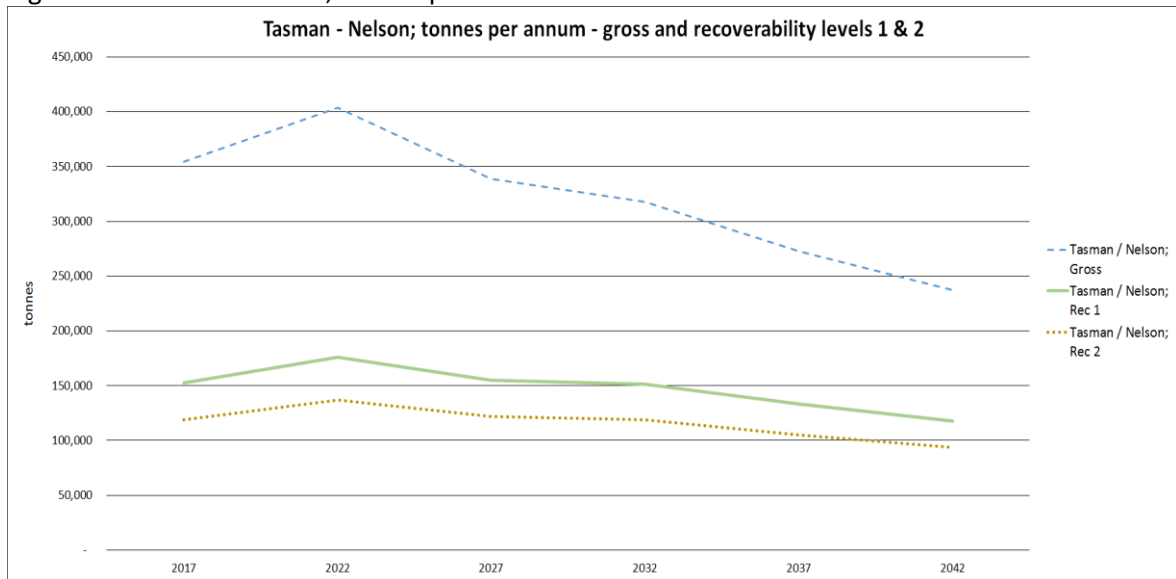




Figure 19 - Tasman-Nelson; GigaJoules per annum

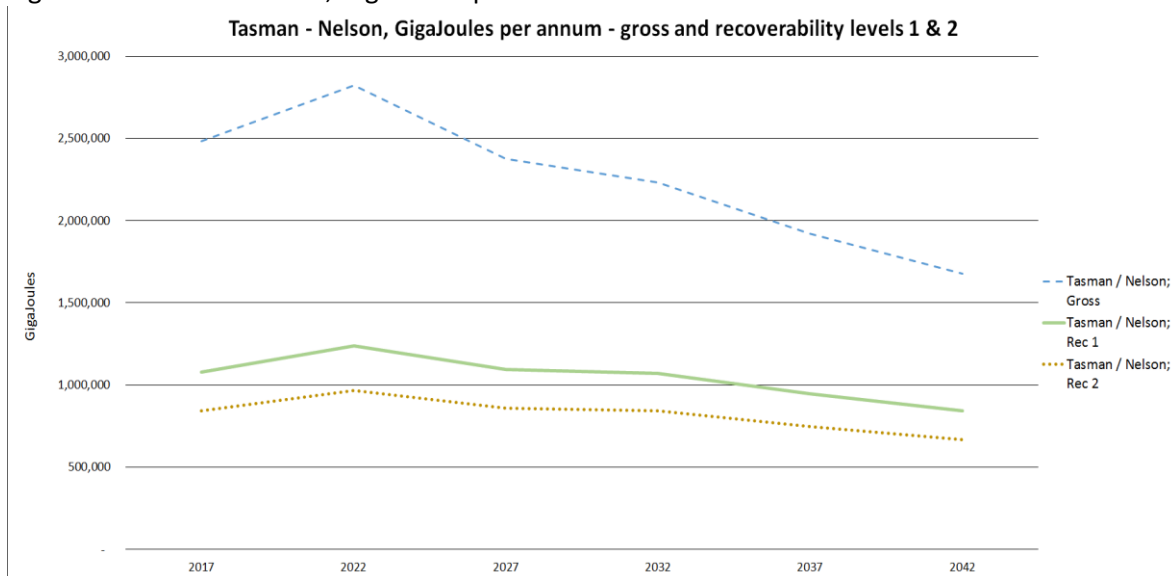


Figure 20 - Marlborough; tonnes per annum

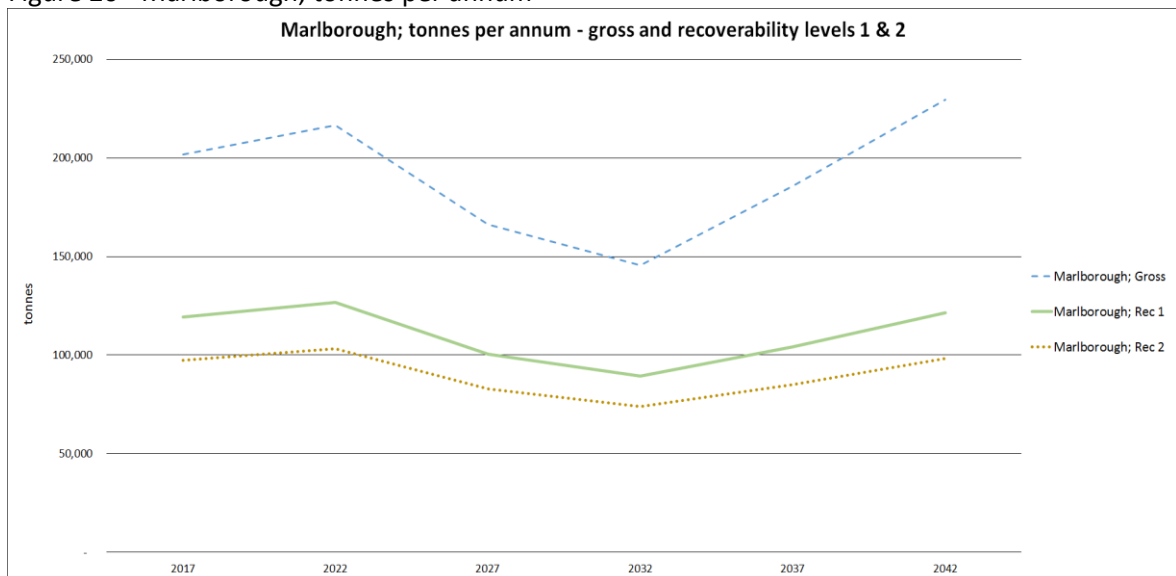


Figure 21 - Marlborough; GigaJoules per annum

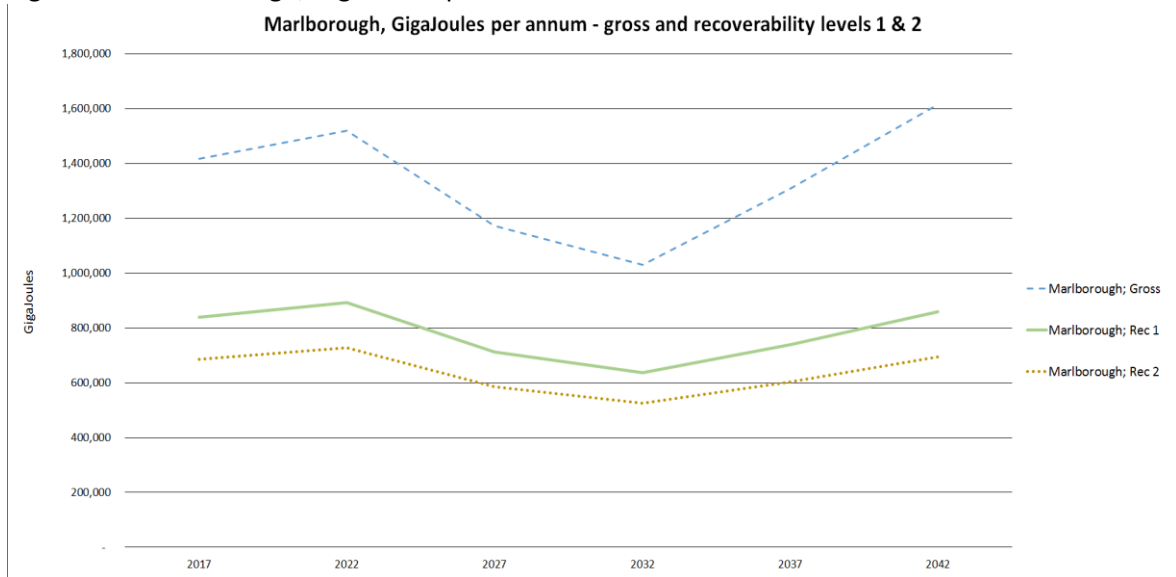


Figure 22 - West Coast; tonnes per annum

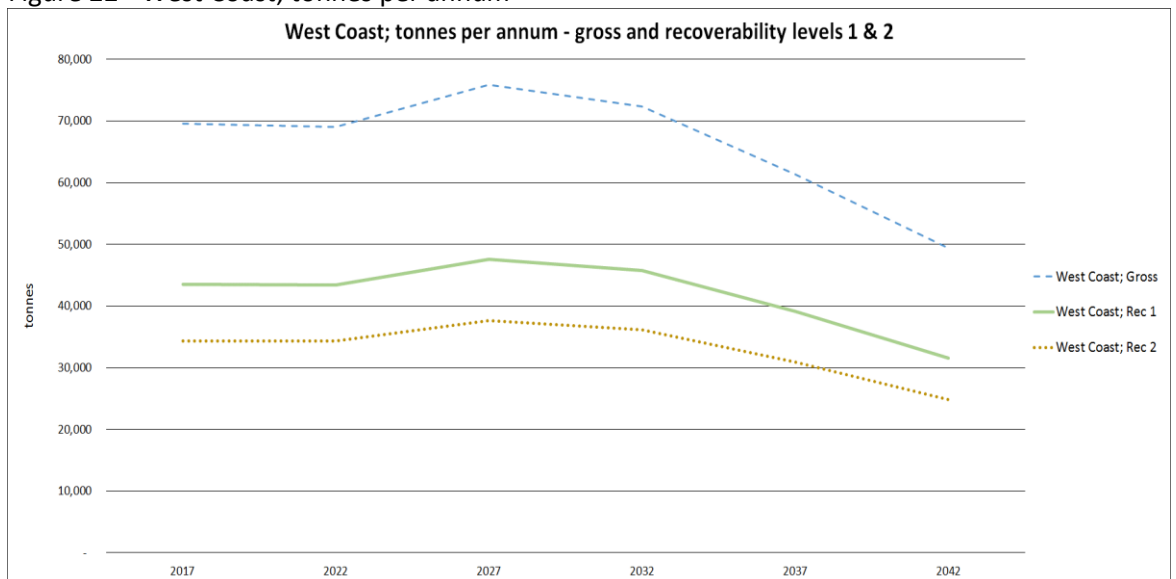


Figure 23 - West Coast; Gigajoules per annum

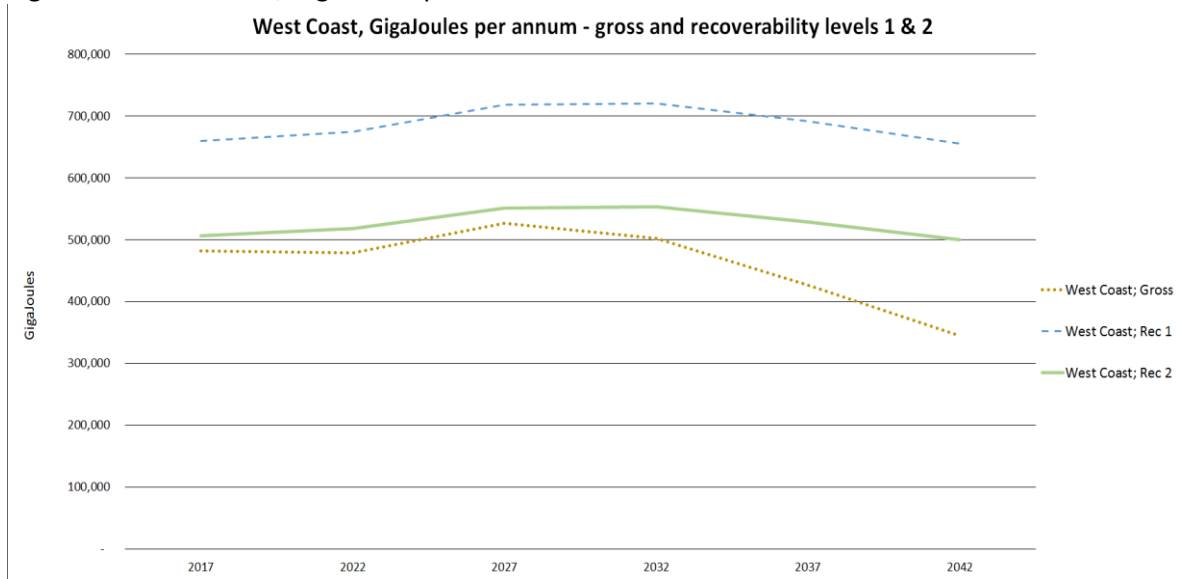


Figure 24 - Canterbury; Tonnes per annum

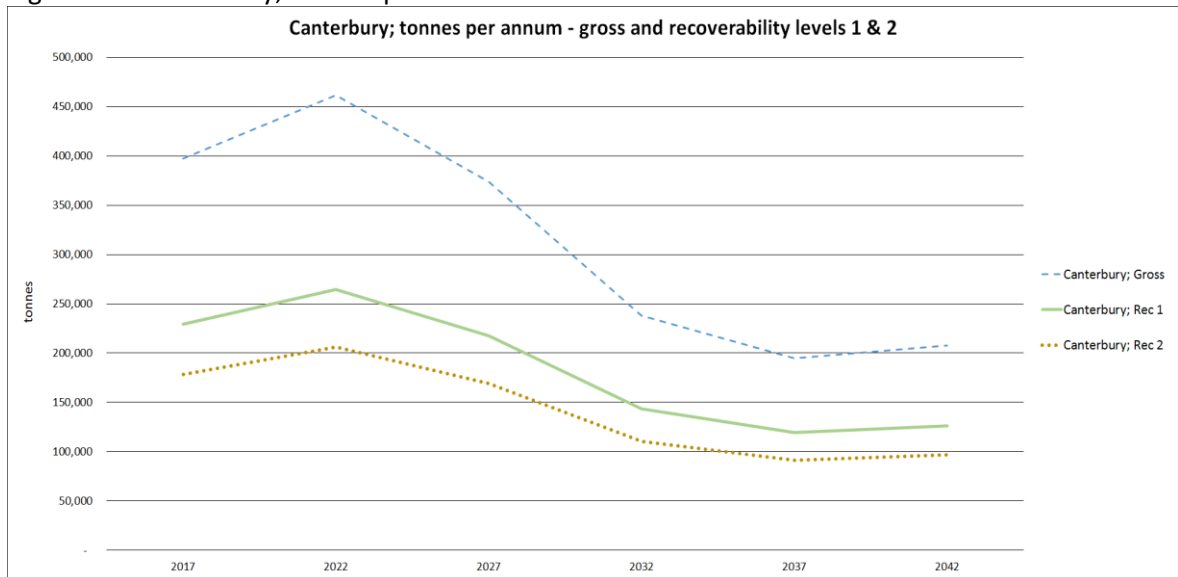


Figure 25 - Canterbury; Gigajoules per annum

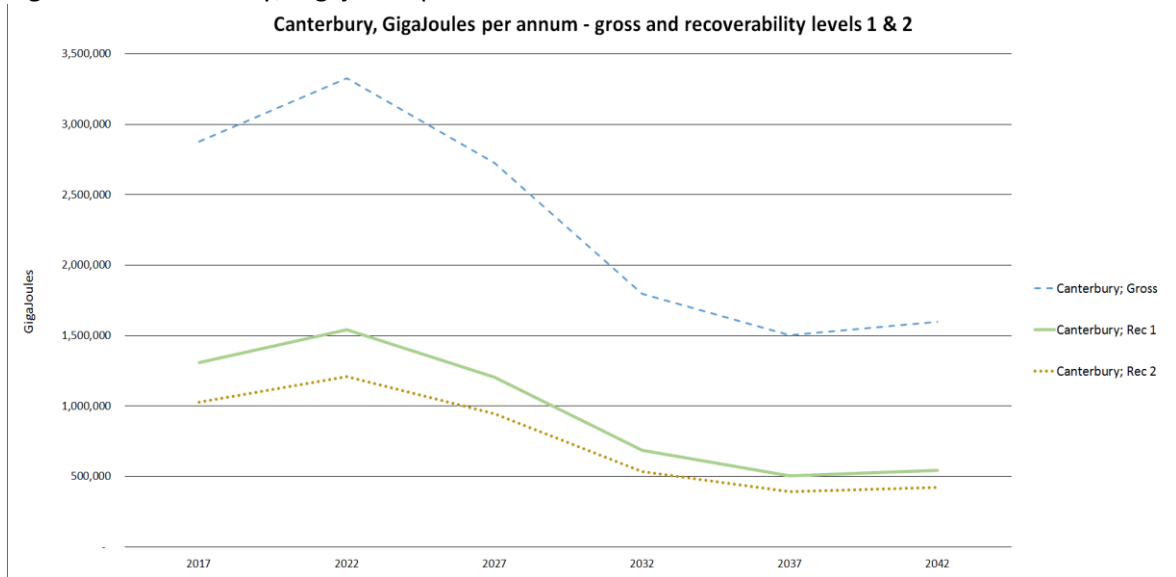


Figure 26 - Otago; tonnes per annum

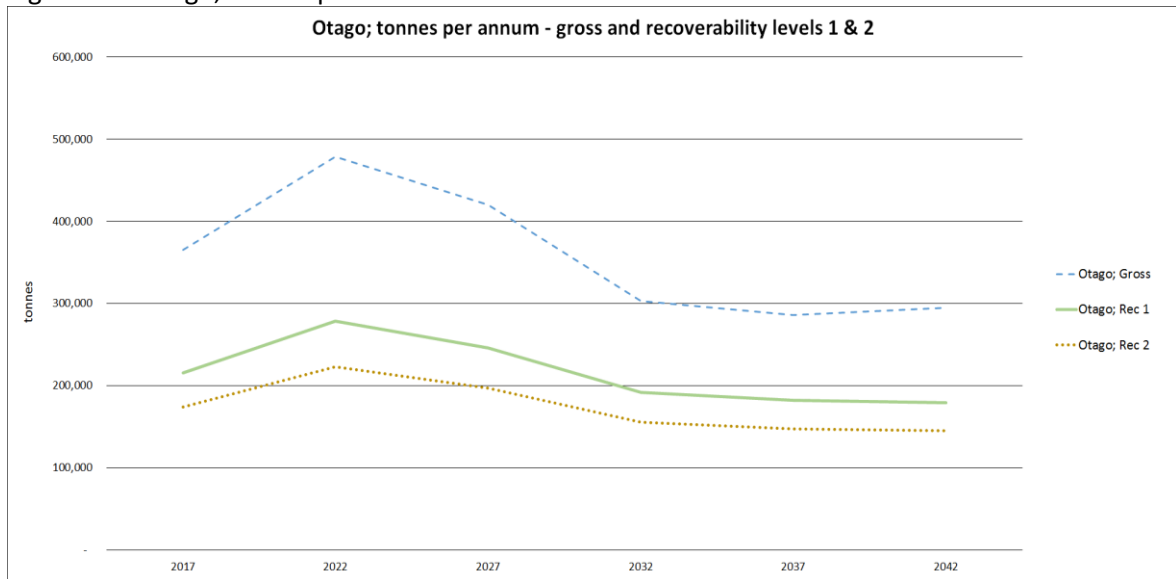


Figure 27 - Otago; Gigajoules per annum

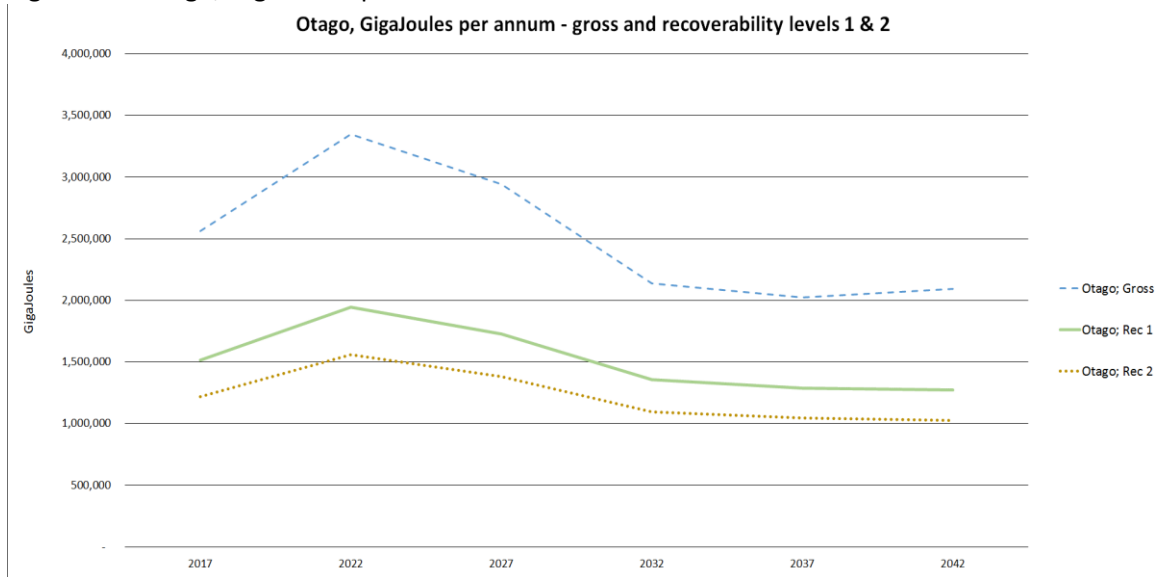


Figure 28 - Southland; tonnes per annum

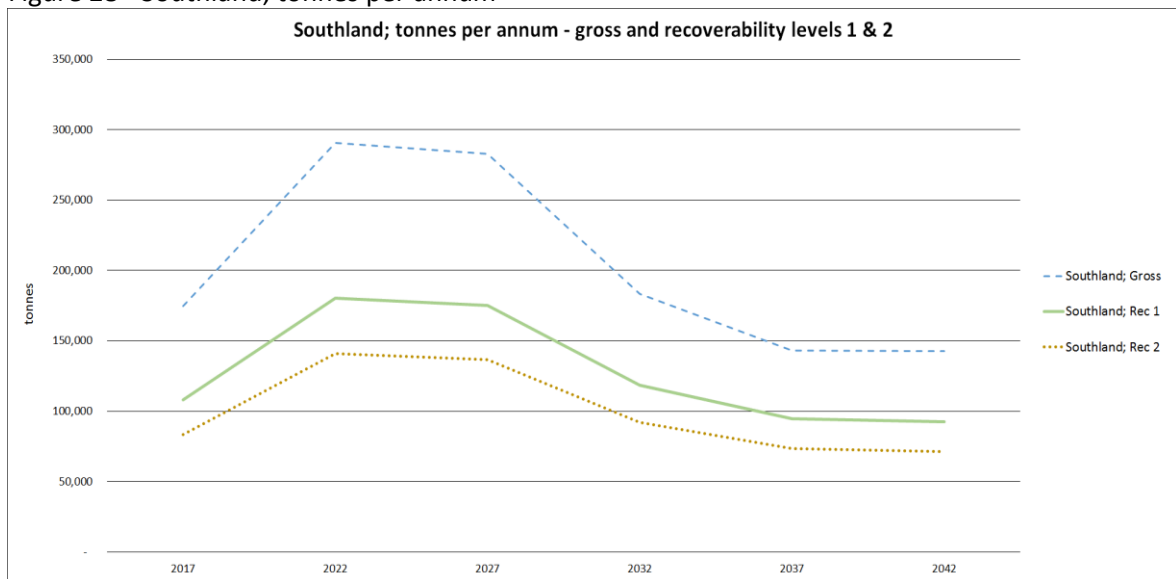


Figure 29 - Southland, Gigajoules per annum

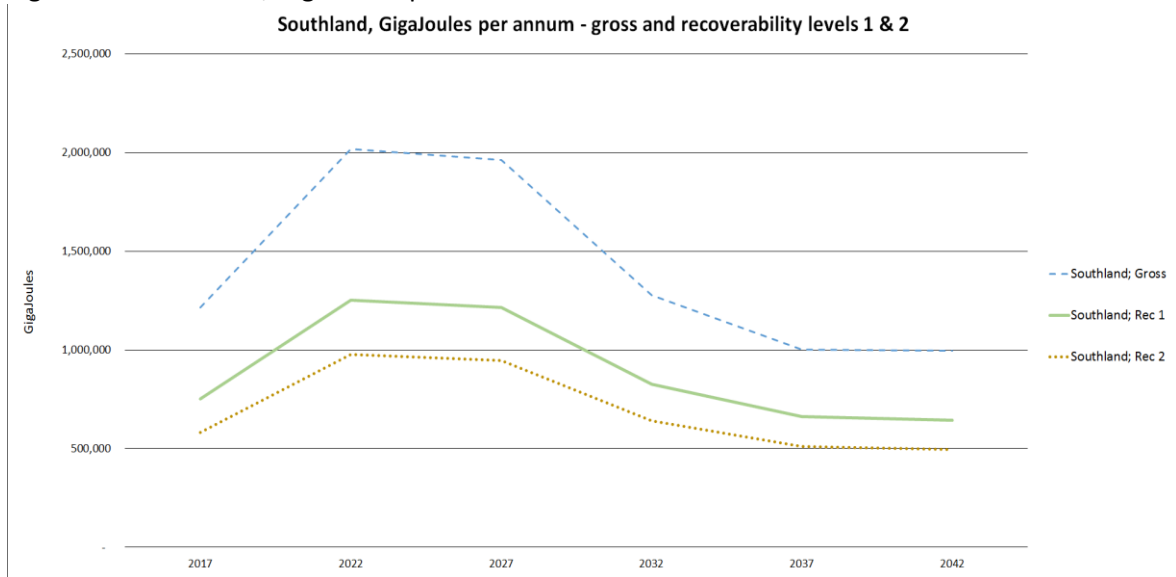


Figure 30 - New Zealand; tonnes per annum



Figure 31 - New Zealand; GigaJoules per annum

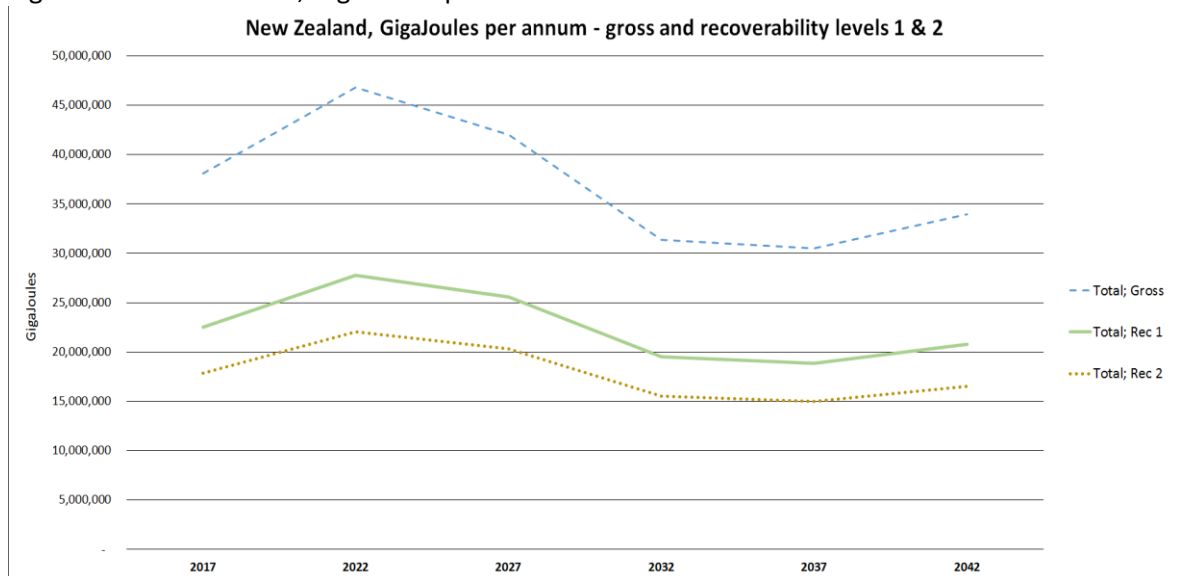


Figure 32 shows the total biomass (green tonnes) under recoverability level 1, by region and resource type for the period 2032 to 2037. This period is chosen as it represents the low point in supply in the 25 year period assessed.

There are some standout items; in-forest residues occur in all regions - in proportion to the size of the forest estate and the slope of the land on which those forests occur. Hence the Bay of Plenty has a large volume of residues available as it has a large forest resource, much of which is on flat to rolling terrain.

Canterbury is the one region that has a substantial resource coming from agricultural straws. Several other regions have small quantities of this material

There are several regions where the wood processing residue volume is negative - this is in regions where there are several energy intensive (LVL, MDF, pulp and paper) wood processors.

Auckland and Waikato have large quantities of municipal wood waste - which is largely population driven.

Residuals from orchards are only prominent in Hawkes bay, Tasman/Nelson and Marlborough

Figure 32 - regional biomass availability (green tonnes per annum) by type in 2037

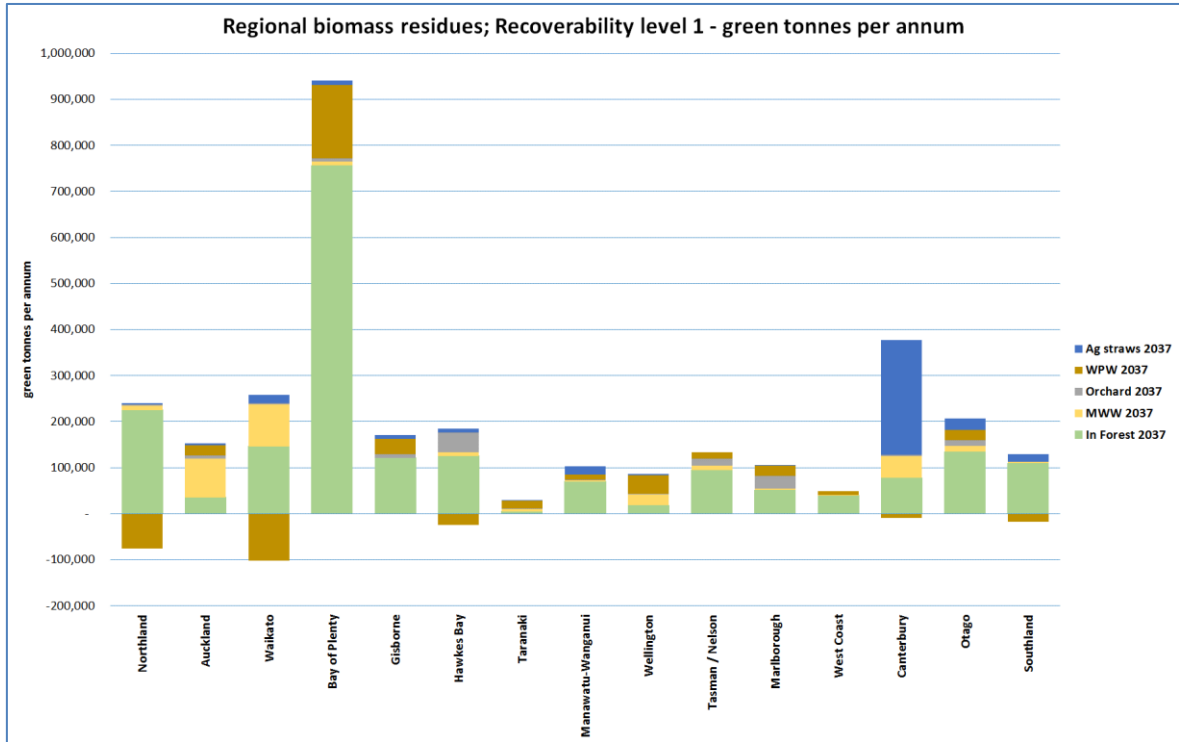
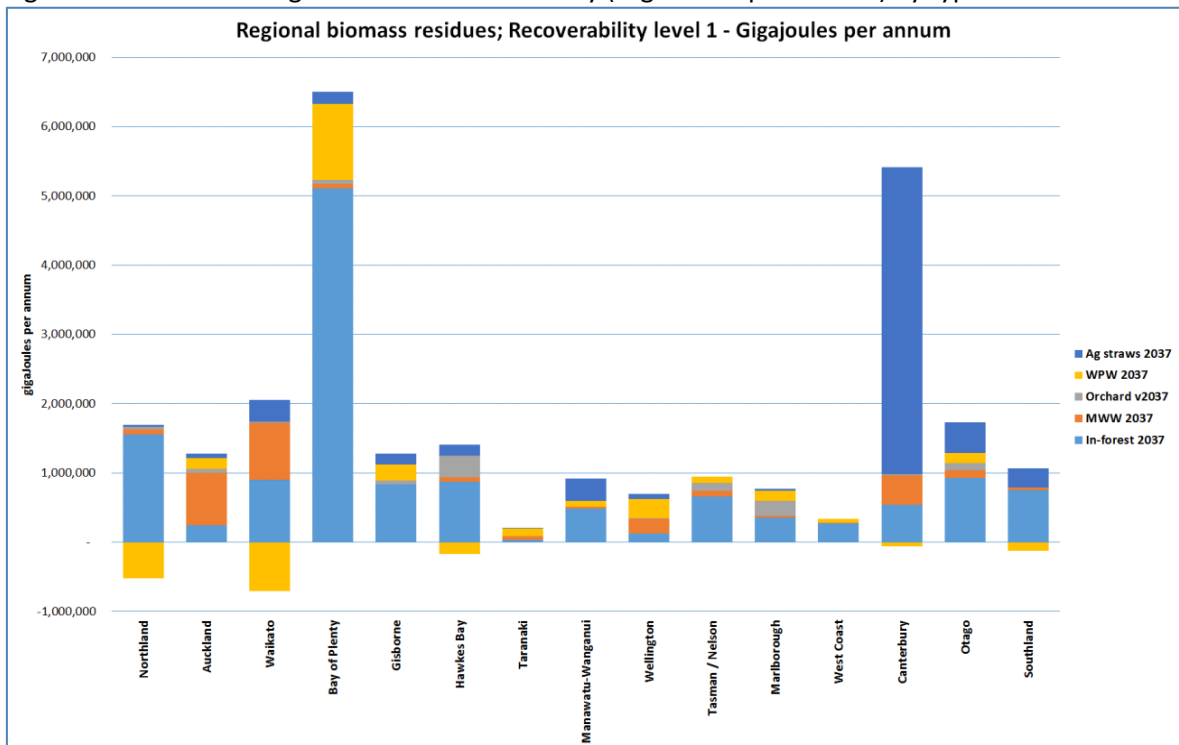


Figure 33 - estimated regional biomass availability (GigaJoules per annum) by type in 2037



The data on volume and costs can be combined to give an indicative cost supply curve for tonnes of woody biomass at a national level (Figure 34). A similar chart can be generated for the cost per unit of energy (GJ, Figure 35). Figures 36 to 339 provide cost supply curves for the two different levels of recovery by tonnage and energy.



Figure 34 - gross residual woody biomass supply; by tonnes per annum and cost

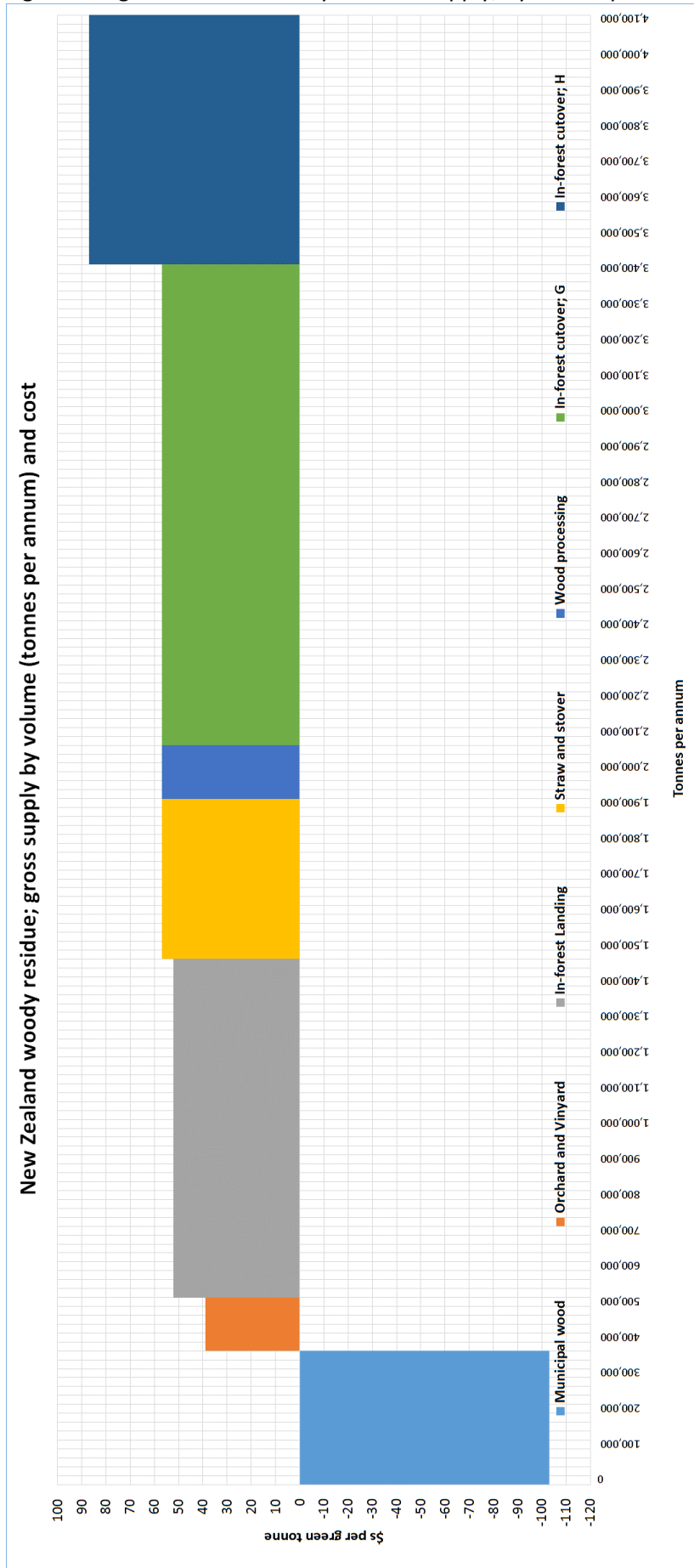


Figure 35 - gross residual biomass supply; by energy (GJ p.a.) and cost

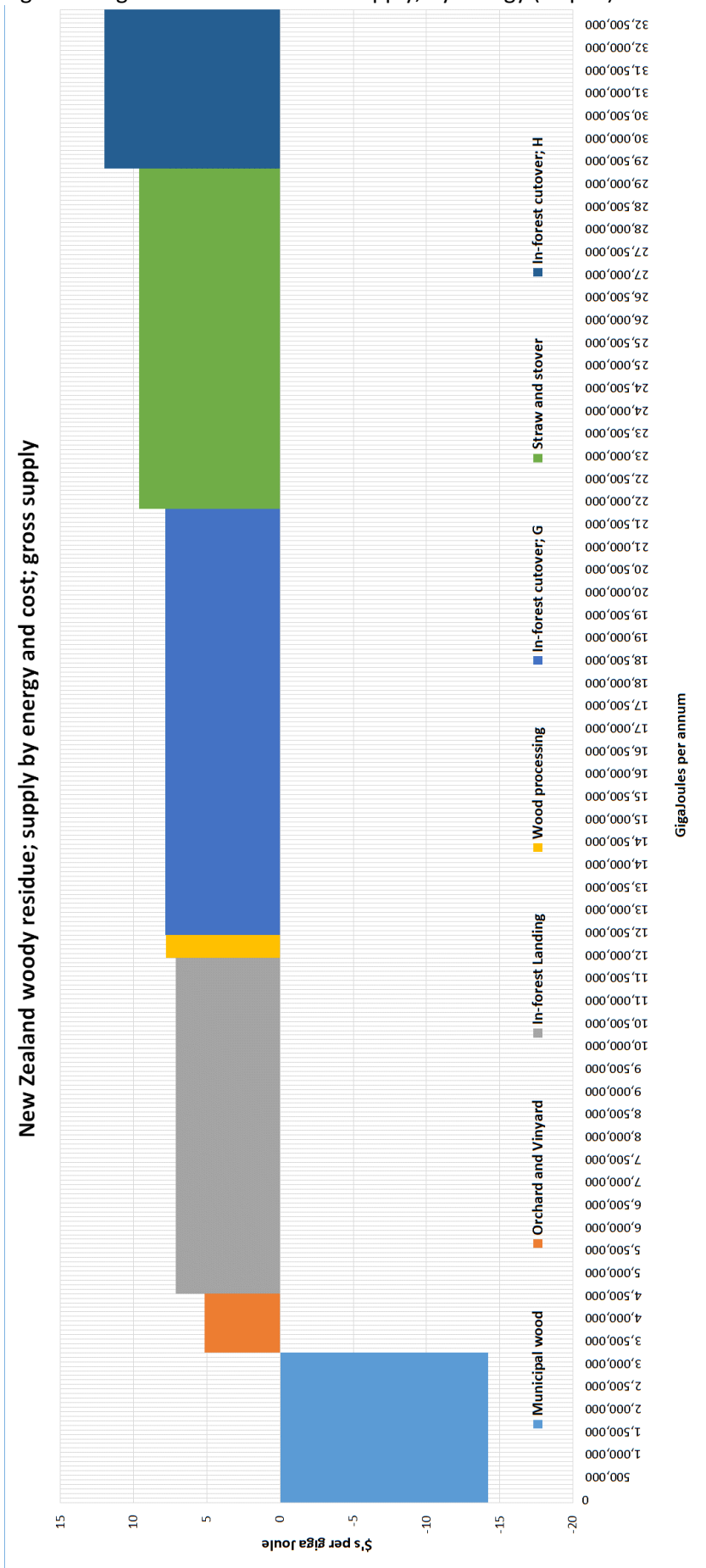


Figure 36 - Recoverability level 1; by tonnes per annum and cost

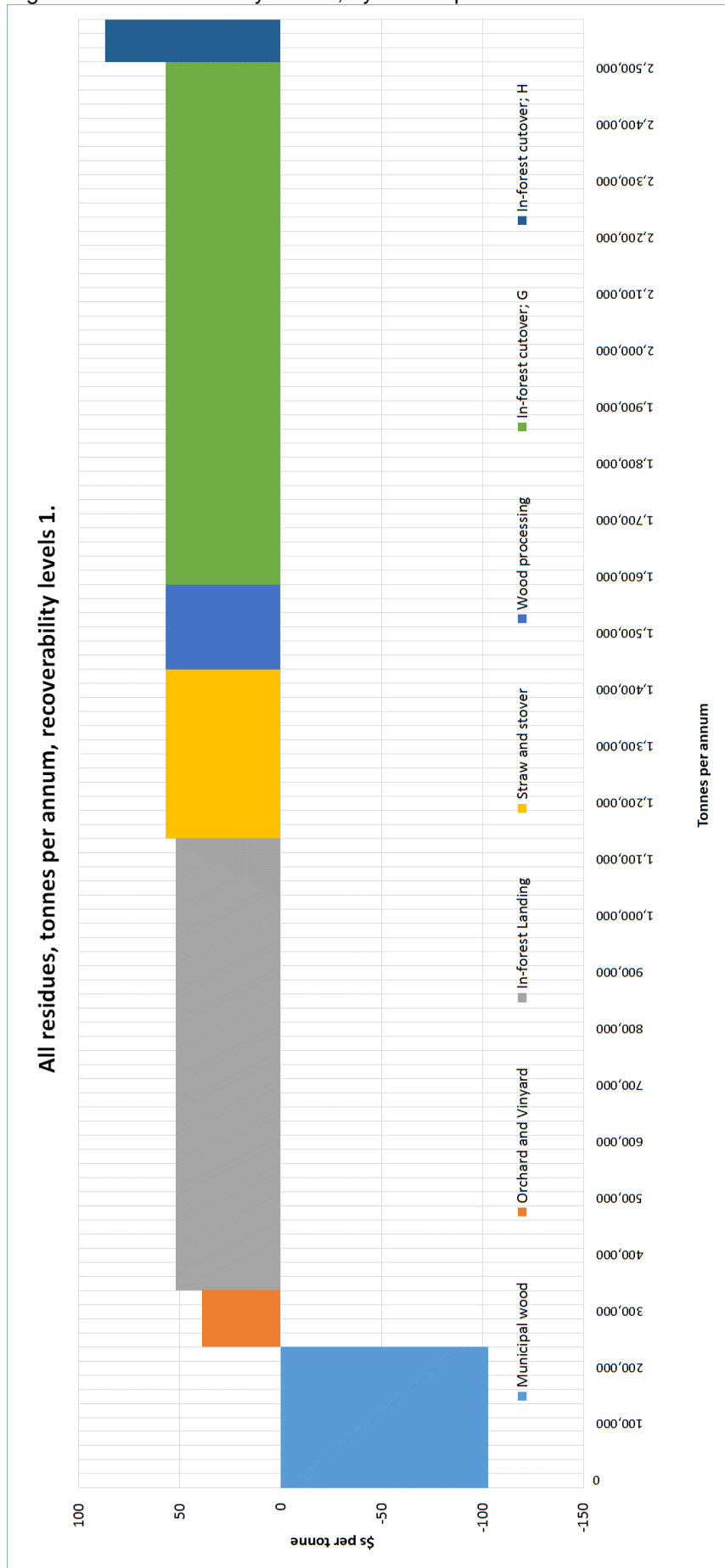


Figure 37 - Recoverability level 1; by energy (GJ per annum) and cost

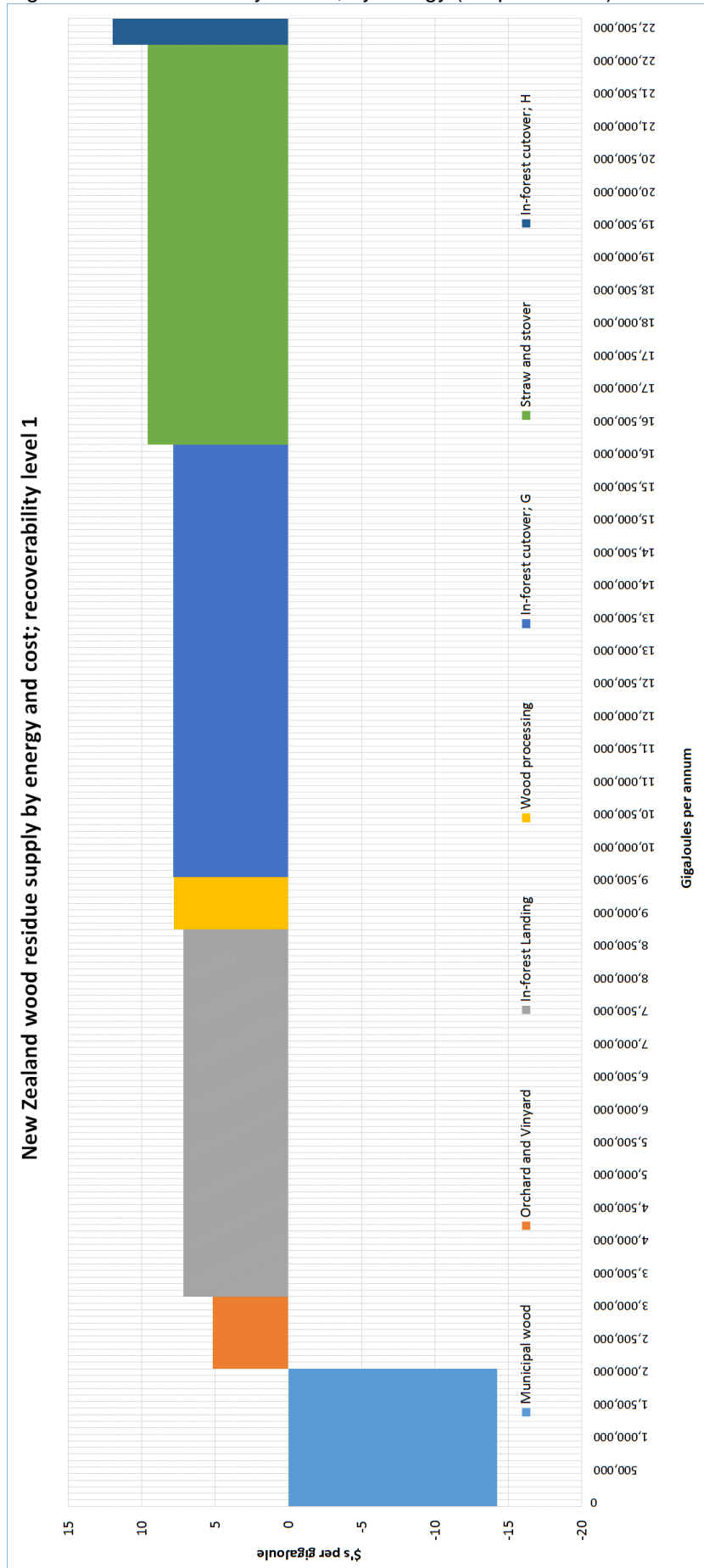


Figure 38 - Recoverability level 2; by tonnes per annum and cost

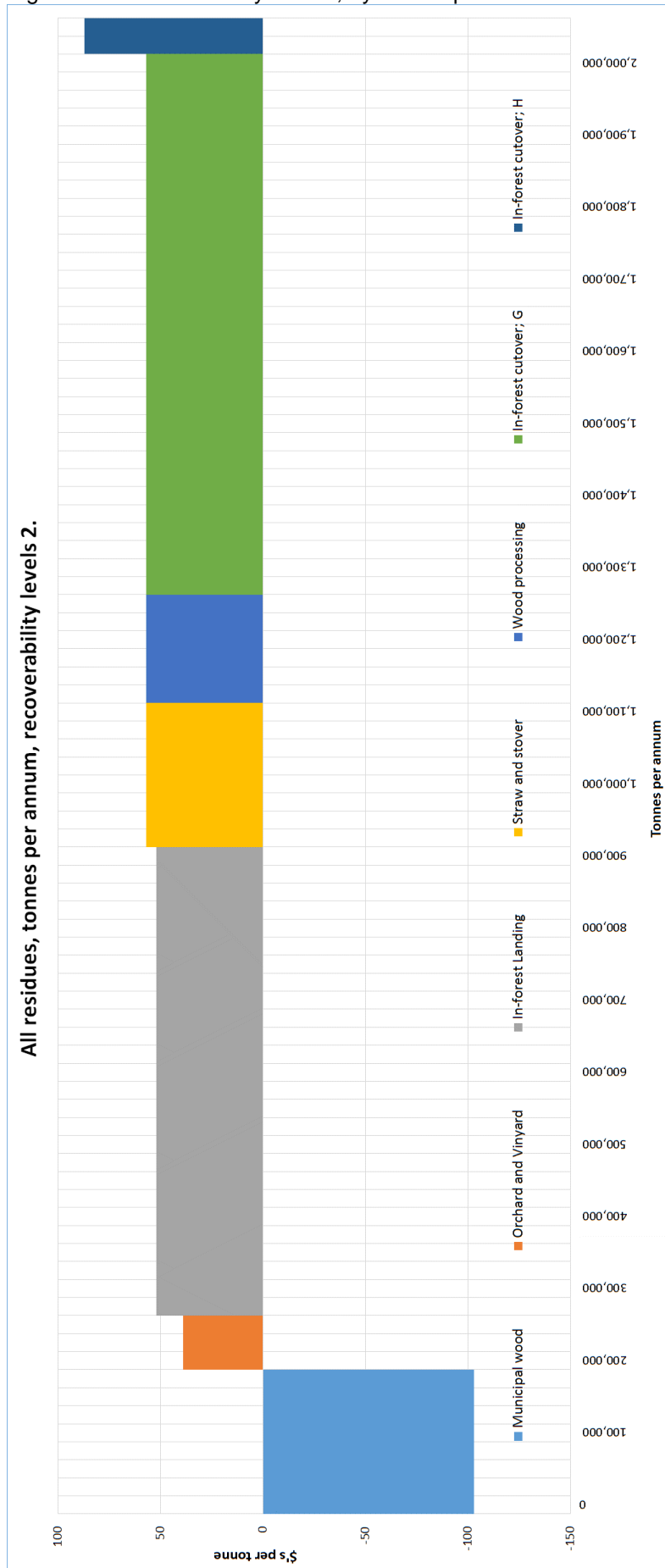
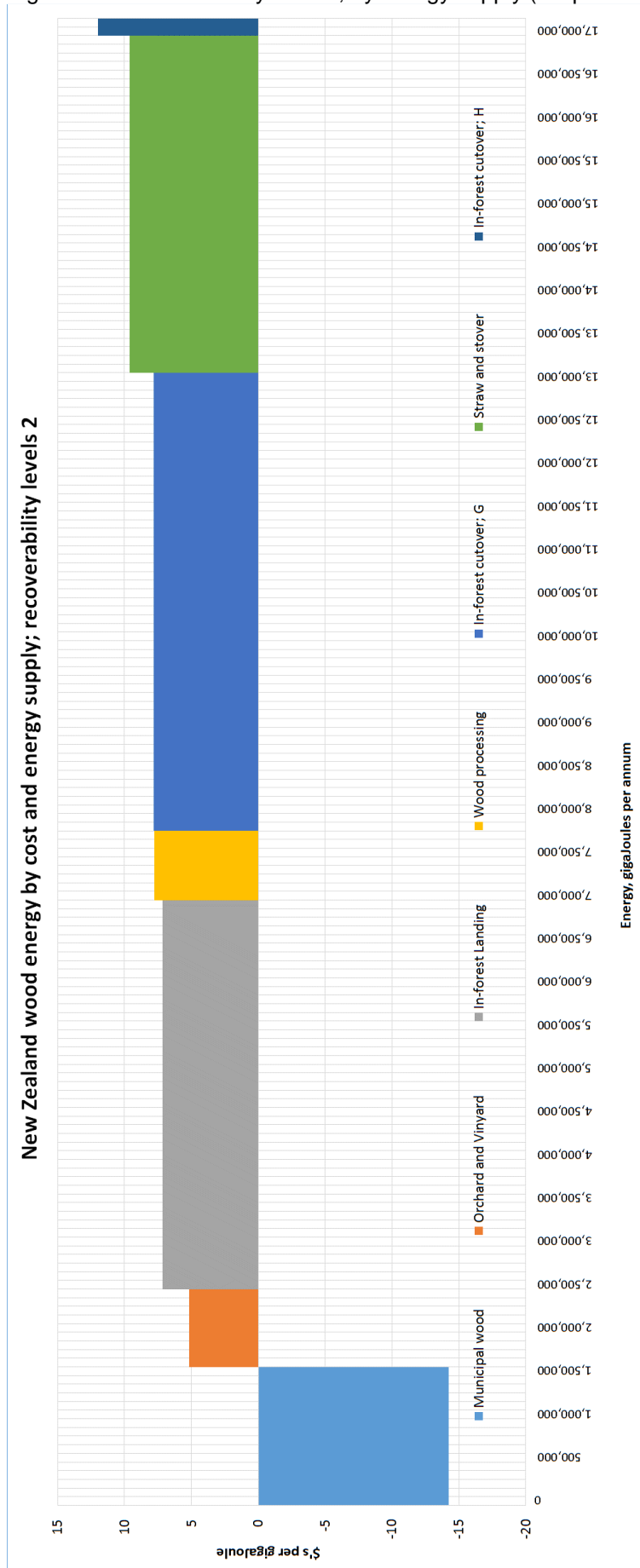


Figure 39 - Recoverability level 2; by energy supply (GJ per annum) and cost



# Other resources

## Port derived bark

There is a potential resource of bark that is generated at log export ports around New Zealand. Currently this material is generally removed and used for landscaping, mulch and compost. The \$ per tonne return on this to the port is generally very low.

Bark at the ports is derived in two ways;

- deliberate debarking
- collateral bark removal during log handling

The material in the second category is usually contaminated with dirt as it falls on the ground and has to be swept up, along with all the other debris that is on the wharf.

The amount of bark produced is proportional to the amount of logs exported, but there is limited data on the amounts port by port and only some ports debark deliberately, and only some logs are debarked.

There is potential for debarking at ports or central facilities to increase the volume of debarking of export logs due to possible changes in phytosanitary requirements.

However, given the number of variables at play (variation in harvest volume, proportion of logs exported versus processing domestically, changes in harvesting practices etc.), it is difficult to predict accurately the amount of bark that might accrue port by port over time.

This is a resource that would warrant a greater focus in any review of this data.

An estimate of the volumes currently produced and exported is provided in Table 5.

Table 5 - green tonnes per annum of bark produced at and exported via New Zealand ports

	<b>Bark at Port</b>	<b>Bark exported</b>
Whangarei	41,025	40,205
Auckland	1,651	1,618
Tauranga	81,641	80,008
Gisborne	34,852	34,155
Napier	17,577	17,226
New Plymouth	4,881	4,783
Wellington	15,512	15,202
Nelson	10,071	9,870
Picton	9,968	9,769
Christchurch	7,945	7,786
Timaru	5,282	5,176
Dunedin	13,261	12,996
Invercargill	7,233	7,088
<b>Total</b>	<b>250,899</b>	<b>245,881</b>

# Green-house gas reduction potential estimate

One of the drivers for using woody biomass as a heat fuel is that it is very low in carbon emissions in comparison to coal. If the woody biomass is used to displace coal for heat then substantial GHG emissions reductions are technically possible (Table 6).

Table 6 - Potential greenhouse gas emission reductions (t CO<sub>2</sub>e) assuming all available biomass is consumed and displaces coal

	<b>Gross</b>	<b>Recoverability level 1</b>	<b>Recoverability level 2</b>
<b>Northland</b>	192,625	108,683	78,985
<b>Auckland</b>	172,099	115,312	90,802
<b>Waikato</b>	212,014	108,942	72,803
<b>Bay of Plenty</b>	897,152	613,626	505,072
<b>Gisborne</b>	199,419	106,887	87,094
<b>Hawkes Bay</b>	187,423	103,500	79,390
<b>Taranaki</b>	26,301	19,249	16,679
<b>Manawatu-Wanganui</b>	97,874	56,408	45,523
<b>Wellington</b>	84,685	59,254	50,086
<b>Tasman / Nelson</b>	63,728	0	0
<b>Marlborough</b>	124,629	70,362	57,424
<b>West Coast</b>	40,629	65,847	50,414
<b>Canterbury</b>	143,235	48,109	37,401
<b>Otago</b>	206,447	131,604	106,543
<b>Southland</b>	102,169	67,551	52,220
<b>Total</b>	<b>2,750,428</b>	<b>1,652,027</b>	<b>1,294,227</b>

## Regional wood supply versus coal demand - matches and mismatches

New Zealand's total coal demand in 2015 was reported as 55.38PJ in total primary energy (MBIE 2016). If electricity generation and co-generation are excluded the demand is around 24 PJ of industrial heat. All biomass residues at a national level total 18.8 PJ at recovery level 1.

There are a number of regions where the supply of wood residues is not well aligned with the local coal demand, for example; the East Coast has a substantial wood residue resource and almost no coal demand. Waikato has coal demand well in excess of its residual wood supply whereas neighbouring Bay of Plenty has a significant wood resource well in excess of its coal demand. There is potential for region to region movement of biomass to correct imbalances in cases where the regions are close to each other. In the case of the East Coast its comparative isolation means transport costs for residues to move to another region would be high. There is potential for densification of residues into pellets, pillow briquettes or log briquettes to increase the energy content per cubic metre, thus reducing the transport cost as trucks can meet their full payload, enabling transport of wood fuels over longer distances.

However, the mismatches at a regional level (Table 7) that mean that not all the coal will be able to be replaced with wood easily, without long transport distances.



Table 7 - estimates of regional coal demand and residual biomass supply

	<b>Coal demand GJ p. a.</b>	<b>Biomass GJ p.a. Recoverability 1</b>	<b>Biomass useable GJ p.a.</b>
<b>Northland</b>	310,500	1,172,536	862,036
<b>Auckland</b>	531,300	1,279,833	748,533
<b>Waikato</b>	4,243,500	1,458,420	- 2,785,080
<b>Bay of Plenty</b>	2,532,300	6,621,748	4,089,448
<b>Gisborne</b>	-	1,273,680	1,273,680
<b>Hawkes Bay</b>	1,352,400	1,242,046	- 110,354
<b>Taranaki</b>	48,300	209,649	161,349
<b>Manawatu-Whanganui</b>	317,400	914,743	597,343
<b>Wellington</b>	207,000	693,923	486,923
<b>Nelson</b>	1,069,500	945,882	- 123,618
<b>Marlborough</b>	227,700	772,963	545,263
<b>Canterbury</b>	4,022,700	4,937,721	915,021
<b>West Coast</b>	1,462,800	756,212	- 706,588
<b>Otago</b>	1,918,200	1,728,139	- 190,061
<b>Southland</b>	5,816,700	943,871	- 4,872,829
<b>Total</b>	<b>24,060,300</b>	<b>25,370,398</b>	<b>15,271,770</b>

Note - assumes recoverability level 1 and the long-term availability level.

The data in table suggests that around 60% of the coal demand for heat could be met from woody biomass.

## Conclusions and recommendations

Whilst the gross levels of biomass availability are a useful start point, they should not be used as an estimate of commercially extractable biomass without further more detailed examination of the resources at a site specific level.

The first level of recoverability figures are suggested as a realistic start point for the amount of material that could be commercially recoverable.

Within any region the residuals resource is finite, and the first users to contract supply are likely to get the cheapest and / or best quality resources. Subsequent entrants to the market may find that the cost of supply is greater than the average suggested here.

As time progresses it is possible that the use of woody residues from a variety of sources will increase. This data on wood energy use needs to be captured and the information added to the data set here, so that true volumes are presented in future updates. For example, at the moment, there is very little use of in-forest residues, but if this changes and large volumes are extracted in a particular region, this should be noted so that the total availability is still accurate.

The development of new or expanded wood processing facilities will have an effect on the supply wood processing residues. These changes are difficult to predict and therefore a review of the data at a regional level on a regular basis (bi-annual) is suggested.

Better, more up-to-date data on orchard and arable crop residues is potentially available and this should be added in the next revision of this data set. The areas of arable cropping can change from year to year. Orchard areas can also change quite quickly at a regional level and this needs to be monitored and kept up to date. Forest areas are not subject to change quite as quickly as the crop rotation length is ~25 years. However, there are still changes to the data on the forest resource and the Ministry of Primary Industries provides an annual update (National Exotic Forest Description) and any major changes in this should be noted and incorporated in any updates. The methods used to generate the NEFD are being reviewed and in the next 2 years it is possible that the data will be more spatially based. Data on bark at ports should be examined in more detail.

Biomass residuals could displace at least half of New Zealand's coal demand, potentially as much as 70% with a subsequent impact on greenhouse gas emissions of ~1.1 million tonnes of CO<sub>2</sub>e per annum displaced.

Use of biomass for heat is not limited to displacing coal, and in some circumstances biomass could substitute for gas, increasing its market penetration and volume of uptake in some regions where coal use is low but gas is used as a heat fuel (Gisborne / East Coast).

# Acknowledgements

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Input into review of the report from Brook Brewerton, Richard Ireland, Scott Fairbairn, Brad Coleman, Brain Cox and John Gifford is appreciated.

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## Appendix 1 - In forest residues

All in-forest residues (smoothed) - gross tonnage (green tonnes per annum)

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	473,017	428,259	343,866	261,702	349,134	451,133
<b>Auckland</b>	97,823	147,582	142,280	100,788	56,528	44,447
<b>Waikato</b>	340,945	510,364	418,602	234,496	240,709	278,972
<b>Bay of Plenty</b>	1,017,020	1,279,328	1,381,768	1,156,904	1,171,779	1,329,208
<b>Gisborne</b>	491,860	557,465	391,539	213,320	258,516	365,789
<b>Hawkes Bay</b>	370,591	528,202	422,080	302,947	237,497	245,670
<b>Taranaki</b>	70,989	84,221	42,873	16,847	10,443	14,758
<b>Manawatu-Wanganui</b>	375,157	468,019	304,027	153,240	130,390	148,780
<b>Wairarapa</b>	14,162	9,551	2,724	2,024	602	151
<b>Wellington</b>	90,939	105,844	77,808	40,501	37,535	48,236
<b>Tasman / Nelson</b>	308,795	357,309	291,837	270,574	224,913	189,037
<b>Marlborough</b>	143,264	156,976	105,536	83,703	122,656	165,607
<b>West Coast</b>	70,076	69,455	76,207	72,530	61,375	49,270
<b>Canterbury</b>	340,207	401,701	311,144	172,820	126,554	136,137
<b>Otago</b>	313,070	425,154	364,800	245,464	226,729	234,284
<b>Southland</b>	188,271	304,299	296,210	196,946	156,780	156,238
<b>Total</b>	<b>4,766,149</b>	<b>5,990,069</b>	<b>5,252,685</b>	<b>3,663,966</b>	<b>3,487,449</b>	<b>3,933,219</b>

All in-forest residues (smoothed) - gross energy (GJ per annum)

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	3,263,816	2,954,988	2,372,674	1,805,742	2,409,021	3,112,819
<b>Auckland</b>	674,979	1,018,316	981,731	695,440	390,046	306,681
<b>Waikato</b>	2,352,522	3,521,510	2,888,352	1,618,021	1,660,893	1,924,907
<b>Bay of Plenty</b>	7,017,436	8,827,363	9,534,198	7,982,640	8,085,274	9,171,537
<b>Gisborne</b>	3,393,834	3,846,510	2,701,616	1,471,906	1,783,758	2,523,944
<b>Hawkes Bay</b>	2,557,076	3,644,591	2,912,349	2,090,335	1,638,729	1,695,120
<b>Taranaki</b>	489,823	581,122	295,826	116,244	72,054	101,827
<b>Manawatu-Wanganui</b>	2,588,585	3,229,334	2,097,786	1,057,353	899,690	1,026,581
<b>Wairarapa</b>	97,718	65,899	18,793	13,966	4,154	1,041
<b>Wellington</b>	627,481	730,324	536,876	279,455	258,994	332,829
<b>Tasman / Nelson</b>	2,130,685	2,465,435	2,013,673	1,866,960	1,551,897	1,304,354
<b>Marlborough</b>	988,521	1,083,132	728,196	577,554	846,326	1,142,691
<b>West Coast</b>	483,527	479,238	525,828	500,456	423,487	339,960
<b>Canterbury</b>	2,347,426	2,771,735	2,146,894	1,192,460	873,223	939,346
<b>Otago</b>	2,160,186	2,933,565	2,517,121	1,693,699	1,564,429	1,616,556
<b>Southland</b>	1,299,073	2,099,665	2,043,846	1,358,929	1,081,783	1,078,045
<b>Total</b>	<b>32,886,430</b>	<b>41,331,480</b>	<b>36,243,524</b>	<b>25,281,366</b>	<b>24,063,395</b>	<b>27,139,213</b>

All in-forest residues; recoverability level 1, green tonnes per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	301,433	271,718	218,591	169,173	225,005	289,503
<b>Auckland</b>	60,231	91,219	88,031	62,450	35,113	27,678
<b>Waikato</b>	208,356	313,747	257,222	143,219	146,344	169,674
<b>Bay of Plenty</b>	650,963	833,790	900,685	754,312	756,486	852,511
<b>Gisborne</b>	231,489	262,719	184,302	100,506	121,431	171,686
<b>Hawkes Bay</b>	196,912	282,068	225,500	160,417	125,737	129,907
<b>Taranaki</b>	33,327	39,478	20,239	8,253	4,941	6,558
<b>Manawatu-Wanganui</b>	201,670	252,584	164,128	81,026	70,116	81,404
<b>Wairarapa</b>	7,809	5,328	1,503	1,136	343	85
<b>Wellington</b>	45,060	52,037	37,833	19,810	18,318	23,532
<b>Tasman / Nelson</b>	116,395	139,049	118,012	113,729	95,229	79,629
<b>Marlborough</b>	69,552	76,334	49,391	37,349	51,296	67,697
<b>West Coast</b>	44,325	44,241	48,316	46,349	39,668	31,956
<b>Canterbury</b>	194,866	228,751	179,714	103,951	77,714	83,007
<b>Otago</b>	172,754	234,092	200,749	145,734	134,440	130,424
<b>Southland</b>	122,747	195,047	189,638	132,989	109,336	106,851
<b>Total</b>	<b>2,709,379</b>	<b>3,449,586</b>	<b>3,108,039</b>	<b>2,192,213</b>	<b>2,071,903</b>	<b>2,312,506</b>

All in-forest residues; recoverability level 1, GJ per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	2,079,889	1,874,857	1,508,278	1,167,292	1,552,533	1,997,572
<b>Auckland</b>	415,595	629,409	607,415	430,905	242,280	190,979
<b>Waikato</b>	1,437,653	2,164,853	1,774,833	988,210	1,009,776	1,170,749
<b>Bay of Plenty</b>	4,491,642	5,753,148	6,214,724	5,204,751	5,219,750	5,882,326
<b>Gisborne</b>	1,597,272	1,812,760	1,271,684	693,488	837,873	1,184,636
<b>Hawkes Bay</b>	1,358,693	1,946,267	1,555,952	1,106,879	867,584	896,358
<b>Taranaki</b>	229,959	272,399	139,647	56,944	34,092	45,252
<b>Manawatu-Wanganui</b>	1,391,524	1,742,831	1,132,485	559,076	483,802	561,688
<b>Wairarapa</b>	53,884	36,763	10,371	7,837	2,364	586
<b>Wellington</b>	310,916	359,058	261,049	136,691	126,393	162,369
<b>Tasman / Nelson</b>	803,127	959,436	814,280	784,732	657,079	549,443
<b>Marlborough</b>	479,911	526,702	340,799	257,708	353,942	467,111
<b>West Coast</b>	305,839	305,260	333,379	319,810	273,710	572,749
<b>Canterbury</b>	1,344,574	1,578,385	1,240,028	717,261	536,229	220,497
<b>Otago</b>	1,192,001	1,615,238	1,385,171	1,005,562	927,637	899,923
<b>Southland</b>	846,956	1,345,821	1,308,504	917,624	754,416	737,273
<b>Total</b>	<b>18,694,717</b>	<b>23,802,144</b>	<b>21,445,472</b>	<b>15,126,272</b>	<b>14,296,132</b>	<b>15,956,290</b>

All in-forest residues; recoverability level 2, green tonnes per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	240,287	216,553	174,236	135,002	179,528	230,927
<b>Auckland</b>	47,901	72,572	70,042	49,695	27,948	22,035
<b>Waikato</b>	165,656	249,570	204,600	113,863	116,315	134,872
<b>Bay of Plenty</b>	519,138	665,795	719,224	602,389	603,746	680,070
<b>Gisborne</b>	180,230	204,575	143,495	78,260	94,523	133,631
<b>Hawkes Bay</b>	154,948	222,053	177,529	126,199	98,917	102,192
<b>Taranaki</b>	25,927	30,705	15,750	6,445	3,845	5,071
<b>Manawatu-Wanganui</b>	158,718	198,863	129,222	63,689	55,190	64,159
<b>Wairarapa</b>	6,160	4,207	1,186	897	271	67
<b>Wellington</b>	35,228	40,656	29,530	15,472	14,305	18,376
<b>Tasman / Nelson</b>	88,424	106,059	90,454	87,590	73,406	61,347
<b>Marlborough</b>	54,385	59,701	38,483	28,958	39,490	51,978
<b>West Coast</b>	35,260	35,206	38,436	36,904	31,624	25,491
<b>Canterbury</b>	153,987	180,679	142,117	82,510	61,820	65,986
<b>Otago</b>	136,219	184,507	158,198	115,683	106,748	102,977
<b>Southland</b>	97,940	155,373	151,031	106,455	87,796	85,648
<b>Total</b>	<b>2,142,429</b>	<b>2,730,697</b>	<b>2,465,717</b>	<b>1,740,884</b>	<b>1,644,544</b>	<b>1,833,905</b>

All in-forest residues; recoverability level 2, GJ per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	1,657,977	1,494,214	1,202,227	931,514	1,238,747	1,593,394
<b>Auckland</b>	330,519	500,745	483,292	342,898	192,842	152,044
<b>Waikato</b>	1,143,028	1,722,030	1,411,743	785,658	802,571	930,618
<b>Bay of Plenty</b>	3,582,054	4,593,984	4,962,648	4,156,483	4,165,850	4,692,484
<b>Gisborne</b>	1,243,590	1,411,564	990,113	539,992	652,210	922,057
<b>Hawkes Bay</b>	1,069,142	1,532,166	1,224,948	870,770	682,524	705,127
<b>Taranaki</b>	178,895	211,867	108,672	44,473	26,533	34,990
<b>Manawatu-Wanganui</b>	1,095,154	1,372,156	891,634	439,451	380,811	442,695
<b>Wairarapa</b>	42,503	29,025	8,181	6,190	1,869	463
<b>Wellington</b>	243,074	280,529	203,756	106,756	98,702	126,793
<b>Tasman / Nelson</b>	610,125	731,810	624,130	604,371	506,504	423,297
<b>Marlborough</b>	375,254	411,939	265,529	199,810	272,481	358,647
<b>West Coast</b>	243,291	242,923	265,208	254,641	218,207	455,306
<b>Canterbury</b>	1,062,511	1,246,683	980,608	569,316	426,555	175,886
<b>Otago</b>	939,911	1,273,098	1,091,567	798,215	736,558	710,542
<b>Southland</b>	675,786	1,072,076	1,042,113	734,539	605,792	590,969
<b>Total</b>	<b>14,782,760</b>	<b>18,841,807</b>	<b>17,013,451</b>	<b>12,012,098</b>	<b>11,347,351</b>	<b>12,653,946</b>

## Appendix 2 - Municipal wood wastes

Municipal wood wastes - gross tonnes per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	10,558	11,307	12,108	12,967	13,886	14,871
<b>Auckland</b>	79,860	90,442	102,427	115,999	131,370	148,778
<b>Waikato</b>	105,118	113,465	122,474	132,199	142,696	154,027
<b>Bay of Plenty</b>	8,964	9,685	10,464	11,306	12,216	13,199
<b>Gisborne</b>	105	116	129	143	158	175
<b>Hawkes Bay</b>	10,540	10,958	11,392	11,843	12,312	12,800
<b>Taranaki</b>	8,483	8,654	8,828	9,006	9,187	9,372
<b>Manawatu-Wanganui</b>	4,119	4,185	4,253	4,321	4,391	4,461
<b>Wellington</b>	27,585	29,512	31,575	33,781	36,141	38,667
<b>Tasman / Nelson</b>	14,254	14,432	14,612	14,794	14,979	15,166
<b>Marlborough</b>	4,018	4,376	4,765	5,190	5,652	6,155
<b>West Coast</b>	1,103	1,211	1,329	1,459	1,601	1,757
<b>Canterbury</b>	63,198	65,768	68,442	71,225	74,121	77,135
<b>Otago</b>	14,482	15,663	16,940	18,321	19,814	21,430
<b>Southland</b>	5,384	5,433	5,482	5,531	5,581	5,631
<b>Total</b>	<b>357,771</b>	<b>385,206</b>	<b>415,219</b>	<b>448,085</b>	<b>484,106</b>	<b>523,624</b>

Municipal wood wastes - gross energy (GJ) per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	95,360	102,121	109,362	117,116	125,420	134,313
<b>Auckland</b>	721,296	816,875	925,119	1,047,706	1,186,538	1,343,767
<b>Waikato</b>	949,426	1,024,814	1,106,188	1,194,024	1,288,834	1,391,172
<b>Bay of Plenty</b>	80,963	87,476	94,514	102,118	110,334	119,210
<b>Gisborne</b>	948	1,050	1,163	1,288	1,426	1,579
<b>Hawkes Bay</b>	95,197	98,969	102,889	106,965	111,202	115,608
<b>Taranaki</b>	76,618	78,161	79,735	81,340	82,978	84,649
<b>Manawatu-Wanganui</b>	37,203	37,802	38,410	39,029	39,657	40,296
<b>Wellington</b>	249,148	266,557	285,182	305,109	326,429	349,238
<b>Tasman / Nelson</b>	128,742	130,349	131,976	133,624	135,292	136,981
<b>Marlborough</b>	36,291	39,522	43,040	46,872	51,045	55,590
<b>West Coast</b>	9,962	10,935	12,002	13,173	14,459	15,870
<b>Canterbury</b>	570,804	594,014	618,168	643,304	669,462	696,684
<b>Otago</b>	130,801	141,466	152,999	165,473	178,965	193,556
<b>Southland</b>	48,628	49,067	49,510	49,957	50,408	50,863
<b>Total</b>	<b>3,233,405</b>	<b>3,481,199</b>	<b>3,752,286</b>	<b>4,049,132</b>	<b>4,374,486</b>	<b>4,731,416</b>



Municipal wood wastes - recoverability level 1, tonnes per annum

	<b>2017</b>	<b>2022</b>	<b>2027</b>	<b>2032</b>	<b>2037</b>	<b>2042</b>
<b>Northland</b>	6,757	7,236	7,749	8,299	8,887	9,517
<b>Auckland</b>	51,110	57,883	65,553	74,240	84,077	95,218
<b>Waikato</b>	67,276	72,617	78,384	84,608	91,326	98,577
<b>Bay of Plenty</b>	5,737	6,199	6,697	7,236	7,818	8,447
<b>Gisborne</b>	67	74	82	91	101	112
<b>Hawkes Bay</b>	6,746	7,013	7,291	7,579	7,880	8,192
<b>Taranaki</b>	5,429	5,538	5,650	5,764	5,880	5,998
<b>Manawatu-Wanganui</b>	2,636	2,679	2,722	2,766	2,810	2,855
<b>Wellington</b>	17,654	18,888	20,208	21,620	23,130	24,747
<b>Tasman / Nelson</b>	9,123	9,236	9,352	9,468	9,587	9,706
<b>Marlborough</b>	2,572	2,800	3,050	3,321	3,617	3,939
<b>West Coast</b>	706	775	850	933	1,025	1,125
<b>Canterbury</b>	40,447	42,091	43,803	45,584	47,438	49,366
<b>Otago</b>	9,268	10,024	10,841	11,725	12,681	13,715
<b>Southland</b>	3,446	3,477	3,508	3,540	3,572	3,604
<b>Total</b>	<b>228,973</b>	<b>246,532</b>	<b>265,740</b>	<b>286,774</b>	<b>309,828</b>	<b>335,120</b>

Municipal wood wastes - recoverability level 1, energy (GJ) per annum

	<b>2017</b>	<b>2022</b>	<b>2027</b>	<b>2032</b>	<b>2037</b>	<b>2042</b>
<b>Northland</b>	61,030	65,358	69,992	74,954	80,269	85,960
<b>Auckland</b>	461,629	522,800	592,076	670,532	759,385	860,011
<b>Waikato</b>	607,632	655,881	707,960	764,175	824,854	890,350
<b>Bay of Plenty</b>	51,816	55,985	60,489	65,355	70,613	76,294
<b>Gisborne</b>	607	672	744	824	913	1,011
<b>Hawkes Bay</b>	60,926	63,340	65,849	68,458	71,170	73,989
<b>Taranaki</b>	49,036	50,023	51,030	52,058	53,106	54,175
<b>Manawatu-Wanganui</b>	23,810	24,193	24,583	24,978	25,381	25,789
<b>Wellington</b>	159,455	170,596	182,517	195,270	208,915	223,512
<b>Tasman / Nelson</b>	82,395	83,423	84,465	85,519	86,587	87,668
<b>Marlborough</b>	23,226	25,294	27,546	29,998	32,669	35,578
<b>West Coast</b>	6,376	6,998	7,681	8,431	9,254	10,157
<b>Canterbury</b>	365,315	380,169	395,628	411,715	428,456	445,878
<b>Otago</b>	83,713	90,538	97,920	105,903	114,537	123,876
<b>Southland</b>	31,122	31,403	31,686	31,972	32,261	32,552
<b>Total</b>	<b>2,068,088</b>	<b>2,226,673</b>	<b>2,400,166</b>	<b>2,590,144</b>	<b>2,798,367</b>	<b>3,026,800</b>

Municipal wood wastes - recoverability level 2, tonnes per annum

	<b>2017</b>	<b>2022</b>	<b>2027</b>	<b>2032</b>	<b>2037</b>	<b>2042</b>
<b>Northland</b>	5,068	5,427	5,812	6,224	6,665	7,138
<b>Auckland</b>	38,333	43,412	49,165	55,680	63,058	71,414
<b>Waikato</b>	50,457	54,463	58,788	63,456	68,494	73,933
<b>Bay of Plenty</b>	4,303	4,649	5,023	5,427	5,864	6,335
<b>Gisborne</b>	50	56	62	68	76	84
<b>Hawkes Bay</b>	5,059	5,260	5,468	5,685	5,910	6,144
<b>Taranaki</b>	4,072	4,154	4,237	4,323	4,410	4,499
<b>Manawatu-Wanganui</b>	1,977	2,009	2,041	2,074	2,108	2,141
<b>Wellington</b>	13,241	14,166	15,156	16,215	17,348	18,560
<b>Tasman / Nelson</b>	6,842	6,927	7,014	7,101	7,190	7,280
<b>Marlborough</b>	1,929	2,100	2,287	2,491	2,713	2,954
<b>West Coast</b>	529	581	638	700	768	843
<b>Canterbury</b>	30,335	31,569	32,852	34,188	35,578	37,025
<b>Otago</b>	6,951	7,518	8,131	8,794	9,511	10,286
<b>Southland</b>	2,584	2,608	2,631	2,655	2,679	2,703
<b>Total</b>	<b>171,730</b>	<b>184,899</b>	<b>199,305</b>	<b>215,081</b>	<b>232,371</b>	<b>251,340</b>

Municipal wood wastes - recoverability level 2, energy (GJ) per annum

	<b>2017</b>	<b>2022</b>	<b>2027</b>	<b>2032</b>	<b>2037</b>	<b>2042</b>
<b>Northland</b>	45,773	49,018	52,494	56,216	60,202	64,470
<b>Auckland</b>	346,222	392,100	444,057	502,899	569,538	645,008
<b>Waikato</b>	455,724	491,911	530,970	573,131	618,640	667,763
<b>Bay of Plenty</b>	38,862	41,989	45,367	49,017	52,960	57,221
<b>Gisborne</b>	455	504	558	618	684	758
<b>Hawkes Bay</b>	45,695	47,505	49,387	51,343	53,377	55,492
<b>Taranaki</b>	36,777	37,517	38,273	39,043	39,829	40,631
<b>Manawatu-Wanganui</b>	17,857	18,145	18,437	18,734	19,035	19,342
<b>Wellington</b>	119,591	127,947	136,888	146,453	156,686	167,634
<b>Tasman / Nelson</b>	61,796	62,568	63,349	64,139	64,940	65,751
<b>Marlborough</b>	17,419	18,970	20,659	22,499	24,502	26,683
<b>West Coast</b>	4,782	5,249	5,761	6,323	6,940	7,618
<b>Canterbury</b>	273,986	285,127	296,721	308,786	321,342	334,408
<b>Otago</b>	62,785	67,904	73,440	79,427	85,903	92,907
<b>Southland</b>	23,342	23,552	23,765	23,979	24,196	24,414
<b>Total</b>	<b>1,551,066</b>	<b>1,670,005</b>	<b>1,800,124</b>	<b>1,942,608</b>	<b>2,098,776</b>	<b>2,270,100</b>

## Appendix 3 - Orchard residues

Orchard residues - gross green tonnes per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	4,479	4,568	4,660	4,753	4,848	4,945
<b>Auckland</b>	8,219	8,383	8,551	8,722	8,897	9,074
<b>Waikato</b>	2,788	2,844	2,901	2,959	3,018	3,078
<b>Bay of Plenty</b>	8,832	9,009	9,189	9,373	9,560	9,752
<b>Gisborne</b>	8,161	8,324	8,491	8,661	8,834	9,011
<b>Hawkes Bay</b>	49,465	50,454	51,463	52,492	53,542	54,613
<b>Taranaki</b>	127	130	132	135	138	140
<b>Manawatu-Wanganui</b>	678	692	706	720	734	749
<b>Wellington</b>	1,443	1,472	1,501	1,531	1,562	1,593
<b>Tasman / Nelson</b>	17,768	18,123	18,485	18,855	19,232	19,617
<b>Marlborough</b>	32,201	32,845	33,502	34,172	34,855	35,553
<b>West Coast</b>	-	-	-	-	-	-
<b>Canterbury</b>	2,980	3,040	3,101	3,163	3,226	3,291
<b>Otago</b>	14,748	15,043	15,344	15,651	15,964	16,283
<b>Southland</b>	-	-	-	-	-	-
<b>Total</b>	<b>151,889</b>	<b>154,927</b>	<b>158,026</b>	<b>161,186</b>	<b>164,410</b>	<b>167,698</b>

Orchard residues - gross energy (GJ) per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	32,964	33,623	34,296	34,982	35,681	36,395
<b>Auckland</b>	60,492	61,702	62,936	64,195	65,478	66,788
<b>Waikato</b>	20,520	20,930	21,349	21,776	22,212	22,656
<b>Bay of Plenty</b>	65,006	66,306	67,632	68,984	70,364	71,771
<b>Gisborne</b>	60,066	61,268	62,493	63,743	65,018	66,318
<b>Hawkes Bay</b>	364,059	371,340	378,767	386,343	394,069	401,951
<b>Taranaki</b>	936	955	974	993	1,013	1,033
<b>Manawatu-Wanganui</b>	4,992	5,092	5,194	5,298	5,404	5,512
<b>Wellington</b>	10,620	10,832	11,049	11,270	11,495	11,725
<b>Tasman / Nelson</b>	130,769	133,384	136,052	138,773	141,548	144,379
<b>Marlborough</b>	237,000	241,740	246,575	251,506	256,536	261,667
<b>West Coast</b>	-	-	-	-	-	-
<b>Canterbury</b>	21,936	22,375	22,822	23,279	23,744	24,219
<b>Otago</b>	108,545	110,716	112,930	115,189	117,492	119,842
<b>Southland</b>	-	-	-	-	-	-
<b>Total</b>	<b>1,117,905</b>	<b>1,140,263</b>	<b>1,163,068</b>	<b>1,186,330</b>	<b>1,210,056</b>	<b>1,234,257</b>

Orchard residues - recoverability level 1, green tonnes per annum

	<b>2017</b>	<b>2022</b>	<b>2027</b>	<b>2032</b>	<b>2037</b>	<b>2042</b>
<b>Northland</b>	3,583	3,655	3,728	3,802	3,878	3,956
<b>Auckland</b>	6,575	6,707	6,841	6,978	7,117	7,260
<b>Waikato</b>	2,230	2,275	2,321	2,367	2,414	2,463
<b>Bay of Plenty</b>	7,066	7,207	7,351	7,498	7,648	7,801
<b>Gisborne</b>	6,529	6,660	6,793	6,929	7,067	7,208
<b>Hawkes Bay</b>	39,572	40,363	41,170	41,994	42,834	43,690
<b>Taranaki</b>	102	104	106	108	110	112
<b>Manawatu-Wanganui</b>	543	553	565	576	587	599
<b>Wellington</b>	1,154	1,177	1,201	1,225	1,250	1,274
<b>Tasman / Nelson</b>	14,214	14,498	14,788	15,084	15,386	15,693
<b>Marlborough</b>	25,761	26,276	26,802	27,338	27,884	28,442
<b>West Coast</b>	-	-	-	-	-	-
<b>Canterbury</b>	2,384	2,432	2,481	2,530	2,581	2,633
<b>Otago</b>	11,798	12,034	12,275	12,521	12,771	13,026
<b>Southland</b>	-	-	-	-	-	-
<b>Total</b>	<b>121,511</b>	<b>123,942</b>	<b>126,420</b>	<b>128,949</b>	<b>131,528</b>	<b>134,158</b>

Orchard residues - recoverability level 1, energy (GJ) per annum

	<b>2017</b>	<b>2022</b>	<b>2027</b>	<b>2032</b>	<b>2037</b>	<b>2042</b>
<b>Northland</b>	26,371	26,899	27,437	27,985	28,545	29,116
<b>Auckland</b>	48,394	49,361	50,349	51,356	52,383	53,430
<b>Waikato</b>	16,416	16,744	17,079	17,421	17,769	18,125
<b>Bay of Plenty</b>	52,004	53,045	54,105	55,188	56,291	57,417
<b>Gisborne</b>	48,053	49,014	49,994	50,994	52,014	53,055
<b>Hawkes Bay</b>	291,247	297,072	303,014	309,074	315,256	321,561
<b>Taranaki</b>	749	764	779	795	811	827
<b>Manawatu-Wanganui</b>	3,994	4,073	4,155	4,238	4,323	4,409
<b>Wellington</b>	8,496	8,666	8,839	9,016	9,196	9,380
<b>Tasman / Nelson</b>	104,615	106,707	108,841	111,018	113,239	115,503
<b>Marlborough</b>	189,600	193,392	197,260	201,205	205,229	209,334
<b>West Coast</b>	-	-	-	-	-	-
<b>Canterbury</b>	17,549	17,900	18,258	18,623	18,995	19,375
<b>Otago</b>	86,836	88,573	90,344	92,151	93,994	95,874
<b>Southland</b>	-	-	-	-	-	-
<b>Total</b>	<b>894,324</b>	<b>912,210</b>	<b>930,455</b>	<b>949,064</b>	<b>968,045</b>	<b>987,406</b>

Orchard residues - recoverability level 2, green tonnes per annum

	<b>2017</b>	<b>2022</b>	<b>2027</b>	<b>2032</b>	<b>2037</b>	<b>2042</b>
<b>Northland</b>	2,911	2,969	3,029	3,089	3,151	3,214
<b>Auckland</b>	5,342	5,449	5,558	5,669	5,783	5,898
<b>Waikato</b>	1,812	1,848	1,885	1,923	1,962	2,001
<b>Bay of Plenty</b>	5,741	5,856	5,973	6,092	6,214	6,339
<b>Gisborne</b>	5,305	5,411	5,519	5,629	5,742	5,857
<b>Hawkes Bay</b>	32,152	32,795	33,451	34,120	34,802	35,498
<b>Taranaki</b>	83	84	86	88	89	91
<b>Manawatu-Wanganui</b>	441	450	459	468	477	487
<b>Wellington</b>	938	957	976	995	1,015	1,036
<b>Tasman / Nelson</b>	11,549	11,780	12,015	12,256	12,501	12,751
<b>Marlborough</b>	20,931	21,349	21,776	22,212	22,656	23,109
<b>West Coast</b>	-	-	-	-	-	-
<b>Canterbury</b>	1,937	1,976	2,016	2,056	2,097	2,139
<b>Otago</b>	9,586	9,778	9,973	10,173	10,376	10,584
<b>Southland</b>	-	-	-	-	-	-
<b>Total</b>	<b>98,728</b>	<b>100,703</b>	<b>102,717</b>	<b>104,771</b>	<b>106,866</b>	<b>109,004</b>

Orchard residues - recoverability level 2, energy (GJ) per annum

	<b>2017</b>	<b>2022</b>	<b>2027</b>	<b>2032</b>	<b>2037</b>	<b>2042</b>
<b>Northland</b>	21,427	21,855	22,292	22,738	23,193	23,657
<b>Auckland</b>	39,320	40,106	40,908	41,726	42,561	43,412
<b>Waikato</b>	13,338	13,605	13,877	14,154	14,437	14,726
<b>Bay of Plenty</b>	42,254	43,099	43,961	44,840	45,737	46,651
<b>Gisborne</b>	39,043	39,824	40,621	41,433	42,262	43,107
<b>Hawkes Bay</b>	236,638	241,371	246,199	251,123	256,145	261,268
<b>Taranaki</b>	608	621	633	646	659	672
<b>Manawatu-Wanganui</b>	3,245	3,310	3,376	3,443	3,512	3,583
<b>Wellington</b>	6,903	7,041	7,182	7,326	7,472	7,621
<b>Tasman / Nelson</b>	85,000	86,700	88,434	90,202	92,006	93,847
<b>Marlborough</b>	154,050	157,131	160,274	163,479	166,749	170,084
<b>West Coast</b>	-	-	-	-	-	-
<b>Canterbury</b>	14,258	14,544	14,834	15,131	15,434	15,742
<b>Otago</b>	70,554	71,965	73,405	74,873	76,370	77,897
<b>Southland</b>	-	-	-	-	-	-
<b>Total</b>	<b>726,638</b>	<b>741,171</b>	<b>755,994</b>	<b>771,114</b>	<b>786,536</b>	<b>802,267</b>

## Appendix 4 - Straw and stover residues

Straw and Stover residues - gross oven dry tonnes per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	2,035	2,076	2,117	2,160	2,203	2,247
<b>Auckland</b>	4,481	4,570	4,662	4,755	4,850	4,947
<b>Waikato</b>	20,406	20,814	21,230	21,654	22,088	22,529
<b>Bay of Plenty</b>	11,592	11,824	12,060	12,302	12,548	12,799
<b>Gisborne</b>	9,820	10,016	10,217	10,421	10,629	10,842
<b>Hawkes Bay</b>	10,075	10,277	10,482	10,692	10,906	11,124
<b>Taranaki</b>	489	498	508	518	529	539
<b>Manawatu-Wanganui</b>	20,920	21,338	21,765	22,200	22,644	23,097
<b>Wellington</b>	4,656	4,749	4,844	4,940	5,039	5,140
<b>Tasman / Nelson</b>	-	-	-	-	-	-
<b>Marlborough</b>	2,217	2,261	2,306	2,352	2,399	2,447
<b>West Coast</b>	-	-	-	-	-	-
<b>Canterbury</b>	287,572	293,323	299,189	305,173	311,277	317,502
<b>Otago</b>	28,527	29,098	29,679	30,273	30,879	31,496
<b>Southland</b>	18,330	18,697	19,071	19,452	19,841	20,238
<b>Total</b>	<b>421,117</b>	<b>429,539</b>	<b>438,130</b>	<b>446,893</b>	<b>455,831</b>	<b>464,947</b>

Straw and Stover residues - gross energy (GJ) per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	36,223	36,947	37,686	38,440	39,209	39,993
<b>Auckland</b>	79,753	81,348	82,975	84,634	86,327	88,054
<b>Waikato</b>	363,218	370,482	377,892	385,450	393,159	401,022
<b>Bay of Plenty</b>	206,338	210,464	214,674	218,967	223,346	227,813
<b>Gisborne</b>	174,796	178,292	181,858	185,495	189,205	192,989
<b>Hawkes Bay</b>	179,335	182,922	186,580	190,312	194,118	198,000
<b>Taranaki</b>	8,695	8,869	9,047	9,228	9,412	9,600
<b>Manawatu-Wanganui</b>	372,376	379,824	387,420	395,168	403,072	411,133
<b>Wellington</b>	82,868	84,525	86,216	87,940	89,699	91,493
<b>Tasman / Nelson</b>	-	-	-	-	-	-
<b>Marlborough</b>	39,454	40,243	41,048	41,869	42,706	43,560
<b>West Coast</b>	-	-	-	-	-	-
<b>Canterbury</b>	5,118,773	5,221,148	5,325,571	5,432,083	5,540,724	5,651,539
<b>Otago</b>	507,781	517,936	528,295	538,861	549,638	560,631
<b>Southland</b>	326,274	332,799	339,455	346,245	353,169	360,233
<b>Total</b>	<b>7,495,883</b>	<b>7,645,800</b>	<b>7,798,716</b>	<b>7,954,691</b>	<b>8,113,784</b>	<b>8,276,060</b>

Straw and Stover residues - recoverability level 1, oven dry tonnes per annum

	<b>2017</b>	<b>2022</b>	<b>2027</b>	<b>2032</b>	<b>2037</b>	<b>2042</b>
<b>Northland</b>	1,628	1,661	1,694	1,728	1,762	1,797
<b>Auckland</b>	3,584	3,656	3,729	3,804	3,880	3,957
<b>Waikato</b>	16,324	16,651	16,984	17,324	17,670	18,023
<b>Bay of Plenty</b>	9,274	9,459	9,648	9,841	10,038	10,239
<b>Gisborne</b>	7,856	8,013	8,173	8,337	8,504	8,674
<b>Hawkes Bay</b>	8,060	8,221	8,386	8,553	8,724	8,899
<b>Taranaki</b>	391	399	407	415	423	431
<b>Manawatu-Wanganui</b>	16,736	17,071	17,412	17,760	18,116	18,478
<b>Wellington</b>	3,724	3,799	3,875	3,952	4,031	4,112
<b>Tasman / Nelson</b>	-	-	-	-	-	-
<b>Marlborough</b>	1,773	1,809	1,845	1,882	1,919	1,958
<b>West Coast</b>	-	-	-	-	-	-
<b>Canterbury</b>	230,057	234,658	239,352	244,139	249,021	254,002
<b>Otago</b>	22,822	23,278	23,744	24,218	24,703	25,197
<b>Southland</b>	14,664	14,957	15,256	15,562	15,873	16,190
<b>Total</b>	<b>336,894</b>	<b>343,631</b>	<b>350,504</b>	<b>357,514</b>	<b>364,664</b>	<b>371,958</b>

Straw and Stover residues - recoverability level 1, energy (GJ) per annum

	<b>2017</b>	<b>2022</b>	<b>2027</b>	<b>2032</b>	<b>2037</b>	<b>2042</b>
<b>Northland</b>	28,978	29,558	30,149	30,752	31,367	31,994
<b>Auckland</b>	63,802	65,078	66,380	67,708	69,062	70,443
<b>Waikato</b>	290,574	296,386	302,314	308,360	314,527	320,818
<b>Bay of Plenty</b>	165,070	168,371	171,739	175,174	178,677	182,251
<b>Gisborne</b>	139,837	142,634	145,486	148,396	151,364	154,391
<b>Hawkes Bay</b>	143,468	146,337	149,264	152,249	155,294	158,400
<b>Taranaki</b>	6,956	7,095	7,237	7,382	7,530	7,680
<b>Manawatu-Wanganui</b>	297,901	303,859	309,936	316,135	322,457	328,907
<b>Wellington</b>	66,294	67,620	68,973	70,352	71,759	73,194
<b>Tasman / Nelson</b>	-	-	-	-	-	-
<b>Marlborough</b>	31,563	32,194	32,838	33,495	34,165	34,848
<b>West Coast</b>	-	-	-	-	-	-
<b>Canterbury</b>	4,095,018	4,176,919	4,260,457	4,345,666	4,432,579	4,521,231
<b>Otago</b>	406,224	414,349	422,636	431,089	439,710	448,505
<b>Southland</b>	261,019	266,240	271,564	276,996	282,536	288,186
<b>Total</b>	<b>5,996,706</b>	<b>6,116,640</b>	<b>6,238,973</b>	<b>6,363,752</b>	<b>6,491,028</b>	<b>6,620,848</b>

Straw and Stover residues - recoverability level 2, oven dry tonnes per annum

	<b>2017</b>	<b>2022</b>	<b>2027</b>	<b>2032</b>	<b>2037</b>	<b>2042</b>
<b>Northland</b>	1,221	1,245	1,270	1,296	1,322	1,348
<b>Auckland</b>	2,688	2,742	2,797	2,853	2,910	2,968
<b>Waikato</b>	12,243	12,488	12,738	12,993	13,253	13,518
<b>Bay of Plenty</b>	6,955	7,094	7,236	7,381	7,529	7,679
<b>Gisborne</b>	5,892	6,010	6,130	6,253	6,378	6,505
<b>Hawkes Bay</b>	6,045	6,166	6,289	6,415	6,543	6,674
<b>Taranaki</b>	293	299	305	311	317	324
<b>Manawatu-Wanganui</b>	12,552	12,803	13,059	13,320	13,587	13,858
<b>Wellington</b>	2,793	2,849	2,906	2,964	3,024	3,084
<b>Tasman / Nelson</b>	-	-	-	-	-	-
<b>Marlborough</b>	1,330	1,356	1,384	1,411	1,440	1,468
<b>West Coast</b>	-	-	-	-	-	-
<b>Canterbury</b>	172,543	175,994	179,514	183,104	186,766	190,501
<b>Otago</b>	17,116	17,459	17,808	18,164	18,527	18,898
<b>Southland</b>	10,998	11,218	11,442	11,671	11,905	12,143
<b>Total</b>	<b>252,670</b>	<b>257,724</b>	<b>262,878</b>	<b>268,136</b>	<b>273,498</b>	<b>278,968</b>

Straw and Stover residues - recoverability level 2, energy (GJ) per annum

	<b>2017</b>	<b>2022</b>	<b>2027</b>	<b>2032</b>	<b>2037</b>	<b>2042</b>
<b>Northland</b>	21,734	22,168	22,612	23,064	23,525	23,996
<b>Auckland</b>	47,852	48,809	49,785	50,781	51,796	52,832
<b>Waikato</b>	217,931	222,289	226,735	231,270	235,895	240,613
<b>Bay of Plenty</b>	123,803	126,279	128,804	131,380	134,008	136,688
<b>Gisborne</b>	104,878	106,975	109,115	111,297	113,523	115,793
<b>Hawkes Bay</b>	107,601	109,753	111,948	114,187	116,471	118,800
<b>Taranaki</b>	5,217	5,322	5,428	5,537	5,647	5,760
<b>Manawatu-Wanganui</b>	223,426	227,894	232,452	237,101	241,843	246,680
<b>Wellington</b>	49,721	50,715	51,729	52,764	53,819	54,896
<b>Tasman / Nelson</b>	-	-	-	-	-	-
<b>Marlborough</b>	23,672	24,146	24,629	25,121	25,624	26,136
<b>West Coast</b>	-	-	-	-	-	-
<b>Canterbury</b>	3,071,264	3,132,689	3,195,343	3,259,250	3,324,435	3,390,923
<b>Otago</b>	304,668	310,762	316,977	323,317	329,783	336,378
<b>Southland</b>	195,764	199,680	203,673	207,747	211,902	216,140
<b>Total</b>	<b>4,497,530</b>	<b>4,587,480</b>	<b>4,679,230</b>	<b>4,772,814</b>	<b>4,868,271</b>	<b>4,965,636</b>



## Appendix 5 - Wood processing residues

Wood processing residues - gross green tonnes per annum (data in red indicates a deficit)

	2017	2022	2027	2032	2037	2042
Northland	-79,356	-79,356	-79,356	-79,356	-79,356	-79,356
Auckland	23,909	23,909	23,909	23,909	23,909	23,909
Waikato	-108,086	-108,086	-108,086	-108,086	-108,086	-108,086
Bay of Plenty	167,264	167,264	167,264	167,264	167,264	167,264
Gisborne	35,319	35,319	35,319	35,319	35,319	35,319
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	42,358	42,358	42,358	42,358	42,358	42,358
Tasman / Nelson	13,574	13,574	13,574	13,574	13,574	13,574
Marlborough	22,419	22,419	22,419	22,419	22,419	22,419
Canterbury	8,245	8,245	8,245	8,245	8,245	8,245
West Coast	-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
<b>Total</b>	<b>124,611</b>	<b>124,611</b>	<b>124,611</b>	<b>124,611</b>	<b>124,611</b>	<b>124,611</b>

Wood processing residues - gross energy (GJ) per annum

	2017	2022	2027	2032	2037	2042
Northland	-547,556	-547,556	-547,556	-547,556	-547,556	-547,556
Auckland	164,972	164,972	164,972	164,972	164,972	164,972
Waikato	-745,796	-745,796	-745,796	-745,796	-745,796	-745,796
Bay of Plenty	1,154,122	1,154,122	1,154,122	1,154,122	1,154,122	1,154,122
Gisborne	243,701	243,701	243,701	243,701	243,701	243,701
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	292,273	292,273	292,273	292,273	292,273	292,273
Tasman / Nelson	93,661	93,661	93,661	93,661	93,661	93,661
Marlborough	154,693	154,693	154,693	154,693	154,693	154,693
Canterbury	56,891	56,891	56,891	56,891	56,891	56,891
West Coast	-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
<b>Total</b>	<b>859,817</b>	<b>859,817</b>	<b>859,817</b>	<b>859,817</b>	<b>859,817</b>	<b>859,817</b>

Wood processing residues - recoverability level 1, green tonnes per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	-75,388	-75,388	-75,388	-75,388	-75,388	-75,388
<b>Auckland</b>	22,714	22,714	22,714	22,714	22,714	22,714
<b>Waikato</b>	-102,682	-102,682	-102,682	-102,682	-102,682	-102,682
<b>Bay of Plenty</b>	158,901	158,901	158,901	158,901	158,901	158,901
<b>Gisborne</b>	33,553	33,553	33,553	33,553	33,553	33,553
<b>Hawkes Bay</b>	-24,240	-24,240	-24,240	-24,240	-24,240	-24,240
<b>Taranaki</b>	16,538	16,538	16,538	16,538	16,538	16,538
<b>Manawatu-Wanganui</b>	11,417	11,417	11,417	11,417	11,417	11,417
<b>Wellington</b>	40,240	40,240	40,240	40,240	40,240	40,240
<b>Tasman / Nelson</b>	12,895	12,895	12,895	12,895	12,895	12,895
<b>Marlborough</b>	21,298	21,298	21,298	21,298	21,298	21,298
<b>Canterbury</b>	7,833	7,833	7,833	7,833	7,833	7,833
<b>West Coast</b>	-8,600	-8,600	-8,600	-8,600	-8,600	-8,600
<b>Otago</b>	22,067	22,067	22,067	22,067	22,067	22,067
<b>Southland</b>	-18,165	-18,165	-18,165	-18,165	-18,165	-18,165
<b>Total</b>	<b>118,381</b>	<b>118,381</b>	<b>118,381</b>	<b>118,381</b>	<b>118,381</b>	<b>118,381</b>

Wood processing residues - recoverability level 1, energy (GJ) per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	-520,179	-520,179	-520,179	-520,179	-520,179	-520,179
<b>Auckland</b>	156,723	156,723	156,723	156,723	156,723	156,723
<b>Waikato</b>	-708,506	-708,506	-708,506	-708,506	-708,506	-708,506
<b>Bay of Plenty</b>	1,096,416	1,096,416	1,096,416	1,096,416	1,096,416	1,096,416
<b>Gisborne</b>	231,516	231,516	231,516	231,516	231,516	231,516
<b>Hawkes Bay</b>	-167,257	-167,257	-167,257	-167,257	-167,257	-167,257
<b>Taranaki</b>	114,110	114,110	114,110	114,110	114,110	114,110
<b>Manawatu-Wanganui</b>	78,781	78,781	78,781	78,781	78,781	78,781
<b>Wellington</b>	277,659	277,659	277,659	277,659	277,659	277,659
<b>Tasman / Nelson</b>	88,978	88,978	88,978	88,978	88,978	88,978
<b>Marlborough</b>	146,958	146,958	146,958	146,958	146,958	146,958
<b>Canterbury</b>	54,046	54,046	54,046	54,046	54,046	54,046
<b>West Coast</b>	-59,337	-59,337	-59,337	-59,337	-59,337	-59,337
<b>Otago</b>	152,260	152,260	152,260	152,260	152,260	152,260
<b>Southland</b>	-125,342	-125,342	-125,342	-125,342	-125,342	-125,342
<b>Total</b>	<b>816,826</b>	<b>816,826</b>	<b>816,826</b>	<b>816,826</b>	<b>816,826</b>	<b>816,826</b>

Wood processing residues - recoverability level 2, green tonnes per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	-71,420	-71,420	-71,420	-71,420	-71,420	-71,420
<b>Auckland</b>	21,518	21,518	21,518	21,518	21,518	21,518
<b>Waikato</b>	-97,278	-97,278	-97,278	-97,278	-97,278	-97,278
<b>Bay of Plenty</b>	150,538	150,538	150,538	150,538	150,538	150,538
<b>Gisborne</b>	31,787	31,787	31,787	31,787	31,787	31,787
<b>Hawkes Bay</b>	-22,964	-22,964	-22,964	-22,964	-22,964	-22,964
<b>Taranaki</b>	15,667	15,667	15,667	15,667	15,667	15,667
<b>Manawatu-Wanganui</b>	10,817	10,817	10,817	10,817	10,817	10,817
<b>Wellington</b>	38,123	38,123	38,123	38,123	38,123	38,123
<b>Tasman / Nelson</b>	12,217	12,217	12,217	12,217	12,217	12,217
<b>Marlborough</b>	20,177	20,177	20,177	20,177	20,177	20,177
<b>Canterbury</b>	7,421	7,421	7,421	7,421	7,421	7,421
<b>West Coast</b>	-8,147	-8,147	-8,147	-8,147	-8,147	-8,147
<b>Otago</b>	20,905	20,905	20,905	20,905	20,905	20,905
<b>Southland</b>	-17,209	-17,209	-17,209	-17,209	-17,209	-17,209
<b>Total</b>	<b>112,150</b>	<b>112,150</b>	<b>112,150</b>	<b>112,150</b>	<b>112,150</b>	<b>112,150</b>

Wood processing residues - recoverability level 2, energy (GJ) per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	-492,801	-492,801	-492,801	-492,801	-492,801	-492,801
<b>Auckland</b>	148,475	148,475	148,475	148,475	148,475	148,475
<b>Waikato</b>	-671,216	-671,216	-671,216	-671,216	-671,216	-671,216
<b>Bay of Plenty</b>	1,038,709	1,038,709	1,038,709	1,038,709	1,038,709	1,038,709
<b>Gisborne</b>	219,331	219,331	219,331	219,331	219,331	219,331
<b>Hawkes Bay</b>	-158,454	-158,454	-158,454	-158,454	-158,454	-158,454
<b>Taranaki</b>	108,104	108,104	108,104	108,104	108,104	108,104
<b>Manawatu-Wanganui</b>	74,634	74,634	74,634	74,634	74,634	74,634
<b>Wellington</b>	263,046	263,046	263,046	263,046	263,046	263,046
<b>Tasman / Nelson</b>	84,295	84,295	84,295	84,295	84,295	84,295
<b>Marlborough</b>	139,223	139,223	139,223	139,223	139,223	139,223
<b>Canterbury</b>	51,201	51,201	51,201	51,201	51,201	51,201
<b>West Coast</b>	-56,214	-56,214	-56,214	-56,214	-56,214	-56,214
<b>Otago</b>	144,246	144,246	144,246	144,246	144,246	144,246
<b>Southland</b>	-118,745	-118,745	-118,745	-118,745	-118,745	-118,745
<b>Total</b>	<b>773,835</b>	<b>773,835</b>	<b>773,835</b>	<b>773,835</b>	<b>773,835</b>	<b>773,835</b>

## Appendix 6 - In forest by category; landing residues

In-forest landing residues - gross green tonnes per annum (100% of resource)

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	128,626	120,930	111,504	76,012	69,900	127,720
<b>Auckland</b>	12,388	39,086	41,371	36,912	19,265	12,940
<b>Waikato</b>	62,978	131,865	167,138	77,891	56,005	82,706
<b>Bay of Plenty</b>	248,521	317,824	422,229	379,501	306,726	391,623
<b>Gisborne</b>	102,209	169,875	140,054	76,660	41,821	100,144
<b>Hawkes Bay</b>	43,148	174,263	138,787	111,692	67,099	73,959
<b>Taranaki</b>	7,253	26,044	12,680	6,231	1,838	2,592
<b>Manawatu-Wanganui</b>	49,678	121,877	97,034	44,654	27,457	34,512
<b>Wairarapa</b>	2,822	4,216	599	756	262	40
<b>Wellington</b>	13,920	22,893	23,969	12,665	6,581	12,407
<b>Tasman / Nelson</b>	33,744	84,548	64,982	78,258	77,811	55,726
<b>Marlborough</b>	34,369	77,400	47,362	30,135	26,237	46,302
<b>West Coast</b>	8,216	6,373	6,701	7,183	11,255	10,506
<b>Canterbury</b>	41,204	62,144	57,682	42,375	37,638	39,018
<b>Otago</b>	42,290	92,037	71,445	60,206	100,159	63,404
<b>Southland</b>	24,054	53,695	39,975	42,284	80,681	58,488
<b>Total</b>	<b>1,030,054</b>	<b>1,478,683</b>	<b>1,801,682</b>	<b>1,289,466</b>	<b>1,007,055</b>	<b>1,187,588</b>

In-forest landing residues - gross energy (GJ) per annum, (100% of resource)

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	887,518	834,418	769,375	524,481	482,307	881,270
<b>Auckland</b>	85,475	269,693	285,457	254,694	132,930	89,284
<b>Waikato</b>	434,546	909,865	1,153,251	537,451	386,437	570,669
<b>Bay of Plenty</b>	1,714,797	2,192,983	2,913,380	2,618,554	2,116,406	2,702,198
<b>Gisborne</b>	705,240	1,172,138	966,372	528,957	288,562	690,992
<b>Hawkes Bay</b>	297,720	1,202,414	957,633	770,674	462,985	510,314
<b>Taranaki</b>	50,045	179,707	87,491	42,995	12,684	17,884
<b>Manawatu-Wanganui</b>	342,777	840,949	669,537	308,116	189,452	238,133
<b>Wairarapa</b>	19,472	29,087	4,131	5,215	1,810	277
<b>Wellington</b>	96,045	157,965	165,384	87,390	45,406	85,609
<b>Tasman / Nelson</b>	232,831	583,378	448,377	539,979	536,897	384,510
<b>Marlborough</b>	237,149	534,062	326,801	207,935	181,038	319,483
<b>West Coast</b>	56,690	43,977	46,239	49,565	77,659	72,493
<b>Canterbury</b>	284,307	428,795	398,008	292,389	259,704	269,221
<b>Otago</b>	291,798	635,055	492,971	415,422	691,099	437,486
<b>Southland</b>	165,970	370,497	275,827	291,759	556,696	403,564
<b>Total</b>	<b>7,107,371</b>	<b>10,202,911</b>	<b>12,431,605</b>	<b>8,897,318</b>	<b>6,948,676</b>	<b>8,194,361</b>

In-forest landing residues - recoverability level 1 (80% of gross), green tonnes per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	102,901	96,744	89,203	60,809	55,920	102,176
<b>Auckland</b>	9,910	31,269	33,096	29,530	15,412	10,352
<b>Waikato</b>	50,382	105,492	133,710	62,313	44,804	66,164
<b>Bay of Plenty</b>	198,817	254,259	337,783	303,601	245,380	313,298
<b>Gisborne</b>	81,767	135,900	112,043	61,328	33,456	80,115
<b>Hawkes Bay</b>	34,518	139,410	111,030	89,353	53,679	59,167
<b>Taranaki</b>	5,802	20,836	10,144	4,985	1,471	2,073
<b>Manawatu-Wanganui</b>	39,742	97,501	77,627	35,724	21,965	27,610
<b>Wairarapa</b>	2,258	3,372	479	605	210	32
<b>Wellington</b>	11,136	18,315	19,175	10,132	5,264	9,926
<b>Tasman / Nelson</b>	26,995	67,638	51,986	62,606	62,249	44,581
<b>Marlborough</b>	27,496	61,920	37,890	24,108	20,990	37,041
<b>West Coast</b>	6,573	5,099	5,361	5,747	9,004	8,405
<b>Canterbury</b>	32,963	49,715	46,146	33,900	30,111	31,214
<b>Otago</b>	33,832	73,630	57,156	48,165	80,127	50,723
<b>Southland</b>	19,243	42,956	31,980	33,827	64,544	46,790
<b>Total</b>	<b>824,043</b>	<b>1,182,946</b>	<b>1,441,345</b>	<b>1,031,573</b>	<b>805,644</b>	<b>950,071</b>

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

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	710,014	667,535	615,500	419,585	385,845	705,016
<b>Auckland</b>	68,380	215,754	228,365	203,755	106,344	71,427
<b>Waikato</b>	347,637	727,892	922,600	429,961	309,150	456,535
<b>Bay of Plenty</b>	1,371,838	1,754,386	2,330,704	2,094,844	1,693,125	2,161,758
<b>Gisborne</b>	564,192	937,711	773,098	423,166	230,849	552,793
<b>Hawkes Bay</b>	238,176	961,932	766,107	616,539	370,388	408,251
<b>Taranaki</b>	40,036	143,765	69,993	34,396	10,147	14,307
<b>Manawatu-Wanganui</b>	274,222	672,759	535,629	246,493	151,561	190,506
<b>Wairarapa</b>	15,577	23,270	3,305	4,172	1,448	221
<b>Wellington</b>	76,836	126,372	132,307	69,912	36,325	68,487
<b>Tasman / Nelson</b>	186,264	466,702	358,701	431,983	429,517	307,608
<b>Marlborough</b>	189,719	427,249	261,441	166,348	144,830	255,586
<b>West Coast</b>	45,352	35,181	36,991	39,652	62,127	57,994
<b>Canterbury</b>	227,446	343,036	318,406	233,911	207,763	215,377
<b>Otago</b>	233,438	508,044	394,377	332,338	552,879	349,989
<b>Southland</b>	132,776	296,398	220,662	233,408	445,357	322,851
<b>Total</b>	<b>5,685,897</b>	<b>8,162,329</b>	<b>9,945,284</b>	<b>7,117,855</b>	<b>5,558,941</b>	<b>6,555,488</b>

In-forest landing residues - recoverability level 2 (65% of gross), green tonnes per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	83,607	78,605	72,477	49,408	45,435	83,018
<b>Auckland</b>	8,052	25,406	26,891	23,993	12,522	8,411
<b>Waikato</b>	40,936	85,712	108,640	50,629	36,403	53,759
<b>Bay of Plenty</b>	161,539	206,585	274,449	246,675	199,372	254,555
<b>Gisborne</b>	66,436	110,419	91,035	49,829	27,183	65,093
<b>Hawkes Bay</b>	28,046	113,271	90,212	72,600	43,615	48,073
<b>Taranaki</b>	4,714	16,929	8,242	4,050	1,195	1,685
<b>Manawatu-Wanganui</b>	32,291	79,220	63,072	29,025	17,847	22,433
<b>Wairarapa</b>	1,834	2,740	389	491	171	26
<b>Wellington</b>	9,048	14,881	15,580	8,232	4,277	8,065
<b>Tasman / Nelson</b>	21,933	54,956	42,238	50,868	50,577	36,222
<b>Marlborough</b>	22,340	50,310	30,786	19,588	17,054	30,096
<b>West Coast</b>	5,340	4,143	4,356	4,669	7,316	6,829
<b>Canterbury</b>	26,783	40,394	37,493	27,544	24,465	25,361
<b>Otago</b>	27,488	59,824	46,439	39,134	65,104	41,212
<b>Southland</b>	15,635	34,902	25,984	27,485	52,442	38,017
<b>Total</b>	<b>669,535</b>	<b>961,144</b>	<b>1,171,093</b>	<b>838,153</b>	<b>654,585</b>	<b>771,933</b>

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

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	576,886	542,372	500,094	340,913	313,499	572,826
<b>Auckland</b>	55,559	175,300	185,547	165,551	86,404	58,035
<b>Waikato</b>	282,455	591,413	749,613	349,343	251,184	370,935
<b>Bay of Plenty</b>	1,114,618	1,425,439	1,893,697	1,702,060	1,375,664	1,756,429
<b>Gisborne</b>	458,406	761,890	628,142	343,822	187,565	449,145
<b>Hawkes Bay</b>	193,518	781,569	622,462	500,938	300,940	331,704
<b>Taranaki</b>	32,529	116,809	56,869	27,946	8,245	11,624
<b>Manawatu-Wanganui</b>	222,805	546,617	435,199	200,275	123,144	154,786
<b>Wairarapa</b>	12,657	18,907	2,685	3,390	1,177	180
<b>Wellington</b>	62,429	102,677	107,499	56,804	29,514	55,646
<b>Tasman / Nelson</b>	151,340	379,196	291,445	350,987	348,983	249,931
<b>Marlborough</b>	154,147	347,140	212,420	135,158	117,675	207,664
<b>West Coast</b>	36,849	28,585	30,056	32,217	50,478	47,120
<b>Canterbury</b>	184,800	278,717	258,705	190,053	168,808	174,994
<b>Otago</b>	189,669	412,786	320,431	270,024	449,214	284,366
<b>Southland</b>	107,881	240,823	179,288	189,644	361,852	262,316
<b>Total</b>	<b>4,619,791</b>	<b>6,631,892</b>	<b>8,080,543</b>	<b>5,783,257</b>	<b>4,516,639</b>	<b>5,326,334</b>

## Appendix 7 - In-forest residues by category - Cutover residues ground-based sites

In-forest ground-based cutover residues - gross green tonnes per annum (100% of resource)

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	297,728	258,229	233,574	161,673	144,772	258,309
<b>Auckland</b>	29,760	78,350	82,653	72,028	37,002	23,626
<b>Waikato</b>	121,621	231,933	294,932	137,074	105,944	139,804
<b>Bay of Plenty</b>	532,735	637,398	852,063	754,278	573,862	742,424
<b>Gisborne</b>	111,859	178,386	149,938	81,056	44,628	108,345
<b>Hawkes Bay</b>	59,969	219,228	179,704	139,044	86,108	89,282
<b>Taranaki</b>	11,242	37,339	21,002	10,106	2,373	5,447
<b>Manawatu-Wanganui</b>	109,410	237,624	192,920	87,528	47,348	70,613
<b>Wairarapa</b>	5,258	7,842	1,117	1,405	519	70
<b>Wellington</b>	21,814	33,816	35,112	18,220	8,749	16,705
<b>Tasman / Nelson</b>	49,728	97,318	72,623	56,357	50,469	36,196
<b>Marlborough</b>	19,605	34,083	22,481	16,563	14,263	31,209
<b>West Coast</b>	62,537	44,831	64,232	55,220	53,590	32,791
<b>Canterbury</b>	167,119	248,459	240,348	138,251	57,296	70,135
<b>Otago</b>	121,400	193,375	254,487	139,485	77,380	104,354
<b>Southland</b>	85,505	170,188	269,252	168,170	66,019	83,810
<b>Total</b>	<b>1,807,290</b>	<b>2,708,399</b>	<b>2,966,440</b>	<b>2,036,457</b>	<b>1,370,324</b>	<b>1,813,120</b>

In-forest ground-based cutover residues - gross energy (GJ) per annum, (100% of resource)

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	2,054,323	1,781,777	1,611,660	1,115,543	998,929	1,782,335
<b>Auckland</b>	205,346	540,614	570,302	496,994	255,316	163,019
<b>Waikato</b>	839,184	1,600,339	2,035,034	945,808	731,016	964,650
<b>Bay of Plenty</b>	3,675,871	4,398,045	5,879,236	5,204,520	3,959,650	5,122,722
<b>Gisborne</b>	771,825	1,230,862	1,034,573	559,285	307,935	747,579
<b>Hawkes Bay</b>	413,785	1,512,676	1,239,961	959,404	594,145	616,044
<b>Taranaki</b>	77,570	257,641	144,916	69,731	16,376	37,585
<b>Manawatu-Wanganui</b>	754,928	1,639,608	1,331,151	603,942	326,698	487,229
<b>Wairarapa</b>	36,278	54,111	7,710	9,693	3,579	480
<b>Wellington</b>	150,515	233,327	242,275	125,719	60,369	115,267
<b>Tasman / Nelson</b>	343,125	671,495	501,100	388,860	348,239	249,751
<b>Marlborough</b>	135,278	235,171	155,120	114,288	98,418	215,340
<b>West Coast</b>	431,507	309,336	443,198	381,018	369,768	226,259
<b>Canterbury</b>	1,153,119	1,714,366	1,658,402	953,930	395,345	483,932
<b>Otago</b>	837,662	1,334,285	1,755,957	962,447	533,919	720,045
<b>Southland</b>	589,988	1,174,297	1,857,841	1,160,374	455,534	578,290
<b>Total</b>	<b>12,470,302</b>	<b>18,687,951</b>	<b>20,468,436</b>	<b>14,051,554</b>	<b>9,455,237</b>	<b>12,510,527</b>

In-forest ground-based cutover residues - recoverability level 1 (80% of gross), green tonnes per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	208,410	180,760	163,502	113,171	101,341	180,817
<b>Auckland</b>	20,832	54,845	57,857	50,420	25,902	16,538
<b>Waikato</b>	85,135	162,353	206,453	95,952	74,161	97,863
<b>Bay of Plenty</b>	372,914	446,179	596,444	527,995	401,704	519,696
<b>Gisborne</b>	78,301	124,870	104,957	56,739	31,240	75,841
<b>Hawkes Bay</b>	41,978	153,460	125,793	97,331	60,276	62,497
<b>Taranaki</b>	7,869	26,138	14,702	7,074	1,661	3,813
<b>Manawatu-Wanganui</b>	76,587	166,337	135,044	61,269	33,143	49,429
<b>Wairarapa</b>	3,680	5,490	782	983	363	49
<b>Wellington</b>	15,270	23,671	24,579	12,754	6,124	11,694
<b>Tasman / Nelson</b>	34,810	68,123	50,836	39,450	35,329	25,337
<b>Marlborough</b>	13,724	23,858	15,737	11,594	9,984	21,846
<b>West Coast</b>	43,776	31,382	44,962	38,654	37,513	22,954
<b>Canterbury</b>	116,983	173,921	168,244	96,775	40,107	49,095
<b>Otago</b>	84,980	135,362	178,141	97,640	54,166	73,048
<b>Southland</b>	59,854	119,132	188,477	117,719	46,214	58,667
<b>Total</b>	<b>1,265,103</b>	<b>1,895,879</b>	<b>2,076,508</b>	<b>1,425,520</b>	<b>959,227</b>	<b>1,269,184</b>

In-forest ground-based cutover residues - recoverability level 1 (80% of gross), energy (GJ) per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	1,438,026	1,247,244	1,128,162	780,880	699,250	1,247,635
<b>Auckland</b>	143,743	378,430	399,212	347,896	178,721	114,113
<b>Waikato</b>	587,429	1,120,237	1,424,524	662,066	511,711	675,255
<b>Bay of Plenty</b>	2,573,110	3,078,632	4,115,465	3,643,164	2,771,755	3,585,906
<b>Gisborne</b>	540,277	861,603	724,201	391,499	215,554	523,305
<b>Hawkes Bay</b>	289,649	1,058,873	867,972	671,583	415,902	431,231
<b>Taranaki</b>	54,299	180,349	101,441	48,812	11,463	26,309
<b>Manawatu-Wanganui</b>	528,449	1,147,726	931,806	422,760	228,689	341,060
<b>Wairarapa</b>	25,395	37,878	5,397	6,785	2,505	336
<b>Wellington</b>	105,360	163,329	169,593	88,003	42,258	80,687
<b>Tasman / Nelson</b>	240,187	470,046	350,770	272,202	243,768	174,826
<b>Marlborough</b>	94,694	164,620	108,584	80,002	68,892	150,738
<b>West Coast</b>	302,055	216,535	310,238	266,713	258,838	158,381
<b>Canterbury</b>	807,183	1,200,056	1,160,882	667,751	276,742	338,753
<b>Otago</b>	586,363	933,999	1,229,170	673,713	373,743	504,031
<b>Southland</b>	412,991	822,008	1,300,488	812,261	318,874	404,803
<b>Total</b>	<b>8,729,211</b>	<b>13,081,565</b>	<b>14,327,905</b>	<b>9,836,088</b>	<b>6,618,666</b>	<b>8,757,369</b>



In-forest ground-based cutover residues - recoverability level 2 (65% of gross), green tonnes per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	166,728	144,608	130,801	90,537	81,072	144,653
<b>Auckland</b>	16,666	43,876	46,285	40,336	20,721	13,231
<b>Waikato</b>	68,108	129,883	165,162	76,761	59,329	78,290
<b>Bay of Plenty</b>	298,332	356,943	477,155	422,396	321,363	415,757
<b>Gisborne</b>	62,641	99,896	83,965	45,391	24,992	60,673
<b>Hawkes Bay</b>	33,583	122,768	100,634	77,865	48,221	49,998
<b>Taranaki</b>	6,295	20,910	11,761	5,659	1,329	3,050
<b>Manawatu-Wanganui</b>	61,270	133,070	108,035	49,016	26,515	39,543
<b>Wairarapa</b>	2,944	4,392	626	787	290	39
<b>Wellington</b>	12,216	18,937	19,663	10,203	4,900	9,355
<b>Tasman / Nelson</b>	27,848	54,498	40,669	31,560	28,263	20,270
<b>Marlborough</b>	10,979	19,086	12,589	9,276	7,988	17,477
<b>West Coast</b>	35,021	25,106	35,970	30,923	30,010	18,363
<b>Canterbury</b>	93,586	139,137	134,595	77,420	32,086	39,276
<b>Otago</b>	67,984	108,290	142,512	78,112	43,333	58,438
<b>Southland</b>	47,883	95,305	150,781	94,175	36,971	46,934
<b>Total</b>	<b>1,012,082</b>	<b>1,516,703</b>	<b>1,661,206</b>	<b>1,140,416</b>	<b>767,382</b>	<b>1,015,347</b>

In-forest ground-based cutover residues - recoverability level 2 (65% of gross), energy (GJ) per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	1,150,421	997,795	902,530	624,704	559,400	998,108
<b>Auckland</b>	114,994	302,744	319,369	278,317	142,977	91,291
<b>Waikato</b>	469,943	896,190	1,139,619	529,653	409,369	540,204
<b>Bay of Plenty</b>	2,058,488	2,462,905	3,292,372	2,914,531	2,217,404	2,868,724
<b>Gisborne</b>	432,222	689,283	579,361	313,199	172,443	418,644
<b>Hawkes Bay</b>	231,719	847,099	694,378	537,266	332,721	344,984
<b>Taranaki</b>	43,439	144,279	81,153	39,049	9,170	21,047
<b>Manawatu-Wanganui</b>	422,760	918,181	745,445	338,208	182,951	272,848
<b>Wairarapa</b>	20,316	30,302	4,318	5,428	2,004	269
<b>Wellington</b>	84,288	130,663	135,674	70,403	33,807	64,549
<b>Tasman / Nelson</b>	192,150	376,037	280,616	217,762	195,014	139,861
<b>Marlborough</b>	75,756	131,696	86,867	64,001	55,114	120,590
<b>West Coast</b>	241,644	173,228	248,191	213,370	207,070	126,705
<b>Canterbury</b>	645,747	960,045	928,705	534,201	221,393	271,002
<b>Otago</b>	469,090	747,199	983,336	538,970	298,995	403,225
<b>Southland</b>	330,393	657,606	1,040,391	649,809	255,099	323,843
<b>Total</b>	<b>6,983,369</b>	<b>10,465,252</b>	<b>11,462,324</b>	<b>7,868,870</b>	<b>5,294,933</b>	<b>7,005,895</b>

## Appendix 8 - In-forest residues by category; cutover residues hauler sites

In-forest hauler cutover residues - gross green tonnes per annum (100% of resource)

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	74,623	65,898	66,384	38,585	32,462	65,103
<b>Auckland</b>	9,927	26,135	27,570	24,026	12,343	7,881
<b>Waikato</b>	47,223	86,272	108,588	51,580	40,497	56,462
<b>Bay of Plenty</b>	158,204	139,358	189,784	165,681	133,762	195,162
<b>Gisborne</b>	162,402	258,990	217,688	117,681	64,794	157,301
<b>Hawkes Bay</b>	49,251	195,322	149,097	125,834	76,117	82,429
<b>Taranaki</b>	13,222	46,877	24,498	11,229	1,916	6,719
<b>Manawatu-Wanganui</b>	68,763	162,963	123,620	62,297	37,196	43,655
<b>Wairarapa</b>	3,596	4,591	736	834	272	41
<b>Wellington</b>	24,080	37,032	39,765	20,437	10,301	19,124
<b>Tasman / Nelson</b>	122,813	229,439	165,709	145,745	132,508	97,115
<b>Marlborough</b>	41,971	79,099	53,525	41,003	39,204	88,097
<b>West Coast</b>	11,324	6,870	9,902	9,176	8,636	5,972
<b>Canterbury</b>	62,308	99,180	95,588	48,044	22,036	26,984
<b>Otago</b>	69,990	107,050	131,916	72,062	41,635	66,525
<b>Southland</b>	14,234	28,867	46,622	26,116	10,622	13,941
<b>Total</b>	<b>933,930</b>	<b>1,573,943</b>	<b>1,450,993</b>	<b>960,331</b>	<b>664,299</b>	<b>932,511</b>

In-forest hauler cutover residues - gross energy (GJ) per annum, (100% of resource)

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	514,902	454,694	458,052	266,238	223,987	449,214
<b>Auckland</b>	68,497	180,332	190,235	165,781	85,165	54,378
<b>Waikato</b>	325,835	595,275	749,256	355,904	279,426	389,589
<b>Bay of Plenty</b>	1,091,605	961,571	1,309,511	1,143,196	922,955	1,346,617
<b>Gisborne</b>	1,120,575	1,787,029	1,502,047	811,998	447,075	1,085,373
<b>Hawkes Bay</b>	339,831	1,347,725	1,028,773	868,254	525,207	568,763
<b>Taranaki</b>	91,231	323,453	169,037	77,482	13,221	46,359
<b>Manawatu-Wanganui</b>	474,463	1,124,444	852,978	429,848	256,650	301,220
<b>Wairarapa</b>	24,810	31,679	5,080	5,757	1,878	284
<b>Wellington</b>	166,155	255,518	274,380	141,019	71,076	131,953
<b>Tasman / Nelson</b>	847,412	1,583,130	1,143,391	1,005,639	914,304	670,093
<b>Marlborough</b>	289,597	545,786	369,325	282,923	270,506	607,868
<b>West Coast</b>	78,139	47,406	68,321	63,315	59,587	41,208
<b>Canterbury</b>	429,924	684,341	659,558	331,501	152,050	186,192
<b>Otago</b>	482,930	738,644	910,219	497,227	287,284	459,025
<b>Southland</b>	98,214	199,179	321,689	180,202	73,292	96,191
<b>Total</b>	<b>6,444,120</b>	<b>10,860,206</b>	<b>10,011,852</b>	<b>6,626,282</b>	<b>4,583,664</b>	<b>6,434,325</b>

In-forest hauler cutover residues - recoverability level 1 (10% of gross), green tonnes per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	7,462	6,590	6,638	3,859	3,246	6,510
<b>Auckland</b>	993	2,614	2,757	2,403	1,234	788
<b>Waikato</b>	4,722	8,627	10,859	5,158	4,050	5,646
<b>Bay of Plenty</b>	15,820	13,936	18,978	16,568	13,376	19,516
<b>Gisborne</b>	16,240	25,899	21,769	11,768	6,479	15,730
<b>Hawkes Bay</b>	4,925	19,532	14,910	12,583	7,612	8,243
<b>Taranaki</b>	1,322	4,688	2,450	1,123	192	672
<b>Manawatu-Wanganui</b>	6,876	16,296	12,362	6,230	3,720	4,366
<b>Wairarapa</b>	360	459	74	83	27	4
<b>Wellington</b>	2,408	3,703	3,977	2,044	1,030	1,912
<b>Tasman / Nelson</b>	12,281	22,944	16,571	14,574	13,251	9,711
<b>Marlborough</b>	4,197	7,910	5,353	4,100	3,920	8,810
<b>West Coast</b>	1,132	687	990	918	864	597
<b>Canterbury</b>	6,231	9,918	9,559	4,804	2,204	2,698
<b>Otago</b>	6,999	10,705	13,192	7,206	4,164	6,653
<b>Southland</b>	1,423	2,887	4,662	2,612	1,062	1,394
<b>Total</b>	<b>93,393</b>	<b>157,394</b>	<b>145,099</b>	<b>96,033</b>	<b>66,430</b>	<b>93,251</b>

In-forest hauler cutover residues - recoverability level 1 (80% of gross), energy (GJ) per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	51,490	45,469	45,805	26,624	22,399	44,921
<b>Auckland</b>	6,850	18,033	19,023	16,578	8,517	5,438
<b>Waikato</b>	32,584	59,528	74,926	35,590	27,943	38,959
<b>Bay of Plenty</b>	109,160	96,157	130,951	114,320	92,295	134,662
<b>Gisborne</b>	112,057	178,703	150,205	81,200	44,708	108,537
<b>Hawkes Bay</b>	33,983	134,773	102,877	86,825	52,521	56,876
<b>Taranaki</b>	9,123	32,345	16,904	7,748	1,322	4,636
<b>Manawatu-Wanganui</b>	47,446	112,444	85,298	42,985	25,665	30,122
<b>Wairarapa</b>	2,481	3,168	508	576	188	28
<b>Wellington</b>	16,616	25,552	27,438	14,102	7,108	13,195
<b>Tasman / Nelson</b>	84,741	158,313	114,339	100,564	91,430	67,009
<b>Marlborough</b>	28,960	54,579	36,933	28,292	27,051	60,787
<b>West Coast</b>	7,814	4,741	6,832	6,331	5,959	4,121
<b>Canterbury</b>	42,992	68,434	65,956	33,150	15,205	18,619
<b>Otago</b>	48,293	73,864	91,022	49,723	28,728	45,903
<b>Southland</b>	9,821	19,918	32,169	18,020	7,329	9,619
<b>Total</b>	<b>644,412</b>	<b>1,086,021</b>	<b>1,001,185</b>	<b>662,628</b>	<b>458,366</b>	<b>643,433</b>

In-forest hauler cutover residues - recoverability level 2 (5% of gross), green tonnes per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	3,731	3,295	3,319	1,929	1,623	3,255
<b>Auckland</b>	496	1,307	1,379	1,201	617	394
<b>Waikato</b>	2,361	4,314	5,429	2,579	2,025	2,823
<b>Bay of Plenty</b>	7,910	6,968	9,489	8,284	6,688	9,758
<b>Gisborne</b>	8,120	12,949	10,884	5,884	3,240	7,865
<b>Hawkes Bay</b>	2,463	9,766	7,455	6,292	3,806	4,121
<b>Taranaki</b>	661	2,344	1,225	561	96	336
<b>Manawatu-Wanganui</b>	3,438	8,148	6,181	3,115	1,860	2,183
<b>Wairarapa</b>	180	230	37	42	14	2
<b>Wellington</b>	1,204	1,852	1,988	1,022	515	956
<b>Tasman / Nelson</b>	6,141	11,472	8,285	7,287	6,625	4,856
<b>Marlborough</b>	2,099	3,955	2,676	2,050	1,960	4,405
<b>West Coast</b>	566	344	495	459	432	299
<b>Canterbury</b>	3,115	4,959	4,779	2,402	1,102	1,349
<b>Otago</b>	3,499	5,352	6,596	3,603	2,082	3,326
<b>Southland</b>	712	1,443	2,331	1,306	531	697
<b>Total</b>	<b>46,697</b>	<b>78,697</b>	<b>72,550</b>	<b>48,017</b>	<b>33,215</b>	<b>46,626</b>

In-forest hauler cutover residues - recoverability level 2 (65% of gross), energy (GJ) per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	25,745	22,735	22,903	13,312	11,199	22,461
<b>Auckland</b>	3,425	9,017	9,512	8,289	4,258	2,719
<b>Waikato</b>	16,292	29,764	37,463	17,795	13,971	19,479
<b>Bay of Plenty</b>	54,580	48,079	65,476	57,160	46,148	67,331
<b>Gisborne</b>	56,029	89,351	75,102	40,600	22,354	54,269
<b>Hawkes Bay</b>	16,992	67,386	51,439	43,413	26,260	28,438
<b>Taranaki</b>	4,562	16,173	8,452	3,874	661	2,318
<b>Manawatu-Wanganui</b>	23,723	56,222	42,649	21,492	12,832	15,061
<b>Wairarapa</b>	1,240	1,584	254	288	94	14
<b>Wellington</b>	8,308	12,776	13,719	7,051	3,554	6,598
<b>Tasman / Nelson</b>	42,371	79,157	57,170	50,282	45,715	33,505
<b>Marlborough</b>	14,480	27,289	18,466	14,146	13,525	30,393
<b>West Coast</b>	3,907	2,370	3,416	3,166	2,979	2,060
<b>Canterbury</b>	21,496	34,217	32,978	16,575	7,603	9,310
<b>Otago</b>	24,146	36,932	45,511	24,861	14,364	22,951
<b>Southland</b>	4,911	9,959	16,084	9,010	3,665	4,810
<b>Total</b>	<b>322,206</b>	<b>543,010</b>	<b>500,593</b>	<b>331,314</b>	<b>229,183</b>	<b>321,716</b>

## Appendix 9 - All woody residues

All woody residues - gross tonnage

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	408,698	364,778	281,278	200,066	288,512	391,593
<b>Auckland</b>	209,811	270,317	277,167	249,419	220,704	226,208
<b>Waikato</b>	340,765	518,586	435,890	261,567	278,337	327,991
<b>Bay of Plenty</b>	1,202,080	1,465,286	1,568,685	1,344,848	1,360,819	1,519,422
<b>Gisborne</b>	535,445	601,225	435,477	257,442	302,826	410,293
<b>Hawkes Bay</b>	405,079	564,097	459,418	341,766	277,835	287,566
<b>Taranaki</b>	97,007	110,412	69,242	43,396	37,176	41,678
<b>Manawatu-Wanganui</b>	391,973	484,915	321,004	170,299	147,533	166,009
<b>Wellington</b>	162,326	179,187	153,242	118,171	117,597	131,005
<b>Tasman / Nelson</b>	354,390	403,438	338,508	317,797	272,698	237,394
<b>Marlborough</b>	201,902	216,616	166,222	145,484	185,582	229,734
<b>West Coast</b>	79,424	78,910	85,781	82,233	71,221	59,272
<b>Canterbury</b>	397,333	461,456	373,635	238,156	194,849	207,511
<b>Otago</b>	365,528	479,088	420,312	302,663	285,735	295,224
<b>Southland</b>	174,534	290,610	282,570	183,356	143,240	142,748
<b>Total</b>	5,400,421	6,654,813	5,950,540	4,397,848	4,260,576	4,749,153

All woody residues - gross energy, GJ per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	2,844,583	2,543,176	1,968,775	1,410,284	2,022,566	2,735,971
<b>Auckland</b>	1,621,738	2,061,865	2,134,758	1,972,313	1,807,035	1,882,208
<b>Waikato</b>	2,576,672	3,821,458	3,270,093	2,088,025	2,226,143	2,592,939
<b>Bay of Plenty</b>	8,317,526	10,135,267	10,850,466	9,307,864	9,420,093	10,516,640
<b>Gisborne</b>	3,698,550	4,152,529	3,008,973	1,780,638	2,093,903	2,835,542
<b>Hawkes Bay</b>	2,840,272	3,938,840	3,217,945	2,407,582	1,967,940	2,036,618
<b>Taranaki</b>	687,493	780,354	496,650	318,694	276,161	307,625
<b>Manawatu-Wanganui</b>	2,713,707	3,355,155	2,224,317	1,184,606	1,027,678	1,155,315
<b>Wellington</b>	1,179,521	1,299,986	1,125,381	888,108	889,191	987,106
<b>Tasman / Nelson</b>	2,483,857	2,822,829	2,375,362	2,233,017	1,922,398	1,679,374
<b>Marlborough</b>	1,416,504	1,519,086	1,172,503	1,030,625	1,308,601	1,614,641
<b>West Coast</b>	550,380	547,063	594,720	570,520	494,836	412,720
<b>Canterbury</b>	2,877,707	3,325,664	2,725,424	1,796,583	1,503,969	1,597,789
<b>Otago</b>	2,559,806	3,346,020	2,943,324	2,134,634	2,021,160	2,090,228
<b>Southland</b>	1,215,762	2,016,794	1,961,418	1,276,947	1,000,252	996,969
<b>Total</b>	38,097,557	46,812,759	42,018,695	31,376,644	30,507,754	33,964,704

All woody residues - recoverability levels 1; tonnage

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	236,385	207,221	154,680	105,886	162,382	227,588
<b>Auckland</b>	140,630	178,522	183,139	166,381	149,021	152,869
<b>Waikato</b>	175,179	285,957	235,244	127,511	137,402	168,032
<b>Bay of Plenty</b>	822,666	1,006,096	1,073,634	927,947	930,853	1,027,660
<b>Gisborne</b>	271,638	303,006	224,730	141,078	162,152	212,560
<b>Hawkes Bay</b>	218,989	305,203	249,721	185,750	152,210	157,549
<b>Taranaki</b>	55,396	61,658	42,532	30,662	27,468	29,206
<b>Manawatu-Wanganui</b>	216,266	267,234	178,832	95,784	84,931	96,276
<b>Wellington</b>	104,110	112,343	99,482	82,896	82,938	89,878
<b>Tasman / Nelson</b>	152,627	175,679	155,047	151,177	133,097	117,924
<b>Marlborough</b>	119,183	126,708	100,541	89,306	104,096	121,377
<b>West Coast</b>	52,863	52,848	56,999	55,115	48,525	40,913
<b>Canterbury</b>	229,097	264,675	217,398	143,466	119,133	126,406
<b>Otago</b>	215,887	278,218	245,932	192,046	181,959	179,232
<b>Southland</b>	108,028	180,358	174,981	118,363	94,742	92,290
<b>Total</b>	3,178,245	3,938,440	3,618,581	2,726,317	2,631,640	2,900,164

All woody residues - recoverability levels 1; energy, GJ per annum

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	1,647,112	1,446,935	1,085,528	750,053	1,141,169	1,592,470
<b>Auckland</b>	1,082,341	1,358,294	1,406,563	1,309,517	1,210,771	1,261,143
<b>Waikato</b>	1,353,195	2,128,972	1,791,367	1,061,300	1,143,893	1,370,717
<b>Bay of Plenty</b>	5,691,878	6,958,593	7,425,734	6,421,710	6,443,071	7,112,453
<b>Gisborne</b>	1,877,448	2,093,962	1,553,939	976,823	1,122,316	1,470,217
<b>Hawkes Bay</b>	1,543,609	2,139,422	1,757,557	1,317,153	1,086,752	1,124,650
<b>Taranaki</b>	393,853	437,295	305,566	223,906	202,119	214,364
<b>Manawatu-Wanganui</b>	1,498,108	1,849,879	1,240,003	667,073	592,286	670,667
<b>Wellington</b>	756,526	815,979	730,064	618,636	622,164	673,507
<b>Tasman / Nelson</b>	1,079,115	1,238,544	1,096,564	1,070,248	945,882	841,592
<b>Marlborough</b>	839,695	892,346	712,563	635,869	738,798	858,980
<b>West Coast</b>	725,200	739,475	783,053	785,571	756,212	720,420
<b>Canterbury</b>	1,309,162	1,543,946	1,206,630	684,978	505,142	542,944
<b>Otago</b>	1,514,810	1,946,609	1,725,695	1,355,876	1,288,428	1,271,932
<b>Southland</b>	752,737	1,251,882	1,214,849	824,255	661,336	644,484
<b>Total</b>	22,473,955	27,757,854	25,592,919	19,482,305	18,879,370	20,787,322

All woody residues - recoverability levels 2; tonnage

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	176,845	153,529	111,656	72,895	117,925	169,858
<b>Auckland</b>	113,095	142,951	146,284	132,563	118,307	120,866
<b>Waikato</b>	120,647	208,603	167,996	81,965	89,493	113,528
<b>Bay of Plenty</b>	679,720	826,837	880,758	764,446	766,362	843,282
<b>Gisborne</b>	217,373	241,828	180,863	115,745	132,128	171,359
<b>Hawkes Bay</b>	169,195	237,143	193,483	143,039	116,664	120,870
<b>Taranaki</b>	45,749	50,611	35,740	26,523	24,012	25,328
<b>Manawatu-Wanganui</b>	171,953	212,138	142,539	77,047	68,591	77,604
<b>Wellington</b>	87,529	93,902	83,784	70,805	70,790	76,161
<b>Tasman / Nelson</b>	119,031	136,983	121,700	119,164	105,314	93,595
<b>Marlborough</b>	97,421	103,328	82,723	73,838	85,036	98,219
<b>West Coast</b>	43,210	43,208	46,494	45,025	39,813	33,755
<b>Canterbury</b>	178,112	206,076	168,838	110,607	91,348	97,003
<b>Otago</b>	173,662	222,708	197,208	155,555	147,540	144,753
<b>Southland</b>	83,315	140,772	136,453	91,901	73,265	71,141
<b>Total</b>	2,525,037	3,128,448	2,879,889	2,172,885	2,095,931	2,306,399

All woody residues - recoverability levels 2; energy (GJ per annum)

	2017	2022	2027	2032	2037	2042
<b>Northland</b>	1,232,376	1,072,286	784,213	517,667	829,340	1,188,720
<b>Auckland</b>	864,536	1,081,425	1,116,732	1,035,999	953,416	988,940
<b>Waikato</b>	940,874	1,556,329	1,285,374	701,727	764,433	941,890
<b>Bay of Plenty</b>	4,701,880	5,717,781	6,090,685	5,289,049	5,303,256	5,835,066
<b>Gisborne</b>	1,502,420	1,671,224	1,250,623	801,374	914,487	1,185,253
<b>Hawkes Bay</b>	1,193,021	1,662,588	1,362,079	1,014,781	833,592	863,432
<b>Taranaki</b>	324,385	358,110	255,682	192,266	175,125	184,397
<b>Manawatu-Wanganui</b>	1,190,890	1,468,245	988,081	536,263	477,993	540,254
<b>Wellington</b>	632,613	678,563	610,871	523,580	525,906	565,557
<b>Tasman / Nelson</b>	841,215	965,372	860,207	843,007	747,745	667,189
<b>Marlborough</b>	685,947	727,264	585,686	525,011	602,955	694,638
<b>West Coast</b>	568,479	579,251	613,130	614,628	590,750	561,496
<b>Canterbury</b>	1,025,337	1,210,262	944,990	534,557	392,715	422,452
<b>Otago</b>	1,217,497	1,557,213	1,382,658	1,096,761	1,043,077	1,025,593
<b>Southland</b>	580,383	976,883	947,133	639,774	511,243	496,638
<b>Total</b>	17,834,300	22,026,818	20,343,404	15,499,656	15,006,498	16,500,148