Promising resources and systems for producing bioenergy feedstocks

Energy from exotic plantation forests in New Zealand

Plantation forests of non-indigenous tree species are a sustainable source of wood for fibre and energy. They represent the largest source of biomass for energy in New Zealand.

This resource could be used to meet a significant proportion of our heat demand currently being met from coal and gas.

There is significant potential to further expand the plantation estate in New Zealand with environmental benefits accruing due to reduced green house gas emissions and hill country erosion.

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Energy from exotic plantation forests in New Zealand

Summary Report

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KEY MESSAGES

New Zealand is heavily dependent on fossil fuels for the production of heat in its primary processing industries.

There is a substantial but unutilized resource available to meet some of this demand, in the form of forest harvest and wood processing residues.

Plantation forests of exotic (introduced) tree species could be expanded and used to meet a much greater proportion of primary energy.

The existing plantation forest estate will be able to produce substantially more wood than it currently does by 2025 due to the age class distribution of the plantings – this represents a significant opportunity in terms of increasing biomass supply that could be available for energy.

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EXECUTIVE SUMMARY

New Zealand is heavily dependent on domestic (coal and gas) and imported (oil) fossil fuels for heat and transport energy. Biomass currently supplies 7.2% (59 PJ) of primary energy, mostly as wood to heat in the wood processing industry.

New Zealand has a significant residual wood resource (12 PJ) from forest harvesting which is currently unused which could be utilised for energy supply.

Our plantation forests have an uneven age class distribution which means we will have a significant expansion in wood available for harvest and processing over the next 10 to 15 years. Domestic processing of some of this resource would lead to additional wood processing residues (17 to 18 PJ) becoming available for energy supply.

Further, New Zealand's land resource could support an additional 1 to 2 million ha of plantation forest. A scenario of 1.8 million ha has been modelled and this area could provide a mix of log products, including a significant volume of energy wood.

New Zealand has the potential to have a substantial part of its energy supply derived from forest derived biomass.

INTRODUCTION

New Zealand's Energy Demand and Supply

New Zealand is a small (26.7 million hectares) island nation in the lower South Pacific. We have a low population (4.1 million) and population density (6.5 ha per person). New Zealand has a developed economy, based largely on export of primary produce (farming, forestry, horticulture and fishing).

In 2010 New Zealand had a primary energy demand of ~781 PJ (MED 2010). This demand was made up of:

- 58 PJ coal
- 273 PJ oil
- 140 PJ gas
- 310 PJ various renewables (hydro, geothermal, wind, biogas, wood etc.)

Consumer demand for electricity was 143 PJ, with 109.5 PJ (76.5%) from renewables made up of:

- 89.0 PJ from hydro
- 9.5 PJ from geothermal
- 5.9 PJ from wind
- 5.1 PJ from wood CHP

Primary energy demand for electricity generation is ~223 PJ. Electricity generation is 76.5% from renewables, with ~62% from hydro. In addition, 82 PJ of gas and 21.8 PJ of coal were used for electricity generation. Electricity generation from renewables is expanding, with substantial new geothermal and wind generation both planned and being constructed.

The difference between primary and consumer energies is particularly relevant to electricity. Consumer demand is the amount of electricity delivered and used by consumers. Primary demand is the amount of energy required to create the energy that is delivered to consumers – the difference being the conversion losses. For example a coal fired power station may consume 3 MW of coal for every MW of electricity it produces.

Liquid fuels demand (domestic) was 6.836 billion litres made up of a mix of petrol, diesel, jet fuel and fuel oil.

New Zealand uses 36.2 PJ of coal and 58 PJ of gas for heat. There are no gas fields in, or gas pipelines to, the South Island, so industrial use of gas in the South Island is limited. However the South Island has abundant coal and lignite reserves (West Coast, Otago and Southland). New Zealand has large coal resources, and at current consumption rates these reserves could last ~300 hundred years.

There are a number of primary industries that operate across most regions in New Zealand (dairy, meat and wood processing) that use heat. Use of industrial heat is therefore wide spread. There are also single site users (cement works, steel mill) which have significant heat demands. At smaller scale (hospitals, schools, hotels) there are many opportunities for biomass to be used for heat. The amount of coal and gas consumed by region is summarised in Table 1.

Table 1 – Regional coal and gas demand, PJ per annum

	Coal	Gas	**Total**
Northland	2.0	1.1	**3.0**
Auckland	16.1	40.4	**56.5**
Waikato	42.8	43.6	**86.4**
Bay of Plenty	1.3	4.3	**5.5**
East Coast	0.2	1.1	**1.3**
Hawkes Bay	0.1	2.4	**2.5**
Taranaki	0.0	31.7	**31.7**
Manawatu-Wanganui	0.4	2.8	**3.2**
Wellington	0.1	27.4	**27.5**
Nelson	0.7	0.0	**0.7**
Marlborough	0.1	0.0	**0.1**
West Coast	2.5	0.0	**2.5**
Canterbury	7.4	0.0	**7.4**
Otago	3.2	0.0	**3.2**
Southland	8.1	0.0	**8.1**
Total	**84.9**	**154.6**	**239.5**

Gas reserves are in decline with New Zealand arguably having gone past its "peak gas" (Figure 1). Gas supply was plentiful and cheap until recent times, but now that the giant Maui field is in decline we face having to either; find new fields, find alternatives to gas, or begin importing gas. By 2015 gas supply will be tight and swing users may drop out of the market.

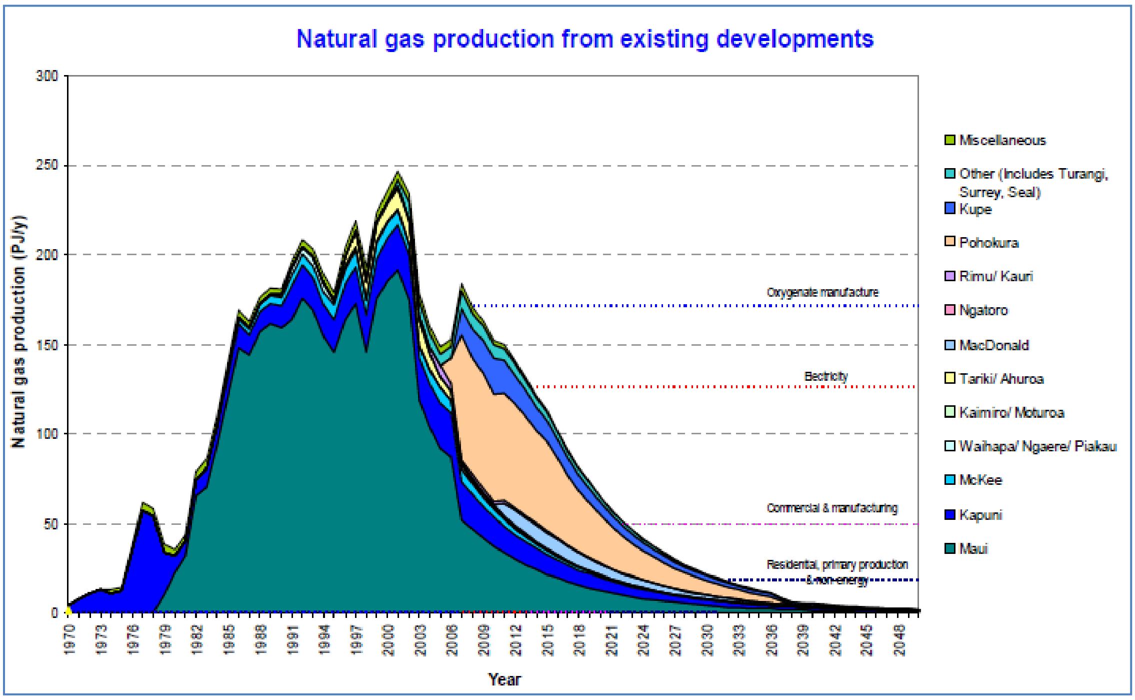

Figure 1. Domestic natural gas production by field. Source – de Vos and Heubeck 2009, In Scion 2009b.

New Zealand's oil reserves are small and we are dependent on imported oil and refined fuels for the majority of the liquid fuel component of energy demand. The oil producing fields we have are small and are typically exploited quickly (Figure 2). Current known oil reserves are also in decline. The government is supportive of oil and gas exploration and development of new fossil fuel resources.

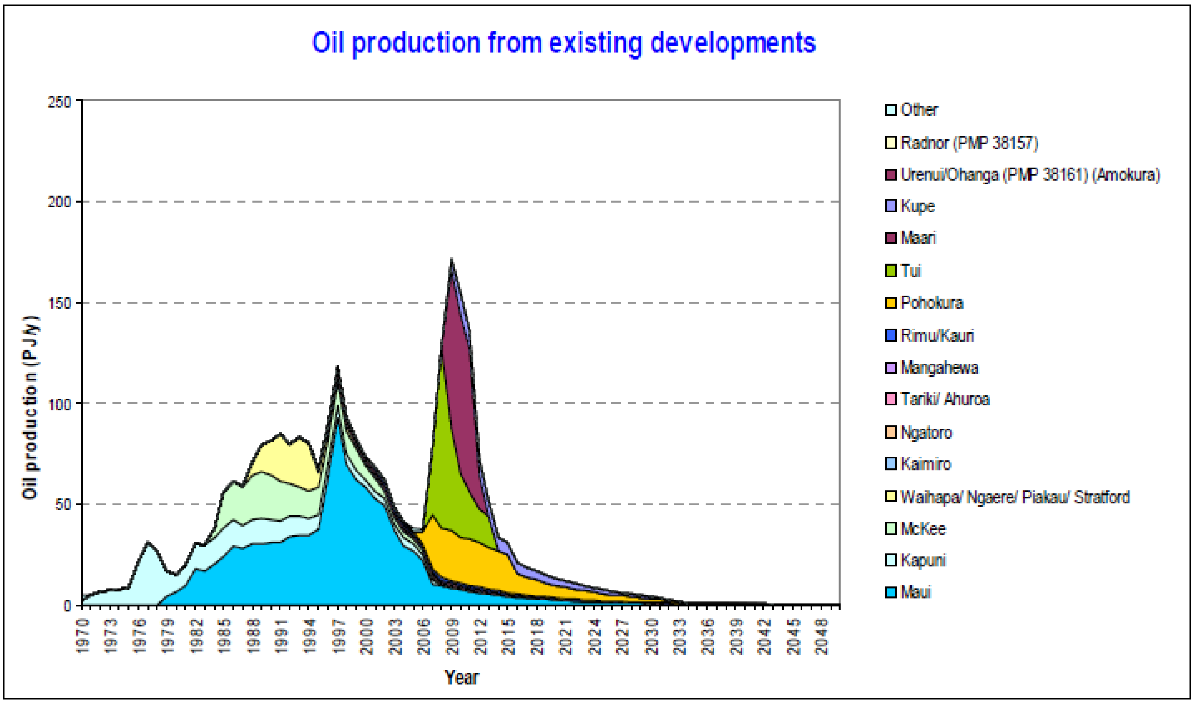

Figure 2 – Domestic oil fields and production. Source – de Vos and Heubeck 2009, In Scion 2009b.

Currently domestic oil production is at a historic high, but the producing fields will be heavily depleted by 2015 (Figure 2). Most (~90%) domestically produced oil is exported as it does not suit the configuration of the one domestic refinery.

The gas and oil field production profiles in Figures 1 and 2 are the drivers behind the current government support for fossil fuel exploration and development.

Current use of wood for energy

Of the total primary energy demand in NZ (781PJ), 59PJ or 7.5 % comes from wood or material derived from wood processing (black liquor). The vast majority of the wood energy consumed is within the wood processing industry, with some domestic heating from traditional firewood, and some industrial use of wood for heat in cement and meat processing. Of the 59 PJ, around 26PJ is used in the pulp and paper industry, 7PJ in domestic heating, 0.5PJ in industries outside of wood processing and the rest (25.5 PJ) is used in panel plants and sawmills for process and drying heat. There are only 2 wood fuelled combined heat and power plants in operation (1 at a pulp mill and 1 at a large sawmill).

New Zealand's bioenergy strategy

The government has a stated goal of achieving 90% renewable electricity by 2025. This will in part be achieved by gradual de-commissioning of our one large (988 MWe in 4 x 247 MWe units) coal fired power station and replacing this capacity with renewable electricity from geothermal and wind resources. New Zealand also has other potential routes for generating renewable electricity in the long term, including tidal and wave generation as well as further hydro development.

In 2011 the Bioenergy Association of New Zealand (NZ) published a Bioenergy Strategy for NZ (BANZ 2011). This strategy has a vision of *"Economic growth and employment built on New Zealand's capability and expertise in forestry, wood processing and bioenergy production - leading to new business opportunities which by 2040 supply more than 25% of the country's energy needs, including 30% of the country's transport fuels."*

It aims to lift the national use of bioenergy to substantially above its current ~7% - with attendant economic, social and environmental benefits. The strategy includes a 60% increase in New Zealand's use of biomass for heat.

At the core of the Bioenergy Strategy for NZ is the increased use of wood for energy. This wood will come from the existing forests and wood processing industries as well as potential new forests and woody biomass crops. These resources and potentials have been extensively described in the Bioenergy Options for New Zealand reports (Scion 2008 a & b, Scion 2009 a & b).

The largest energy demand in NZ is for liquid transport fuels, with the most strategically important being diesel for primary industries and heavy transport (PCE 2010), and jet fuel. There is significant interest in developing use of wood to create liquid biofuels.

New Zealand's forest resource

New Zealand's exotic plantation forest resource is described in Table 3. There is also a significant area (11.7 million ha or 43.7 % of land area) of indigenous forest cover in New Zealand, but this forest is almost all protected as National Parks and Reserves and there is very little native logging. Wood production is 99.8% from plantation forests of exotic tree species, 89% of this is *Pinus radiata,* which is grown on a ~28 year rotation.

Table 3 – New Zealand's plantation forest resource (as at April 2010)*

Net stocked forest area (ha)	1,738,000
Area by species (ha)	
Radiata pine	1,556,000
Douglas-fir	110,000
Cypress species	10,000
Other exotic softwoods	25,000
Eucalyptus species	24,000
Other exotic hardwoods	13,000
New planting (ha)	
Total estimated new planting	24,300
Harvesting (ha)	
Area clear felled (ha)	43,500
Average clear fell yield (m^3/ha)	473
Area-weighted average clear fell age for radiata pine (years)	28.4
Estimated planted forest round wood removal (m3), 2010	21,941,000

*Source NZ Forest Owners Association. – Facts and Figures 2010/2011

New Zealand had a forest planting boom in the mid 1990s, when abnormally large amounts of afforestation occurred. These plantings are now aged 15 to 20 years (Figure 3) and will be due for harvest around 2020 to 2025 (Figure 4) when they reach ~28 years of age. Current (2011) forest harvest is expected to be ~25 million m^3.

Figure 3 – Age class distribution of New Zealand's forest (2010).

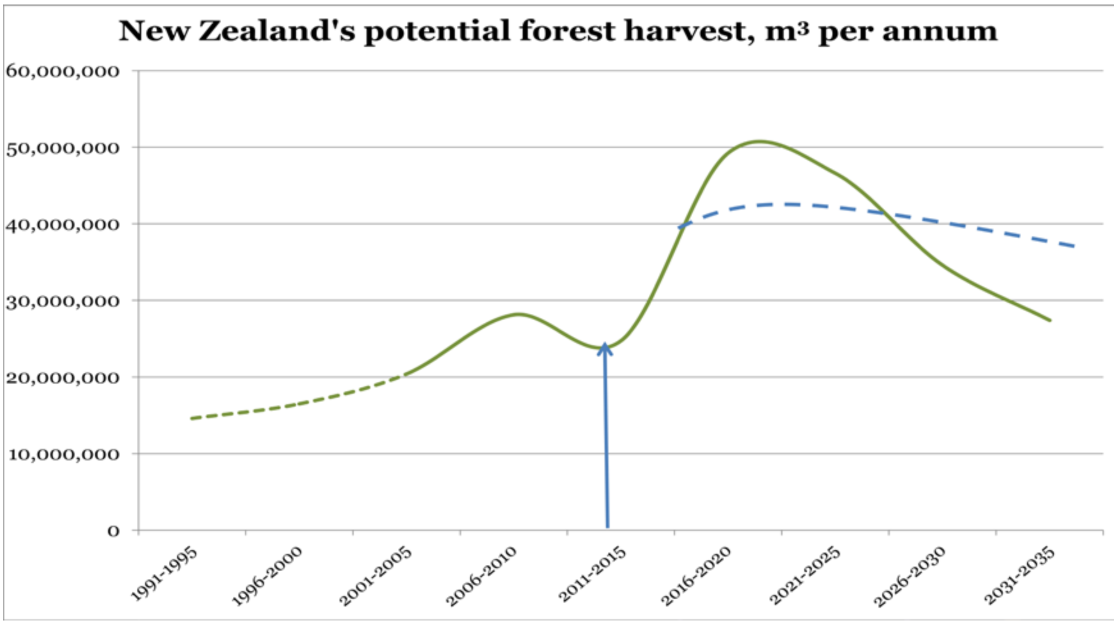

Figure 4 – New Zealand's potential future forest harvest volume.

The scale of the potential peak harvest means that it is probable that some smoothing of the harvest volumes (blue dotted line in Figure 4) will occur, with harvests of 35 to 40 million m^3 per annum possible for a period of around 15 years. This volume of harvest is significantly higher than current levels (25M m^3 per annum). This increased harvest will create increased volumes of in-forest residues (Table 4).

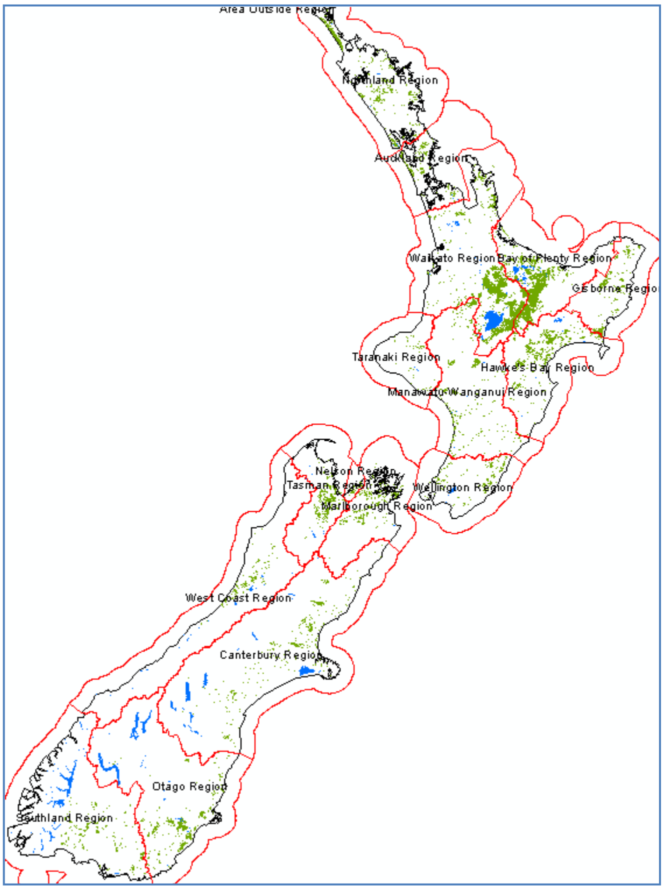

Figure 5 – New Zealand plantation forest by region.

Plantation forests in New Zealand (green areas in Figure 5) are spread over all regions, but there is a major concentration in the Central North Island.

Summary of residual biomass resources

New Zealand's biomass resources were comprehensively assessed in 2007 (Scion 2008a). The results are presented in Table 4. This is material which is currently available as it is not being used, and does not include resources such as those wood processing residues that are already being used for energy. There are a wide range of resources available, some of which are small; and seasonal (straws, fruit and vegetable culls). These resources collectively could contribute 8% to 9% of consumer energy (over half, or 4.7% to 6.3% from wood).

Table 4 - Current and future (2030) residual and waste biomass resources

Residuals & wastes type / source	2005 PJ p.a.	2030 PJ p.a.
Forest Residues	14.6	34.4
Wood Process Residues	7.0	9.1
Municipal wood waste	3.5	2.2
Horticultural wood residues	0.3	0.3
Straw	7.3	7.3
Stover	3.0	3.0
Fruit and Vegetable Culls	1.2	1.2
Municipal Biosolids	0.6	0.7
Municipal solid waste as landfill gas	1.9	2.3

Farm Dairy	1.2	1.2
Farm Piggery	0.1	0.1
Farm Poultry	0.0	0.0
Dairy Processing Industry	0.4	0.4
Meat processing Industry (effluent only)	0.5	0.5
Waste vegetable oil	0.2	0.2
Tallow	3.6	3.6
Total	45.9	66.5
% of consumer energy	8.5	9.2
% of primary energy	6.6	7.3

Woody biomass is the largest biomass resource, and forest harvest and wood processing residues are the largest contributors to the total woody biomass resource. Forest harvest residues have significant potential increases due to the age class distribution of the ~1.74 million ha plantation forest resource (MAF 2010). Of the non-wood resources many are true wastes (municipal biosolids) rather than residues. These materials may only make a small contribution to the energy supply but if they are utilised for energy production they will produce significant environmental benefits (reduced GHGs, land filling, effluent flows and loadings).

Logging residues - potential volumes by region

Logging residues occur at different locations and in differing volumes, depending on the harvesting system, but typically in New Zealand we extract tree length stems to a landing and process these into logs (Figure 6). These landings might service a harvest area of 6 to 20 hectares, and there is typically a large accumulation of unmerchantable residues (large limbs, malformations, poor quality sections) (Figure 7). Only a small proportion of the available residues are removed and used. Most landing residues are abandoned in-situ and left to decompose.

Figure 6. Stem to log processing (residue pile in background).

Figure 7. Landing residues from stem to log processing.

These residues usually have high moisture content, dirt contamination, and only found in relatively small volumes at individual landings, although the collective volume in a region can be large; for example, the East Coast region has unutilised landing residues of 170,000 m^3 per annum.

Logging residues also occur on the cutover, where the majority of the material is composed of limbs and tops which frequently break off during felling (Figure 8).

Figure 8. Cutover residues.

The total volume of residues potentially available is shown in Table 6. The amount that is realistically recoverable is also calculated. The recoverable material is assumed to 80% of the landing and rolling cutover, with no recovery of residues from steep terrain cutover. Extraction of residues from steep land cutover is not currently economically viable. Overall around 55% of the total residue volume is estimated to be recoverable.

Table 6. Volume (m^3 per annum*) of logging residue by region and type for 2016 to 2020.

	Landing	Rolling	Steep	Total	**Recoverable**
Northland	219,299	156,627	132,896	508,822	300,741
Auckland	32,616	17,938	29,825	80,379	40,443
Waikato	331,442	244,477	145,223	721,142	460,735
Bay of Plenty	221,509	133,235	138,501	493,245	283,795
East Coast	127,799	28,752	146,373	302,924	125,241
Hawkes Bay	49,912	18,417	44,014	112,342	54,663
Taranaki	12,115	24,359	31,002	67,476	29,179
Manawatu-Wanganui	45,287	13,209	16,812	75,308	46,797
Wellington	38,962	22,822	37,937	99,721	49,427
Nelson	68,115	28,878	55,131	152,124	77,595
Marlborough	59,435	27,560	52,614	139,609	69,596
West Coast	5,279	6,249	11,931	23,458	9,222
Canterbury	55,609	59,239	40,597	155,445	91,878
Otago	53,416	42,820	54,498	150,734	76,989
Southland	39,244	23,550	29,973	92,768	50,236
Total	1,360,038	848,133	967,328	3,175,498	1,766,536

*$1m^3$ = 0.42 oven dry tonnes = 7.938 GJ

The total figure for recoverable logging residues in 2020 to 2025 could be 3.3 million m^3 of residues (an increase of 1.6 million m^3 over current levels). The increase is due to the age class distribution of the forests.

The amount of wood energy available and heat energy demand at regional level are presented in Table 7. In all but the Marlborough region, all the available wood residues could be utilised to satisfy heat demand currently supplied from fossil fuels, as heat demand generally exceeds potential biomass supply.

Table 7 – Regional wood energy matched with regional heat demand currently supplied by coal or gas.

Region	PJ of wood residues	PG of heat demand	% of heat that wood could satisfy
Northland	2.11	3.0	70%
Auckland	0.28	56.5	1%
Waikato	3.23	86.4	4%
Bay of Plenty	1.99	5.5	36%
East Coast	0.88	1.3	67%
Hawkes Bay	0.38	2.5	15%
Taranaki	0.20	31.7	1%
Manawatu-Wanganui	0.33	3.2	10%
Wellington	0.35	27.5	1%
Nelson	0.54	0.7	78%
Marlborough	0.49	0.1	487%
West Coast	0.06	2.5	3%
Canterbury	0.64	7.4	9%
Otago	0.54	3.2	17%
Southland	0.35	8.1	4%
Total	**12.37**	**239.5**	**5%**

Harvesting practices and options for integrating residue recovery

Harvesting techniques will depend on the location of the residues. Techniques used on landings, flat to rolling cutover or steep cutover will be discussed below.

Landing residues

There are a number of operations, centred on major wood processors (pulp and MDF mills) who purchase additional fuel, sourced from in-forest residues where the landing residues from harvesting operations are collected and processed into boiler fuel. Typically these operations are post-harvest salvage, and separate to the conventional logging operation. A common approach is to retrieve and pile the material from the area surrounding the landing using an excavator loader, this machine then loads bin trucks which transport the material to a central landing. The wood is then converted into hog fuel using a trailer or track mounted chipper or hogger. Various configurations of chippers / hoggers / shredders have been used for the comminution (Figure 9). The hog fuel is then transported to the user (pulp or panel mill) by high volume chip or bin trucks (Figure 10).

Delivered cost of this material (NZ Dollars) is $35 to $45 per green tonne ($5.00 to $6.5 per GJ). Pulp log costs are $45 to $55 per tonne (Agrifax 2012).

The volume of landing residues being used nationally is not well documented, but estimated to be ~200,000 green tonnes per annum, or approximately 1.3 to 1.4 PJ per annum.

Figure 9. Wood-Weta converting reject logs into hog fuel.

Figure 10. Truck with load of hog fuel.

It is widely accepted that it would be more efficient to integrate the residue collection with the log harvesting operation, but this is not practised in New Zealand. Some changes in the approach from forestry and logging companies to fuel supply, along with a clear and consistent demand would be needed to implement integrated systems.

Rolling terrain cutover

There are no currently active operations for cutover salvage of logging residues in New Zealand, although there have been some operations looking to recover pulp logs and residues for fuel in the past. The cost of these operations makes the resulting hog fuel uncompetitive with coal, which can be bought by large users for NZ$6 to $8 per GJ delivered. The current price for pulp logs is around $55 per m^3 ($8 per GJ) delivered to a mill, with chipping an additional cost. Collecting and transporting cutover residues is more expensive than log harvest and thus the demand for biomass fuels is low due to the comparatively low cost of coal. Gas is more expensive per unit of energy but the capital cost of the fuel infeed infrastructure is negligible. The low coal cost and convenience of gas have made it difficult for wood fuels to break into the heat market.

There are some trials being undertaken with stump harvesting from flatter cutovers in the Central North Island – but the primary use of the feedstock material being produced is for high value chemical extractives, not fuel.

Increased recovery of cutover residues could be achieved by altering harvesting practices. However to recover a large proportion of the available material a separate operation would be necessary as clearfell equipment is not suited to handling residuals. Bundlers are not considered to be viable at this time due to the high cost of the bundlers and their modest production rates, which lead to a high cost per tonne.

Use of forwarders with extended load spaces with chipping or hogging at roadside or landings is the most likely processing system in the near term.

The target material would be the large pieces of stem wood which occur due to felling breakage (Figure 11). Branch material, especially small branches with green needles are not a desired fuel product and most forest managers would prefer that they be left on site for nutrient recycling.

Figure 11. Stem wood residues left after harvest.

Steep terrain cutover

Currently there are no operations in New Zealand that collect the cutover residue from steep terrain (Figure 12). Residues from steep terrain cannot be economically harvested in a separate operation, so increased volume recovery would need to occur with the existing log harvest. This would involve increased costs as the many small pieces take more time to harvest, and may contribute a relatively small volume of additional biomass.

Figure 12. Steep terrain cutover.

However, there are concerns from councils in some regions that have steep terrain and severe rainstorm events that changes need to be made to log harvesting practices to reduce slash from ending up in waterways and causing downstream damage. These concerns may force increased slash management costs which would in turn cause the forestry companies to look for alternative uses for the residues, including removal for energy use.

In these steep terrain operations, using cable logging systems, there is often limited space to land, process, store, load and haul out logs, and having a large volume of additional material to deal with would put increased pressure on the system. Integrating residue harvest into a logging operation would require that the material be removed on a regular basis. Chipping at the source landing is therefore problematic and a central processing yard or super skid approach is the most likely to be used.

Impact of log export and onshore processing on residue

New Zealand's forest age profile presents some challenges and opportunities. The log harvest could increase from its current level of around 25 million m^3 per annum to 35 to 40 million m^3 per annum in the next 10 to 15 years. Whilst some of this increased harvest volume will be exported as logs (NZ currently exports around 42% of its harvest as unprocessed logs), some of it could be processed on-shore in sawmills, with the subsequent production of sawdust and slab-wood or chip which are potential energy resources. Allied with this log harvest is an increase in pulp log production, which could also be a wood energy resource as the current mills have adequate log supply and much of the increase in harvest will take place in regions that do not have pulp mills (Northland, East Coast, Wellington, Otago and Southland).

Estimated volumes available from the increased harvest

If we assume that the increase in log harvests moves from its current 25 million m^3 to 35 million m^3, with 80% of the volume being sawlogs and 60% of the increased sawlog volume being processed on shore (currently around 51% is processed on shore, MAF 2012), we would have an extra 4.8 million m^3 of logs going to sawmilling, with residues of:

1.25 million green tonnes of chips

0.46 million green tonnes of sawdust

0.24 million green tonnes of bark

0.08 million green tonnes of sawn lumber defect off-cuts

This resource could total 2.0 million green tonnes, or 13.8 PJ of energy, this would equate to 1.7% of our primary energy demand. Further it would be distributed across a number of regions, which have heat demand for other primary processing (dairy, meat etc). There is an opportunity for New Zealand to make more use of residual biomass energy if the cost of wood fuels can be competitive with coal and gas.

If the increase in wood residues from wood processing and the currently unused and future increases in logging residues are added together it can be seen that NZ has a significant opportunity to increase its use of renewable energy substantially over the next 10 to 15 years – from 59 PJ per annum to ~87 PJ per annum (+47%).

Potential & rationale for further plantation forest expansion

New Zealand also has the opportunity to expand its forests resources. There is a significant area of hill country land, currently used for sheep and beef grazing that is highly erodible and has low productivity (earning less than $100 per hectare per annum) in its current use.

A GIS analysis (Scion 2009a) identified the land that was suitable for forest establishment based on slope, soil type and current land use. This candidate forest estate expansion area (1.7 million to 1.8 million ha) is shown in Figure 11 (light green). The existing 1.7 million hectares of plantation forests is shown in dark green.

Based on this candidate area Scion completed a scenario based study of the potential of forests to provide bioenergy in New Zealand (Scion 2009a). This study looked at the energy supply volume, cost, land use change and associated environmental and macro-economic impacts of four large-scale afforestation scenarios for liquid biofuels production.

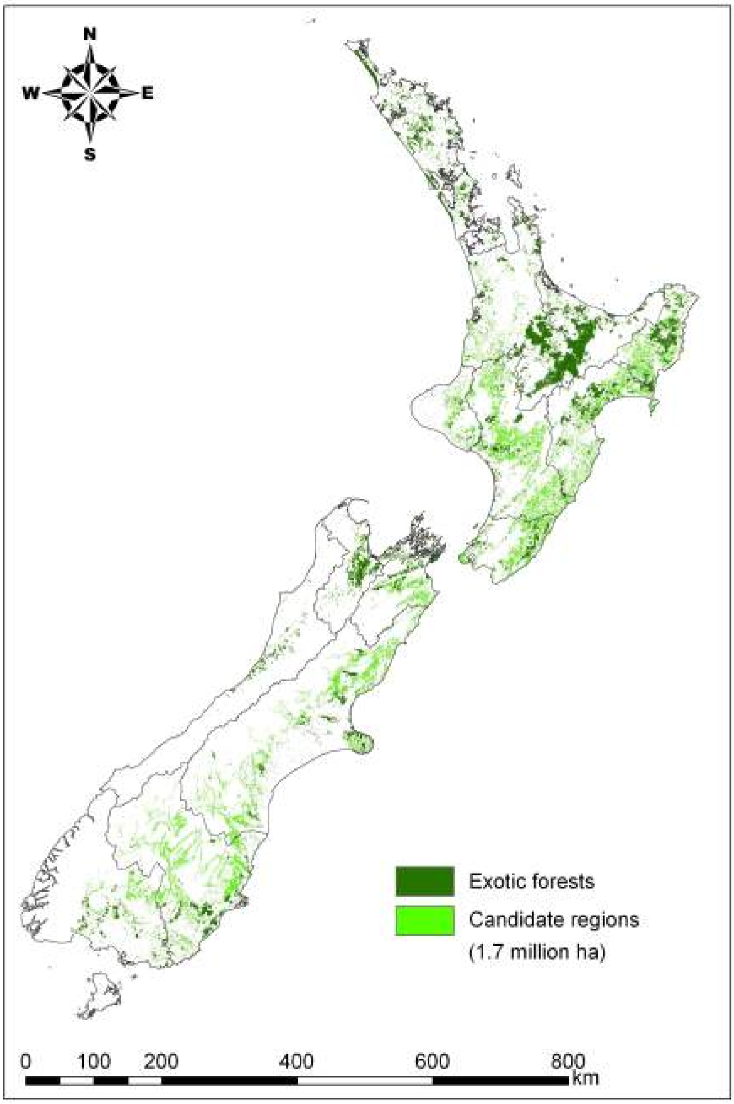

Figure 11. Current and potential new forest area (~1.7 to 1.8 million ha).

The large-scale afforestation scenarios were based on the assumption that the crop would be radiata pine. This does not mean that all the afforestation would or should be radiata pine. It is however the species that has the most information available at a national level on its productivity, thus allowing more detailed and accurate predictions than is possible for other species.

The forest management regime (plant 833 stems per with no pruning or thinning) assumed in the scenarios gives market options for the logs produced other than 100% to energy; for example, 56% sawlog and 44% chip. This option provides high volumes of carbon sequestered or stored.

For a given estate area, some of the land could be retained as carbon forests, some logged, and there are a range of options for marketing the material produced. Table 8 summarises the environmental impacts of the afforestation scenario on some key environmental variables (erosion, water yield, nitrogen (N) leaching and carbon). The impacts of increased afforestation are generally positive with reduced GHGs, a large carbon / energy store created and reductions in erosion and N leaching.

Table 8. Environmental Impacts of 1.8M ha afforestation scenario.

Scenario, millions of ha, new forest	GHG impacts, Reduced emissions, millions of tonnes, CO_2e	Stored carbon, millions of tonnes, CO_2e	% reduction in erosion	% reduction in N leaching	% reduction in water yield
1.8	15.49	651.1	8.0	3.4	2.6

National Economic Welfare

In the scenario considered, development of a large scale biofuels industry led to a decrease in national productive efficiency and this implies a reduction in macro-economic welfare. However, the production and use of biofuels reduces CO_2 emissions, so if there is a price on carbon, New Zealand's liability to purchase offshore emission units is ameliorated. This generates a gain in Real Gross National Disposable Income. In addition, the increase in allocative efficiency reflected in increases in the terms of trade for high oil prices also leads to increases in economic welfare.

Economically it is better to use only lower value (chip or pulp grade) logs for energy and saw logs for sawn lumber as opposed to all product grades for energy. Forests should be regarded as having multiple values and many potential end-uses for the wood, including carbon.

CONCLUSIONS

Residual woody biomass from plantation forest harvest and wood processing is the largest biomass resource available in New Zealand. A significant part of this resource (90%) is not being utilised.

New Zealand is not making full use of its existing biomass resources (residuals and wastes), which could contribute around 45 PJ per annum, or 8% of primary energy.

Based on our land resources we have potential to have a significantly larger plantation forest estate, with environmental benefits as well as significantly increased wood supply.

Biomass could make an increasing contribution to New Zealand's bioenergy supply over the next 30 years (Table 9). Explicit use of forest and wood processing residues from the available plantation forests could see biomass contribute 17% to 18% of primary energy by 2020.

Developing a larger forest estate could see 30% of primary energy being derived from forests by 2040.

Table 9 – current and potential energy supply from forest derived biomass

Source	PJ per annum	% of Primary energy	Cumulative % of Primary energy	Year available
Current use	59	7.2	7.2	2012
Landing and cutover residues, now	12.5	1.5	8.7	2012
Landing and cutover residues, 2020	10.8	1.3	10.1	2020
Increased wood processing residues	17.5	2.1	12.1	2020
New forests Landing and cutover residues	44.3	5.4	17.5	2040
New forests, 40% of volume	102.0	12.5	30.0	2040

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IEA Bioenergy

IEA Bioenergy is an international collaboration set up in 1978 by the IEA to improve international co-operation and information exchange between national RD&D bioenergy programmes. IEA Bioenergy's vision is to achieve a substantial bioenergy contribution to future global energy demands by accelerating the production and use of environmentally sound, socially accepted and cost-competitive bioenergy on a sustainable basis, thus providing increased security of supply whilst reducing greenhouse gas emissions from energy use. Currently IEA Bioenergy has 22 Members and is operating on the basis of 13 Tasks covering all aspects of the bioenergy chain, from resource to the supply of energy services to the consumer.

IEA Bioenergy Task 43 – Biomass Feedstock for Energy Markets – seeks to promote sound bioenergy development that is driven by well-informed decisions in business, governments and elsewhere. This will be achieved by providing to relevant actors timely and topical analyses, syntheses and conclusions on all fields related to biomass feedstock, including biomass markets and the socioeconomic and environmental consequences of feedstock production. Task 43 currently (Jan 2012) has 14 participating countries: Australia, Canada, Denmark, European Commission - Joint Research Centre, Finland, Germany, Ireland, Italy, Netherlands, New Zealand, Norway, Sweden, UK, USA.

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