



# Wood Energy Demand Assessment

---



Document Prepared by:



Nathan Surendran      EIS Energy - Lead Engineer  
phone.                    +64 (3) 214 2046  
mobile.                  +64 (27) 555 8715  
email.                    [nathans@eisenergy.co.nz](mailto:nathans@eisenergy.co.nz)  
web.                      [www.eisenergy.co.nz](http://www.eisenergy.co.nz)

COPYRIGHT: This work is copyright and is issued under a Creative Commons license.



<http://creativecommons.org/licenses/by-nc/3.0/>

The copying, adaptation, or issuing of this work to the public on a non-profit basis is welcomed. No other use of this work is permitted without the prior consent of the copyright holder(s), Venture Southland.

ACKNOWLEDGEMENTS: Financial support has been received from the Energy Efficiency Conservation Authority, Wood Energy New Zealand, Energy For Industry, Venture Southland, Living Energy, Southwood Export, Niagara Wood Fuels, Lindsay Dixon Sawmills. More information on the project funders can be found in Appendix A. Thank you to the project group members Chris McArthur, David Blue, Craig Unahi, Steve Chandler and Karyn Owen for your valuable time in helping this project come to fruition, as well as the contribution from all those who attended the Wood Energy Forum.

Particular thanks to all those who took the time to answer the questions in the survey, and participate in discussions around specific issues.

#### LIMITATION:

The opinions in the Report have been provided in good faith and on the basis that every endeavour has been made to be accurate and not misleading and to exercise reasonable care, skill and judgment in providing such opinions.

The funders of this work and EIS Energy accept no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party. A person using documents or data accepts the risk of:

- a) Using the documents or data in electronic form without requesting and checking them for accuracy against the original hard copy version.
- b) Using the documents or data for any purpose not agreed to in writing by EIS Energy.

#### Revision History

Rev	Date	Description	Author
1	17/06/11	Final Draft – Funder Review	Nathan Surendran
2	27/06/11	Final Document – For Issue	Nathan Surendran

## 1. Executive Summary

A significant increase in the use of woody biomass for energy is a realistic and desirable goal for Southland. Switching to renewable forms of energy helps reduce the risks associated with limited supply of fossilised sources of energy, as well as providing environmental benefits. There is good evidence from the International Energy Agency (IEA) that 'conventional' oil supply has already peaked, and the predicted global supply 'crunch' in 2012/2013, is likely to 'turn up the heat' significantly on issues such as price volatility. Acting now to improve diversity in fuel supply can be seen as a strategic 'hedge', as well as providing businesses working towards sustainability goals a cleaner, efficient heat source option. Furthermore, strategic changes with stricter air quality standards and carbon pricing influences will likely make woody biomass even more economically competitive with other energy sources.

This report identifies potential demand for wood energy in Southland, investigates barriers to up-take and identifies strategic actions that could stimulate demand. This research has demonstrated ample potential demand locally against the 4MW installed capacity that was identified in the Nov 2010 Southland Wood Energy Forum as a threshold for investment. The results are broadly consistent with the findings of the 2010 'NZ Bioenergy Strategy' published by the Bioenergy Association of New Zealand (BANZ), which this report should be read in conjunction with.

A summary of the identified strategic actions to address identified barriers to uptake include:

- Start collating and publishing information on woody biomass historic and projected prices.
- Encourage the signing of long term supply agreements and bulk pricing to give suppliers and end users the ability to plan.
- Raise awareness of the potential applications for thermal energy from woody biomass by making information accessible, easy to understand and engaging, utilising existing resources where possible.
- Capture information from existing local users and disseminate this, along with information on biomass supply, suppliers, and information on maintenance requirements.
- Include the other benefits of wood energy in promotional material, in particular the health and wellbeing aspects of fewer particulate and other emissions from wood energy should be included in promotional material.

Strategic actions to stimulate demand include:

- The formation of a regional bio-energy cluster to strategically coordinate activities is a desirable mechanism, and should be enacted for Southland, including consideration of collaboration with Otago.
- Encourage cofiring of biomass as a way to quickly stimulate demand.
- Enact policy / guidance with a target of ensuring that all new solid fuel fired installations in the region are clean and efficient dual / multi fuel systems, or are easily converted to firing woody biomass.
- Quality control for the installation of systems and the supply of fuel was identified as a strategic area of focus which could be addressed by reviewing existing practice, leveraging international standards and striving for best practice.
- Advocate to central government to extend protections around liquid fuel reserves to other forms of energy such as wood. Consider local initiatives to put such reserves in place for essential services.
- There may be value in any marketing initiatives to stimulate demand for wood energy to segment their target audience and alter the key messages accordingly.
- Advocate for stricter Air Quality Emissions standards, which stimulate demand for cleaner energy sources such as wood.
- Energy and Design Audits carried out in Southland should have biomass for heat energy as a particular consideration to be assessed. Adopt standards and work with national bodies to develop these.
- Feed learning experiences back into the national efforts through case studies and participation in working groups, etc.
- Only landing site waste from the forestry process and waste processing residues are likely to be considered as potentially economic as a heat energy source at present. Further investigation is required in this area.
- It is recommended that in order to plan for a peak in wood residue in 15-20 years, additional plantings, or investigations into short rotation crops are undertaken.
- With regard to supply and logistics Energy Return on Energy Invested (EROI) is important. Locations which have micro-climates suited to air drying should be investigated. Consideration of the potential use of rail to increase transport efficiency should be considered. Torrefaction is an emerging technological opportunity which could increase energy densities and improve transportation efficiencies, provided cost of production does not make cost of the end product uneconomic.

## Contents

1.	Executive Summary .....	3
2.	Purpose of document.....	7
3.	Scope .....	7
4.	Methodology .....	8
	Survey .....	9
	Survey response target and actual response figures.....	10
	Report methodology.....	10
5.	Background.....	11
	Wood Energy Forum - Southland.....	11
	Increased demand for energy .....	12
	Regional Bio-Energy Cluster .....	12
	Wood Energy Uses.....	13
	Types of Woody Biomass .....	16
	Wood Suppliers .....	17
	Boiler Suppliers .....	18
6.	Woody Biomass Supply.....	19
	Forestry Residues.....	19
	Processing Residues .....	24
	Potential to meet demand .....	26
	Co-firing of Biomass.....	28
	Summary of Supply Challenges.....	28
7.	Torrefied Biomass .....	30
8.	Demand Assessment.....	33
	Existing Biomass Users .....	33
	Potential Demand.....	34
	Significant Potential Users .....	35
9.	Stimulating Demand .....	37
	Key Drivers .....	37
10.	Historical Fuel Price Analysis .....	42

Strategic Backdrop .....	42
Competing Fuel Sources.....	49
Historic and Projected Price Analysis - background information .....	52
Historic and Projected Price Analysis.....	57
Additional Factors Influencing Change - Strategic.....	57
Limitations to the Analysis.....	59
11. Additional Strategic Actions .....	61
Air Quality .....	61
Carbon Emissions.....	65
Strategic Quality Control.....	67
Driving demand.....	72
An innovative alternative approach for Southland.....	77
12. Next Steps.....	78
Bibliography of Sources .....	79
Works Cited .....	79
List of References For Additional Information.....	84
Appendix A – Funders .....	87
Appendix B – Questionnaire.....	88
Appendix C – Lloyds Sustainability Energy Security Report Exec Summary .....	94

## 2. Purpose of document

This assessment was commissioned by Venture Southland, in response to existing and potential suppliers of wood energy (and other associated services), desire to better understand the potential demand for wood energy in Southland.

This report provides an understanding of potential demand, barriers to up-take, and strategic actions that could stimulate demand. The objectives are to:

- Investigate the opportunity of creating a locally owned and sourced wood fuel market for Southland.
- Facilitate development of a secure supply of energy for Southland.
- Inform future strategic planning for a wood energy industry in Southland.

## 3. Scope

This assessment was limited to assessing potential demand for wood energy in Southland region. However, this did not preclude the assessment from considering South Otago potential demand - if identified to be of significance or strategic advantage.

Wood energy in the context of this assessment refers to energy derived from wood fuel. Wood fuel may come in the form of wood chips, wood pellets, logs, trimmed branches, or even waste wood (treated and untreated). It is also acknowledged that some of this wood fuel, such as wood pellets may include other biomass such as nutshells, etc.

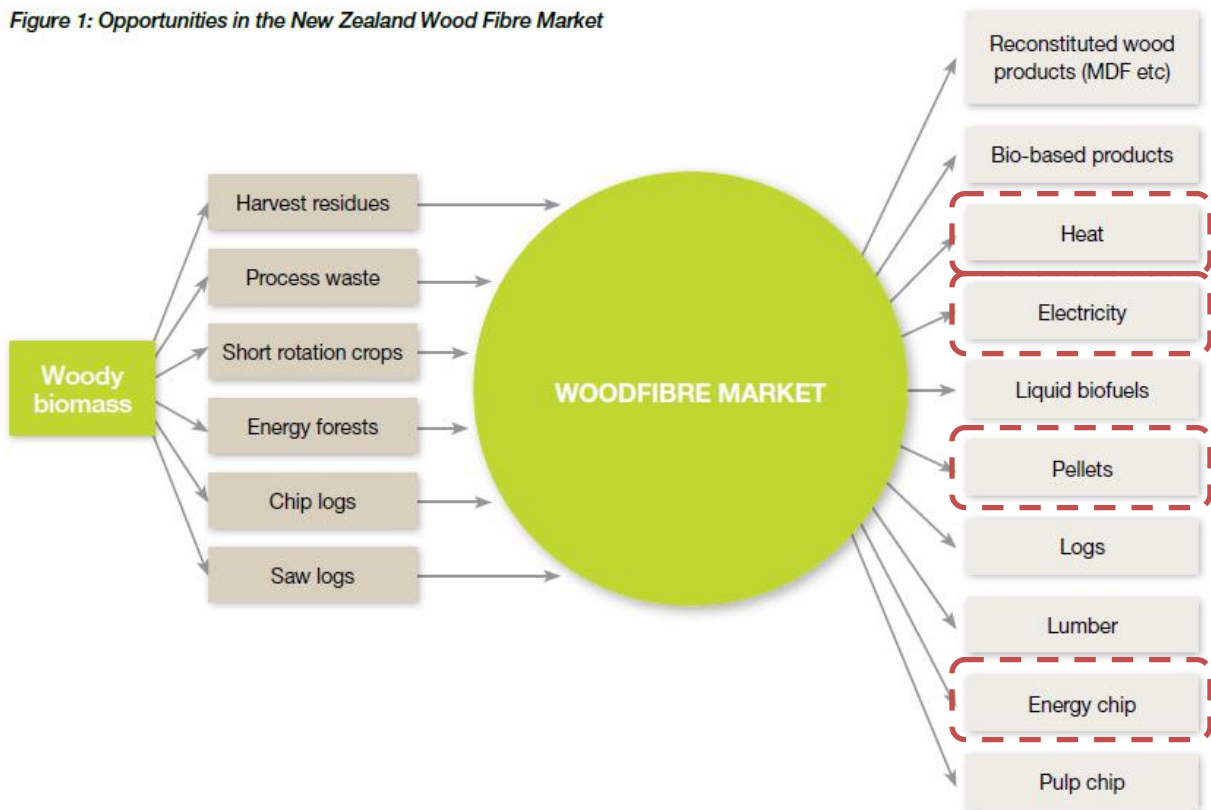
Potential demand includes any community, or industrial energy users using large-scale boiler systems. Domestic users are not the focus of this assessment, despite space and water heating from wood burners being common in the region.

Gasification as a technique for harvesting wood energy is also within the scope of this assessment. Wood converted to a liquid bio fuel such as diesel, is however outside the scope of this assessment.

The information in this report refers to 'woody biomass' intentionally as a reminder that wood is but one source of biomass.

The modified diagram below from the Bio-Energy Strategy <sup>1</sup> shows visually the focus of this report:

*Figure 1: Opportunities in the New Zealand Wood Fibre Market*



The information in this report provides at best 'order of magnitude' estimates of potential supply. The demand scenarios discovered through analysis of the survey accompanying this report are based on partial responses only.

## 4. Methodology

This assessment was prepared by undertaking a survey of potential users, an extensive online literature review, and a number of interviews with specific parties.

The report was written in parallel with the survey, and updated with the results towards the end of the process.

---

<sup>1</sup> (BANZ, 2010)



## Survey

A list of potential users of wood energy was developed using the EECA 'heat plant users' 2008 spreadsheet database<sup>2</sup> and researching industry users based on the descriptive list of potential users provided by Venture Southland. The survey targeted potential users who have heat plant over 100kW

A questionnaire was developed<sup>3</sup> to gauge respondents':

- Awareness of wood energy as a viable fuel option
- Awareness of predicted oil price spikes in 2012, including the likely impact on all fossil fuel prices.
- Awareness of costs of wood fuel sources as compared to other sources.
- Current sources of energy used, approximate quantities used, and costs.
- Expected time frame for replacing current fuel using technology. i.e. When are they expecting to replace current boilers? When does their current resource consent expire?
- Factors of importance when considering fuel options. e.g. Cost, maintenance, supply, emissions reductions goals, desire to support local business
- Identified price triggers for supply. e.g. If coal was equal or lesser cost, would they chose that over wood?
- Awareness of any limitations such as availability of space for fuel storage (fuel bunkers), or restrictions in their district plan zoning.
- Need for any further information.
- Desire to be contacted to learn more about wood energy.

This questionnaire was put into online form. A webpage was developed to host the questionnaire on EIS Energy's website, along with supporting information to allow people looking for further information to access it easily.

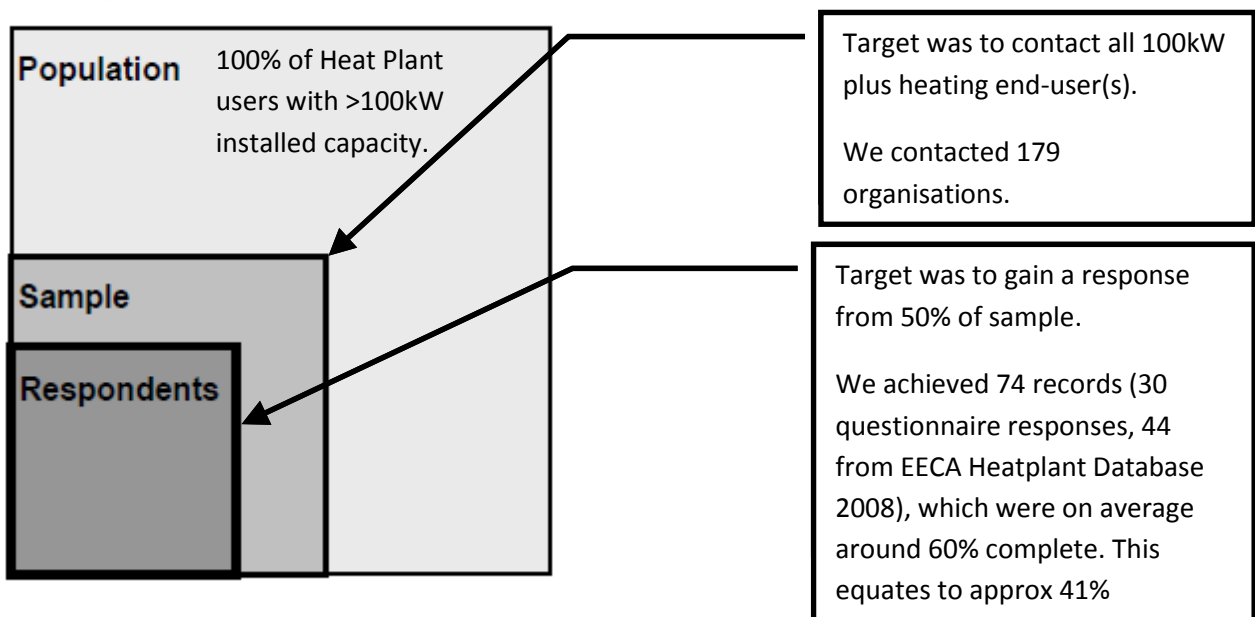
The survey administrator telephoned every potential user identified, and the link to the questionnaire was emailed out to them. Venture Southland also assisted in promoting the questionnaire through their contacts as the initial response rate was low.

---

<sup>2</sup> (EECA, 2008)

<sup>3</sup> Refer to Appendix : Questionnaire

## Survey response target and actual response figures



## Report methodology

This report was drafted whilst the survey was underway. An extensive online literature review was undertaken to ensure that the best information sources were being used.

Additional stakeholder interviews were undertaken with the Ministry of Education, biomass research organisation Scion, and industry players as well as existing biomass end-user(s) to better understand drivers in these industries.

Analysis of the questionnaire responses was undertaken and incorporated into this report.

## 5. Background

### Wood Energy Forum - Southland

In November 2010 Venture Southland and EECA hosted a forum on 'Wood Energy' in Invercargill. The forum was well attended by almost 40 people, with wood chip users, potential wood biomass users, sawmills, forestry owners, boiler engineers, consultants and associated services such as transport operators.

The purpose of the forum was to identify if there was a desire for a formal cluster of interested parties to work towards setting some strategic and marketing objectives to advance Southland's wood energy industry. The forum explored this opportunity, and identified that:

- All who attended believed the wood biomass to energy industry had potential in Southland. A number of attendees were interested in forming a working group to progress the opportunities.
- It was identified that there was potential demand for wood fuelled boiler systems in Southland. However, there were some barriers, namely securing consistent supply early on in the process to ensure the boiler system design matches the fuel source (type, moisture content, size, delivery).
- A number of technologies were energy efficient and commercially viable, including wood chip and pellet boilers, as well as gasification options. However, without government funding, large scale boiler systems were often only commercially viable when replacing end of life fossil fuelled boilers. Some government funding still exists through crown loans and business grants. Conversions however are an option if other non-price related drivers were a factor.
- A regional supply network that provided consistent quality fuel is still in its infancy.

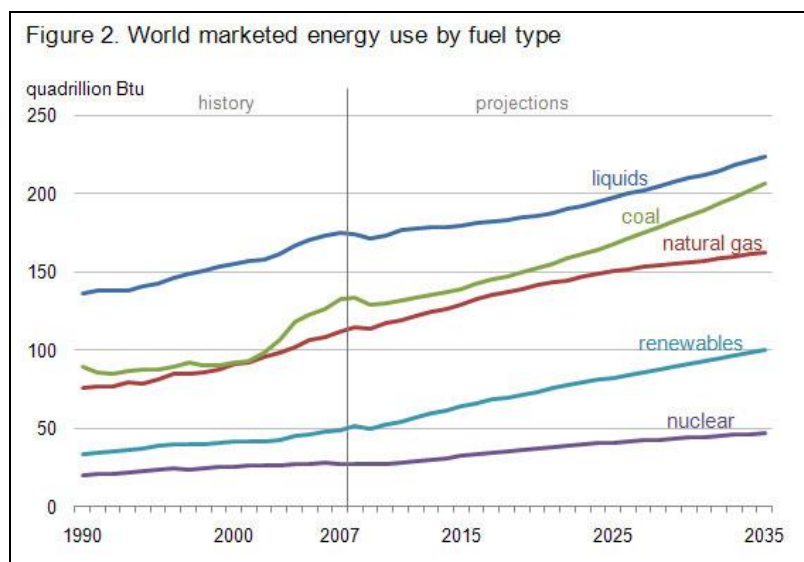
There were many ideas as to how the above issues could be addressed. The main action identified in the forum was a need to undertake a demand assessment, with stakeholders such as 'Natures Flame' (Solid Energy) and 'Energy for Industry' (Wood Energy NZ) indicating that if there was demand for 4MW of supply, they would consider establishing a supply network in Southland. This report summarises the survey work undertaken under this demand assessment and adds information regarding strategic considerations.

It is considered important to establish a secure chain of supply, because uncertainty of supply is presently deterring businesses from investing in the technology to harness energy from this renewable form of biomass. In addition to organisations involved in biomass supply in other regions, there are a number of local businesses

who are also interested in quantifying the potential local demand for wood energy to inform their own strategic planning.

## Increased demand for energy

The last few decades have seen growth in energy demand globally. The chart below from the Energy Information Administration shows the historic trend and projections:



(Energy Information Administration, 2010)

Whether the growth that we have seen can be sustained going forward remains to be seen, the projected growth figures are considered optimistic. There are a number of potential limiting factors such as limited resources, which are discussed elsewhere in this report.

## Regional Bio-Energy Cluster

The potential for a regional cluster of bio energy suppliers is one of the drivers for this demand assessment. Given that the concept is well established and appears to be achieving the intended objectives (stimulating demand for heat energy from woody biomass) in the regions where clusters have been established, it is recommended that a similar group could be established for Southland.

In Otago, there is not a cluster as such, suppliers use Wood Energy NZ for wholesale supply and then deliver it themselves. This works well for addressing any seasonal issues with supply. This model could be replicated for Southland, but

potentially enhanced further. Such a model could be actively encouraged if a not for profit organisation was able to pull all of the parties together, perhaps by offering something the commercial parties can't get on their own. E.g. Land and buildings for log and chip storage. This cluster could combine efforts to address any supply related challenges, such as seasonality and logistics to ensure Energy Return On Investment (EROI). Such a cluster could also undertake joint marketing initiatives to promote wood energy to potential users, as well as addressing any other barriers or strategic challenges in the local industry as it develops. Such a cluster could develop proactive relationship with national organisations such as the Bioenergy Association to ensure local issues and opportunities are reflected in national efforts.

EECA have recently commissioned a review of the efficacy of their wood-energy efforts in recent years, and it is important that the lessons learnt from that review (once published) are given close attention. It may be wise to revisit any strategic actions of a cluster after the EECA review has been published.

A review of the foundational strategic documents for the established clusters and liaison with them would be key to establishing a successful cluster in Southland.

## Wood Energy Uses

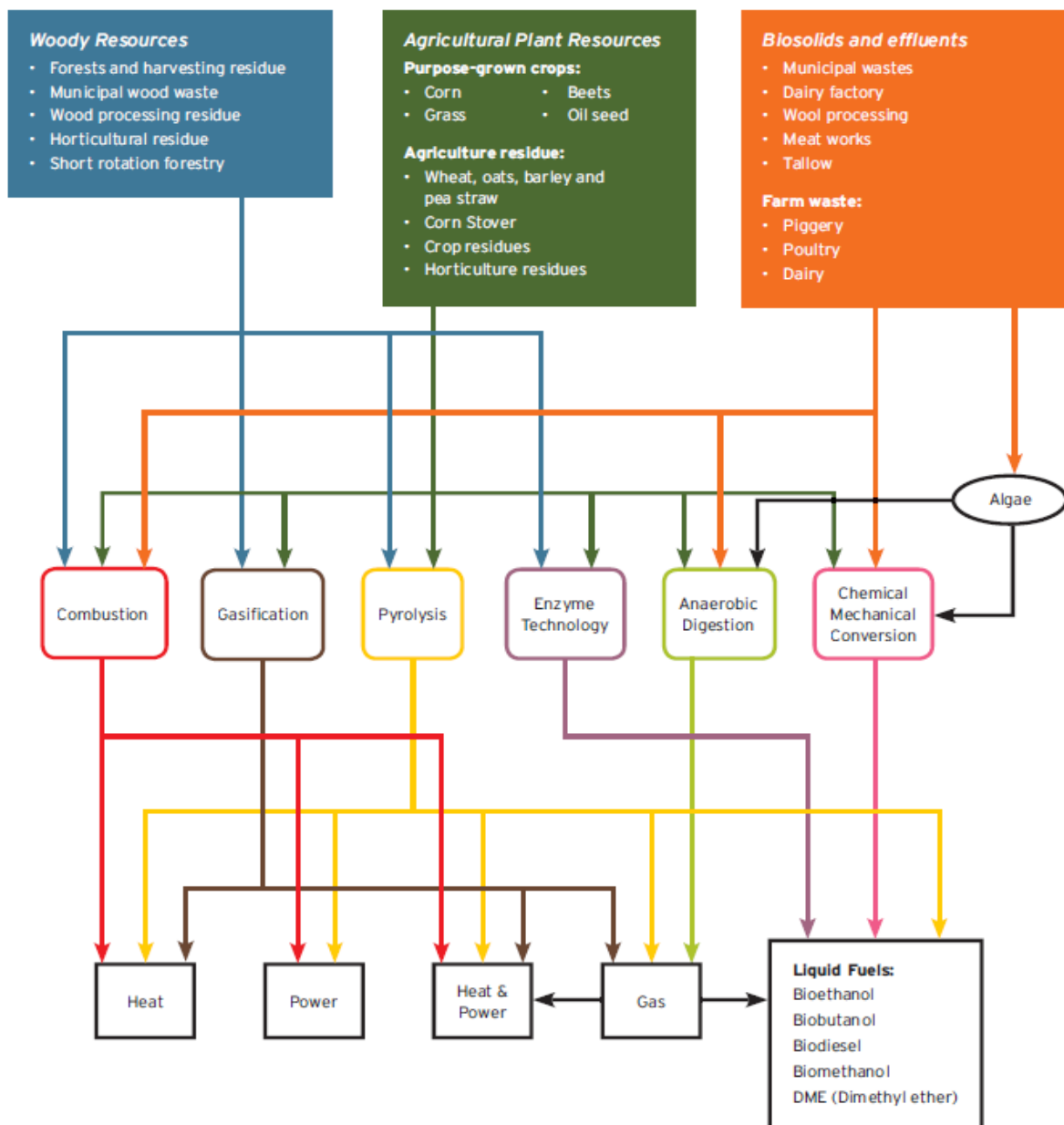
Biomass is organic matter of contemporary biological origin (i.e. that was living recently) such as wood, straw, energy crops, sewage sludge, waste organic materials, and animal litter. It can be viewed as a form of stored solar energy which is captured by the organic matter as it grows. This energy is released by combustion (burning) or fermentation and distillation (to produce liquid transport fuels).<sup>4</sup> Biomass materials used as fuel sources can provide heat, electrical and motive power.

Other sources of biomass are shown in the diagram below<sup>5</sup>:

---

<sup>4</sup> (Carbon Trust, 2009)

<sup>5</sup> (Scion, 2007)



It should be noted that most of the mechanical systems that are installed to combust wood for heat and/or power could potentially run on other biomass sources, if the economics were favourable, and adjustments were made to the system. This gives end-users flexibility in sourcing fuel, and enables competition in the energy market. However, making these adjustments may not be straight forward, and could be expensive depending on the plant used.

Wood as a source of fuel can be used in a range of ways. Space heating from wood burners is a traditional method, which many in Southland are familiar with, as is

using wood for hot water heating from a wetback in their homes. Wood can also be used to provide energy in a number of different forms:

- Heat energy production direct from combustion for domestic, commercial and industrial applications, to heat air, boilers producing hot water, or steam. This is used for space heating, or in a huge variety of industrial / commercial processes.
- Electrical energy production as part of a cogeneration (also known as Combined Heat and Power - CHP) system utilising a steam turbine. Heat from the system is used on site or sold to a nearby 3<sup>rd</sup> party with a heat requirement. Electricity from the system is typically used on site but can be sold to the grid.
  - An approach used internationally to enable this type of system configuration from a business risk perspective is to have an 'Energy Supply Company' (ESCo) that owns and operates the plant and enters into supply agreements with the end-user(s) of the electricity and heat energy produced by the plant. This avoids the end-user(s) having to take on the running of the plant from a technical perspective, and also from having to incorporate a new energy supply business into their operations.
- Heat energy production (direct and indirect) via gasification of wood to create an alternative to natural gas:
  - Can be used for direct heat energy. There are commercially available heating systems available in the New Zealand market that use the process of gasification to provide heat energy for domestic and commercial applications.
  - Can be used as an alternative gas source where a gas supply network already exists, but natural gas is becoming unavailable / uneconomic.
  - It is also to be considered in the context of transportation energy resilience. During World War II, many people successfully ran vehicles on wood gas, using a simple gasifier to provide combustion gases which ran the engine.

This report focuses on wood (and by implication other biomass) energy for heating, and does not include liquid and gaseous alternatives / substitutes to transportation fuels from biomass other than to mention in passing where appropriate.

## Types of Woody Biomass

There are a variety of wood products that are suitable for use in heating plant. The table below lists the different products and energy densities:

<sup>6</sup>	Ref. Code	Moisture Content [%]	Bulk Density [% Solid Vol]	Solid Density [kg/m <sup>3</sup> ]	Bulk Density [kg/m <sup>3</sup> ]	Solid Specific Density [m <sup>3</sup> /T]	Bulk Specific Density [m <sup>3</sup> /T]	Calorific Value [GJ/T]	Solid Energy Density [GJ/m <sup>3</sup> ]	Bulk Energy Density [GJ/m <sup>3</sup> ]
Logs/Green	LGR	56%	70%	960	672	1.04	1.49	6.94	6.7	4.7
Logs/AD	LAD	40%	70%	813	569	1.23	1.76	11.42	9.3	6.5
Logs/OD	LOD	1%	70%	420	294	2.38	3.4	18.66	7.8	5.5
Chip/Green	CGR	56%	40%	960	384	1.04	2.6	6.94	6.7	2.7
Chip/AD	CAD	40%	40%	813	325	1.23	3.08	11.42	9.3	3.7
Chip/OD	COD	1%	40	420	268	2.38	5.95	18.66	7.8	3.1
Hog/Green	HGR	56%	36	960	346	1.04	2.89	6.94	6.7	2.4
Hog/AD	HAD	40%	36	813	293	1.23	3.42	11.42	9.3	3.3
Hog/OD	HOD	1%	36	420	252	2.38	6.61	18.66	7.8	2.8
Wood Pellets	WPT	1%	55	1200	660	0.83	1.52	18.8	22.6	12.4
Torrefied Chip/Hog	TCH	1%	40	285	114	3.51	8.77	23	6.6	2.6
Torrefied Chunks	TWC	1%	30	285	86	3.51	11.7	23	6.6	2
Torrefied Pulverised	TPU	1%	80	285	228	3.51	4.39	23	6.6	5.2
Torrefied Pelletised	TPE	1%	55	1545	849	0.65	1.18	23	35.5	19.5
Coal/Bituminous	CBI						28			
Coal/SubBituminous	CSB						20			
Coal/Lignite	CLI						15			

Of particular interest beyond the conventional wood chip and wood pellets are the Torrefied biomass options at the bottom of the table. The thermo-physical properties of the Torrefied products have energy per unit mass that compares favourably to local sub-bituminous and lignite coal, and in pelletised form compared well in energy per unit volume as well. Torrefied biomass is not currently available in Southland.

<sup>6</sup> Based on Wood Energy Properties (Peter Hall, 2011) and Coal Energy Properties (Covec, 2009)



## Wood Suppliers

- **Natures Flame (Solid Energy)** is the largest producer of wood pellets in the country. They have stated they have no desire to establish local production of pellets, instead they want to fully maximise their production plant in Taupo; they also have plants in Christchurch and Rotorua. They have identified that they would be interested in establishing a supply network of wood pellets in Southland, if there was adequate local demand (4MW).
- **Energy for Industry (Wood Energy NZ)** are a key wood chip supplier in Christchurch and would also be interested to know if there was adequate local demand to justify establishing a supply network in Southland.
- **Southern Wood Pellets** (Makarewa) have been producing wood pellets in Southland using waste hazelnut shells and wood. They have identified lack of local demand as an issue.
- **Pomahaka Wood Pellets**, based at the old Blue Mountain Lumber sawmill in Tapanui, have a desire to locally supply wood pellets.
- **Lindsay & Dixon Sawmill** in Tuatapere have wood residues, which they would be interested in supplying as a fuel source.
- **Niagara Sawmill** in Invercargill currently supply wood chips to McCallums Drycleaners in Invercargill and are interested in supplying chips to other points of demand, with the ability to produce 70-100 tonnes per hour.
- **Dongwha Patinna** are potentially interested in supplying process residues for local use as a fuel source.
- There are multiple other supply options from outside the region, namely Spark Biomass (Queenstown) and City Forests (Dunedin).

There are approximately two dozen sawmills/processors in Southland in addition to those mentioned above, many of whom are embedding their waste wood into their own processes: Invercargill (Great Southern Posts & Timber, Beaver Milling, Beven West Sawmilling, Carters, EH Ball ITM Truss & Roof, SX Products, Straightline Timber, Southland Veneers, Southern Lumber Company), Lorneville (Goldpine), Riverton (Pankhurst), Tuatapere (Alan Johnston Sawmilling), Lumsden (Great Southern Posts & Timber, Lumsden Sawmill), Winton (Findlater Sawmilling Ltd, Southbuild ITM, Craigpine Timber), Maitua (Ngahere sawmilling), Tapanui (Stewart Timber Co Ltd).

The above list is not exhaustive, and should be developed as part of any future supply investigation.

## Boiler Suppliers

There are local boiler suppliers who are installing and providing maintenance on systems in Southland:

<b>Company Name</b>	<b>Rayners Total Heating and Cooling Solutions</b>	<b>RCR Energy Service</b>	<b>Quality Sheet Metal &amp; Heating</b>	<b>Fogarty Industries</b>	<b>Faul CH &amp; Co Ltd.</b>
<b>Contact First Name</b>	Wayne	Jacci	Mike	John	John
<b>Contact Last Name</b>	Harpur		Hughes	Fogarty	Faul
<b>Position within the Organization</b>	Manager	Administration	General Manager	Owner	Owner
<b>Phone 1</b>	03 2189552	03 455 9922	03-218 9461	03 214 4316	03 216 9248
<b>Phone 2</b>		0800 727 783	027 295 4346		
<b>Email</b>	wayne@rayners.co.nz		mike@qualitysheetmetal.co.nz		john@chfaul.co.nz
<b>Physical Address (Street Number and Name)</b>	17 Bond Street		249 Bond St	137 Crinan St	121 Don Sreet
<b>Town or City:</b>	Invercargill - 9810		Invercargill 9810	Invercargill 9810	Invercargill 9810
<b>Website (if available)</b>	www.rayners.co.nz	http://www.rcrtom.com.au	www.qualitysheetmetal.co.nz		

There are other national suppliers and lists can be found on the EECA Business Wood Energy Knowledge Centre and the Bio-energy Association of New Zealand (BANZ) Website<sup>7</sup>.

### With regard to the Background:

- **The formation of a regional bio-energy cluster to strategically coordinate activities is a proven concept for other parts of New Zealand and should be enacted for Southland. Its initial focus would be wood, however it should not limit itself in this regard.**

<sup>7</sup> <http://www.eecabusiness.govt.nz/renewable-energy/wood-energy-knowledge-centre> and <http://www.bioenergy.org.nz/>

## 6. Woody Biomass Supply

New Zealand forests contain a large resource of woody biomass that has potential to be used for bio-energy. Most of this biomass will arise from the 1.7 million hectares of pine plantation forests currently spread throughout New Zealand. Residues from routine harvesting operations offer a significant resource that is already available, with no need to plant new areas or use any additional land.

The use of these harvesting residues potentially creates a new value stream for forest growers. Wood processors will have the opportunity to sell excess process residue, or sell high grade process residue for production of wood pellets and buy in lower grade harvest residues for combustion.

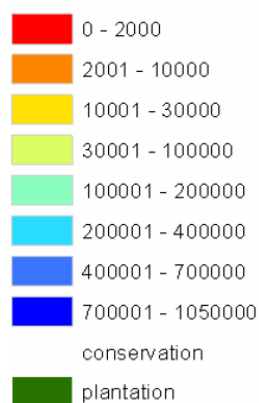
Note on projected supply and demand: The supply situation needs more detailed investigation, with the information in this report providing at best 'order of magnitude' estimates of potential. The demand scenarios discovered through analysis of the survey accompanying this report are based on partial responses only. The estimations in this section are an engineering approach that aims to give an 'order of magnitude' guide as to the potential supply to inform the demand conversation.

### Forestry Residues

In 2008 Scion released a series of maps showing the lignocellulosic residues, known as the New Zealand Biomass Resource Atlas<sup>8</sup>. Southland looks to have increasing volumes of wood processing residues available. From the report:

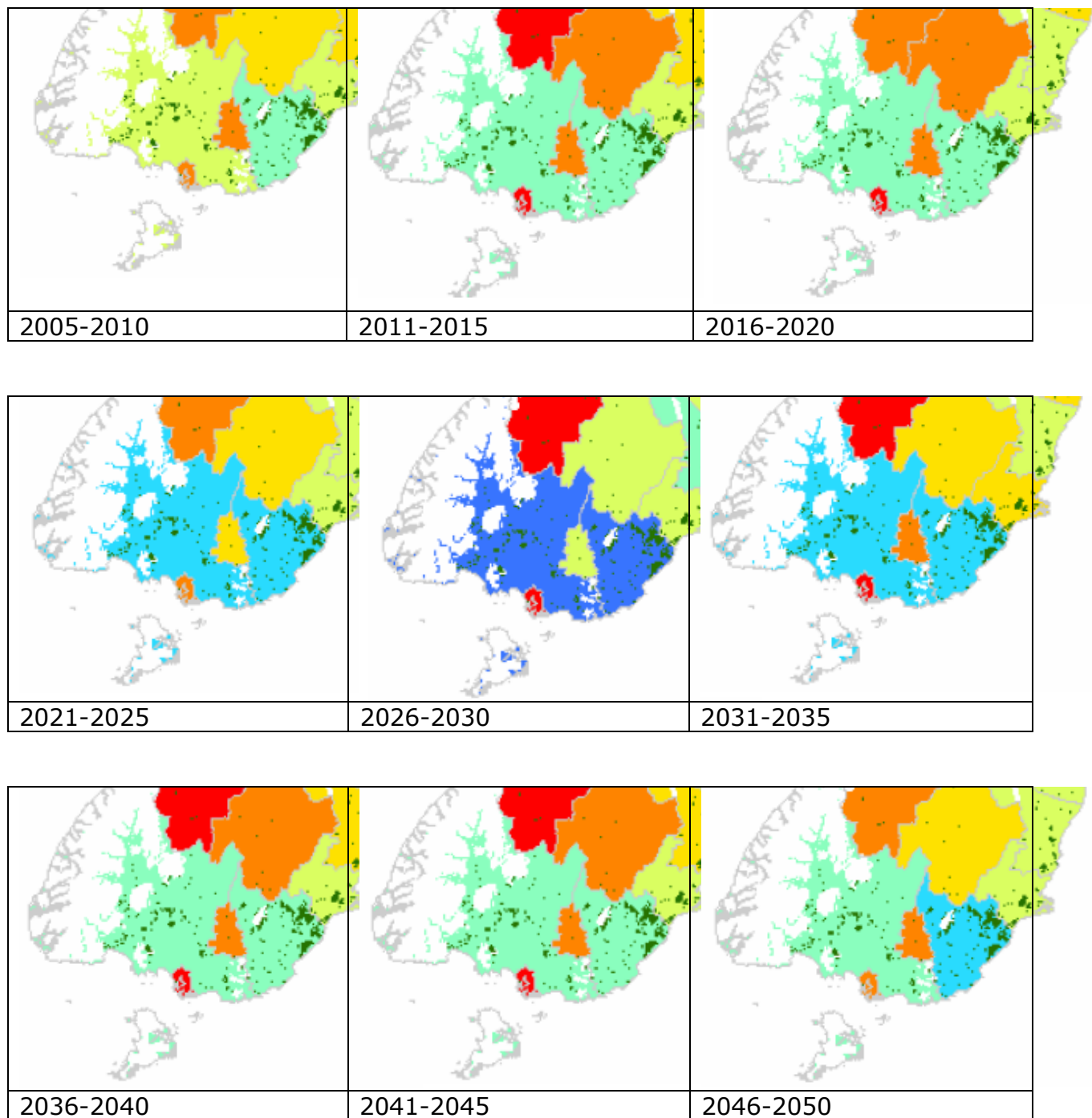
#### Total Forest Harvest Residue, m<sup>3</sup> per annum

##### Legend

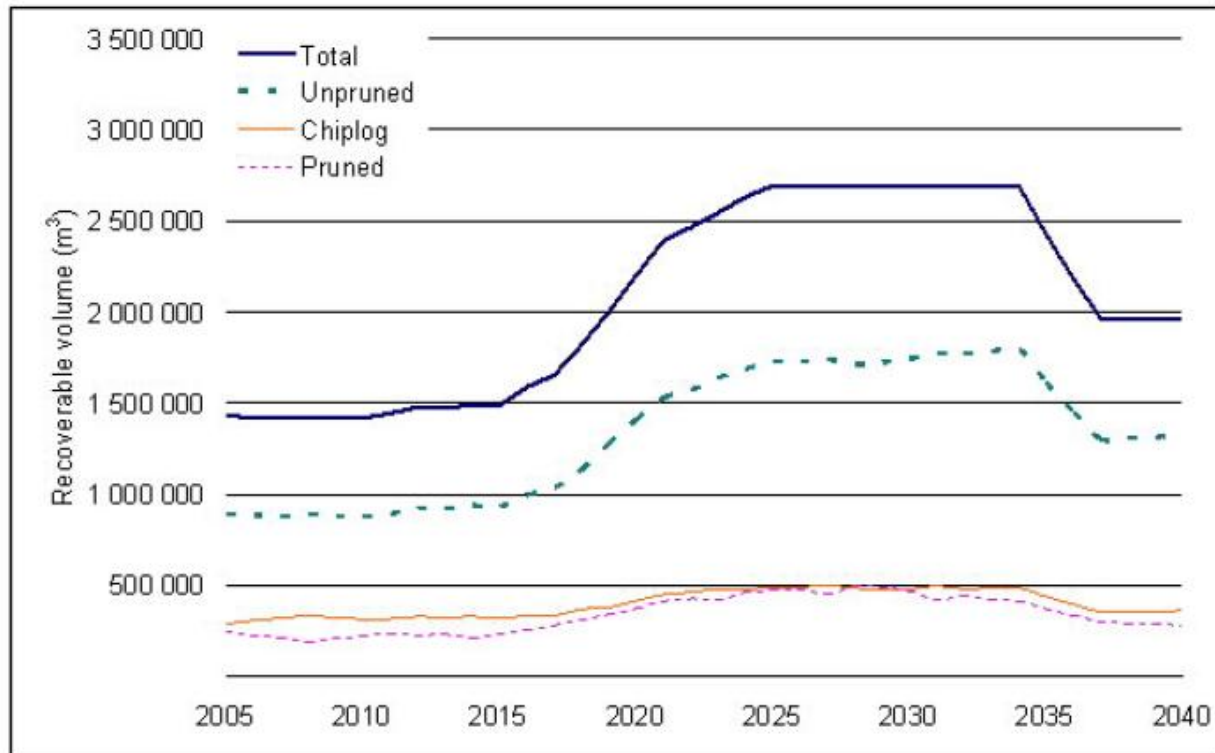


---

<sup>8</sup> (Peter Hall B. H., 2008)



This is represented in a chart based on MAF data<sup>9</sup>:



The Southern Wood Council reports (for the combined Otago / Southland Region)<sup>10</sup>:

- Around a quarter of the annual harvest was exported as logs from 1998-2008.
- This has increased rapidly since 2008, with the rise in log prices and increasing demand from China.
- The Radiata Pine harvest in 2020 is projected to reach 2.6 to 2.8 million cubic metres a year.
- 63.7% of the regional plantation is Radiata Pine; across other New Zealand regions the national plantation has an average of 89.5% Radiata Pine.
- Otago-Southland has a significant proportion of New Zealand's Douglas-fir (50.5%) and Eucalypt (54%) plantings.
- The Otago/Southland Douglas-fir harvest is projected to climb from approximately 80 to 100,000 cubic metres to 435,000 cubic metres in 2025.
- The average age of the region's plantings is 15 years. The standing volume of timber is estimated at 39.8 million cubic metres. As the estate matures the region's standing timber resource will continue to increase.

<sup>9</sup> (Forest Environments Limited, 2009)

<sup>10</sup> (Southern Wood Council, 2011)

Residual materials that result from forestry activities are created from sustainably managed pine forests at two general locations<sup>11</sup>:

1. In the forest (cutover) large trees frequently break when they are felled, typically at around two-thirds to three-quarters of the tree height. Often these broken sections are small and of low value so they are not extracted to the landings, but left on the cutover, along with the branches, to rot away.
2. On central landings (skid sites) tree-length material is cut into logs. Off-cuts from the base, tip and midsections of trees become waste material that averages 4 to 6% of the extracted volume. A variable amount of branch material is also produced. Because these landings are centralised processing sites, they make it relatively easy to recover significant volumes of wood residues.

Recoverable landing residue varies significantly:

	Poor Quality Site	Average Quality Site	High Quality Site
<b>Total woody residue as proportion of total recoverable volume</b>	20%	12%	4%
<b>Usable woody residue as proportion of total recoverable volume</b>	12%	7%	2%

Techniques for optimal extraction of the woody biomass from landings are fairly well understood. There is a good amount of New Zealand related literature that gives insight into the efficient removal and storage for drying of this material, as described in a number of reports, including a thorough treatment in the report "Wood Energy Supply Options for City Forests Limited"<sup>12</sup> and "Greater Wellington Regional Council - Forest Residue Utilisation Trial"<sup>13</sup>. Further key facts from the City Forests report:

- Branch residues from cutovers are a valuable nutrient resource for the forest, and extracting them for biomass energy is not sustainable.
- Air drying in the Dunedin climate is unlikely to get logs / chips below 40% m.c.

<sup>11</sup> (Forest Environments Limited, 2009)

<sup>12</sup> (Forest Environments Limited, 2009)

<sup>13</sup> (Clean Energy Centre, 2009)

Note that microclimates vary considerably across the Southland region, and a site favourable to air drying may exceed the Dunedin figure of 40%.

**With regard to Forestry Residues:**

- **If demand were to be significantly stimulated, then the supply of woody biomass should be noted as reducing in 15-20 years as a result of current plantation maturity and projected extraction volumes. The following actions may be appropriate:**
  - **Plan for a lower peak availability than the 2026-2030 peak when assessing market potential.**
  - **OR**
  - **Take strategic action through ensuring sufficient planting in the next few years of extra forest plantations, or ensuring short rotation biomass sources closer to the time (will require long term planning and monitoring). Short rotation coppice and Miscanthus on marginal lands should be a significant consideration alongside supply from forestry.**
- **Only landing site waste from the forestry process is considered as potentially economic and sustainable as a heat energy source.**
- **The locations micro-climatically suited to air drying should be investigated as part of any future consideration of a supply chain.**

## Processing Residues

Residues in Southland are mapped out in the diagram below.

The Southern Wood Council published the following statistics for the combined Otago / Southland Region<sup>14</sup>:

- Harvests (round wood removal) in Otago/Southland averaged 1.4 to 1.5 million cubic metres a year from 2005 to 2009. The March 2010 year figure was 1.56 million cubic metres; the demand for logs from China increased harvesting levels.
- About 60% of the harvest was processed in the region (March 2010 year), as sawn timber, veneers, mouldings, Medium Density Fibreboard (MDF) or posts.
- 344,000 cubic metres of sawn timber was produced by the region's sawmills (March 2010 year).
- \$62 million of sawn timber (181,500 cubic metres ) was exported through Bluff and Port Chalmers in 2010.
- \$97.2 million of logs (847,000 cubic metres) were exported through Bluff and Port Chalmers in 2010 (f.o.b – free on board). 464,000 cubic metres was exported in 2009.

New Zealand national wood processing volumes <sup>15</sup> overlaid with estimated Otago / Southland volumes for 2010 (extrapolated from <sup>16</sup> and<sup>17</sup>):

---

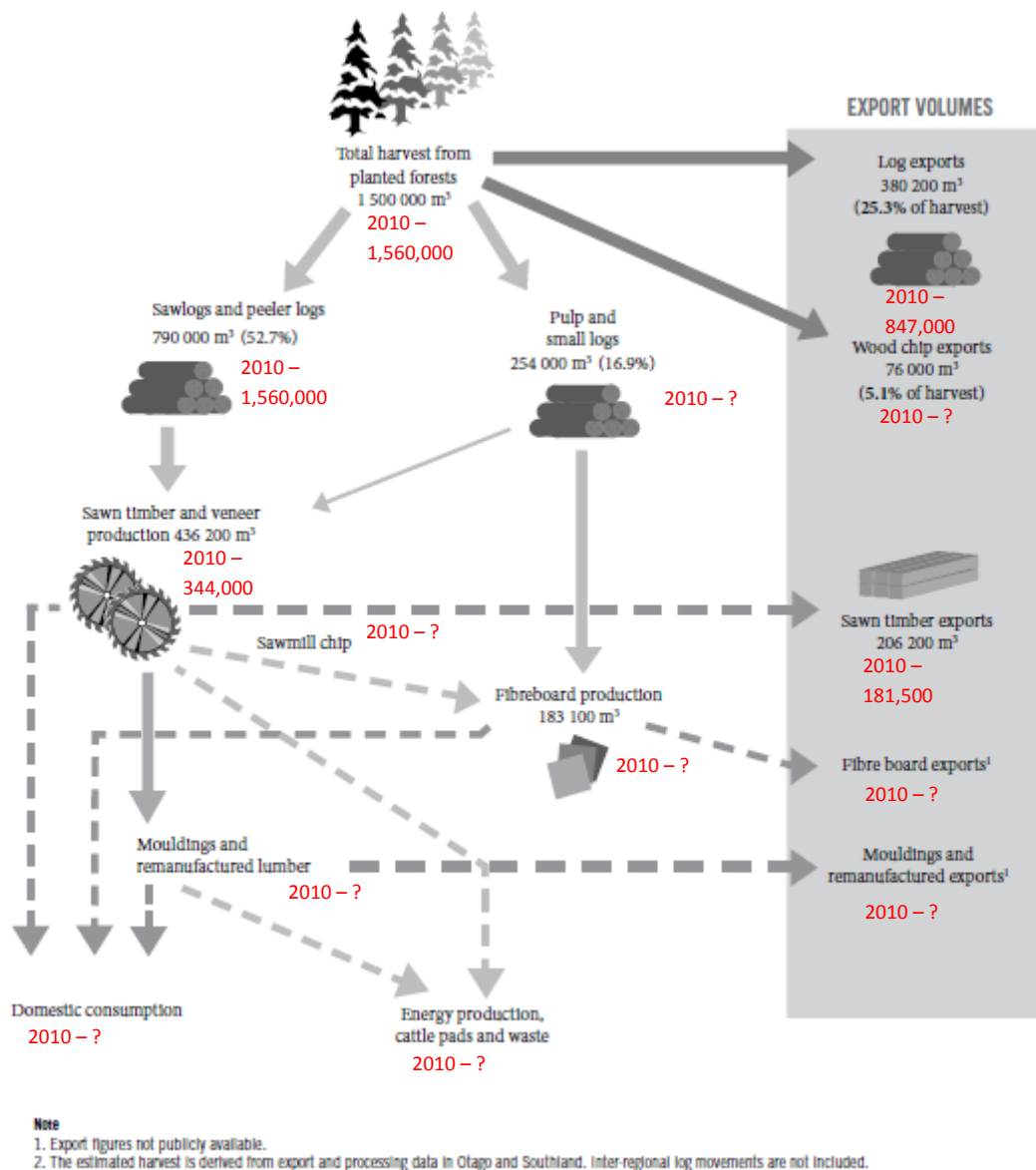
<sup>14</sup> (Southern Wood Council, 2011)

<sup>15</sup> (MAF, 2007)

<sup>16</sup> (Ministry of Agriculture and Fisheries, 2010)

<sup>17</sup> (Southern Wood Council, 2011)





The volumes for just Southland can only be estimated based on the forest volumes and an assumption that activities are fairly uniform across both regions.

It should be noted that it is often difficult to get exact measures of material flows within the industry, as much of this information is:

- Commercially sensitive.
- Changing with price and other industry circumstances.
- Inaccurately measured or estimated.
- Not centrally recorded or reported.<sup>18</sup>

<sup>18</sup> (Scion , 2007)

Most processing residues from milling (chips or sawdust) are used as an energy input into the sawmill process or are sold for MDF production (Dongwha Patinna), or for mouldings. During this demand assessment, it has been ascertained that there are further downstream wood residues from these processes as well. McCallums Group's biomass boiler is fed with kiln dried wood from the finger jointing process at the Niagara Sawmill.

Some are also selling chip for cattle pads. However, there is a move from farms to use rubber matting instead, so this market is likely to reduce.

Southland has one major landfill, near Winton, 11% of which is estimated to contain waste timber. Most of this could reasonably be expected to be treated timber. The landfill operator, AB Lime, is considering 'waste to energy' projects at present, which would consist of harnessing the methane generated. The timber in the landfill is largely the result of construction and demolition activity, and there is the possibility of engaging local construction companies in a recovery scheme. Some construction companies, such as Cunninghams, are already actively recycling, but the only option for treated timber currently available is disposing of it in landfill.

## **Potential to meet demand**

Another way of looking at the proposition is to examine whether there exists sufficient wood waste to potentially completely replace coal in solid fired installations (ignoring for now the concomitant issues around energy density, plant's ability to utilise, etc). At the macro level, figures exist in the literature for potential supply and they are summarised below.

Quantity of woody biomass available in Southland / Otago (grouping is due to MAF data collection practice) as tonnes of coal equivalent<sup>19</sup>:

---

<sup>19</sup> (Peter Hall, 2011)

### Appendix Three

Wood residues available per annum (2010 to 2015), converted to tonnes of coal equivalent

	Landing residues	GB* Cutover residues	Pulp Logs	MWW**	WPW*** (2007)	Total	Excluding Pulp logs
Northland	71,060	78,540	283,699	8,500	0	441,799	158,100
Auckland	14,620	10,880	58,785	89,760	55,760	229,805	171,020
Central North Island	157,080	154,700	628,868	34,000	214,540	1,189,188	560,320
East Coast	43,180	12,580	172,523	2,720	0	231,003	58,480
Hawkes Bay	30,600	13,260	122,930	8,840	25,160	200,790	77,860
Southern North Island	30,940	26,860	123,887	61,200	46,580	289,467	165,580
Nelson Marlborough	42,500	29,920	169,559	9,180	0	251,159	81,600
West Coast	5,100	9,520	19,892	2,040	1,360	37,912	18,020
Canterbury	15,300	25,840	61,145	30,940	22,440	155,665	94,520
Otago Southland	35,700	35,700	142,854	22,780	7,820	244,854	102,000
<b>National Total</b>	<b>446,080</b>	<b>397,800</b>	<b>1,784,143</b>	<b>269,960</b>	<b>373,660</b>	<b>3,271,643</b>	<b>1,487,500</b>

\*GB = ground based, \*\* MWW = Municipal wood waste, \*\*\* Wood processing waste 2007 estimate

Table 3 shows the amount of wood residues available in the period 2001 to 2015, expressed as tonnes of coal equivalent.

### Southland coal use in 2008<sup>20</sup>:

#### Appendix One

Coal demand by region and industry, tonnes per annum, 2008

	Electricity	Steel	Dairy	Meat	Wood	Cement	Hospitals	Wool	Food	Education	Other	Total
Northland	-	-	-	12,000	9,000	72,000*	-	-	-	430	-	93,430
Auckland	-	750,000	-	14,300	-	-	-	-	-	3,200	-	767,500
Waikato	1,800,000*	-	188,000	6,500	14,500	-	27,500	-	-	790	-	2,037,290
Bay of Plenty	-	-	-	-	53,800	-	5,600	-	-	1,680	-	61,080
East Coast	-	-	-	10,600	-	-	-	-	-	160	-	10,760
Hawkes Bay	-	-	-	-	-	-	-	4,400	-	550	-	4,950
Taranaki	-	-	-	-	350	-	-	-	-	220	-	570
Manawatu-Wanganui	-	-	-	8,800	6,600	-	5,600	-	-	140	-	21,140
Wellington	-	-	-	-	-	-	4,100	-	-	360	-	4,460
Nelson	-	-	20,000	-	-	-	6,400	-	5,700	340	-	32,440
Marlborough	-	-	-	2,200	-	-	-	-	-	170	-	2,370
West Coast	-	-	44,000	10,500	1,100	55,000*	7,600	-	-	220	-	118,420
Canterbury	-	-	184,000	25,700	11,300	-	14,800	30,500	30,300	6,040	-	360,550
Otago	-	-	37,000	50,900	9,600	-	53,000	-	-	1,710	-	152,210
Southland	-	-	125,000	184,700	42,800	-	11,700	9,000	6,300	610	5,800	385,070
<b>Total</b>	<b>1,800,000</b>	<b>750,000</b>	<b>598,000</b>	<b>376,200</b>	<b>148,950</b>	<b>127,000</b>	<b>136,300</b>	<b>42,900</b>	<b>41,300</b>	<b>16,600</b>	<b>5,800</b>	<b>4,043,310</b>

\* = pulverised coal

It can be seen from the above that the potential for woody biomass from residues in the region is well below the coal consumed, and only accounts for around 19% of the coal use when expressed as tonnes of coal equivalent. Torrefaction of the biomass (discussed elsewhere in this report) will lose around 5% of the calorific

<sup>20</sup> (Peter Hall, 2011)

value, and would therefore be able to provide around 18% of demand, if all biomass were Torrefied.

This must be read in conjunction with the predicted increases in woody biomass availability from the MAF projections, which indicated potentially another 200,000+ tonnes of woody biomass residues per annum during the peak availability for the existing plantations for Southland.

## **Co-firing of Biomass**

In order to reduce capital costs and lead times, the potential to co-fire woody biomass with coal should be explored. See the EROI section of this report for an analysis of why this is recommended.

The process of co-firing is well understood internationally, and there are many proven sites where the benefits have been noted, particularly at the industrial scale and for power stations.

A novel application for which some research<sup>21</sup> has been carried out, and could be a significant benefit to the region, given the number of significant heat users that are meat processing works, is co-firing woody biomass with biomass waste from animal residues.

## **Summary of Supply Challenges**

Typically, when investigating biomass options from local wood residues, research to date comes to the conclusion that air dried wood chip from landing site residues is the most promising option. A caveat to this is that it is subject to air drying being feasible – all NZ based studies have been in more northern climates. There has been some work done in Dunedin which will be worth-while investigating further during any consideration of the supply chain<sup>22</sup>.

The analyses of available woody biomass from forestry and process residues are based on projections that require continuous growth in the overseas market, to provide the business case for replanting to a level which matches the capacity of the plantations already planted in the 1990's that will be maturing over the next 20 years. This is not guaranteed, as competing land uses may be considered more profitable, and alternative strategies to mitigate the risk should be considered.

---

<sup>21</sup> (Virmond, 2008)

<sup>22</sup> (Forest Environments Limited, 2009)

There is sufficient supply going forward to meet a significant portion of the heat energy demand in the region. Demand reduction activities should be supported to enable wood energy to have a higher percentage input to the overall fuel mix over time.

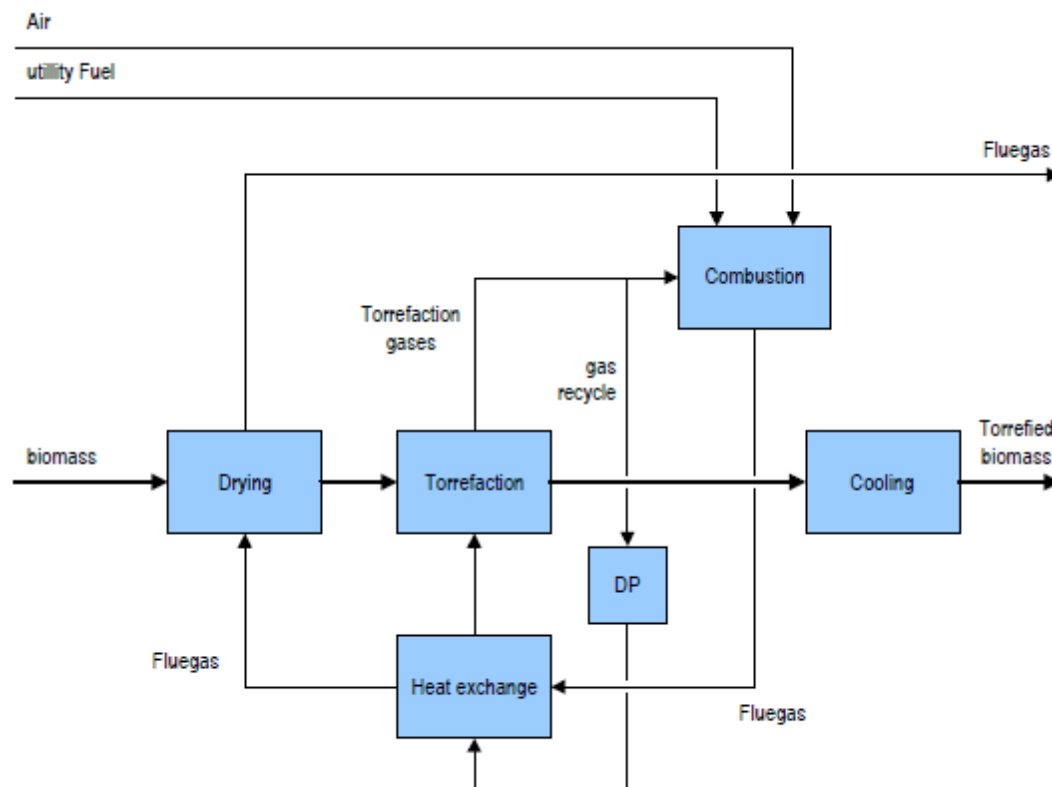
**With regard to the Supply of Woody Biomass:**

- **Wood energy is an attractive proposition for Southland, which could supply a significant portion of the heat demand and further woody biomass planting should be encouraged**
- **Advice and input from national organisations should be sought to enable best practice to be used and common pitfalls avoided. Given the proximity of a large portion of the Southland plantations to Dunedin, close collaboration and coordination with the existing hub there is advised.**
- **The opportunity to move the biomass via rail from the North of the region to the industrial users who already have rail infrastructure should be explored, particularly with respect to delivered cost.**

## 7. Torrefied Biomass

Torrefaction of biomass can be described as a mild form of pyrolysis ('dry roast biomass') at temperatures typically ranging between 200-320°C. During torrefaction the biomass properties are changed to obtain a much better fuel quality for combustion and gasification applications<sup>23</sup>.

Variations on the torrefaction process are primarily between indirect and direct heating. In this basic torrefaction process, illustrated below<sup>24</sup>, the biomass is in indirect contact with the heat transfer medium (usually oil) through a wall.



### Basic concept directly heated torrefaction

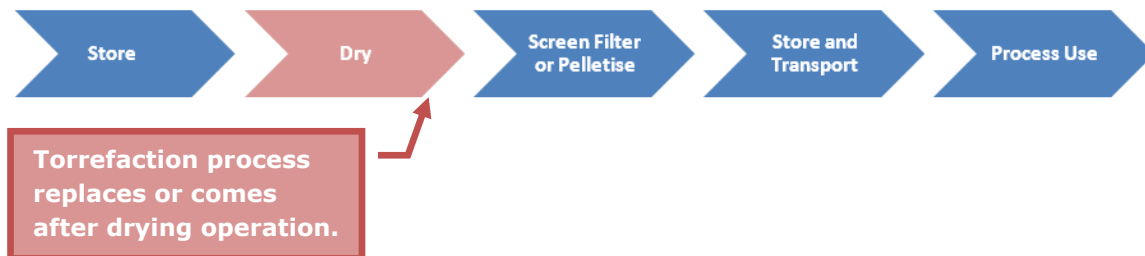
With the direct heated method, the direct heat exchange between gas and the solids is much faster. This contributes to a smaller reactor volume and complexity requirement and so overall costs are still reduced despite the penalties associated with the gas recycle circuit (dust and volatile component condensation leading to fouling).<sup>25</sup>

<sup>23</sup> (Peter Hall G. E., 2011)

<sup>24</sup> (Bergman, 2005)

<sup>25</sup> (Bergman, 2005)

Torrefaction can be considered as a 'drop-in' to the residues to wood fuel process, where an existing drying stage can be kept to provide consistently drier material to the torrefication plant, reducing its size and cost:



Torrefied biomass has a net energy of approximately 95% of the gross wet biomass energy, but its mass is approximately 60% of the wet biomass.<sup>26</sup>

Energy density for pellets of 18 - 20 GJ/m<sup>3</sup>, (above that for lignite) compared to 11 - 13 GJ/m<sup>3</sup> drives a significant reduction in transportation costs (Peter Hall G. E., 2011). The Scion table <sup>27</sup> indicates this is only true for densified (specifically pelletised) biomass.

The potential benefits of Torrefied woody biomass pellets to be factored into life cycle costs when considering if it can be produced economically:

- Lower moisture content than wood pellets
- Significantly higher calorific value than wood pellets
- High bulk density giving transport advantages
- Energy bulk density nearly twice that of wood pellets
- Torrefied pellets are hydrophobic and more stable in storage
- Torrefied biomass is brittle and has higher grind-ability than fibrous wood
- Production and delivery costs significantly lower than wood pellets
- Highly competitive with heavy fuel oil and heating oil
- Highly competitive when co-firing with coal
- Premium feedstock for gasification and Biomass to Liquid (BTL) technologies

Torrefaction is developing at a research and implementation level globally. It will be important to liaise with Scion and keep an eye on potential systems, etc in any scenario where the torrefaction option is taken forward.

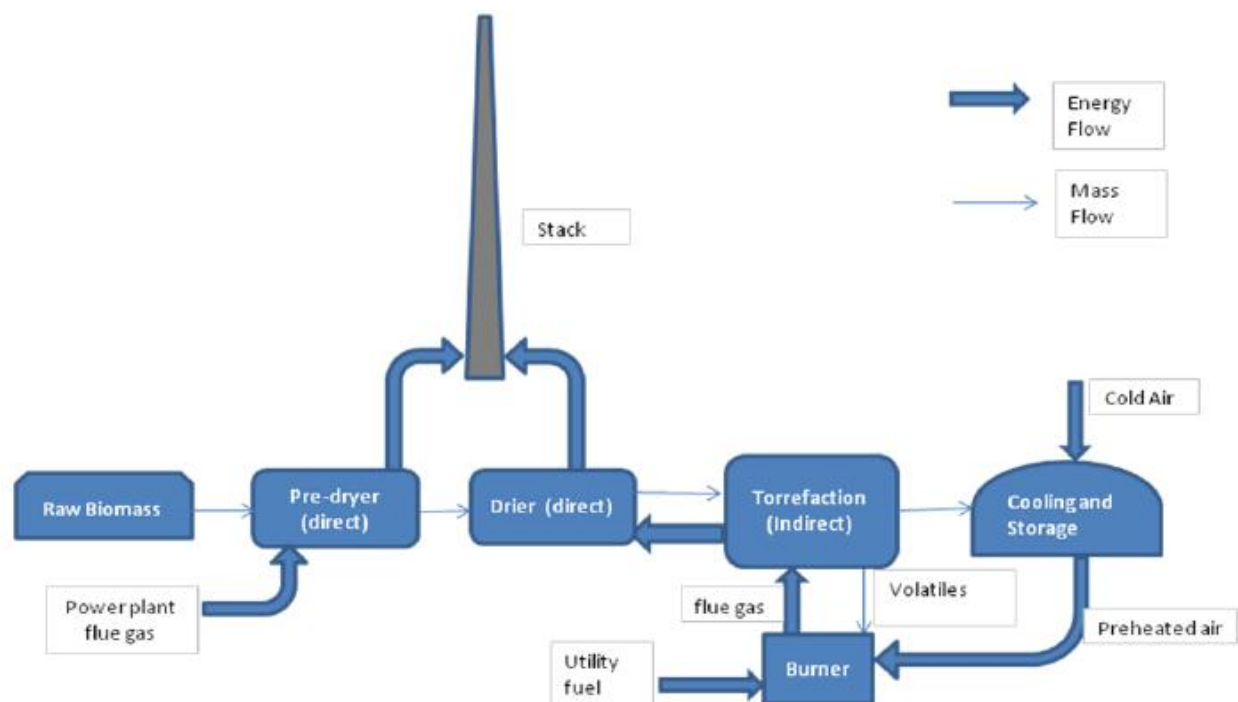
---

<sup>26</sup> (Anex, 2010)

<sup>27</sup> (Peter Hall, 2011)

### Co-firing of Torrefied biomass

The concept of co-firing biomass with coal is well understood as noted earlier in this report. Less understood, but with greater potential for existing solid fuel plant is co-firing of Torrefied biomass with coal. For pulverised coal systems, the grind-ability of the Torrefied product means reduced costs and greater % application. A system to co-fire the coal for a power station is described in the diagram below, to assist the reader in understanding the complexities<sup>28</sup>:



In the report, it is noted that the energy needed for torrefaction can come mostly from the flue gas and the torrefaction process itself. The stated net efficiency for this example (Lingan Power Plant Cofiring) is 70%.

#### With regard to Torrefaction of Biomass:

- Investigate potential for funded trials as part of the setup of regional bio-energy cluster.
- Co-firing is a particularly attractive option in response to issues around capital cost barriers in establishing a supply chain for Southland.
- Torrefied pellets in particular are worth consideration due to decreased transport costs per unit of energy.
- If not chosen at this point, regularly review cost analysis looking at the potential for Torrefaction.

<sup>28</sup> (P. Basu, 2010)



## 8. Demand Assessment

This research focussed on potential users who have heat plant over 100kW installed capacity. It excluded heat pump installations above this size, as the conversion back to a combustion based heat plant is not commonly economic, as piped hot water distribution systems to utilise the heat are typically removed. (EECA Business)

The data collected in the survey forms the basis of the following analysis, and is available separately as a confidential database. Enquiries regarding access should be directed to Venture Southland.

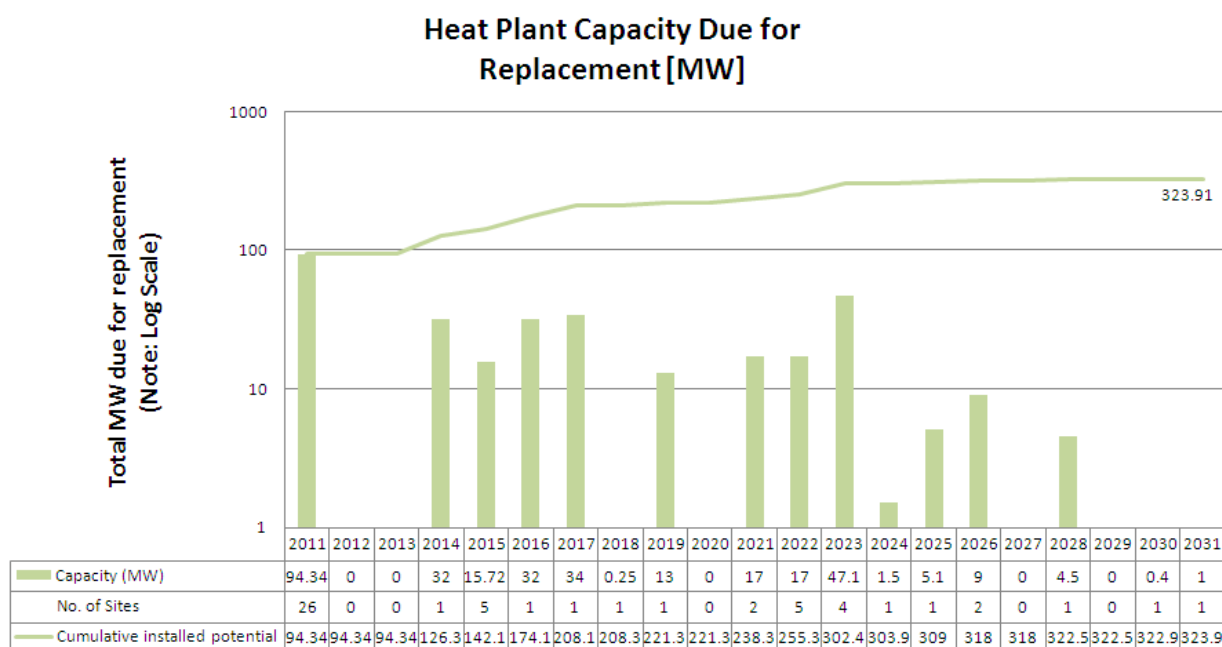
### Existing Biomass Users

In addition to those who are using wood in domestic burners, there are a number of larger scale energy users who are using biomass in Southland for heating:

- McCallums Drycleaners (Invercargill) using wood chips
- Bowmont Meats recently converted to use wood chips
- New River Primary School using wood pellets
- Menzies College using wood pellets
- Most of the Sawmills in the region use their waste biomass for process heat.

There are also a number of feasibility studies into biomass being undertaken in Southland, particularly within council owned and operated facilities.

## Potential Demand



Notes on the above chart:

1. The 2011 replacement capacity is derived from installed year plus life expectancy of 20 years for boilers. This figure from the CIBSE OOM Guide<sup>29</sup> is a guide for properly maintained plant. Clearly some boiler plant lasts longer with several of the installations listed in this year running to 40+ years old.
2. This chart based on 55 responses from the questionnaire that gave either an expected replacement date, or year installed (to which was added 20 years life expectancy to give indicative replacement date) and an installed capacity.

The November 2010 Forum<sup>30</sup> established a notional 4MW installed capacity as a target figure that could support the supply chain investment required. This was based on input from 'Natures Flame' (Solid Energy) and 'Energy for Industry' (Wood Energy NZ) in the forum. The above figures clearly indicate that at least that much is due, even if you took a conservative view of say 5% of the immediate potential replacement capacity being realised over the first 3 years.

Based on the input from forum members, and the wider community of potential supply chain members. "It is considered important to establish a secure chain of supply, because this uncertainty of supply is presently deterring businesses from investing in the technology to harness energy from biomass. In addition to organisations involved in biomass supply in other regions, there are a number of local businesses who are also interested in quantifying the potential demand for wood energy to inform their own strategic planning."

<sup>29</sup> (CIBSE, 2009)

<sup>30</sup> (Owen, Wood Energy Forum - Meeting Minutes - Nov 2010.pdf, 2010)

## Significant Potential Users

The Invercargill City Council presents an obvious choice. They are planning towards the installation of a 1.5 MW biomass installation to replace their existing lignite burning unit for the public swimming pool in Invercargill, Splash Palace. The council is also involved in the consideration of energy options for the Stadium Southland rebuild, which has identified either LPG or wood as options.

Within the region there exist many large potential users in the industrial sector. These industrial boilers have the potential to co-fire large quantities of biomass, with significant sites including:

- NZ Aluminium Smelter
- Fonterra - Edendale
- Open Country Dairy – Awarua
- Alliance – Maitava, Makarewa, Lorneville
- Blue Sky Meats – Woodlands
- Silver Fern Farms – Gore
- Prime Range Meats – Invercargill
- South Pacific Meats – Awarua

Further sites with boiler plant which have potential for replacement:

- Southland Hospital – 9 MW steam boiler installed in 1955 – concern around heat of steam required.

There are also many other significant users who did not respond to the survey, and further investigation into these would be recommended.

There are also other groups of potential users, which combined would represent significant demand, such as schools and community swimming pools (48 in Southland). These kind of potential users would have similar concerns and may present opportunities for effective target marketing for any cluster initiatives. However, the response rate in the survey from these sectors was not high, so further advice in this regard is not able to be provided in this report.

Schools used to receive heat, lighting and water funding according to the costs. This is changing at the moment. The new allocation method is yet to be confirmed, but the intention is that it will reward schools that manage their energy usage

efficiently. There is further information available on the proposed changes on the Ministry for Education website<sup>31</sup>

Thanks to these changes, demand for energy efficiency from schools is projected to increase significantly, and many do not have expertise in house. Support will be required and a targeted program is an opportunity for the wood energy group.

#### **With regard to Significant Potential Users:**

**There may be value in any marketing initiatives to stimulate demand for wood energy to segment their target audience into the following groups, and alter the key messages accordingly:**

- **Significant sites:** These potential users will have high energy demands which mean capital costs for infrastructure are high. It may be beneficial to promote opportunities for joint investment in infrastructure, such as through ESCo arrangements (discussed in following section).
- **Schools:** This potential group of woody biomass energy users have similar ownership models, drivers and funding options. This would be worth noting in marketing initiatives. The timing for targeted marketing to this group would be well placed around 2012, when their funding structure for energy costs changes.
- **Community Swimming Pools:** These potential users have similar political situations, which would be worthy of consideration in any marketing initiatives. Public facilities may offer public demonstration benefits and awareness raising opportunities for the industry.
- **Council owned:** Funding options, drivers for change, and links with supply may differ between council owned infrastructure and private enterprise.

**Any joint marketing initiatives to promote wood energy in Southland should be informed by further research looking at some of the significant users who did not respond to the survey.**

- **Change the guidance for regional schools to ensure that efficiency and carbon emissions are considered when making decisions regarding heat plant replacement. This would ideally come from national level, but may have to be done locally first.**

---

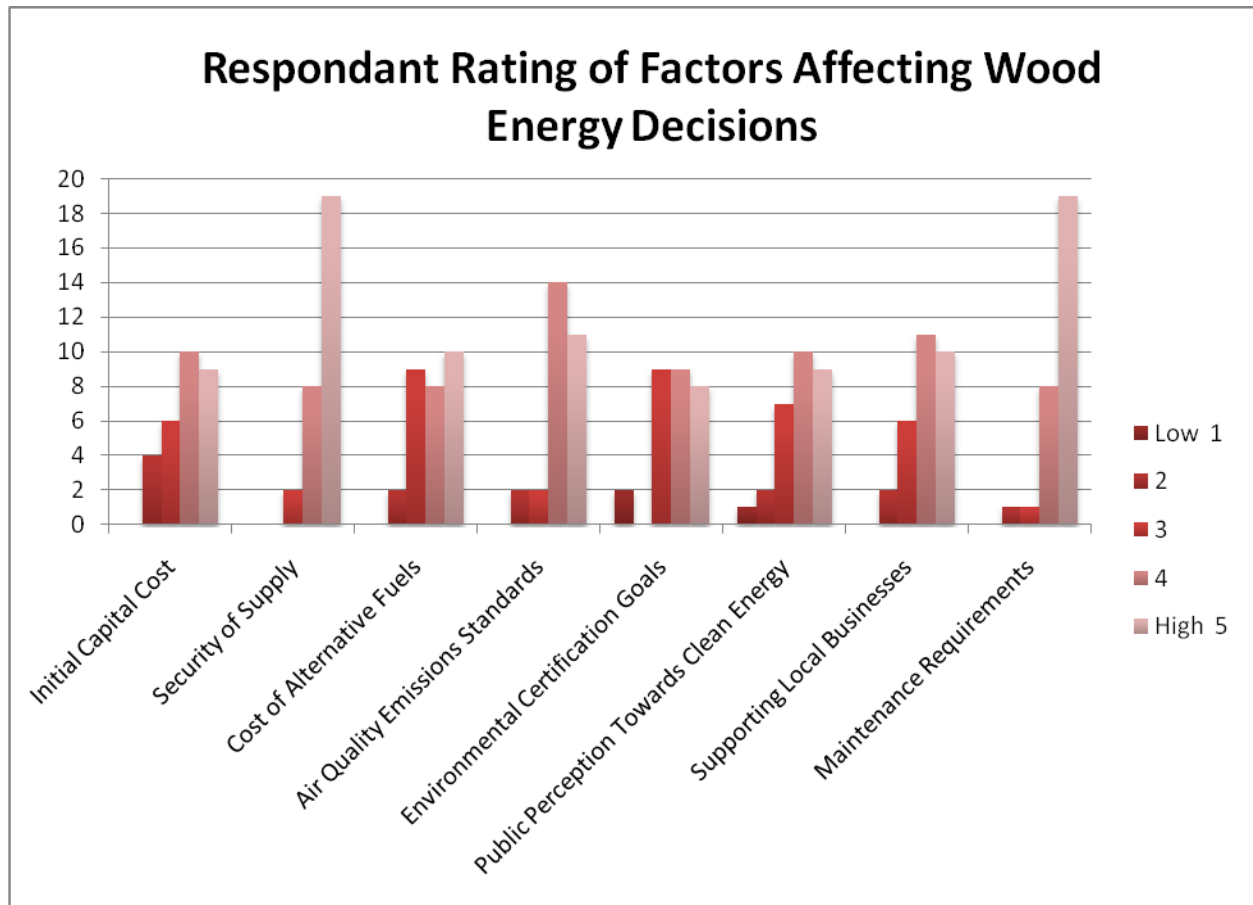
<sup>31</sup>

<http://www.minedu.govt.nz/NZEducation/EducationPolicies/Schools/SchoolOperations/Resourcing/OperationalFunding/SchoolsResourcingFor2011.aspx>

## 9. Stimulating Demand

### Key Drivers

30 respondents answered the rating questions section of the survey, which attempted to draw out the level of importance of various factors for heat end-user(s) with regard to wood energy. The chart below summarises the responses received:



From the above chart it can be seen that the two major issues users identify are security of supply and maintenance requirements. Addressing these issues will be key to stimulating demand.

### Maintenance

The misplaced maintenance requirements concern for wood fuel boilers is an education issue. Provided that the systems are correctly designed and installed, wood fuel boilers should be at least comparable to coal boilers from a maintenance perspective, if not better. Of the 19 respondents giving this issue a high importance rating, only 2 used oil. Education is thought to be key to achieve improved understanding.

In certain areas, maintenance staff are not used to the common issues around automated solid fuel feed mechanisms, and despite this not being the case in Southland, the survey showed maintenance was a principle concern.

Best practice from across the globe points to vertical integration of plant and fuel supply being a model that works. Considerable uncertainty around maintenance is a concern that can be addressed through this model, as cost certainty can be achieved as part of an ESCo arrangement where a third party owns, supplies, installs and maintains the plant, selling energy back to the end user for an agreed price to give them cost certainty, whilst allowing the ESCo to recoup its initial investment plus margin.

### **Security of Supply**

Reassurances with no specifics are a big red sign to many consumers. The regional bio-energy cluster is proposed as a potential approach, but is only one part of the solution.

Further actions that attempt to improve the security of supply are worth considering. Examples of the types of action that might be considered include:

- Ensure that local contracted end-user(s) fuel requirements are met before export of woody biomass residues is an option. This implies some form of overall monitoring system to ascertain that this is happening.
- Take strategic steps to ensure that Southland's essential services can continue to operate in the event of liquid fossil fuel supply disruption. This could take many forms, with stockpiling, biomass to liquid, coal to liquid, wood gas conversions, etc all to be considered as options within the strategy.
- Providing information to potential users to give confidence in supply: range of suppliers, actual biomass availability over coming years.
- Encouraging long term supply contracts over the expected life of the capital, with periodic reviews enabling a switch in suppliers.

Furthermore, give end users flexibility by ensuring that all new solid fuel fired installations in the region are clean and efficient dual / multi fuel systems, or that they are easily converted (rate of fuel feed, or similar small tweaks) to complete or co-firing of woody biomass. As an example, moving grate and fluidised bed furnaces are extremely flexible in this regard, and enables the system to burn a wide variety of different types of potential biomass fuels (including lower quality woodchips, Miscanthus grass, agricultural residues, and fuels with high moisture contents – up to 55-60%, even agricultural slurry), as well as other solid fuels such as coal.

An alternative approach to the multi fuel option is the Torrefaction discussed in this report that is under development. The idea is to have a pellet burner that can take

pellets, as the Torrefied pellets would have higher consistency from whatever source than just pelletised dried wood.

### **Air Quality Emissions Standards**

Air Quality Emissions Standards is identified as the third most important issue, and this could be due to awareness of the impending changes to the standards identified later in this report.

The potential to burn these other fuels must be considered in the light of the Ministry For the Environment (MFE) requirements regarding environmental performance:

*"After 1st September 2005 the national environmental standards for air quality require that all wood burners installed on properties less than 2 hectares must have a discharge of less than 1.5 grams of particles for each kilogram of dry wood burnt, and a thermal efficiency at least 65%."*

The MFE publish a list of 'authorised wood burners' as part of their 'National Environmental Standards'<sup>32</sup> although a review of the systems on offer indicates that this is aimed more at the domestic market. If it were agreed to extend the list of approved products available in Southland, there would be a requirement to test and approve through demonstration of compliance with the standards (relevant standards are listed in the documentation linked to for wood burners and pellet burners). These include:

1. AS/NZS 4012:1999 Domestic solid fuel burning appliances - Method for determination of power output and efficiency
2. AS/NZS 4013:1999 Domestic solid fuel burning appliances - Method for determination of flue gas emission
3. AS/NZS 4014 series<sup>33</sup> specifically for wood:
  1. AS/NZS 4014.1:1999 Domestic solid fuel burning appliances - Test fuels - Hardwood
  2. AS/NZS 4014.2:1999 Domestic solid fuel burning appliances - Test fuels - Softwood
  3. AS/NZS 4014.6:2007 Domestic solid fuel burning appliances - Test fuels - Wood pellets
4. AS/NZS 4886:2007 Domestic solid fuel burning appliance - Pellet Heaters - Determination of flue gas emission
5. AS/NZS 5078:2007 Domestic solid fuel burning appliances - Pellet Heaters - Method for determination of power output and efficiency

---

<sup>32</sup> (Ministry For the Environment, 2011

<sup>33</sup> (Standards NZ, 1999/2007),

## Other Issues

The following is a summary of the key concerns of those considering changing their source of energy to wood biomass, as received from the survey respondents:

Those already using biomass:

- Have already done this but it is not always easy to achieve, and there is little or no production of biomass to burn unless you produce it yourself. (1 mention)

Potential users currently using another fuel source:

### Cost

- Operating cost. (9 mentions) "The present investigation shows wood biomass is more expensive than lignite by \$12,000 p.a."
- Capital cost of conversion and running. (2 mentions)
- "Dollars used on converting to biomass energy source could be used on other building upgrades." (1 mention)
- "The cost would require a new boiler and that money would have to come from dollars that could be spent on building upgrades to deliver the core curriculum." (1 mention)
- Price fluctuation.(1 mention)
- "Our steam plant is reliable, cost of fuel is relatively cheap, we are well within our consent limits." (1 mention)

### Reliability of supply

- Supply. (8 mentions)
- "Ideal if the wood chip supply is from as local a source as possible to keep the embodied energy low." (2 mentions)
- Distance from source. (1 mention)
- Reliability of supply of chips dried to about 30% mc. (1 mention)
- "My main concern would be the fuel and boiler combination operated hassle free." (1 mention)

### Reliability of operation

- Problem providing dry (97%) steam for autoclaves. (1 mention)
- As an intermittent use electricity is viewed as the best option. (1 mention)
- Less heat output. (1 mention)

### Other

- Storage (2 mentions)
- Don't consider wood to be a correct alternative. (2 mentions)



- Right advice. (1 mention)
- Are woodchips truly a better option? (1 mention)

### **Regarding Stimulating Demand**

- **The signing of long term supply agreements and bulk pricing would give suppliers and end users understood costs and the ability to plan.**
- **Advocate to central government to extend protections around liquid fuel reserves to other forms of energy such as wood. Consider local initiatives to put such reserves in place for essential services.**
- **View the creation of the biomass supply chain and the regional bio-energy cluster as a strategic 'hedge' against too much dependence on energy imports when weighting supply options.**
- **Educate potential woody biomass clients about the reduced maintenance of using woody biomass, particularly through local users who are able to share experiences. Capture and disseminate this, along with information on biomass supply and suppliers.**
- **Advocate for stricter Air Quality Emissions standards, which stimulate demand for cleaner energy sources such as wood.**
- **Encourage new solid fuel fired installations in the region to be clean and efficient dual / multi fuel systems, or are easily converted, through careful selection of systems .**

## 10. Historical Fuel Price Analysis

### Strategic Backdrop

#### Global Strategic Environment

Looking at the global picture, the next decade is a period of considerable uncertainty with regard to traditional energy supply and demand.

On the demand side, uncertainty is closely linked to structural weakness in the global economic system, exacerbated by a series of recent natural disasters that are affecting supply chains and the economic markets.

On the supply side, evidence increasingly suggests that we are reaching a point where the exponential growth seen over the last century and a half has reached some fundamental physical limits regarding resource consumption. In an example of this, the Global Peak Extraction Rate Of Conventional Oil (GPEROCO) was recently admitted to have occurred in 2006 by the International Energy Agency (IEA), reversing the position that they had held up to that point that the GPEROCO was estimated around 2020-2030<sup>34</sup>. What this means in practical terms is that we are around (near, at, or have passed recently) the end of the age of cheap energy. This was recognised by Nobuo Tanaka (Executive Director of the IEA) in April 2011 ***"The age of cheap energy is over... The only question now is, will the extra rent from dearer energy go to an ever smaller circle of producers, or will it be directed back into the domestic economies of the consumers, with the added benefits of increased environmental sustainability?"***<sup>35</sup>

This will have significance in every area of our lives, as we are forced to adapt to a lower 'net energy' operating environment through declining 'Energy Return On Energy Invested' (EROEI). The "Chatham House - Lloyd's 360° Risk Insight Sustainable energy security: strategic risks and opportunities for business" report<sup>36</sup> gives another recent high profile example of the growing awareness of the strategic change that is needed to address current issues around energy. There have been a significant number of similar reports from many heavyweight sources in the last 12-18 months. The full executive summary from the Lloyds 360 Risk Insight report is included in the appendices of this report.

The 'summary of the summary' is that there is a serious risk to those businesses that do not take seriously, and plan towards, significant energy market volatility with a strong upward trend in prices in the short to medium term. In particular 2012/2013 is thought to be a time when significant disruption relating to an 'energy

---

<sup>34</sup> (Birol, 2011)

<sup>35</sup> (International Energy Agency, 2011)

<sup>36</sup> (Lahn, 2010)

crunch' and 'price spike' is possible, giving little time to act. Within this period there will be risks (for example supply chain failure and transport fuel shortages), and opportunities (new energy sources becoming economic faster, demand for technology to implement these measures). Reduction in fossil fuel consumption is an imperative, and as identified in the (Energy Return On Investment) EROI section of this report, the woody biomass for heat energy alternative is particularly attractive when compared to the alternatives, having good EROI and Energy Internal Rate of Return (EIRR) compared to other renewables. However as this can only supply a portion of the demand, even in a favourable region such as Southland, there is still an imperative to move towards a lower 'net energy' use as a society.

It is hoped that the above backdrop sets the scene for the importance of acting now to take a proactive approach in encouraging Southland to take advantage of its woody biomass resource. Investment in this infrastructure now is a timely move, and could offer considerable benefits associated with a degree of energy independence from a renewable source going forward, as well as the potential to develop skills and products with significant export value.

### **Energy Internal Rate of Return (EIRR)**

The Internal Rate of Return (IRR) on an investment or project is the "annualized effective compounded return rate" or discount rate that makes the net present value (NPV) of all cash flows (both positive and negative) from a particular investment equal to zero.

The IRR is the rate of return a project produces when the net present value is set to zero. This is a great tool for comparing multiple project with different lifespans or end of useful lives (EULs). In practical terms, IRR is nearly always calculated in a spreadsheet from a column of numbers indicating the directional cash flows (negative for investment, positive for returns.)

Timing of energy flows is as important as total energy flows because renewable electricity generation typically requires almost all energy to be invested up front, while fossil generation technologies spread out this investment over the lifetime of the plant.

Therefore the Energy Internal Rate of Return is a measure of the annualized effective compounded return rate on the energy investment in the setup and operation of a system.

Given a collection of pairs (time, energy) involved in a project, the internal rate of return follows from the net present value as a function of the rate of return. A rate of return for which this function is zero is an internal rate of return.

Given the (period, energy flow) pairs  $(n, C_n)$  where  $n$  is a positive integer, the total number of periods  $N$ , and the net present value NPV, the energy internal rate of return is given by  $r$  in:

$$NPV = \sum_{n=0}^N \frac{C_n}{(1+r)^n} = 0$$

### Energy Return on Investment (EROI)<sup>37</sup>

The concept of EROI has been identified as an important concept when measuring the potential for an energy source. It is not enough to consider its current or future availability. The 'net energy' or EROI gives an indication of the relative worthiness of a fuel source with regard to its return on energy invested in its extraction, processing and transportation to the point of use ('the process').

This lost energy must be added into the costs because of the "opportunity cost" related to other economic and/or energy production processes in which the energy could have been invested. Having defined this loss as  $E_{lost}$ , EROI is defined as:

$$EROI = \frac{E_{out} + (E_{lost} - E_{in})}{E_{lost}}$$

This can be derived by analogy with the familiar concept of Return on Investment. If  $P_i$  is the principle invested and  $\Delta P$  is the increase in value of the principle after investment, then the rate of return is:

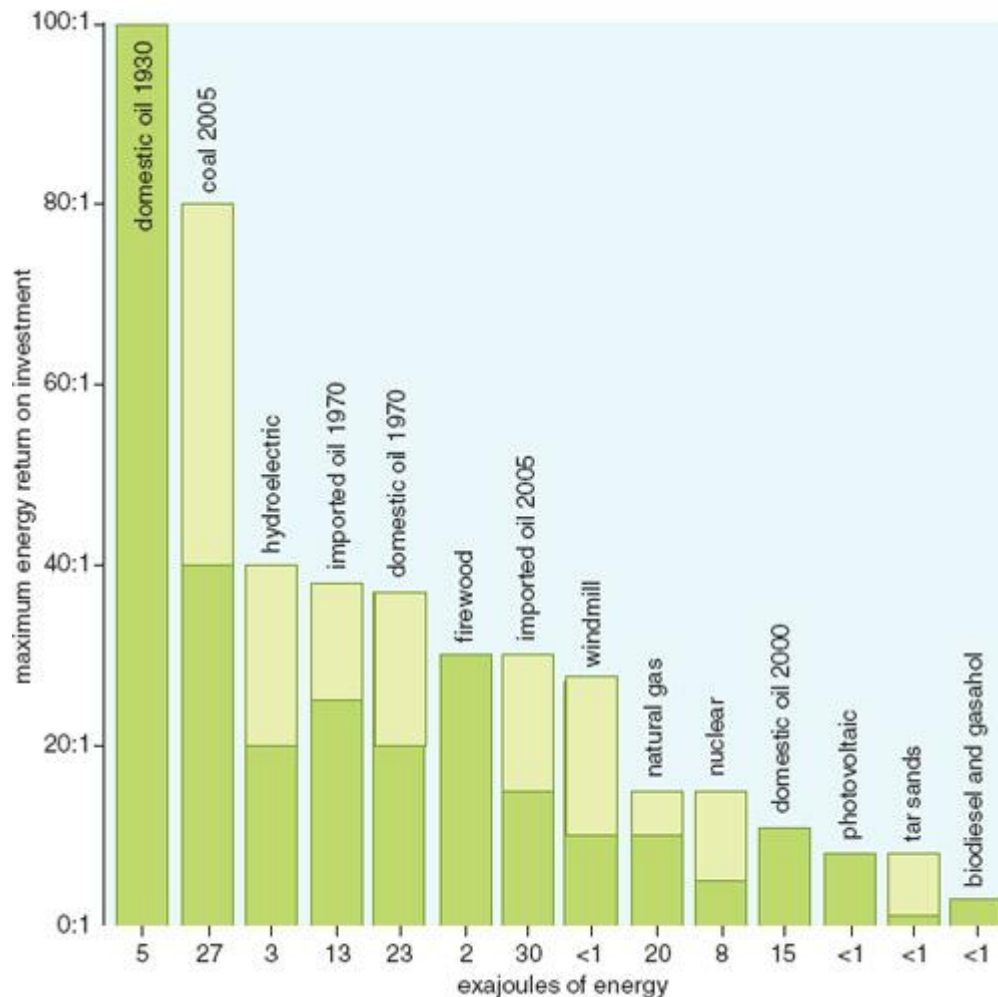
$$ROI = (P_i + \Delta P) / P_i$$

The EROI formula follows by substituting  $E_{lost}$  for  $P_i$  and  $(E_{out} - E_{in})$  for  $\Delta P$ .

The following table indicates EROI calculations for various fuel sources, from a Scientific American study:

---

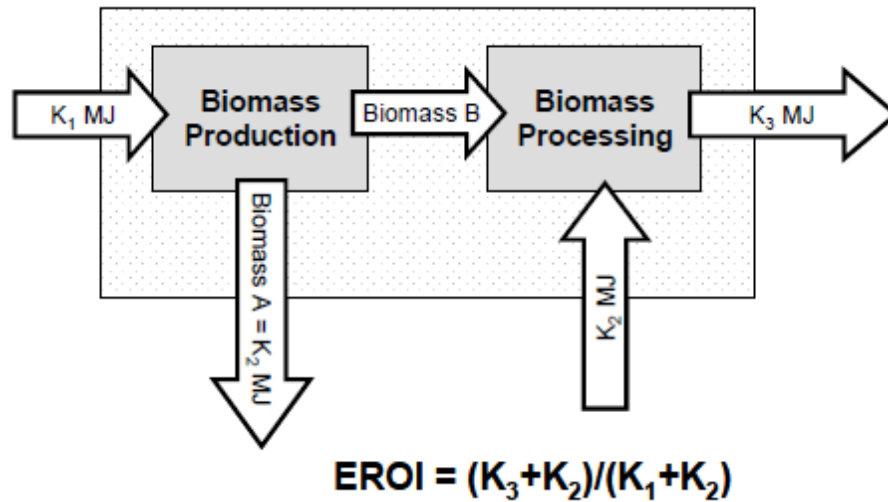
<sup>37</sup> (Hagens, 2010)



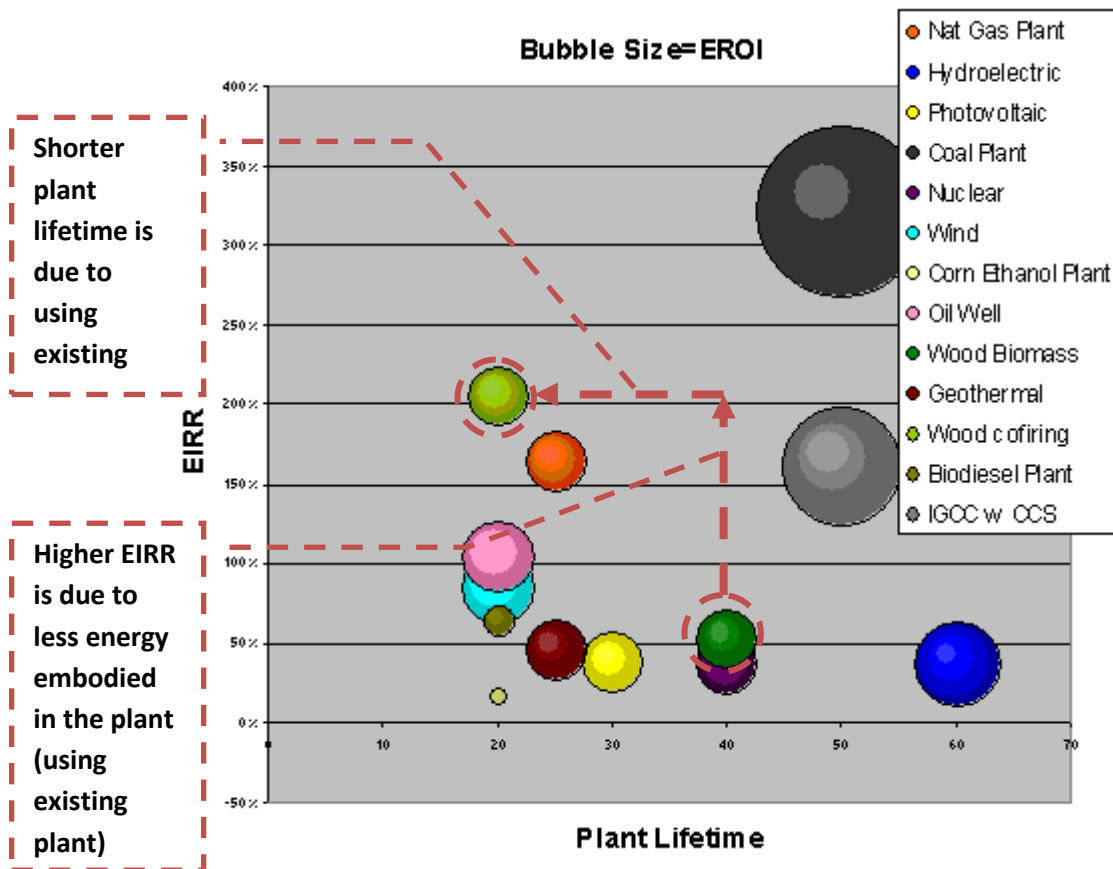
In the above chart, 'firewood' is the generic label given to woody biomass for heat energy. An EROI between 25-30 is generally accepted for woody biomass from forestry. This figure compares well with other renewable, with only wind turbines coming close.

It should be noted that most commentators suggest that an EROI below 3 for our fuel supply would not allow an industrialised society to function.

When calculating EROI for biomass using the formula above, the following flow diagram is helpful:



This is a helpful tool in considering alternative end uses for the biomass and the source document <sup>38</sup> contains a complete treatment of the application for comparison purposes.



<sup>38</sup> (Hagens, 2010)

By using EROI in conjunction with EIRR, it can be seen from the diagram above that wood co-firing with coal makes a lot of sense, leveraging existing heat plant infrastructure with relatively minor cost technical changes to enable it compared to replacement<sup>3940</sup>. This would be a cost effective way of generating sufficient demand to stimulate setting up the supply chain.

### Southland Strategic Considerations

Southland has a number of factors that affect our position in relation to this global picture. They include the following:

- Low population density – average 2.6 ppl / km<sup>2</sup> (Environment Southland, 2005).
- Industry dispersed over a large area.
- Large amount of road infrastructure.
- Economy has a strong bias toward export dependent industry.
- Significant fossil fuel resources such as lignite coal.
- Significant forestry resources coming to maturity in the next 25 years.

### Regional Skill-Set

Southland has many of the right conditions and skills to take advantage of this opportunity:

- A number of local organisations are considering wood as a more environmentally and financially sustainable source of energy.
- Some innovative businesses manufacturing waste wood and other biomass into user friendly forms of fuel.
- Within the region exists much of the engineering capability to design, build and install the technology needed to utilise this energy.

---

<sup>39</sup> **Invalid source specified.**

<sup>40</sup> (Konrad, EIRR spreadsheet analysis)

### **Regarding Strategic Considerations:**

- **The key finding in this report regarding immediate potential demand for woody biomass is that the use of higher EIRR biomass co-firing with coal will incrementally reduce emissions and provide sufficient demand to make attractive the supply chain / regional setup, ahead of the potential dedicated biomass fired plant installations identified via the potential demand analysis.**
  - **It is recommended that co-firing opportunities are identified (plant types and budget costs per kW installed capacity) and then promoted within wood energy marketing initiatives.**
- **Transportation resilience is not just Southland's ability to weather temporary commodity price fluctuations, but achieving a balance between imported fuel sources and locally sourced alternatives. Southland is likely to be a net exporter of energy in the coming decades however it is a net importer of liquid fossil fuel for transportation. The creation of a supply chain that could scale and diversify to act as a building block for foreseeable future attempts at 'biomass to liquid' and 'biomass to wood gas' for transportation needs is highly desirable in this context, and worthy of further investigation.**



## Competing Fuel Sources

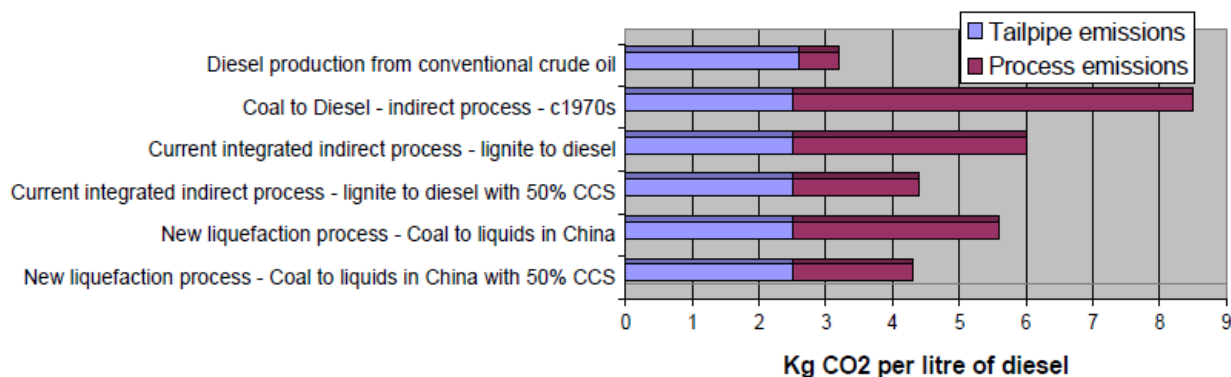
The analysis compares the price of wood energy in its various forms against the alternative sources, and attempts to ascertain at what point in time woody biomass will compete on price terms with the alternatives currently available in Southland.

### Coal

Due to limited competition from other fuel sources, coal price in the South Island is deemed largely dependent on mining and transportation costs<sup>41</sup>. The study on national coal prices indicates that the price of coal in the lower South Island is projected to remain stable at 2009 levels for the period 2010-2035. This appears to be due to the perceived availability of lignite in the region.

However lignite is presumed to be limited in application within the region outside of its existing uses, due to its high sulphur content, low calorific value, and competition with export demand for briquettes and potentially Coal to Liquid plant.

The net emissions of CO<sub>2</sub> for coal to liquid is noted in the chart below<sup>42</sup> as a reminder to include the net carbon emissions and the current carbon price of these fuel sources when performing comparison with woody biomass (zero net carbon). Solid Energy data shows that making diesel from lignite in Southland would emit 3.5 kg CO<sub>2</sub>/litre compared with emissions of 3.1 kg CO<sub>2</sub>/litre from making diesel from coal in China and transporting it to NZ:



### Oil

Fuel oil for heating is already at a significant cost disadvantage to woody biomass in individual supply applications, and will become more so as fuel oil and diesel prices continue on their upward trend in response to peak oil and global demand pressures.

<sup>41</sup> (Covec, 2009)

<sup>42</sup> **Invalid source specified.**

## Gas

Due to limited supply at present, and a lack of a piped distribution network, it is difficult to see large scale application of gas in the region, unless coal seam methane option is developed further<sup>43</sup>. The exception to this is in large industrial applications, where certain locations close to ports could see imported LNG becoming cost competitive, particularly as emissions standards are tightened. There is ongoing discussion around extraction of gas and oil from the Great Southern Basin, however these projects have 5 year plus lead in times, and are unlikely to be available before current price increases in coal make biomass cost effective. There does exist the potential to use Torrefied biomass as a feedstock to gasifiers that could be co-fired with coal seam gas for specific applications as well.

## Geothermal

There is no evidence available that points to geothermal power being a viable option in Southland.

## Solar Hot Water

Solar thermal heating is a heat source with the potential to replace upwards of 50% of the water heat demand in a typical household, and could significantly cut residential emissions associated with heat energy for residences using coal or biomass via a wetback for water heating. Trials are underway to test solar water heating in and demonstrate particular system configurations for the Southland region in a separate Venture Southland pilot project (<http://www.solarcitysouthland.co.nz/>) at the time of writing.

## Wood

Historic prices for woody biomass are limited. The information mainly exists in analysis funded by BANC, EECA, and other interested parties from some of the other biomass energy hubs in NZ.

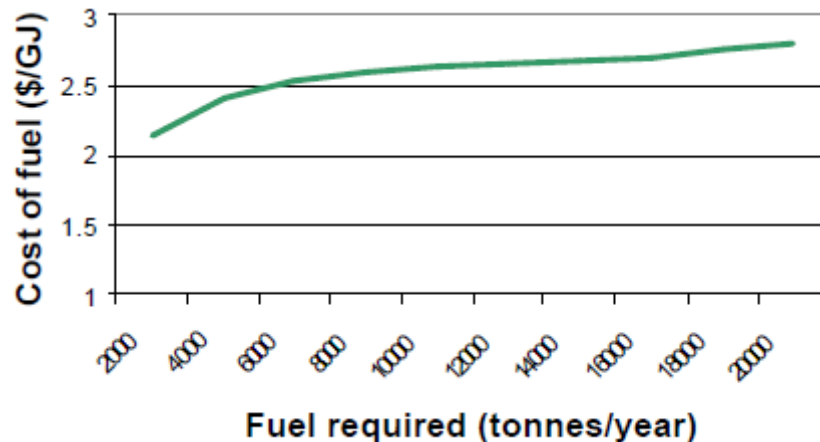
There are two principal sources of wood considered to potentially be economic, landing sites from forestry activities, and wood from the processing / end use centres such as sawmills, and end product production sites.

For landing sites, the following chart shows delivered cost of forest residues for the energy plant during the period 2002-2005<sup>44</sup>.

---

<sup>43</sup> Draft Southland Energy Strategy 2011

<sup>44</sup> (John Gifford, 2006)



In the research that produced this chart, it was noted that *"the cost of obtaining forest residues is likely to be more expensive compared to wood process residues, but they are increasingly competitive with fossil fuels"*<sup>45</sup>.

In researching this report, significant difficulties in ascertaining wood energy costs were experienced.

#### **With Regard to Economic Competitiveness of Woody Biomass:**

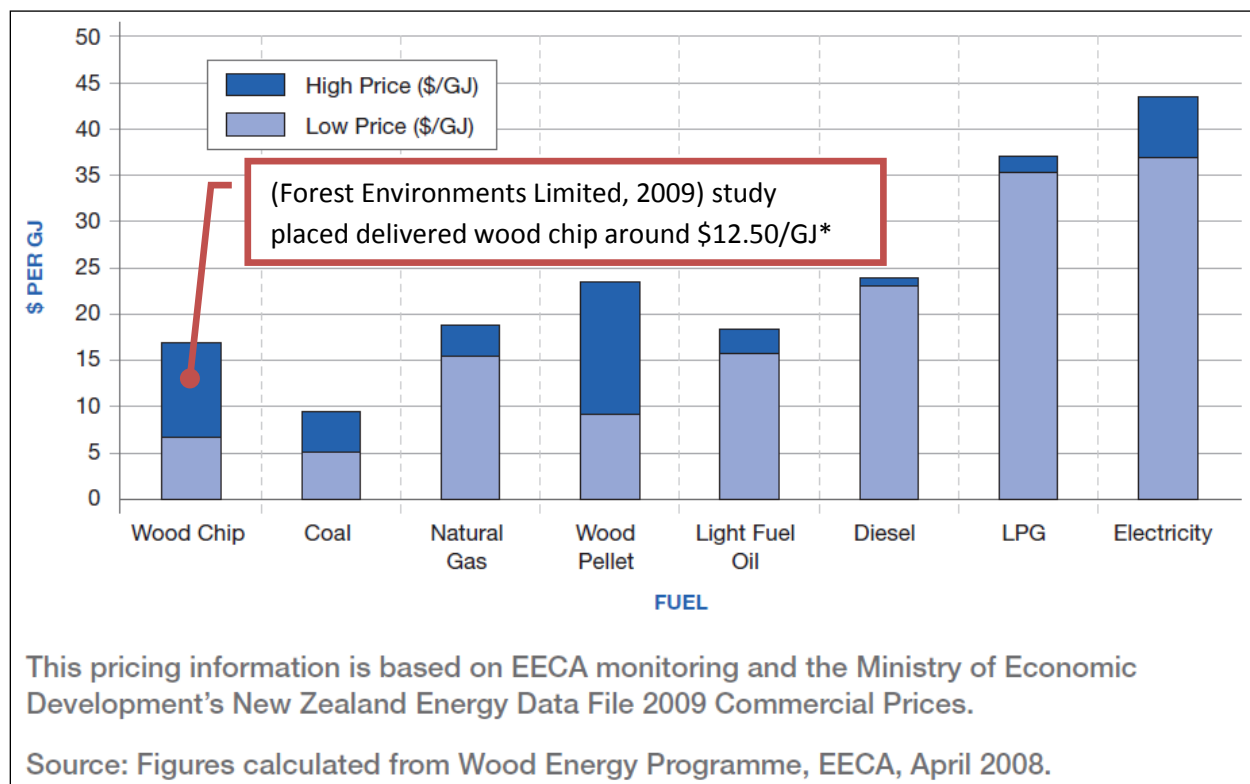
- **For wood energy to compete with other sources of energy, users have to be able to understand costs. All alternative fuels have comprehensive information available on current, historic and projected prices. Start collating and publishing within the industry ahead of official government statistics being produced.**
  - **Advocate for this information on wood energy costs to be collected and made available through MAF, MFE and other government agencies in the same way as other energy cost information.**
- **Suggest having on a regional basis \$/GJ information available for:**
  - **Raw Waste Wood (by type – forestry landing residues, process specific waste, etc)**
  - **Processing Costs (by type and process: Green / Air Dried / Oven Dried / Torrefied comparison)**
  - **Transportation Costs (by type and therefore vehicle configuration)**

<sup>45</sup> Ibid

## Historic and Projected Price Analysis - background information

### Economies of Scale - Considerations

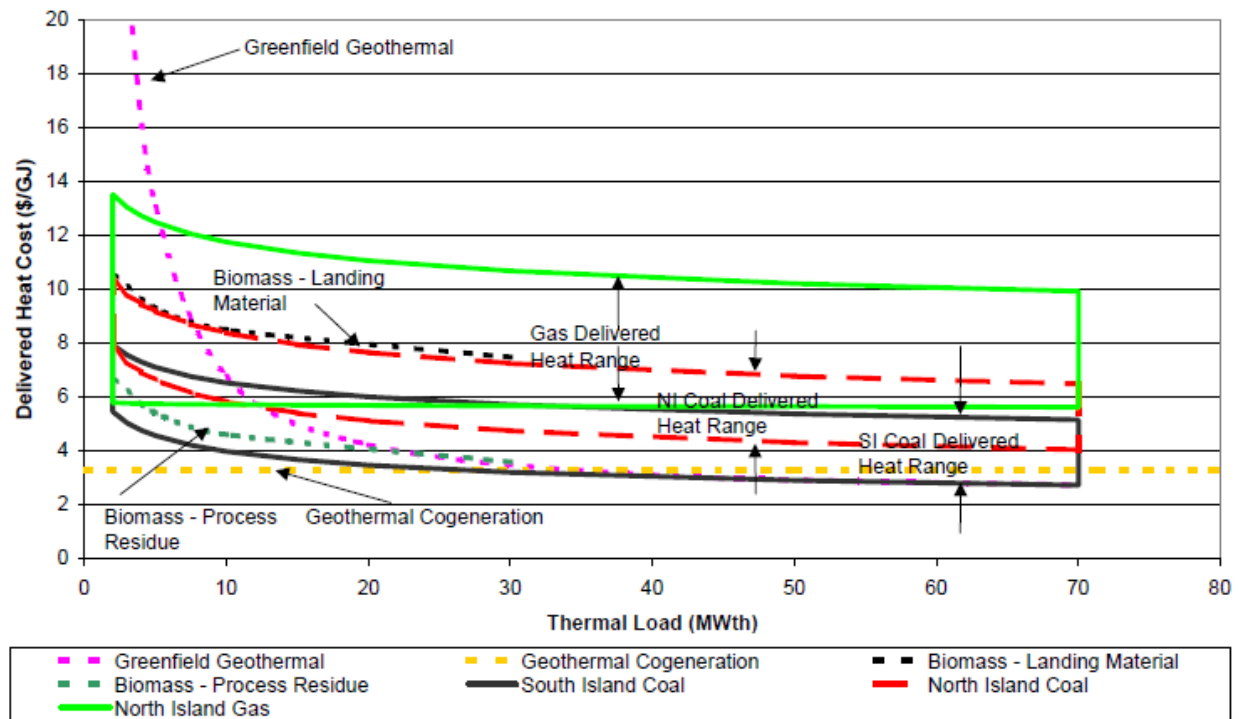
The following shows a 2008 snapshot of NZ range of prices per unit delivered energy (\$/GJ):



From 2008, the above data exists which can be used to 'sanity check' our estimates and analysis below.

\*Based on the information in this chart, wood chip (assumed to be air dried to approx 30% m.c.) looks to be coming close to competitive on price with coal. It should be noted that there are various qualities of chip, which vary according to size, moisture, ash etc. Along with logistics these have a significant impact on the price. Murray Cowan (WENZ) has stated that this could mean the price varies 2-3 fold, as indicated in the chart.

Torrefaction of pellets, if it were to bring the overall delivered cost of pellets down through transportation gains would mean pellets could start to compete with coal after perhaps 50-100% increase in coal price. However, in our analysis below, we have taken a pessimistic view that Torrefaction would add 5% to the delivered cost based on the literature indications (+5% from Process Costs, +5% from Reduced Net Energy, -5% from Increased Transport Efficiency). This estimate needs a more thorough treatment through further investigation.



It can be seen from the above chart<sup>46</sup> that biomass from landing sites is estimated to track 1.5-2 times the delivered cost of South Island coal. This has the potential to change rapidly as international demand for coal grows and other industrial uses for lignite are developed in the region.

### Transportation Costs - considerations

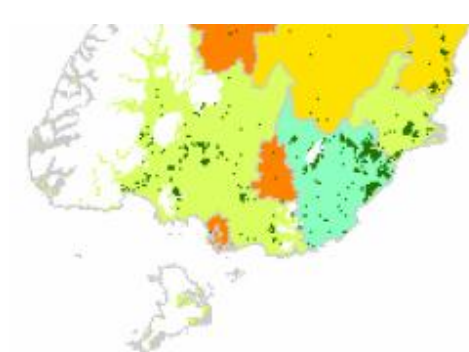
The EROI of woody biomass is considered to be around 25:1, although this is highly dependent on the efficiencies achieved in transport of the chips to the burning facilities<sup>47</sup>. It is noted that "distance and load size were important components that should be considered when designing new burning facilities".

The Southland Region has low population density and geographic dispersion. The main population centres are in the south of the region. The distribution of plantations in the region (dark green) can be observed from the figure below<sup>48</sup>:

<sup>46</sup> (Cox, 2008)

<sup>47</sup> (Gingerich & Hendrickson, 1993)

<sup>48</sup> (Peter Hall B. H., 2008)



High demand areas are distributed as per the data collected in this survey. This should be mapped against forestry locations and processing (existing and proposed) sites in any future consideration of supply.

**Table 2: Delivered costs of forest residues to a user (\$/m<sup>3</sup>, 2007)**

Transport distance (one way)	Landing residues		Rolling cutover Ground based harvest		Steep terrain Hauler harvest	
	Low	High	Low	High	Low	High
25 km	\$24	\$34	\$36	\$50	\$63	\$78
50 km	\$27	\$39	\$39	\$55	\$67	\$83
75 km	\$30	\$43	\$42	\$59	\$70	\$87
100 km	\$33	\$47	\$45	\$63	\$72	\$91

**Table 3: Cost per GJ of delivered fuel (assumes 8 GJ per m<sup>3</sup>)**

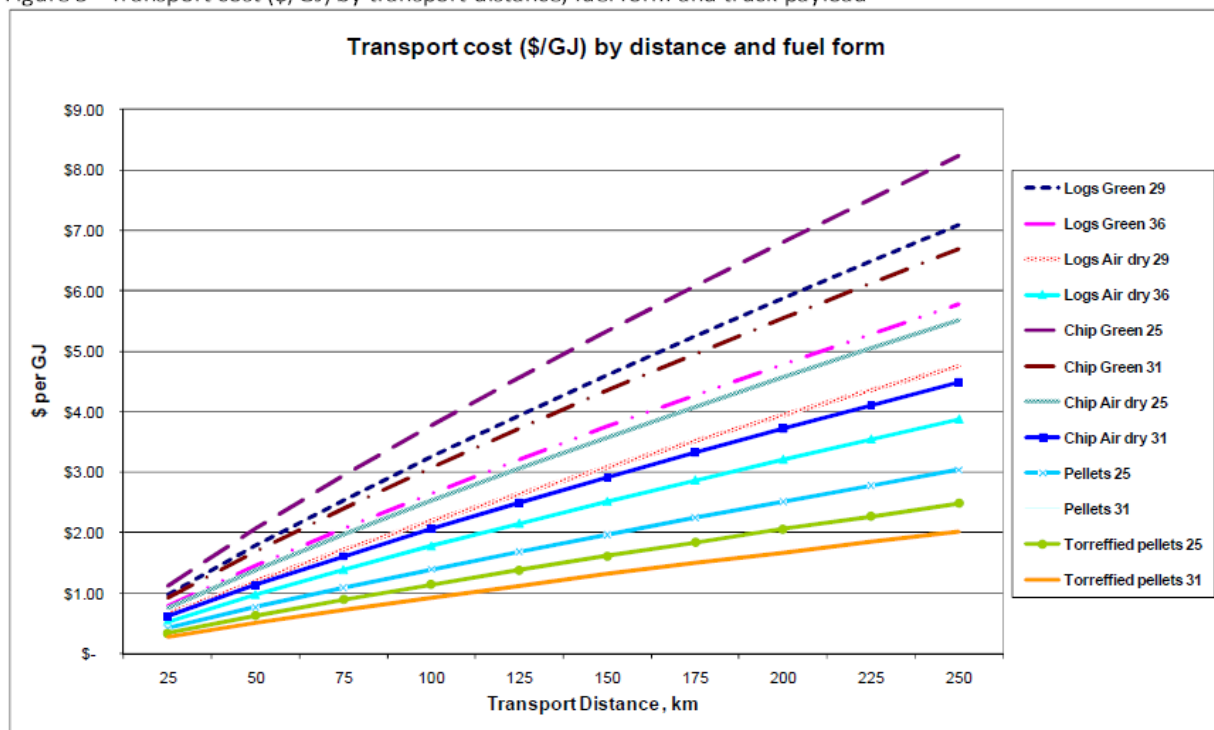
Transport distance (one way)	Landing residues		Rolling cutover ground based harvest		Steep terrain hauler harvest	
	Low	High	Low	High	Low	High
25 km	\$3.00	\$4.25	\$4.50	\$6.25	\$7.90	\$9.75
50 km	\$3.40	\$4.90	\$4.90	\$6.90	\$8.40	\$10.40
75 km	\$3.75	\$5.35	\$5.25	\$7.40	\$8.75	\$10.90
100 km	\$4.10	\$5.90	\$5.65	\$7.90	\$9.00	\$11.40

The main heat end users are dispersed geographically. When performing any future consideration of supply, the physical relationship of the end users must be considered to attain least cost in the supply chain through optimised transportation component. The location information gathered in the demand assessment has provided a good starting point for this analysis. A good example of the type of

analysis that can be undertaken was discovered<sup>49</sup>, which gives useful considerations when looking at the distribution, such as considering the delivered cost per source relative to individual end users.

The following chart gives an 'at a glance' reference for transportation costs associated with the various forms of woody biomass and was used in our analysis<sup>50</sup>.

Figure 5 - Transport cost (\$/GJ) by transport distance, fuel form and truck payload



\* **Note** - Pellets 31 and Torrefied pellets 25 tonne lines (2<sup>nd</sup> from bottom) are so close that they are indistinguishable on the graph. The 36, 31, 29 and 25 tonne lines represent the payload under the 53 and 44 GVM rules and variation between log truck and bulk carrier payloads.

It is noted that Fonterra have made a significant investment in software that performs route optimisation, and investigating the use of this through a partnership approach could be considered.

<sup>49</sup> (MÖLLER, 2003 Dec)

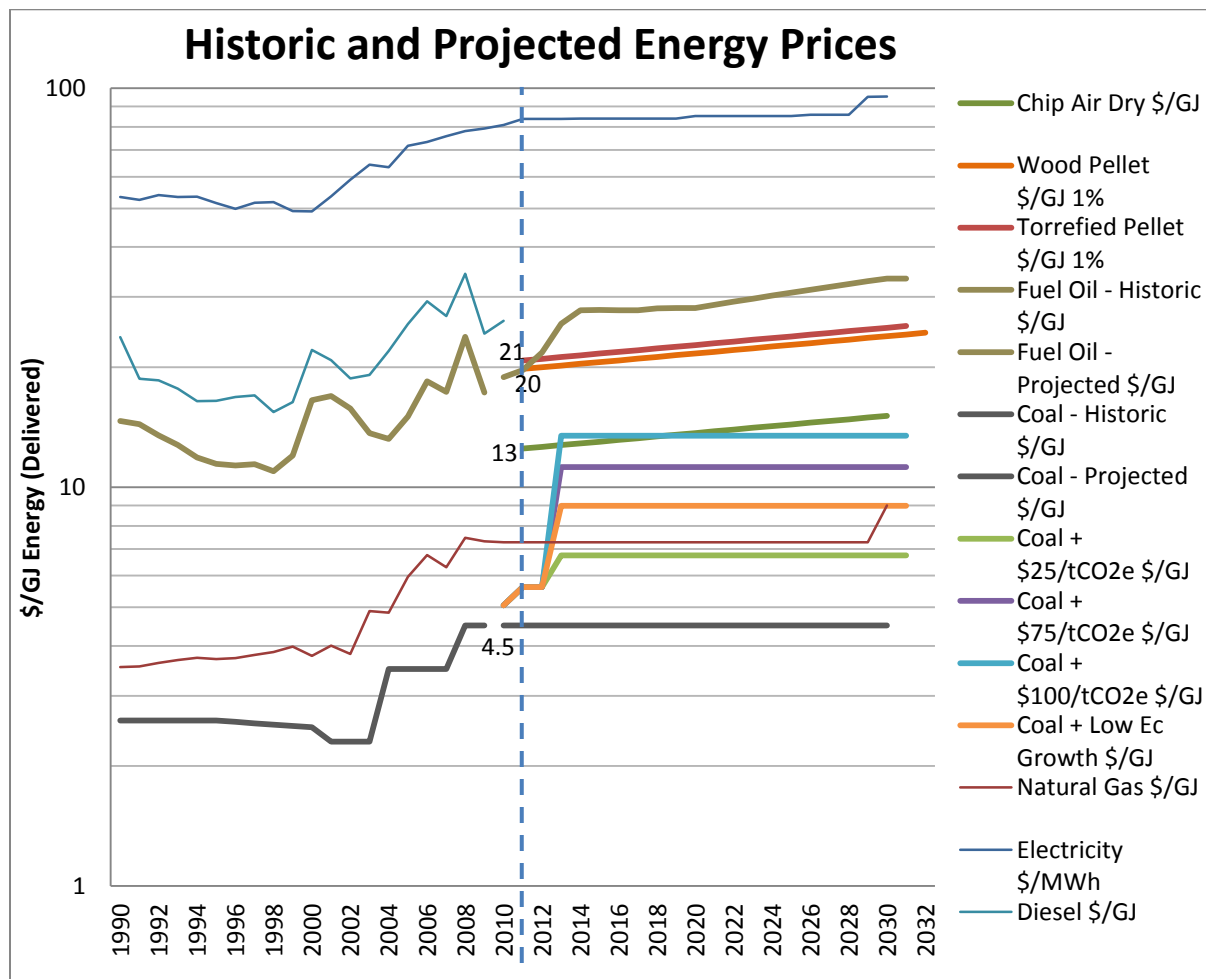
<sup>50</sup> (Peter Hall, 2011)

**With Regard to Historic and Projected Price Analysis - background information:**

- **Economies of scale come into play and larger users are likely to be easier to realise an initial return from, particularly with the co-firing option and torrefaction proposed elsewhere in this report.**
  - **The energy security angle should not be ignored, and contingency strategies to supply to other users should be included in parallel.**
  - **Medium size users could be a target for a regional ESCo that has a standard range of products and uses aggregation to achieve economies of scale.**
  - **Smaller users in aggregate (particularly residential) are already being targeted through national initiatives to replace high emission wood burners. The potential to supply a high quality Torrefied pellet product to them is perhaps a significant market, although uptake of pellet boilers in Southland may be well below national average due to firewood availability.**
- **More work needs to be done on the supply side where data is potentially inaccurate, particularly on logistics and delivered costs. This should be a focus for a future potential supply assessment.**
- **Efficiency of Transportation: the utilisation of a higher energy density fuel such as kiln dried or torrefied chips / pellets would significantly reduce the volume of material to be transported.**
  - **A detailed investigation into the net impact of Torrefaction on delivered cost for different feedstock and end uses at various distances relevant to Southland is recommended.**
  - **Investigate portable processing plant.**
  - **Investigate the potential to utilise rail using existing and re-laid historic rail lines to give the greatest possible efficiency to the transport element as an alternative to portable processing plant mooted in this report.**
  - **Investigate potential partnerships between the regional hub and end users with particular skill-sets required. Route planning and optimisation by Fonterra is given as an example.**



## Historic and Projected Price Analysis



The above chart is based on MED data for historic fuel prices, combined with a projection of future woody biomass prices based on 1% cost inflation per year.

The 'today' costs for the woody biomass products are estimated based on data from the research. They are within the bounds of the EECA cost information chart from 2008 presented earlier in this section as a 'sanity check'. Torrefied pellets are assumed to have a delivered cost around 5% more than normal woody biomass pellets.

### Additional Factors Influencing Change - Strategic

It is worth considering a scenario whereby a global peak in oil production puts a natural cap on economic growth globally, leading to a period of significant commodity price volatility and re-imagination of the economic paradigm. As discussed elsewhere in this report, there is good evidence that peak oil has already occurred. Peak coal, a related concept linked to global coal supply may well occur in

the next period as well<sup>51</sup>, with global energy delivered from coal potentially peaking in or around 2011, and only 50% of the peak being available in 2047. These peaks are due to the requirement to exploit harder to reach (deeper for high quality coal, meaning more energy needed to extract) and lower quality (e.g. lignite, energy density in GJ/tonne is 75% of sub-bituminous coal).

From the survey results, there are already a number of biomass users in Southland, many of whom would likely be happy to share their learning's with others. This is a key way Southland businesses have identified how they want to get information<sup>52</sup>.

"We have burnt biomass since 2003 and have now installed a generator to complete our combined cycle or co-generation plant. We are happy to advise others on tuning for bio fuel and difficulties they may have."<sup>53</sup>

Others who are considering using biomass have indicated they have an interest in receiving more information covering a range of areas:

- Suppliers of pellets and chips, including information on moisture content
- Financial assistance (subsidies or grants)
- The current heating/cooling/humidification system is one recommended by the Invercargill City Council and approved by our Trust Board. I presume all options were considered in coming to this decision. (large heat pump/ chiller, boiler used as back-up)
- A summary of facts and figures of coal versus wood i.e. price, emissions, energy per unit, quantity needed (wood less dense so need more tonnes?), embodied energy
- Availability of boiler makers & other technical support for specifying and installing replacement boiler.

Many of the above queries have been covered by sections of this report and within the referenced documents identified during the research.

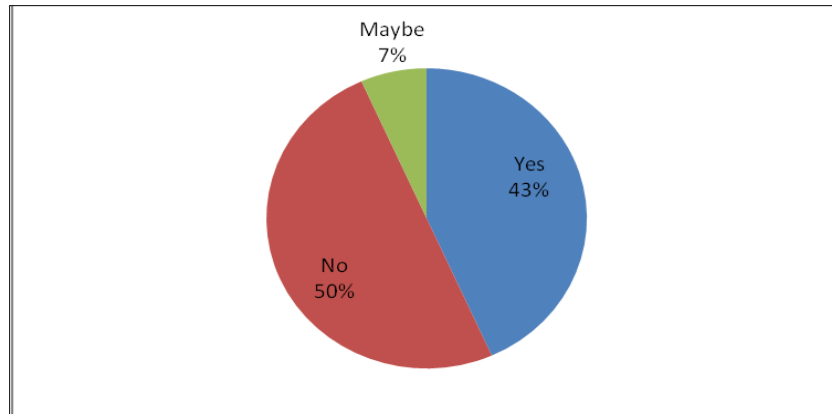
Of the responses regarding a potential location to store fuel, the respondents were split evenly between those who had plenty of space and those who thought they probably or definitely did:

---

<sup>51</sup> (Tadeusz W. Patzek, 2010)

<sup>52</sup> Sustainable Business in Southland: Primary Research Results (2008)

<sup>53</sup> Wood Energy Questionnaire Response



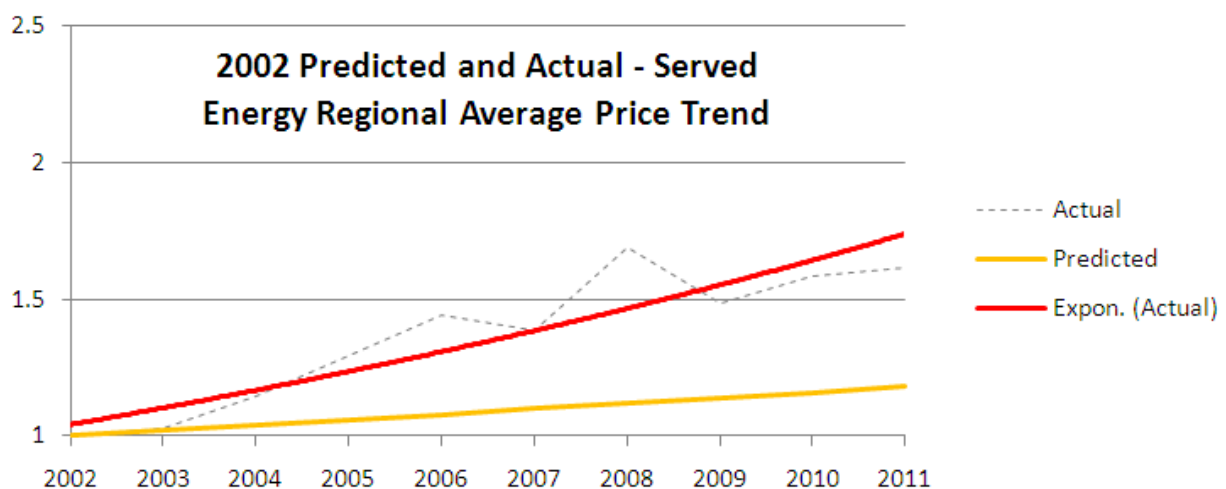
Issues around storage space could potentially be addressed by more regular deliveries in some situations.

### Economic Considerations

It is important that residues cost less than pulp wood to extract, otherwise biomass to energy projects will utilise pulp wood supply and push wood prices upwards for pulp, paper and board mills. Given the available woody biomass residues available are less than the total assessed supply, the danger of creating demand for a commodity rather than use and value for a by-product should be considered in any strategic decisions. Unfortunately this relies on projected commodity prices in a period of significant instability in the global commodity markets.

### Limitations to the Analysis

As the chart below<sup>54 55</sup> demonstrates, prediction of future energy price trends is an art rather than a science, and is often wrong. The analysis and predictions offered above are for the scenario that is the best fit with the strongest current indicators.



<sup>54</sup> (East Harbour Management Services, 2002)

<sup>55</sup> (Ministry of Economic Development, 2011)

Given the current and future volatility in fuel prices, there is considerable uncertainty attached to any projections. Significant growth driving up fossil fuel energy prices is not a scenario we predict to eventuate in the next 5 years. Rather, a peak in oil production and potentially coal as well (see elsewhere in this report) could lead to an upward trend in fuel prices, with significant short term fluctuations. How that will effect a vulnerable economic situation is something that we can't predict.

**With regard to the historic and projected analysis of costs:**

- **The historic and projected analysis indicates that woody biomass is unlikely to compete on cost terms with coal unless the price of coal goes up by 2.5-5 times depending on the biomass product.**
  - **The MED data does not indicate this is likely to happen soon, however it appears that the projections are out to 2 years, and then a flat line indicating no further projection.**
  - **Even with the carbon price set at \$100/tCO<sub>2</sub>e, there is a significant gap between this and pelletised woody biomass.**
  - **However, if it were to continue on the trajectory that a trend line for 2012-2014 indicates, then within 1 or 2 years, the projection would cross the line for Torrefied biomass.**
- **Coal and woody biomass should not be compared on just least cost of fuel terms.**
  - **The analysis is on fuel costs only and does not take into account installation costs (significantly reduced for the co-firing option) and ongoing maintenance costs. Nor does it account for the compliance costs associated with tightening emissions standards.**
  - **Global changes in coal prices could change the economics very quickly.**

## 11. Additional Strategic Actions

### Air Quality

There exists potential for Southland to improve significantly its performance with regard to air quality. The comparison table below gives a view of Southland's emissions standards against international practice (2006). The regional air quality plan was approved in 1999 and needs updating.

International Comparison of Ambient Air Quality Standards and Guidelines as compared with recommendations of the World Health Organization (WHO)

POLLUTANT	WHO	EUROPEAN	AUSTRALIA	UNITED STATES	CANADA	SOUTHLAND, NZ
Ozone (8 hour, parts per billion)	50	60	80	80	65	100
Fine particulate (24 hour, micrograms per cubic meter)	25	50	25	65	30	120
Sulphur dioxide (24 hour, ppb)	8	48	80	140	115	125
Nitrogen dioxide (Annual, ppb)	21	21	30	53	53	100
Carbon monoxide (8 hour, ppm)	9	9	9	9	13	10
Lead (Micrograms per cubic meter)	-	0.5	0.5	1.5	-	0.75

Notes:

A dash (-) indicates that no standard or guideline has been established for a particular parameter.

International figures from 'The Air We Breathe' (David Suzuki Foundation, 2006)

Southland NZ figures from 'Regional Air Quality Plan for Southland' (Environment Southland, 2005)

### Particulates – PM10 and PM2.5

Environment Southland (ES), the Regional Council, are currently investigating their Air Quality Plan changes. The latest National Emissions Standards (NES) – version 2, has imposed PM10 limits to meet by 2016 and 2020. Southland has 35 exceedances per year and will only be allowed 1 per year under the new standards by 2020. It is acknowledged by ES that the majority of emissions contributing to the exceedances comes from domestic use.

Industry recognises that the Southland standards are lower than other regions such as Otago.

When measured against the "Revised National Environmental Standards for Air Quality – Evaluation"<sup>56</sup>, Invercargill is not on track to comply with the legislation by 2013, along with 14 other airsheds in NZ:

<sup>56</sup> (Ministry For the Environment, 2011)

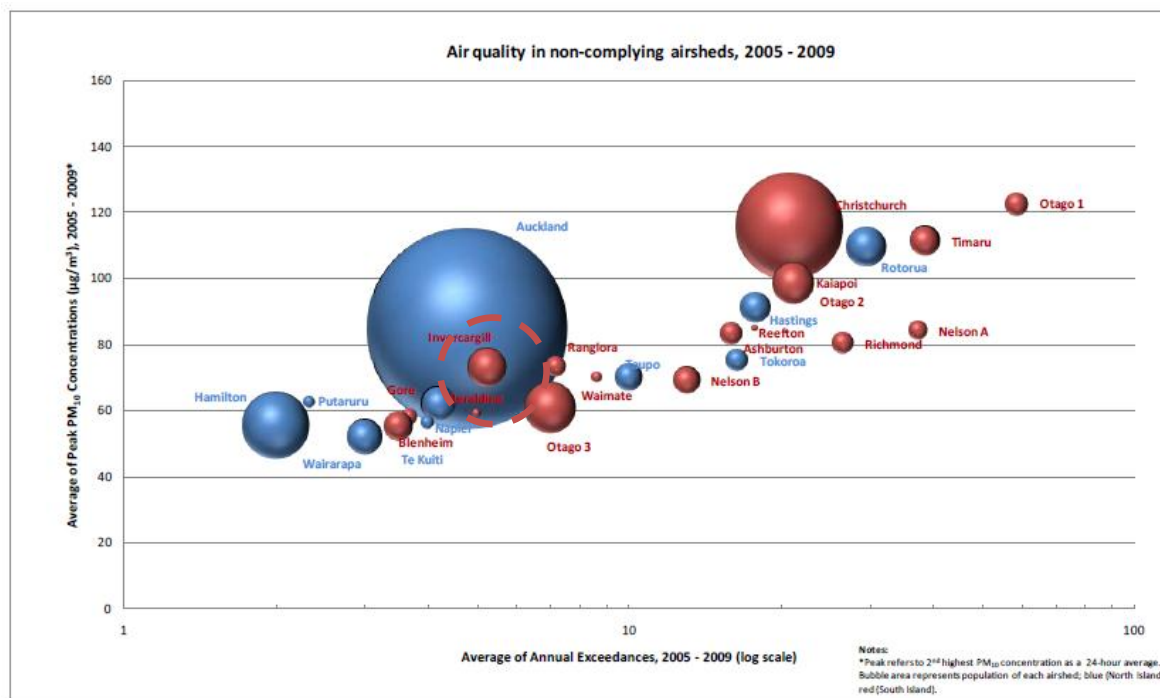


Figure 1 Air quality in over-allocated airsheds, 2005 – 2009

A regional study in Otago<sup>57</sup> showed that hospitalisation rates are significantly higher for residents of high pollution areas in Otago than for residents in low pollution areas. The study further showed that children under 5 years old living in areas with higher PM<sub>10</sub> are more than twice as likely to be admitted to hospital with a respiratory condition as children living in areas with low PM<sub>10</sub>. This is in line with international findings regarding the contribution of particulates to health related risks.

The 'Split Targets' approach recommended by the review<sup>58</sup> consists of:

- Split target compliance dates:
  - Heavily polluted airsheds to meet 3 exceedances by 2016;
  - Polluted airsheds to meet 1 exceedance by 2016;
  - All airsheds to meet 1 exceedance by 2020.
- New open fires prohibited in overallocated airsheds after 2012.
- New industry must offset emissions in over-allocated airsheds after 2012.
- Assisted compliance.
- Review national ambient air quality guidelines for PM<sub>2.5</sub> and consider future standards for annual PM<sub>10</sub> and PM<sub>2.5</sub>.
- Explicit provision for exceptional events.

<sup>57</sup> (Public Health South, 2006)

<sup>58</sup> (Ministry For the Environment, 2011)

It should also be noted that during the research into motivations for sustainable practices<sup>59</sup>, actions which had health and wellbeing benefits were considered most important and correlated to most action on behalf of businesses surveyed. This indicates that if the promotion of wood energy includes the health and wellbeing aspects of reduced particulate emissions, it is more likely to motivate businesses to change fuel sources, particularly given the health impacts are likely to affect those within the vicinity of the operation, staff and locals.

### Upcoming PM2.5 emissions limits

The “Revised National Environmental Standards for Air Quality – Evaluation” document references potential future legislation to introduce PM2.5 emissions standards in line with international developments. Filtration of this size particulate requires you to go beyond the cyclonic / scrubbing filtration of PM10 particulates and consider alternatives including ceramic, electrostatic or other filter types, all of which carry significant capital cost premiums and have higher ongoing costs.

National developments should be monitored, and included in any bioenergy cluster periodic review process to manage the risk.

### Torrefied Biomass waste components compared to coal

	Coal	Torrefied Pellets
Heating Value	25 GJ/T	23 GJ/T
Ash	10%	3%
Sulphur	3%	0.1%
Nitrogen	1.5%	0.2%
Chlorine	0.05%	0.01%

<sup>60</sup> Indicative values: can change depending upon the biomass and coal type

### Potential Local Bylaws

Rotorua implemented a bylaw in 2010 that goes beyond national standards in response to a local need. The circumstances and drivers could apply in Southland and create a mandate for local council to act, ahead of national measures if needed.<sup>61</sup>

<sup>59</sup> (Sustainable Business in Southland: Primary Research Results, 2011)

<sup>60</sup> (P. Basu, 2010)

<sup>61</sup> (Ministry For the Environment, 2010)

### **Regarding Air Quality:**

- **The major benefit to air quality for woody biomass over coal is NOX and SO2 emissions, and it is in these areas that changes to emissions standards in Southland would have greatest benefit to woody biomass.**
- **Policy mandating reductions in particulates are also desirable due to woody biomass's competitive advantage against coal (1/3 to 1/5 the ash content).**
  - **The cost implications of the higher installation costs due to extra filtration should be accounted for in all installations.**
  - **Funds that would otherwise go towards health care for those affected later in life should be diverted to pay for the marginal cost increase.**
  - **An advocacy approach nationally, with other bioenergy hubs and through BANZ, is thought to offer most potential regarding this end use cost reduction strategy.**
  - **We would recommend that Environment Southland improve their standards in line with national best practice. This implies the following:**
    - **Recognising the findings in the upcoming EECA report on PM10 emissions from woody biomass.**
    - **Researching and adopting best practice including the by-laws to phase out open fires and non-compliant burners as adopted in Rotorua. Also, ensure minimum standards for the wood that is supplied, e.g. the Nelson 'Good Wood' scheme. We encourage working with local suppliers to achieve these goals, perhaps with a labelling scheme in line with national standards.**
    - **Ensure Industrial limits specified in the air quality plan are tightened in line with best practice. Otago has a good example and this will assist in a level playing field for local suppliers / consultants / end users.**
- **Any standard introduced in response to national standards, should consider upcoming revisions to standards to include PM2.5 emissions and required mitigation measures. Approved plant for installations of any kind must have facility for retrofit of suitable additional filtration.**
- **The health and wellbeing aspects of fewer particulate emissions from wood energy should be included in promotional material.**



## Carbon Emissions

It is the case, as stated in Forest Biomass and Air Emissions<sup>62</sup> that:

*Emissions of carbon dioxide (CO<sub>2</sub>) and other greenhouse gasses from combustion of forest biomass to produce energy are considered "carbon neutral." This is because these emissions contribute to the already cycling stock of carbon that is being exchanged between the biosphere and the atmosphere as part of the earth's carbon cycle. As CO<sub>2</sub> emissions from the combustion of forest biomass for energy production (or from slash burns, forest fires, tree respiration, and forest biomass decomposition) enter the atmosphere, CO<sub>2</sub> is simultaneously being reabsorbed by growing forests. Carbon neutrality, in this context, is dependent on maintaining the overall stock of forests.*

*There can also be a short-term climate benefit from controlled forest biomass combustion compared to in-forest slash burning or uncontrolled wildfires (the likely alternative fate of forest biomass). In contrast to controlled combustion, open burning produces more methane (CH<sub>4</sub>), a greenhouse gas that's 25 times more potent than CO<sub>2</sub>. (Also see differences in air pollutant emissions, below.)*

*Finally, biomass is often produced when over-crowded forests are thinned in order to improve the productivity and fire resiliency of forests. In so doing, the forests are better able to absorb and store more carbon over time.*

It should be noted that there are concerns about using forest planting as an offset for fossil fuel carbon emissions, as the carbon from the planted forests will have a far shorter 'capture' period, and the net atmospheric CO<sub>2</sub> in the longer term will still go up.

In the table below<sup>63</sup>, the colours used make it easier on a line by line basis to distinguish relative magnitudes of the values, as the scientific notation necessary makes it hard to see 'at a glance':

---

<sup>62</sup> (Washington State Department of Natural Resources, 2010)

<sup>63</sup> (Washington State Department of Natural Resources, 2010)

POLLUTANT	WOOD Controlled Combustion kg/GJ	COAL Controlled Combustion kg/GJ	NATURAL GAS CCGT kg/GJ	WOOD Slash / Burn kg/GJ
<b>Uncontrolled emissions in the absence of pollution control</b>				
NOX	9.46E-08	2.19E-07	1.60E-08	1.29E-07
CO	2.58E-07	1.07E-08	3.22E-09	5.33E-06
SO2	1.07E-08	3.83E-07	1.20E-09	
VOC	7.31E-09	1.29E-09	1.85E-09	3.44E-07
PM	2.45E-07	1.98E-07	3.57E-09	5.59E-07
CO2	8.90E-05	9.20E-05	5.03E-05	8.90E-05
<b>Controlled emissions in the presence of pollution control</b>				
NOX	4.30E-08	9.67E-08	3.53E-09	1.29E-07
CO	1.50E-07	1.07E-08	2.15E-09	5.33E-06
SO2	1.07E-08	4.82E-08	1.20E-09	
VOC	2.24E-09	0.00E+00	6.02E-10	3.44E-07
PM	6.45E-09	4.49E-09	3.57E-09	5.59E-07
<b>GHG emissions</b>				
(CO2e)*	1.91E-06	9.24E-05	5.06E-05	1.91E-06
CO2	8.90E-05	9.20E-05	5.03E-05	8.90E-05
CH4	8.60E-09	9.46E-10	3.61E-09	8.60E-09
N2O	5.59E-09	6.45E-10	8.60E-10	5.59E-09

\*CO2 is one of three gases used to calculate CO2e, carbon dioxide equivalent, the primary unit of measure for greenhouse gases. In calculating carbon dioxide equivalent, the annual emissions of a chemical are multiplied by its respective global warming potential to determine the equivalent quantity of CO2 that they represent. The global warming potential for carbon dioxide is 1, methane is 21 and nitrous oxides is 310. The CO2e calculation for wood discounts CO2 as explained above.

#### **Regarding Carbon Emissions:**

- **Reducing carbon emissions is the right thing to do, as identified nationally and internationally in policy designed to manage and guarantee the reduction.**
- **The performance advantage in CO2e emissions through the designation of woody biomass as carbon neutral means organisations employing woody biomass as a fuel source future can limit their ETS liabilities and therefore risk. This is a compelling argument for organisations concerned with their ETS liabilities.**

## Strategic Quality Control

### Supply Side Quality Control

It has been identified that quality of supply is an issue <sup>64</sup>as in the situation of a high profile public failure, the perception of the woody biomass option would become problematic. Quality control of the supply, installation and commissioning process is emphasised, and quality of ongoing fuel supply is an issue meriting close attention. Standards are actively under development nationwide in this regard, drawing on best practice from overseas. An example of these standards include the BANZ Wood Fuel Classification Guidelines<sup>65</sup> standard under development. This includes the following example tables summarising the classifications for a particular product:

**Table 2 – Specification of properties for wood chips**

Size <sup>3</sup>		S30	S50	S100
Coarse Fraction ≥ 20% of total by weight	Cross sectional area max, (cm <sup>2</sup> )	3	5	10
	Length max (cm) (Max of 1% of the total mass)	8.5	12	25
	Nominal mesh size – coarse screen (mm)	16	31.5	63
Main Fraction ≥ 60-100% by weight	Nominal mesh size – medium screen (mm)	2.8	5.6	11.2
Fine Fraction ≤ 5% by weight	Nominal mesh size – fine screen (mm)	1	1	1
<b>Moisture % by weight (moist basis)</b>				
M20	≤ 20%			
M30	≤ 30%			
M35	≤ 35%			
M40	≤ 40%			
M55	≤ 55%			
M65	≤ 65%			
<b>Ash % by weight (dry basis)</b>				
A.5	≤ .5%			
A1	≤ 1%			
A3	≤ 3%			
A6	≤ 6%			
A6+	> 6% - Actual Value Stated			
<b>Bulk Density</b>				
Kg/m <sup>3</sup>	Actual value stated			
<b>Energy Density</b>				
MJ/Kg	Actual Value Stated – If sold by weight			

Wood chip S30 M35 A1 BD200 ED25

This would be a 30mm sized chip (S30), with a moisture content of 35% (M35), ash content of 1% (A1), bulk density of 200kg/m<sup>3</sup>, (BD200) and an energy density of 25MJ/kg (ED25).

<sup>64</sup> (Forest Environments Limited, 2009)

<sup>65</sup> (BANZ, 2010)

**Table 3 – Specification of properties for Hog fuel**

Dimensions <sup>5</sup>			
	Main Fraction > 80% of weight	Fine fraction < 5% of weight	Coarse fraction – max length of particle < 1% of weight
S63	3.15mm ≤ P ≤ 63mm	< 1mm	< 100mm
S100	3.15mm ≤ P ≤ 100mm	< 1mm	< 200mm
S300	3.15mm ≤ P ≤ 300mm	< 1mm	< 400mm
Moisture % by weight (moist basis)			
M20	≤ 20%		
M35	≤ 35%		
M55	≤ 55%		
M65	≤ 65%		
Ash % by weight (dry basis)			
A.5	≤ .5%		
A1	≤ 1%		
A3	≤ 3%		
A6	≤ 6%		
A6+	> 6% - Actual Value Stated		
Bulk Density			
Kg/m <sup>3</sup>	Actual Value Stated		
Energy Density			
MJ/Kg	Actual Value Stated – If sold by weight		

These standards should be adopted wherever they exist and a practical process of continuous improvement should be explicit in the adoption of such standards, with revised versions being adopted frequently, but not so frequently as to cause industry excessive compliance problems.

#### **Regarding Supply Side Quality Control:**

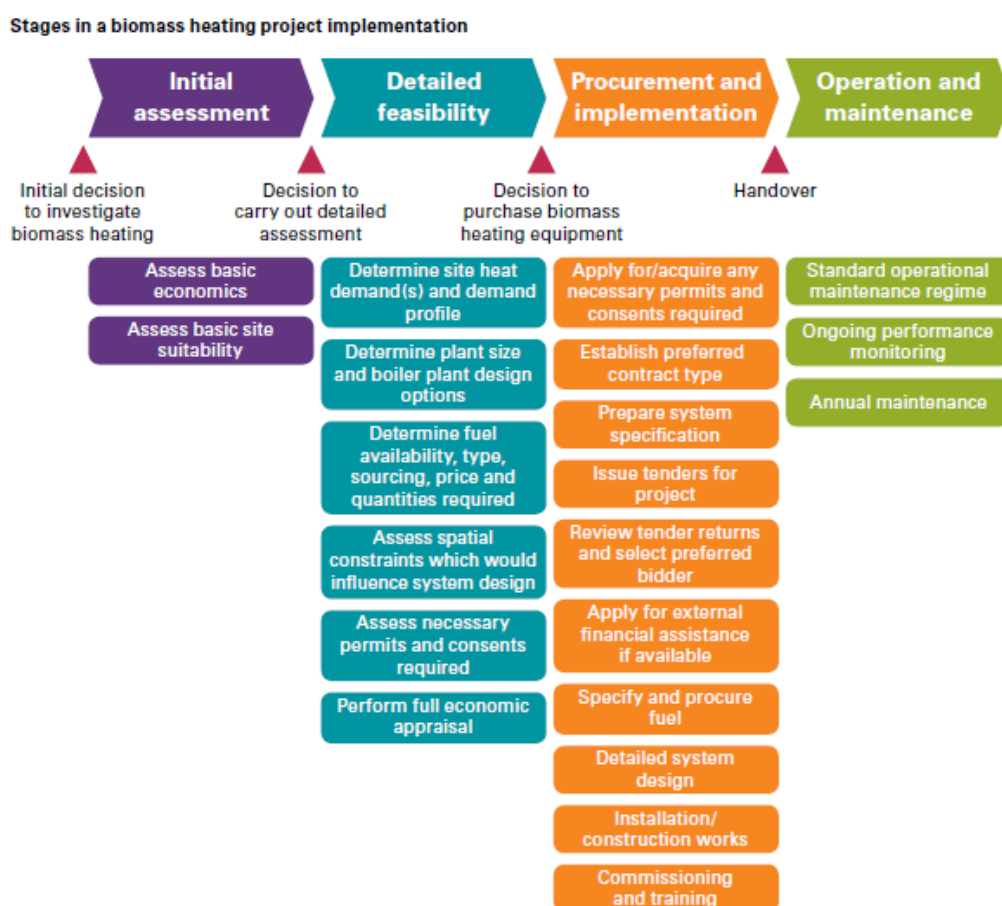
- **Adopt standards and work with national bodies to develop these.**
- **Feed project learning experiences back into the national efforts through case studies and participation in working groups, etc.**
- **The public experience and common view of woody biomass as a fuel source is critical. Woodchip has some great exponents in Southland, and a publicity campaign building on existing case study material should be part of any market entry strategy targeting smaller end users.**
  - **For the larger organisations, direct approach and negotiation to define quality required should be undertaken to define processing equipment required in the supply chain.**
- **Ensure that feedback loops are enacted in the setup of processes so that best practice is fed back into the development cycle.**

## Demand Side Quality Control

It is a significant risk to the development of a biomass supply chain that sufficient biomass conversion projects are not enacted. The issues perceived by potential end-user(s) are many and misinformation from competing industry can be expected.

In order to give the demand side the best chance of succeeding, the need to act to provide simple and consistent guidance is paramount. Currently, at the national level, there are many competing information portals which all have partial information. It would be a good idea for government and commercial interests to work together to amalgamate the information available into a single source, and to perform some end user testing and gap analysis to try to provide a 'one stop' shop for vetted guidance.

The flow chart below gives a useful overview of the different stages in a biomass heat plant life cycle. It would provide a good starting point for the gap analysis.



66

<sup>66</sup> (Carbon Trust, 2009)

In the biomass implementation process defined in the diagram above, it can be seen that many of the design steps required are the same as for any heating plant installation under consideration. For each stage, there exist a multitude of options and there is no definitive right way of doing things. Having said that, national and international best practice and standards exist, along with certain calculation methodologies that can be recommended:

- BANZ have published a series of technical guides on parts of the process – for example tendering. These are currently under review pending inclusion in the EECA Wood Energy Knowledge Centre. Alternatives exist internationally, such as the Carbon Trust Guide CTG012 Biomass Heating – A practical guide for potential users. This is a comprehensive document that covers many aspects of the process. It could be used as a reference directly, or form the basis for a region specific planning and implementation tool.
- EECA have guidelines and case studies, but little 'actionable' information. Advocate for more step by step guides to be generated that give practical process and links to templates, etc. See recommendations later in the report.
- In the initial assessment phase, basic economic assessment should not be a simple payback. Given current fuel price inflation which is predicted on an upward trend, an appropriate method to calculate return on investment for potential systems would include future predicted energy prices. The Life Cycle Cost, Internal Rate of Return or other appropriate measure should be utilised. Natural Resources Canada produce the well regarded RETScreen system that is a very powerful early stage assessment tool that would be suitable for use within the regional hub and on larger scale projects. It allows multiple financial analysis options to be utilised as well as having good data to make early stage technical appraisals.
- The use of a particular level of expertise and peer review for installations of the size (>100kW) this report and survey has focussed on could be mandated through consent conditions. The use of the documentation on the ACENZ website with regard to engaging consulting engineers should be utilised, and their standard forms of contract used.

When considering biomass heating, fundamental constraints of this type of system are to be considered, in particular when making a comparison with alternatives. Examples include:

- The relatively slow modulation of most solid fuel plant, and efficient operation via use of appropriately sized buffer vessels.
- Deliver frequency vs store size analysis.

**Regarding Quality Control:**

- **Create a single information portal or resource for end-user(s) to come to for the information and guidance that they need to make positive decisions towards woody biomass heat energy. Amalgamate, develop and extend information from the disparate sources currently in existence.**
- **Undertake a thorough review of process around scoping and installation of large heat energy projects across the region. Leverage international standards and best practice to guide local policy and commit sufficient resources to enforcing of compliance.**
- **Provide standardised tender documentation and process that allows good decisions to be made. In particular, the appraisal of tender prices should be on a life cycle basis, rather than least cost.**

## Driving demand

From our research, in order for local businesses to take up biomass energy from wood residues in Southland, the primary consideration in their current thinking is security of supply and maintenance requirements.

A big part of this can be addressed through strategic consideration when setting up the regional bio-energy hub that is envisaged as a successful outcome of this demand assessment and any future consideration of supply. The following headlines and discussion attempt to give a broad brush appraisal of the areas for consideration and some insight into the potential pitfalls that await the unwary:

## Carbon Pricing via the ETS - risks

The New Zealand Emissions Trading Scheme (NZETS) is a form of carbon trading. Carbon trading has its origins in economic theories, first formulated in the 1960s, that seek to attach a production cost to pollution. The theory held that if pollution had a price, market forces would eventually deter businesses from polluting the environment because it would become less cost effective for them to do so<sup>67</sup>. The system has been adopted globally, with many countries introducing carbon trading mechanisms. It is clear from the evidence internationally that the markets are struggling to price carbon, leading to significant volatility and price risk once the cap is removed.

Most Southland organisations pay ETS costs indirectly through their energy sources. If the energy sources are fossil fuel derived, they are more susceptible to price fluctuations as the price of carbon credits fluctuate – and it is reasonable to expect the fluctuations will only result in higher energy costs. While foresters also pay the cost of carbon credits during harvest, they are somewhat buffered from the effects of rising carbon costs, because they are also receiving income from carbon credits. Therefore, it could be assumed that energy from renewable forms of biomass, such as wood will have more stable pricing in the future, compared to fossil fuels.

Regarding the potential impact of the ETS, the following responses came from the potential users who responded to the survey:

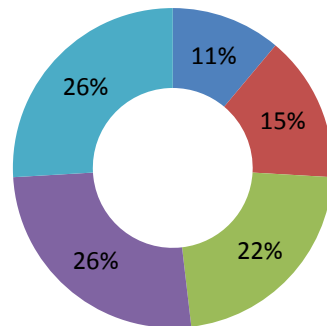
---

<sup>67</sup> (Jutta Kill, 2010)



## Potential Impact Of ETS On Fuel Source Decisions

■ Low 1 ■ 2 ■ 3 ■ 4 ■ High 5



It can be seen from this that it is generally thought that the ETS will have an impact on their fuel sourcing decisions, with nearly 75% indicating that this was of medium to high importance. It is assumed that most of those surveyed had experienced energy price increases when the ETS charges for the energy sector were introduced, therefore the impact of the ETS on their decisions with energy sources will largely be cost related. There were no specific queries with regard to the ETS in the survey responses, indicating either a good level of understanding of the scheme or a worrying level of ignorance.

### Regional Policy aimed towards improved resource efficiency

In line with the idea of market mechanisms to stimulate uptake of woody biomass as a fuel source, there exists the potential to extend activities around a more all-encompassing view of sustainability. It is desirable to do this, as the pressing issues identified in the "Global Strategic Backdrop" section of this report mean that strong positive action is required.

Setting a strategic policy goal for businesses working towards carbon neutral status could provide the strategic direction that local business needs to begin the process. This has the added benefit, if done right, of giving a competitive advantage to businesses who can demonstrate they're already well underway in this respect. There are many examples of voluntary standards, with the 'Carbon Trust Standard' as an example. It uses a continuous reduction in carbon emissions as an improvement measure and is a growing success amongst larger business. The key for Southland would be to adopt a standard that has a proven track record and is concisely articulated and appropriate to the mix of business that exists in the region. Another tool for encouraging improved resource efficiency in business would

be the adoption of sustainable procurement policy in business, and local government could take the lead in this.

### **Energy auditing in the region**

Local energy audits to include consideration of wood as an energy source. This can be achieved through a common set of deliverables, in line with the national standard AS/NZS 3598:2000, that allow the people commissioning audits to ask for this explicitly. A standard RFP clause should be drafted and made freely available online.

Furthermore, mandatory design audits through a framework with defined costs and timeframes for new developments would ensure that the potential for all energy efficiency measures is being investigated.

#### **Regarding Regulation and Policy Changes and Incentives:**

- **The performance advantage in CO<sub>2</sub>e emissions means future ETS liabilities are limited for organisations employing woody biomass as a fuel source. The ETS should not be relied on solely as a mechanism to incentivise zero and low carbon fuel sources, as the carbon trading concept has yet to prove itself internationally, or in the New Zealand market.**
- **Regional and Local policies and regulations can lead to an improvement in carbon emissions. Whilst this needs to be done sensitively to allow businesses struggling with adverse economic conditions, at least the low hanging fruit regarding fuel agnostic plant types when replacing as part of 'business as usual' activities can be made cost effective through legislative pressure.**
- **Encourage the adoption of sustainable procurement policies to ensure good decisions are made on the life cycle costs and to 'triple bottom line' type accounting principles. The sustainable Southland website has some information as a starting point.**
- **Energy and Design Audits carried out in Southland should have biomass for heat energy as a particular consideration to be assessed.**

## Independent Advice

A desirable approach from the perspective of an end user is that information is readily accessible and presented in layman's terms, as well as being vendor neutral. Information made available on the internet should be easily converted to pdf and printed hard copy, as this is still the dominant way people consume information of this type. Furthermore, being associated with an independent authority, such as EECA and / or Venture Southland adds a level of neutrality.

Building on the work started in the sustainable energy section of the Sustainable Southland website ([www.sustainablesouthland.co.nz](http://www.sustainablesouthland.co.nz)) is the preferred mechanism at this point, although this site needs development from a content and interaction perspective to allow effective communication on this topic.

Technical content for lay-people is a troublesome area, and there needs to be significant effort into development of simple, multi-media (print, voice, visual, face to face) communications that have as their outcome actionable information.

Actionable information is defined here as information that *enables* action. The definition comes from the 'Getting Things Done' system of task management, where it is suggested<sup>68</sup> that the correct question is: "Is it actionable?", i.e. does it require you to perform an action?

- If it is actionable, then you have to decide, "What is the next physical action?"
  - if there is more than one action required, turn it into a Project and have a checklist of steps.
  - if the action requires less than two minutes, it is not worth the effort of entering it into the system: better perform it immediately.
  - if you are not the best person to do it, delegate the action to a more qualified person/organization, and keep track of whether you get back the desired result by entering a note in a 'Waiting For' file.
  - if the action is to be done on a particular day and time, defer it to this moment, and note it on your Calendar.
  - if the only time constraint is that you should do it as soon as you can, put it in your 'Next Actions' file (aka 'Today's ToDo List').

Tools are available to make many of the actions described above 'one click'.

It is not proposed to undertake creation of information resources from scratch as many resources already exist internationally. These can be offered directly or developed to be specifically applicable to the Southland market.

---

<sup>68</sup> (Francis Heylighen, 2007)

The information presented should have a 'social' component to the interaction. In recent times, forums have been a popular way to provide this information, however the disconnection between the technical content and the information / discussion means this is a disjointed experience which impedes the ability to form knowledge from the available information. Use of a wiki type platform with flexible editorial permission controls offers much promise in this regard, as by displaying technical content alongside the conversation, and other multi-media content, the usefulness of both is significantly enhanced.

#### **Regarding raising awareness of thermal energy from woody biomass**

- **Make information accessible, easy to understand and engaging. People learn through different media types and an approach that provides reading material, podcasts, video content and face to face interaction opportunities should be pursued.**
- **Consider the use of an interactive platform to run the technical information site, that gives users the ability to self-service via interaction with content (comments, etc) and dialog with other users (discussion threads, etc).**
- **Engage an organisation to develop technical information to be prominently displayed on the Sustainable Southland website. Utilise linking to the already available resources on the Banz, EECA, etc websites, and supplement to provide region specific, actionable info.**
  - **This could be displayed on the Sustainable Southland website.**
  - **Alternatively this could be an addition to the EECA Wood Energy Knowledge Centre, or another portal (noting the recommendation elsewhere in this report to consolidate sources of information nationally to reduce consumer confusion).**
- **Conduct a media campaign that offers all interested parties something – the technical information portal that has been recommended is the suggested place to point people, and this should have a 'who are you?' specific navigation page to guide people to the content they need.**
- **A regular meeting should be put in place (online or in person) with a private element (for the hub to coordinate) and a public element (to have a personal dialog with end users, and other interested parties).**

## An innovative alternative approach for Southland

The research carried out as part of this work has established that:

1. Compacted Torrefied biomass has comparable physical properties to coal.
2. A centralised biomass torrefication plant as part of a regional supply hub would allow the producers with suitable woody biomass residues to convert these to Torrefied biomass. However EROI should be considered because transport distances may be great. The options for management and allocation of capacity of this plant would need investigation.
3. A source of low oxygen gas for the torrefaction plant would be required. Capture and refining of waste gases from a large industrial facility such as one of the Dairy Dryers (Flue Gases) or NZAS (CO<sub>2</sub> from the potlines) perhaps offers the potential for this to be done economically within the region. Even better if the hot gases from these processes can be utilised directly for pre-heat of the biomass, as to cool down the gas then re-heat is sub-optimal. As large end-user(s), they are an attractive target for co-development of the Torrefied waste, particularly if one of them uses pulverised coal (to which pulverised Torrefied biomass can be added directly at up to 40% concentration for co-firing<sup>69</sup>).
4. Identification of a source of medium to high grade waste heat which could be utilised to power or at least pre-heat the torrefaction plant would have a significant impact on the economics of this approach.
5. If the forestry wood residue locations did not map well to the potential static centralised processing plant locations, consideration should be given to smaller distributed plant or even a mobile processor of some description.

**Torrefaction offers promise with regard to cost effective delivery of woody biomass to end-user(s). However there are a number of hurdles that will have to be overcome first. Having said that, given the international research in this area, solutions are being developed as wood energy starts to become economic. There is a choice as to whether New Zealand chooses to rely on others to develop the plant or to lead development and potentially export the machines.**

- **As a new technology, there exists the potential to develop a product for export markets, and government funding for up to 50% of the 'to market' development costs can be accessed through the Ministry for Science and Innovation.**

---

<sup>69</sup> (Peter Hall, 2011)

## **12. Next Steps**

The next step in the process towards establishing a co-ordinated supply chain is to establish a Memorandum of Understanding between interested parties and agree a strategy for the next phase. This should state that:

- A future consideration of supply should be undertaken, along with more detailed exploration of the potential end-user(s) identified in this survey (that have agreed to be approached) and a business case should be built.
- The correct legal structure for a regional bio-energy cluster should be considered.

## Bibliography of Sources

### Works Cited

- Anex, M. D. (2010, Oct). *Techno-Economic Analysis of Cellulosic Biomass Upgrading Through Torrefaction*. Retrieved May 2011, from Biobased Industry Center - Iowa State University:  
[http://biobasedindustrycenter.iastate.edu/files/2010/10/Darr\\_Torrefaction\\_BIC\\_FinalReport1.pdf](http://biobasedindustrycenter.iastate.edu/files/2010/10/Darr_Torrefaction_BIC_FinalReport1.pdf)
- BANZ. (2010, Sep). *Home Page*. Retrieved Apr 2011, from BioEnergy Association of New Zealand: <http://www.bioenergy.org.nz/#NZBioenergyStrategy>
- BANZ. (2010, Jul). *Wood Fuel Classification Guidelines*. Retrieved May 2011, from BANZ: [BANZ banz-wood-fuel-classification-guidelines-july-2010.pdf](#)
- Bergman, B. Z. (2005, Jul). *Torrefactions for biomass co-firing in existing coal fired power stations*. Retrieved May 2011, from ECN Biomass.
- Birol, D. F. (2011, April 28). Chief Economist - IEA. *Oil Crunch*. (D. J. Newby, Interviewer) ABC.
- Bishop, R. C. (1997). *Downloads*. Retrieved Apr 2011, from  
<http://www.energysolutions.co.nz/>:  
<http://www.energysolutions.co.nz/pdf/paybackproblem.pdf>
- Carbon Trust. (2009, Jan). *CTG012 Biomass heating a practical guide for potential users.pdf*. Retrieved Apr 2011, from [www.carbontrust.co.uk](http://www.carbontrust.co.uk).
- CIBSE. (2009). *Ownership, Operation and Maintenance of building services guide - Indicative life expectancy for building services plant, equipment and systems*. Retrieved May 2011, from Chartered Institute of Building Services Engineers:  
<http://www.cibse.org/pdfs/newOOMtable1.pdf>
- Clean Energy Centre. (2009). *Greater Wellington Regional Council - Forest Residue Utilisation Trial*. Retrieved May 2011, from Clean Energy Centre:  
<http://www.nzcleanenergycentre.co.nz/>
- Covec. (2009, Jul). *Coal Prices in New Zealand Markets*. Retrieved May 2011, from Covec.
- Cox, B. (2008). *Where May Gasification Fit in the NZ Bioenergy Market*. Presentation to Workshop: Biomass Gasification Technology and Biomass Energy 13 Feb 2008: BioEnergy Association of New Zealand BANZ.
- David Suzuki Foundation. (2006). *International Comparison of Ambient Air Quality Standards and Guidelines, as compared with recommendations of the World Health Organization (WHO)*. Retrieved May 2011, from David Suzuki

Foundation: <http://www.davidsuzuki.org/publications/downloads/2006/DSF-HEHC-Air-summ-web1.pdf>

DEFRA. (2011). *What assessment should be made to identify the impacts on air quality of biomass boilers?* Retrieved May 2011, from Local Air Quality Management (LAQM) Support : [http://laqm.defra.gov.uk/documents/What\\_assessment\\_should\\_be\\_made\\_to\\_identify\\_the\\_impacts\\_on\\_air\\_quality\\_of\\_biomass\\_boilers.pdf](http://laqm.defra.gov.uk/documents/What_assessment_should_be_made_to_identify_the_impacts_on_air_quality_of_biomass_boilers.pdf)

East Harbour Energy. (2007). *Assessment-of-possible-renewable-energy-targets-woody-biomass-07.pdf*. Retrieved April 2011, from Renewable Energy >> East Harbour: <http://www.eastharbour.co.nz/renewable-energy/>

East Harbour Management Services. (2002, Nov). *Wood Processing Strategy - Future Energy Supply and Demand*. Retrieved May 2011, from East Harbour.

EECA Business. (n.d.). <http://www.eecabusiness.govt.nz/renewable-energy/wood-energy-knowledge-centre/using-wood-energy/wood-energy-options-for-schools-commerical-buildings>. Retrieved May 2011, from EECA Business: <http://www.eecabusiness.govt.nz/renewable-energy/wood-energy-knowledge-centre/using-wood-energy/wood-energy-options-for-schools-commerical-buildings>

EECA. (2011). *Crown Loans*. Retrieved May 2011, from EECA Business: <http://www.eecabusiness.govt.nz/services-and-funding/crown-loans>

EECA. (2010, Jul). *Draft NZEECS*. Retrieved Jan 2011, from Energy Efficiency and Conservation Authority New Zealand: <http://www.eeca.govt.nz/sites/all/files/nzes-nzeecs-draft-july-2010.pdf>

EECA. (2008, Mar 1). *Heat plant database*. Retrieved Apr 2011, from <http://www.eeca.govt.nz/node/11066>: <http://www.eeca.govt.nz/sites/all/files/heat-plant-database-march-2008.pdf>

Energy Information Administration. (2010, May). *International Energy Outlook 2010 - Highlights*. Retrieved May 2011, from <http://www.eia.gov/oiaf/ieo/highlights.html>

Environment Southland. (2005, Jun). *Air Quality Plan*. Retrieved May 2011, from Environment Southland : <http://www.es.govt.nz/plans/air/air-quality-plan.aspx>

Environment Southland. (2005). *Southland Civil Defence Emergency Management Group Plan - Appendix 1 - Overview of the Southland Region*. Retrieved May 2011, from Civil Defence NZ: <http://www.civildefence.co.nz/plans/chapters/Appendix%201%20-%20Overview%20of%20the%20Southland%20Region.pdf>



- Forest Environments Limited. (2009, Jul). *Wood Energy Supply Options for City Forests Limited*. Retrieved May 2011, from EECA Business: <http://www.eecabusiness.govt.nz/renewable-energy/wood-energy-knowledge-centre/producing-wood-for-energy/revenue-from-residue/regional-supply#all>
- Gingerich, J., & Hendrickson, O. (1993). The theory of energy return on investment: a case study of whole tree chipping for biomass in Prince Edward Island. *Forestry Chronicle* , 300-306.
- Greenspan, A. (2008, 10). *Testimony of Dr. Alan Greenspan to the Committee of Government Oversight and Reform*. Retrieved May 2011, from Committee on Oversight and Governmental Reform: <http://oversight-archive.waxman.house.gov/documents/20081023100438.pdf>
- Hagens, N. J. (2010, Oct). *TOWARDS AN APPLIED NET ENERGY FRAMEWORK*. Retrieved May 2011
- International Energy Agency. (2011, Apr). *The age of cheap energy is over, IEA Executive Director warns* . Retrieved May 2011, from International Energy Agency: [http://www.iea.org/index\\_info.asp?id=1928](http://www.iea.org/index_info.asp?id=1928)
- John Gifford, F. R. (2006?). *Bioenergy Reference Project 6 - Wood Processing Residues as Fuel*. Retrieved May 2011, from BioEnergy Association of NZ: [www.bioenergy.co.nz](http://www.bioenergy.co.nz)
- Jutta Kill, S. O. (2010, Aug). *Trading Carbon - How it works and why it is controversial*. Retrieved May 2011, from The Corner House: [http://www.thecornerhouse.org.uk/sites/thecornerhouse.org.uk/files/FERN\\_designedtofail\\_internet.pdf](http://www.thecornerhouse.org.uk/sites/thecornerhouse.org.uk/files/FERN_designedtofail_internet.pdf)
- Konrad, T. (n.d.). *EIRR spreadsheet analysis*. Retrieved May 2011, from Clean Energy Wonk: <http://tomkonrad.com/blog/EIRR.xls>
- Konrad, T. (2009, Dec). *Managing the Peak Fossil Fuel Transition: EROI and EIRR*. Retrieved May 2011, from Energy Bulletin: <http://www.energybulletin.net/node/51060>
- Lahn, A. F. (2010, Jun). *Chatham House - Lloyd's 360° Risk Insight Sustainable energy security: strategic risks and opportunities for business* . Retrieved Apr 2011, from Chatham House: [http://www.chathamhouse.org.uk/publications/papers/download/-/id/891/file/16720\\_0610\\_froggatt\\_lahn.pdf](http://www.chathamhouse.org.uk/publications/papers/download/-/id/891/file/16720_0610_froggatt_lahn.pdf)
- Ministry For the Environment. (2011, May). *National environmental standards: Authorised wood burners*. Retrieved May 2011, from Ministry for the Environment: <http://www.mfe.govt.nz/laws/standards/woodburners/index.html>

- Ministry For the Environment. (2010, Dec). *Regulatory Impact Statement - Amending the PM10 Air Quality Standards: Final Recommendations*. Retrieved May 2011, from MFE - Air Quality: <http://www.mfe.govt.nz/laws/standards/air-quality/review/ris-air-quality-standards.pdf>
- Ministry For the Environment. (2011, Apr). *Revised National Environmental Standards for Air Quality: Evaluation under Section 32 of the Resource Management Act* . Retrieved May 2011, from MFE - Air Quality: <http://www.mfe.govt.nz/publications/air/national-air-quality-standards-section32/index.html>
- Ministry For the Environment. (2010, Dec). *The NZ Emissions Trading Scheme* . Retrieved Apr 2011, from Ministry For the Environment: <http://www.climatechange.govt.nz/emissions-trading-scheme/about/>
- Ministry of Agriculture and Fisheries. (2010, Dec). *Forestry statistics*. Retrieved May 2011, from MAF: <http://www.maf.govt.nz/news-resources/statistics-forecasting/forestry.aspx>
- Ministry of Economic Development. (2010, June). *Draft New Zealand Energy Strategy 2010*. Retrieved Apr 2011, from Ministry of Economic Development: [http://www.med.govt.nz/templates/MultipageDocumentTOC\\_\\_\\_\\_44085.aspx](http://www.med.govt.nz/templates/MultipageDocumentTOC____44085.aspx)
- Ministry of Economic Development. (2011). *Energy Data*. Retrieved Apr 2011, from MED Home: [http://www.med.govt.nz/templates/ContentTopicSummary\\_\\_\\_\\_20511.aspx](http://www.med.govt.nz/templates/ContentTopicSummary____20511.aspx)
- MÖLLER, B. (2003 Dec). LEAST-COST ALLOCATION STRATEGIES FOR WOOD FUEL SUPPLY FOR DISTRIBUTED GENERATION IN DENMARK – A GEOGRAPHICAL STUDY. *International Journal of Sustainable Energy* , 187-197.
- New Zealand Government. (2011, Mar). *Issues statement for public consultation*. Retrieved May 2011, from Climate Change Information New Zealand: <http://www.climatechange.govt.nz/emissions-trading-scheme/ets-review-2011/statement-for-consultation.html>
- Owen, K. (2011). *Wood Energy Assessments Brief April 2011.pdf*. Invercargill: Venture Southland.
- Owen, K. (2010). *Wood Energy Forum - Meeting Minutes - Nov 2010.pdf*. Invercargill: Venture Southland.
- P. Basu, A. D. (2010, Feb). *Torrefaction – a new option for bioenergy conversion*. Retrieved May 2011
- Paul Mitchell, J. K.-R. (2007, May). *Torrefied Biomass - A Foresighting Study into the Business Case for Pellets from Torrefied Biomass as a New Solid Fuel* .

- Retrieved May 2011, from All Energy UK: <http://www.all-energy.co.uk/UserFiles/File/2007PaulMitchell.pdf>
- Peter Hall, B. H. (2008, Jun). *NEW ZEALAND BIOMASS RESOURCE ATLAS - VOLUME 1 - LIGNOCELLULOSIC RESIDUE*. Retrieved May 2011, from Scion.
- Peter Hall, G. E. (2011). *Torrefaction of woody biomass for improving solid fuel characteristics "Residues to Revenues 2011 Paper v8.pdf"*. Rotorua: Scion.
- Scion . (2007, Nov). *Bioenergy Options Project - Bioenergy Options : Situation Analysis : Biomass Resources and Conversion Technologies*. Retrieved May 2011, from Scion Next Generation Biomaterials:  
[http://www.scionresearch.com/\\_\\_data/assets/pdf\\_file/0008/5786/SCIONBioenergyOptions\\_situationAnalysis.pdf](http://www.scionresearch.com/__data/assets/pdf_file/0008/5786/SCIONBioenergyOptions_situationAnalysis.pdf)
- Scion. (2007, Nov). *Bioenergy Options for New Zealand - A situation analysis of biomass resources and conversion technologies*. Retrieved May 2011, from Scion.
- Southern Wood Council. (2011, May). *Reports and Media Releases*. Retrieved May 2011, from Southern Wood Council:  
[http://www.southernwoodcouncil.co.nz/pdfs/Otago\\_Southland\\_Forestry\\_Facts\\_052010.pdf](http://www.southernwoodcouncil.co.nz/pdfs/Otago_Southland_Forestry_Facts_052010.pdf)
- Standards NZ. (1999/2007). Retrieved May 2011, from Standards NZ:  
[http://www.standards.co.nz/web-shop/?action=basicShopSearch&mod=search&SearchBox1\\_txtShopName=4014&selStatus=CURRENTANDDRAFT&catalog=NZ](http://www.standards.co.nz/web-shop/?action=basicShopSearch&mod=search&SearchBox1_txtShopName=4014&selStatus=CURRENTANDDRAFT&catalog=NZ)
- Tadeusz W. Patzek, G. D. (2010). A global coal production forecast with multi-Hubbert cycle analysis. *Energy* , 3109-3122.
- Virmond, E. F. (2008). Co-combustion of wood chips with the biomass obtained from the physico-chemical treatment of slaughterhouse wastewater for steam generation -- A case study. . *Proceedings of the International Conference on Waste Technology & Management* (pp. 1177-1188). Retrieved from EBSCOhost.
- Washington State Department of Natural Resources. (2010, Apr). *Forest Biomass and Air Emissions*. Retrieved May 2011, from Washington State Department of Natural Resources:  
[http://www.dnr.wa.gov/Publications/em\\_forest\\_biomass\\_and\\_air\\_emissions\\_factsheet\\_8.pdf](http://www.dnr.wa.gov/Publications/em_forest_biomass_and_air_emissions_factsheet_8.pdf)
- Wikipedia. (2011, May). *Torrefaction*. Retrieved May 2011, from Wikipedia:  
<http://en.wikipedia.org/wiki/Torrefaction>

## List of References For Additional Information

<http://www.mfe.govt.nz/laws/standards/woodburners/index.html>

Bioenergy Association of New Zealand. (2008, Mar). Heat Plant Database 2008. Retrieved 2011 May, from Heat Plant Database 2008: <http://www.eeca.govt.nz/sites/all/files/heat-plant-database-march-2008.pdf>

Boiler Directive UK/EU (No 3083), American Refrigeration Institute Standard 550/590-1998. (1993, 1998). Seasonal Efficiency Boilers. Retrieved May 2011, from Seasonal Efficiency Boilers: <http://www.cibse.org/pdfs/seasonalboilers.pdf>

Chandni Patel, P. L. (2010, February). Techno-Economic Performance Analysis Of Small to Medium Scale Biomass Combustion Plants for Energy Production. *Journal of Solid Waste Technology & Management* , 1(32)-10(33).

DI Matthias Heckmann, D. (. (2011). Determination of annual efficiency and emission factors of small-scale biomass boiler. Retrieved May 2011, from Determination of annual efficiency and emission factors of small-scale biomass boiler: [http://www.bioenergy2020.eu/files/publications/pdf/Schwarz\\_etal\\_-\\_Annual\\_Efficiency.pdf](http://www.bioenergy2020.eu/files/publications/pdf/Schwarz_etal_-_Annual_Efficiency.pdf)

Dr Vincent Gray, e. a. (1999). Chemistry in the Coal Industry. Retrieved May 2011, from Chemistry in the Coal Industry: <http://nzic.org.nz/ChemProcesses/energy/7E.pdf>

EECA. (2010, Jul). Draft NZEECS. Retrieved Jan 2011, from Energy Efficiency and Conservation Authority New Zealand: <http://www.eeca.govt.nz/sites/all/files/nzes-nzeecs-draft-july-2010.pdf>

EECA. (2010, May). Mcallum Group Builds for the Future With Wood Chips. Retrieved May 2011, from Mcallum Group Builds for the Future With Wood Chips: <http://www.eecabusiness.govt.nz/sites/all/files/mccallum-group-builds-future-with-wood-chips-may-10.pdf>

Estcourt, D. P. (2003). Short Rotation Crops. Retrieved May 2011, from <http://www.shortrotationcrops.org/PDFs/2003Mtg/17-GilesSupplyChain.pdf>

Jeremy Cockroft, (. E. (2009, July). The Heat Demand Profile. Retrieved May 2011, from

[http://www.sesg.strath.ac.uk/Presentations/Biomass\\_Demand\\_JCockroft\\_170310.pdf](http://www.sesg.strath.ac.uk/Presentations/Biomass_Demand_JCockroft_170310.pdf)

Ministry For The Environment et al. (2008, Apr). National Wood Burner Performance Review Phase 2. Retrieved May 2011, from National Wood Burner Performance Review Phase 2: <http://www.mfe.govt.nz/publications/air/national-wood-burner-review-phase2-apr08/national-wood-burner-review-phase2-apr08.pdf>

Ministry of Economic Development. (1997, Jul). New Zealand Coal Statistics to 1996. Retrieved May 2011, from New Zealand Coal Statistics to 1996: <http://www.med.govt.nz/upload/21472/edf797c.pdf>

NZ Institute of Economic Research Inc. . (2010, Jan). Tariffs in New Zealand. Retrieved May 2011, from Tariffs in New Zealand: [http://www.eastasiaforum.org/testing/eaber/sites/default/files/documents/NZIER\\_Ballingall\\_2010.pdf](http://www.eastasiaforum.org/testing/eaber/sites/default/files/documents/NZIER_Ballingall_2010.pdf)

Okkonen, L. (2008). From Exogenous to Endogenous Development in Scottish Forestry: The Feasibility of Small-Scale Wood Energy Enterprise. *Journal of Environmental Planning and Management* Vol. 51, No. 2 , 221–232.

P.C.A. Bergman, A. B. (2005, July). Torrefaction For Biomass Co-Firing In Existing Coal-Fired Power Stations. Retrieved May 2011, from Torrefaction For Biomass Co-Firing In Existing Coal-Fired Power Stations: <http://www.ecn.nl/docs/library/report/2005/c05013.pdf>

Paul Mitchell, J. K.-R. (2007, May). Torrefied Biomass - A Foresighting Study into the Business Case for Pellets from Torrefied Biomass as a New Solid Fuel . Retrieved May 2011, from All Energy UK: <http://www.all-energy.co.uk/UserFiles/File/2007PaulMitchell.pdf>

SCION. (2011, May). Torrefaction Leads To Energy-Dense Wood Fuels. Retrieved May 2011, from Torrefaction Leads To Energy-Dense Wood Fuels: [http://www.scionresearch.com/\\_\\_data/assets/pdf\\_file/0016/33352/torrefaction-05-11.pdf](http://www.scionresearch.com/__data/assets/pdf_file/0016/33352/torrefaction-05-11.pdf)

Southern Wood Council. (2009, June). Energy Source Heating Up. Retrieved May 2011, from Energy Source Heating Up: [http://www.southernwoodcouncil.co.nz/pdfs/SWC\\_Release-BIOENERGY-Dodson\\_09.pdf](http://www.southernwoodcouncil.co.nz/pdfs/SWC_Release-BIOENERGY-Dodson_09.pdf)

Southern Wood Council. (2009, June). Installation of More Wood Fuelled Burners In Southern NZ. Retrieved May 2011, from Installation of More Wood Fuelled Burners In Southern NZ: [http://www.southernwoodcouncil.co.nz/pdfs/SWC\\_Release-BIOENERGY-Mallinson\\_March09.pdf](http://www.southernwoodcouncil.co.nz/pdfs/SWC_Release-BIOENERGY-Mallinson_March09.pdf)

Taylor & Francis Ltd . (2003). Least-Cost Allocation Strategies For Wood Fuel Supply For Distributed Generation In Denmark - A Geographical Study. International Journal of Sustainable Energy Vol. 23, No. 4 , 187–197.

The Bioenergy Association of New Zealand et al. (2010, Sep). New Zealand Bioenergy Strategy. Retrieved May 2011, from New Zealand Bioenergy Strategy: <http://www.bioenergy.org.nz/NZBioenergyStrategy2010.pdf>

Venture Southland. (2008, Dec). Strategy For Sustainable Business in Southland. Retrieved May 2011, from Strategy For Sustainable Business in Southland: [www.southlandnz.com](http://www.southlandnz.com)

Wikipedia. (2011, May). Torrefaction. Retrieved May 2011, from Wikipedia: <http://en.wikipedia.org/wiki/Torrefaction>

## Appendix A – Funders

	<p>EECA Business enable businesses to increase their domestic and international competitiveness by adopting energy efficiency and renewable energy practices. We are part of the Energy Efficiency and Conservation Authority (EECA) and have a particular focus on businesses and government organisations.</p>
	<p>Wood Energy New Zealand (WENZ) is New Zealand's premium supplier of high quality wood chip fuel. WENZ supplies New Zealand industry with wood fuel for their building heating and industrial processes. Our wood chip fuel is natural, renewable and cost effective. With guaranteed security of a consistent and long term supply, it is an ideal choice for eco-conscious businesses and organisations.</p>
	<p>Energy for Industry Limited is New Zealand's leading industrial clean energy services provider delivering tailored solutions for onsite process heat and combined heat and power services. The company has achieved industry recognition and awards over the years for project innovation, energy efficiency, renewable solutions and its ability to partner with industries across a number of industry sectors in discovering their energy future.</p>
	<p>Venture Southland is a joint initiative of the Invercargill City Council, Southland District Council and Gore District Council. Venture Southland delivers Enterprise, Tourism, Promotion, Events and Community Development services to the region.</p>
	<p>Living Energy specialise in the supply of the full turn-key wood energy solution for commercial and industrial heat users. We manage the design and install of optimal fuel storage, and use well proven and robust boilers with a proven wood pedigree.</p>
	<p>Niagara Wood Fuels are a local supplier 5km from Invercargill who already supply the local market and have an unlimited stock of wood fuels. For all your enquiries contact David Blue 021 228 6050.</p>
	<p>Wholesalers of Quality Native woodchip and Sawdust sourced from local sustainably managed forests.</p>
	<p>Southwood Export Ltd is a Forest owner/Manager/Processor with a woodchip mill located at Awarua, 10km from Invercargill. It's operations are based on over 12,000 ha of mostly Eucalypt forests, with woodchips exported from Bluff port. While currently export focused it has the volumes available to supply competitive domestic energy markets.</p>

## Appendix B – Questionnaire

### Wood Energy Demand Assessment - Questionnaire

EIS Energy are carrying out an assessment on behalf of Venture Southland regarding the potential demand for wood pellets and chips as an alternate heat energy source in the Southland region. The following survey will take around 10-15 minutes to complete. There are not many 'compulsory' questions (marked with a \*). Please take the time to enter your contact information, even if you don't have very much else available, to allow us to follow up with you. Southland Businesses are already having success with wood energy. This case study from EECA highlights one such success:

<http://link.eisenergy.co.nz/Southland%20Wood%20Energy%20Success%20Story>

\* Required

Organisation Name

Organisation Type \*

- ☐ Industrial
- ☐ Pool
- ☐ Local Govt
- ☐ Accommodation
- ☐ Domestic
- ☐ Commercial
- ☐ Hospitality
- ☐ School
- ☐ Other:

Contact - First Name \*

Contact - Last Name \*

Job Title

Phone 1 \* Preferred contact number

Phone 2 If Available

Contact email If Available



Contact Postal Address - Street Number and Name e.g. 17 Eye Street, PO Box 5

Contact Postal Address - Town / City e.g. Invercargill

Contact Postal Address - Region e.g. Southland

Contact Postal Address - Postcode e.g. 9810

Preferred Method of Contact Please indicate 1 only

- ☐ Phone
- ☐ Email
- ☐ Post

Heat Plant Physical Address - Street Name and Number The actual location of the plant, NOT the organisation's postal address.

Heat Plant Physical Address - Town / City The actual location of the plant, NOT the organisation's postal address.

Heat Plant Physical Address - Region The actual location of the plant, NOT the organisation's postal address.

Heat Plant Physical Address - Postcode The actual location of the plant, NOT the organisation's postal address.

Heat Plan GPS co-ordinate In a new tab, navigate to your heat plant's location on <http://maps.google.co.nz>. Hover pointer over location, and right click. Select the "Whats Here?" option, and copy the numbers from the map address bar into this box e.g.: -49.4169, 168.349126

Boiler Make

Boiler Fuel Type \* NEEDS COMPLETING!

- ☐ Oil
- ☐ Gas
- ☐ Wood
- ☐ Coal
- ☐ Other:

Year Installed

Capacity (MW)

Output Type

Output (t/h)

Pressure bar

Boiler Annual Heat Output (GWh)

Annual Process Heat (GWh)

Cogen Elec Output (kWh)

Temp Heat (Deg C)

Boiler Fuel Type

Boiler Effy

Fuel use

Load Factor (Annual)

Energy Use (TJ)

Annual CO2e Emission tonne

Can we send this information to EECA (Energy Efficiency and Conservation Authority) to become part of a publicly available database? We will only send technical information on the boiler (from 'Boiler make' information box to 'Annual CO2e Emmision tonne')

- ☐ Yes
- ☐ No

Expected expiry of current boiler (year) if known

Date of expiry of current consent If known

Heating demand profile for your boiler

- ☐ Seasonal - Building Comfort Heating
- ☐ Process - 8 hours daily, 5 days
- ☐ Process - 16 hours daily, 5 days
- ☐ Process - 24 hours daily, 5 days
- ☐ Process - 8 hours daily, 7 days

- ☐ Process - 16 hours daily, 7 days
- ☐ Process - 24 hours daily, 7 days
- ☐ Other:

Your current fuel costs (per unit)

How would you rate your awareness of wood as an alternative fuel source?

	1	2	3	4	5	
Low	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High

Are you aware of the predicted oil price spikes in 2012? Have you considered the impact energy price volatility may have on your business?

- ☐ Yes
- ☐ I've thought about it, but don't know how to assess this.
- ☐ No

Are you aware of the cost of wood fuel sources as compared to other sources?

- ☐ Yes
- ☐ No

What's the most important factor when considering your fuel source?

Rate the importance of initial capital cost of a boiler on a decision on your fuel source: Over time, the cost of fuel outweighs your initial capital outlay. Paying more for a more efficient boiler can make financial sense in the future.

	1	2	3	4	5	
Low	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High

Rate the importance of security of supply on a decision on your fuel source: How available the resources for your boiler are:

	1	2	3	4	5	
Low	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High

Rate the importance of cost of alternative fuel sources on a decision regarding wood energy:

	1	2	3	4	5	
Low	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High

What impact do you think the ETS may have on your decisions on your fuel source? The New Zealand Emissions Trading Scheme (ETS) is a way of meeting our international obligations around climate change. The ETS puts a price on greenhouse gases to provide an incentive to reduce emissions and to encourage tree planting. More info: <http://www.climatechange.govt.nz/emissions-trading-scheme/>

	1	2	3	4	5	
Low	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High

Rate the importance of air quality emissions standards on a decision on your fuel source.

	1	2	3	4	5	
Low	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High

Rate the importance of any environmental certification goals on a decision on your fuel source.

	1	2	3	4	5	
Low	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High

Rate the importance of public perceptions towards clean energy on a decision on your fuel source.

	1	2	3	4	5	
Low	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High


Rate the importance of supporting local businesses on a decision on your fuel source.

	1	2	3	4	5	
Low	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High

Rate the importance of maintenance requirements on a decision on your fuel source.

	1	2	3	4	5	
Low	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High

What are your concerns about changing your source of energy to wood biomass?




Do you have in mind a potential location for storage of fuel? Wood Pellets and Chips are a bulky fuel and require significant storage space.

- ☐ Yes, there's plenty of space.
- ☐ Maybe, I'm not sure.
- ☐ No, it's not clear where we'd put it.

Is there any further information you would like Venture Southland to contact you with on this

topic?



Would you like your contact details to be passed on to wood fuel suppliers or advice providers? We can give your contact information to people who may be able to help. The wood energy hub being formed in Southland aims to ensure a high and consistent level of information is supplied to end users.

- ☐ Yes
- ☐ No

## Appendix C – Lloyds Sustainability Energy Security Report Exec Summary

The executive summary from the 360° Risk Insight report is repeated here in its entirety as a useful précis of the issues and importantly, proactive strategic responses that are possible and desirable (emphasis added):

### *1. BUSINESSES WHICH PREPARE FOR AND TAKE ADVANTAGE OF THE NEW ENERGY REALITY WILL PROSPER – FAILURE TO DO SO COULD BE CATASTROPHIC*

*Energy security and climate change concerns are unleashing a wave of policy initiatives and investments around the world that will fundamentally alter the way that we manage and use energy. Companies which are able to **plan for and take advantage of this new energy reality** will increase both their resilience and competitiveness. Failure to do so could lead to expensive and potentially catastrophic consequences.*

### *2. MARKET DYNAMICS AND ENVIRONMENTAL FACTORS MEAN BUSINESS CAN NO LONGER RELY ON LOW COST TRADITIONAL ENERGY SOURCES*

*Modern society has been built on the back of access to relatively cheap, combustible, carbon-based energy sources. Three factors render that model outdated: surging energy consumption in emerging economies, **multiple constraints on conventional fuel production** and international recognition that continuing to release carbon dioxide into the atmosphere will cause climate chaos.*

### *3. CHINA AND GROWING ASIAN ECONOMIES WILL PLAY AN INCREASINGLY IMPORTANT ROLE IN GLOBAL ENERGY SECURITY*

*China and emerging Asian economies ... importance in global energy security will grow. First, their economic development is the engine of demand growth for energy. Second, **their production of coal and strategic supplies of oil and gas will be increasingly powerful factors affecting the international market.** Third, their energy security policies are driving investment in clean energy technologies on an unprecedented scale. China in particular is also a source country for some of the critical components in these technologies. Fourth, as 'factories of the world', the energy situation in Asian countries will impact on supply chains around the world.*

### *4. WE ARE HEADING TOWARDS A GLOBAL OIL SUPPLY CRUNCH AND PRICE SPIKE*

***Energy markets will continue to be volatile as traditional mechanisms for balancing supply and price lose their power.** International oil prices are likely to rise in the short to mid-term due to the costs of producing additional barrels from difficult environments, such as deep offshore fields and tar sands. **An oil supply crunch in the medium term is likely** to be due to a combination of insufficient investment in upstream oil and efficiency over the last two decades and rebounding*

demand following the global recession. This would create a **price spike prompting drastic national measures to cut oil dependency.**

5. ENERGY INFRASTRUCTURE WILL BECOME INCREASINGLY VULNERABLE AS A RESULT OF CLIMATE CHANGE AND OPERATIONS IN HARSHER ENVIRONMENTS

Much of the world's energy **infrastructure lies in areas that will be increasingly subject to severe weather events caused by climate change.** On top of this, extraction is increasingly taking place in more severe environments such as the Arctic and ultra-deep water. For energy investors this means long-term planning based on a changing – rather than a stable climate. **For energy users, it means greater likelihood of loss of power for industry and fuel supply disruptions.**

6. LACK OF GLOBAL REGULATION ON CLIMATE CHANGE IS CREATING AN ENVIRONMENT OF UNCERTAINTY FOR BUSINESS, WHICH IS DAMAGING INVESTMENT PLANS

Without an international agreement on the way forward on climate change mitigation, **energy transitions will take place at different rates in different regions. Those who succeed in implementing the most efficient, low-carbon, cost-effective energy systems are likely to influence others and export their skills and technology.** However, the lack of binding policy commitments inhibits investor confidence. **Governments will play a crucial role in setting policy and incentives that will create the right investment conditions, and businesses can encourage and work with governments to do this.**

7. TO MANAGE INCREASING ENERGY COSTS AND CARBON EXPOSURE BUSINESSES MUST REDUCE FOSSIL FUEL CONSUMPTION

The introduction of carbon pricing and cap and trade schemes will make the unit costs of energy more expensive. The **most cost-effective mitigation strategy is to reduce fossil fuel energy consumption.** The carbon portfolio and exposure of companies and governments will also come under increasing scrutiny. **Higher emissions standards are anticipated across many sectors with the potential for widespread carbon labelling.** In many cases, an early capacity to calculate and reduce embedded carbon and life-cycle emissions in operations and products will increase competitiveness.

8. BUSINESS MUST ADDRESS ENERGY-RELATED RISKS TO SUPPLY CHAINS AND THE INCREASING VULNERABILITY OF 'JUST-IN-TIME' MODELS

**Businesses must address the impact of energy and carbon constraints holistically, and throughout their supply chains. Tight profit margins on food products, for example, will make some current sources unprofitable as the price of fuel rises and local suppliers become more competitive.** Retail industries will need to either re-evaluate the 'just-in-time' business model which assumes a ready supply of energy throughout the supply chain or increase the resilience of their logistics against supply disruptions and higher prices. Failure to do

*so will increase a business's vulnerability to reputational damage and potential profit losses resulting from the inability to deliver products and services in the event of an energy crisis.*

#### **9. INVESTMENT IN RENEWABLE ENERGY AND 'INTELLIGENT' INFRASTRUCTURE IS BOOMING. THIS REVOLUTION PRESENTS HUGE OPPORTUNITIES FOR NEW BUSINESS PARTNERSHIPS**

*The last few years have witnessed unprecedented investment in renewable energy and many countries are planning or piloting 'smart grids'. This revolution presents **huge opportunities for new partnerships between energy suppliers, manufacturers and users.** New risks will also have to be managed. These include the scarcity of several essential components of clean energy technologies, incompatible infrastructures and the vulnerability of a system that is increasingly dependent on IT.*