Scoping Report 2:

Investigation into alternative uses for end of life tyres in New Zealand and internationally

This scoping report has been prepared for the Tyrewise Working Group as part of a process to develop an industry led product stewardship programme for end of life tyres in New Zealand.

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Document Control and Sign Off

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Contents

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TYREWISE
SOLUTIONS FOR ENDOFLIFE TYRES

1.0 Executive Summary

Some 80,000 tonnes of End of Life Tyres (ELTs) are derived in New Zealand annually. The minority of these are diverted to beneficial use, the balance are disposed to consented landfill or a range of informal disposal arrangements.

The purpose of this report is to identify the alternative uses for collected ELTs internationally (to inform what is possible in New Zealand in the known future) and understand what, from that, is possible to be achieved within New Zealand given our various constraints.

Identified uses are broken down into four product groupings

- Whole Tyres (page 13)
- Fabricated/Cut Products (page 14)
- Ambient and Cryogenic Material recovery
    - Further use – Crumb as an end use functional product (page 15)
    - Further use – Crumb as an additive in a product (page 16)
    - Further Use – Crumb in a secondary process (page 18)
    - Further Use – Crumb in a destructive process (page 18)
- Devulcanisation (page 21)

On investigation it was agreed that, in New Zealand, fabricated/cut products and devulcanisation were unlikely options and that use of cryogenic processes was also unlikely. The focus then came on whole tyres and the various options within ambient material recovery for potential uses.

Most successful stewardship programmes internationally use the Waste Hierarchy combined with a series of questions around environmental, economic and social factors to tease out the relative merits of use options. This is then used to guide "best use" outcomes over time.

A set of core questions has been developed for environmental and economic factors and the social aspects are woven into the commentary that follows them. The questions are the working group's selection. A set of further possible questions are included in Appendix 1.

A table that scores each of the potential uses against the waste hierarchy and the questions to arrive at a weighted value for that use is shown in Table 6.3 on page 29.

A feature of successful programmes internationally is a mix of uses from energy recovery in some form (e.g. tyre derived fuel) through to high value end uses from fine crumb. The next report will identify a range of structural options for a programme in NZ and the costs/benefits for each.

Within this report the current collection of ELTs has not been addressed but will be in the following milestone.

2.0 Introduction

This report is the second in a series of documents that collectively intend to provide the necessary information for developing a comprehensive and robust nationwide product stewardship programme for end of life (ELT) tyres.

The purpose of this second report is to;

A. Conduct an investigation into:
   a. Alternative uses for collected tyres internationally (this informs what is possible in New Zealand in the future)
   b. Alternative uses for collected tyres in New Zealand (what is possible now and informs what is possible in the future, showing any constraints including investment)

B. Then with this data, show a ranking by:
   a. Cost efficiency (eg economic, minimum feedstock required)
   b. Resource Recovery effectiveness (environmental, social, other)

C. Then evaluate using key criteria

The first report presented an investigation into the current situation for collection and disposal of ELTs in New Zealand and internationally.

Two further reports will be developed during the project to address the following topics:

- A range of feasible product stewardship options with likely costs and benefits
- Develop a set of guiding principles for the ELT product stewardship programme

A working group comprising eight industry members, Ministry for the Environment and Local Government have come together to take a leadership role in the development of this programme, and have signed a mandate to represent their sector. It was recognised that from the broader industry sector, this was the group that had the most influence and opportunity within the ELT process to bring about effective change and to ensure that a structure for ELT development within New Zealand was robust. One of their key tasks is to ensure that the wider industry stakeholder groups (inclusive of ELT tyre collectors, processors and end users) know how to have their say throughout the process.

The working group participants are:

Organisation	Participant
Motor Trade Association (Inc.) (MTA)	Liezel Jahnke
Bridgestone NZ Ltd	Heath Barclay
Goodyear Dunlop Tyres (NZ) Ltd	Bill Prebble
Motor Industry Association Incorporated (MIA)	Perry Kerr
Imported Motor Vehicle Industry Association Incorporated (IMVIA)	David Vinsen
The NZ Automobile Association Incorporate (AA)	Stella Stocks
Fleetsmart (Cardlink)	Alan Roberts
Local Government NZ	Dave Beresford
Value Tyres Ltd	Billie Watmuff
Ministry for the Environment	Dana Peterson (observer)

3.0 Background

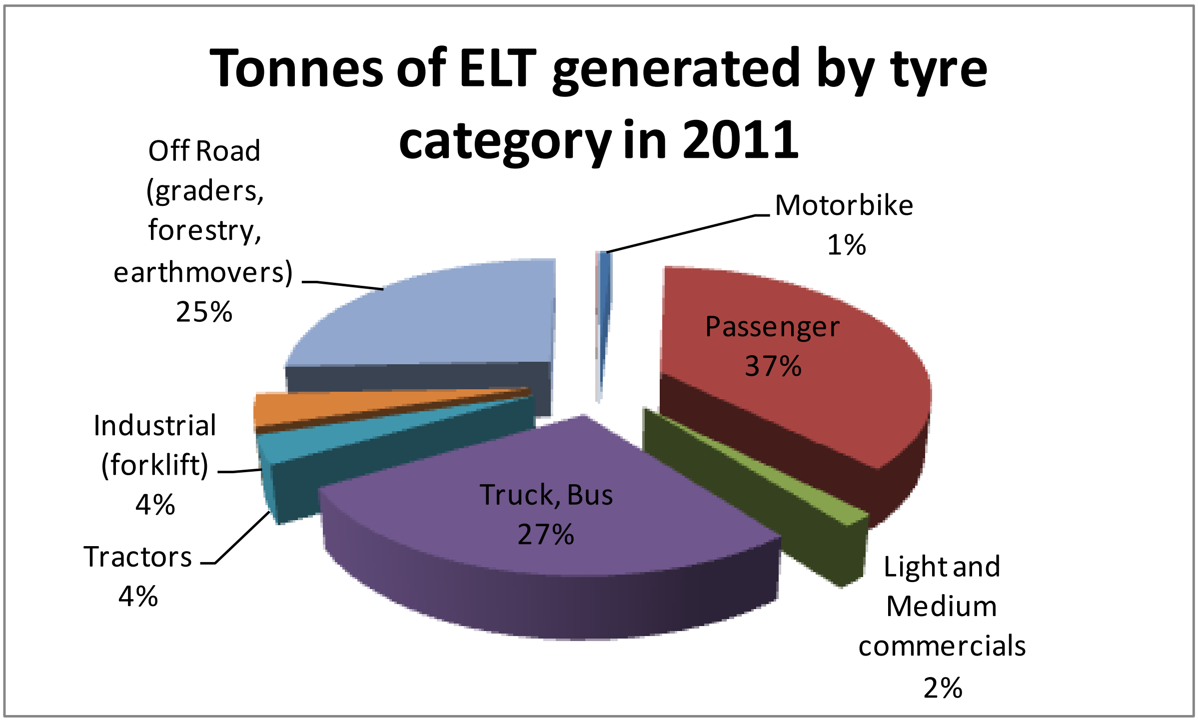
In order to understand the volume of ELTs available in New Zealand, the following data from Tyrewise Scoping Report 1[3] has been carried forward for use in Scoping Report 2.

It is estimated that 4.8 million tyres are imported into New Zealand every year and the corresponding number of ELTs require disposal.

This equates to approximately 80,000 tonnes of end of life tyres on an annual basis. Previous industry estimates were in the region of 34,000 to 40,000 tonnes of ELTs, but these estimates were based predominantly on passenger tyres.[3]

On the following page is Table 3 which includes the total units and weights by material type of the ELT market in New Zealand.

Table 3.0 2011 Number of Tyres and Material Composition													
Tyre Type	**Avg Used Weight (kg)**	**Material Composition Percentage**			**Volume of tyres**				**Weight (Tonnes)**				
		Rubber	**Steel**	**Textile**	**New Tyres Imported**	**Used tyres imported**	**Tyres on Vehicles**	**Total Tyres (Units)**	**Rubber**	**Steel**	**Textile**	**Total Weight**
Motorbike	4	70%	18%	12%	138,916		34,192	173,108	485	125	83	692
Passenger	8	73%	21%	6%	2,666,530	211,493	830,955	3,708,978	21,660	6,231	1,780	29,672
Light and Medium commercials	16	70%	25%	5%	5,292	6,338	74,610	86,240	966	345	69	1,380
Truck, Bus	40	68%	32%	0%	496,077	33,050	21,518	550,645	14,978	7,048	0	22,026
Tractors	64	75%	20%	5%	30,015		14,768	44,783	2,150	573	143	2,866
Industrial (forklift)	28	80%	10%	10%	88,636	28,763		117,399	2,630	329	329	3,287
Off Road (graders, forestry, earthmovers)	200	70%	30%	0%	102,849	132		102,981	14,417	6,179	0	20,596
Aircraft	14	70%	10%	20%	3,997	2,377		6,374	62	9	18	89
	Totals				**3,532,312**	**282,153**	**976,043**	**4,790,508**	**57,348**	**20,839**	**2,422**	**80,609**



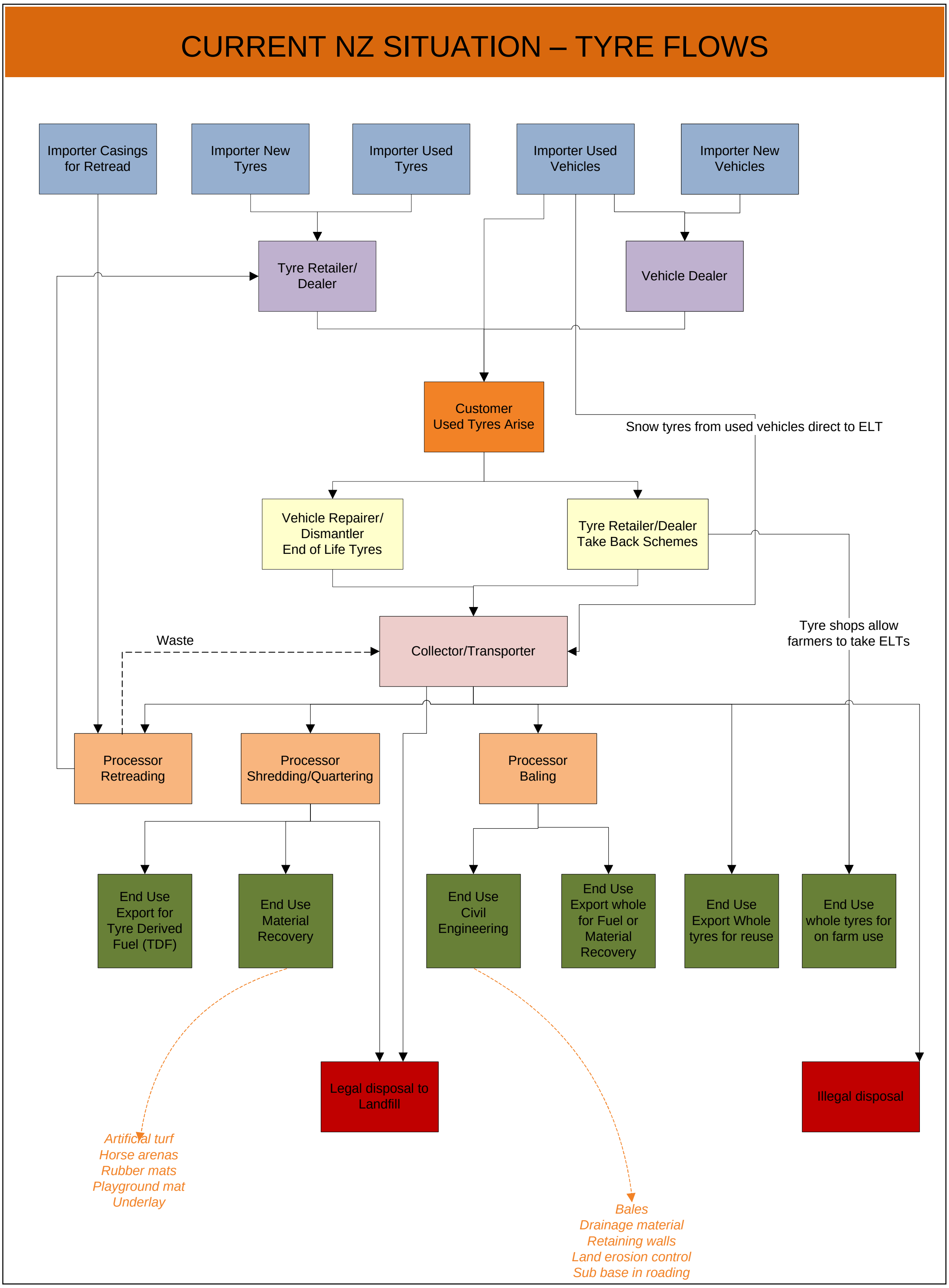
The total estimate of end of life tyres generated annually in New Zealand is 80,000 tonnes[3]

3.1 Legacy Tyres

There is an unknown but very large number of end of life tyres currently being used on farms as weights for silage covers or stockpiled as they are no longer needed. There are around 12,000 dairy farms in New Zealand and if an average farm had 300 tyres that would equate to 3.6 million tyres. Farmers are generally not willing to pay to have unwanted tyres collected for recycling so they continue to stockpile them even if they no longer have a use for them.[3]

These stockpiled tyres will also have weathered and aged as well as potentially having significant levels of organic contamination. Information gathered from commercial tyre processors indicates the weathered or aged tyres will still be able to be processed in a number of applications. Depending on the application a possible initial step when dealing with stockpiled tyres will be to ask the owner of the tyres to remove significant levels of organic contamination to ensure that the tyres are more recyclable.

The following diagram describes the flows of tyres through the industry in New Zealand and the different end use pathways for end of life tyres.



As demonstrated in Scoping Report 1, the uses for ELTs are wide and varied and can be as simple as using a whole passenger car tyre to grow potatoes in the back yard, ranging up to a set of complicated chemical processes to break the tyre back down into its original components for use in further processing.

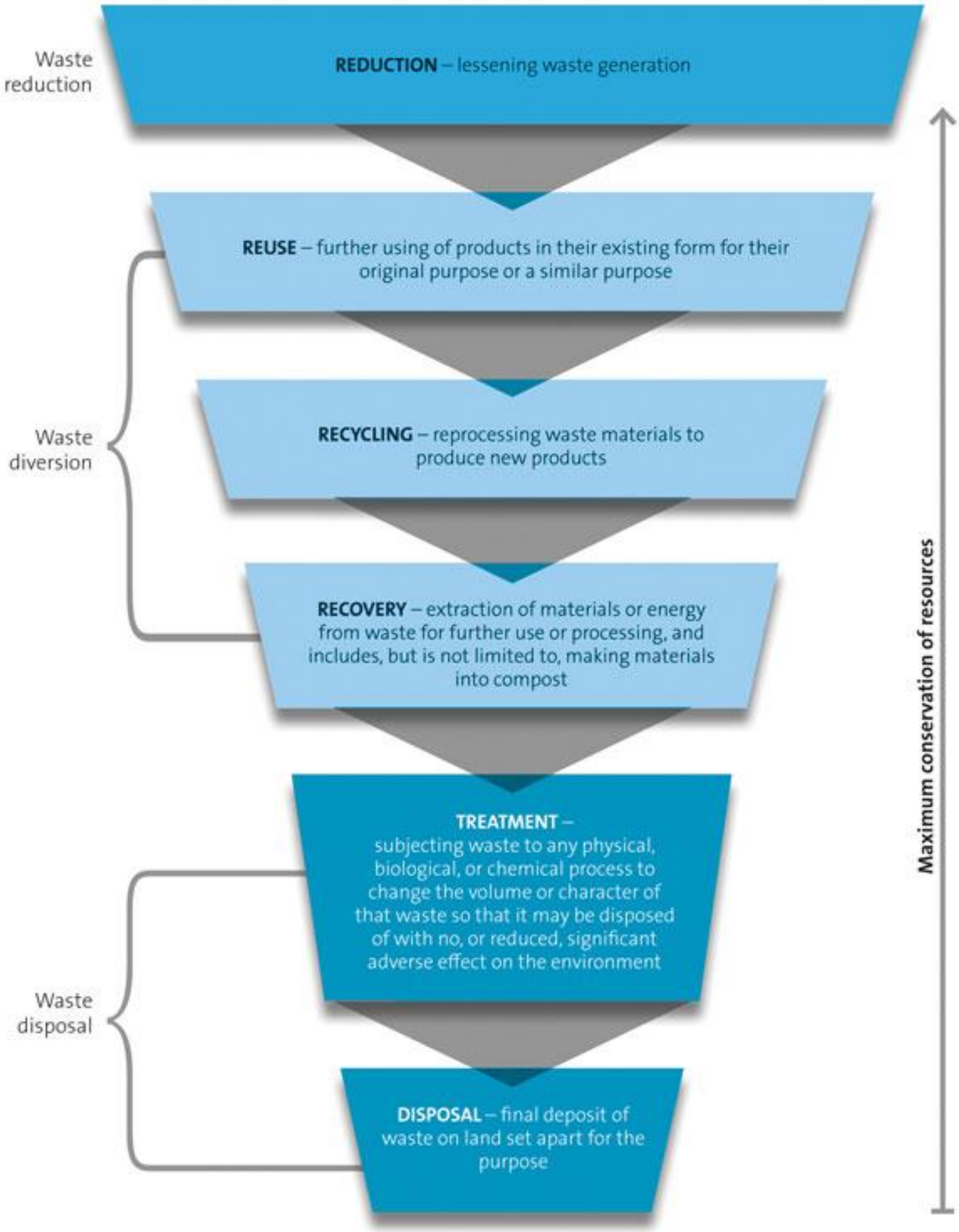
To be able to determine what is the best end use for ELTs in New Zealand, international ELT programmes were researched as well as the various technologies that are available to process tyres.

Through the research of international programmes it became evident that a number of international programmes and agencies - Ontario Tire Stewardship, Tire Stewardship BC, Tyre Stewardship Manitoba and the United States Environmental Protection Agency (EPA) - used the waste hierarchy as a basis for establishing what were the best uses for ELTs. The waste hierarchy (as used by the New Zealand Ministry for the Environment) has been used in this report to help establish what the best use for ELTs in New Zealand would be.

4.0 The Waste Hierarchy

The waste hierarchy[1] illustrated below has been formed on the basis that actions at a higher level can reduce the costs of actions at a lower level and the environmental impacts of activity at a higher level are generally less than those at a lower level.[1]

Figure 1
The waste hierarchy



5.0 Alternative Uses for ELTs

For the purpose of this report, a used tyre is defined as a used, rejected or unwanted tyre, that can be reused for its original purpose, retreaded, transformed, recycled or that may be destined for final disposal.[3]

5.1 Investigation Overview

Section 5.0 provides commentary on the following:

a. Alternative uses for collected tyres internationally (this informs what is possible in New Zealand in the future)
b. Alternative uses for collected tyres in New Zealand (what is possible now and informs what is possible in the future, showing any constraints including investment)

There is a significant range of alternative uses for ELTs undertaken internationally. In order to better communicate the extent of the potential uses, we have created four distinct product groupings which are;

- Whole Tyres
- Fabricated/Cut Products
- Ambient and Cryogenic Material recovery
  - Further use – Crumb as an end use functional product
  - Further use – Crumb as an additive in a product
  - Further Use – Crumb in a secondary process
  - Further Use – Crumb in a destructive process
- Devulcanisation

5.2 Whole Tyres

The following end uses involve using the tyre in its original state; that is no transformation process that reduces the tyre into its component parts. The only slight exception to this is the baling of tyres as a civil engineering use - whilst the tyre is not broken into its component parts it is no longer used as a tyre.

Export of Used Tyres for Reuse

International: A variety of countries import used tyres for further use on vehicles. These used tyres come from a number of countries including New Zealand. The data from Statistics New Zealand Infoshare database shows that in 2011 used tyres were exported from New Zealand to Vietnam, Namibia, Fiji, Tonga, Samoa, Romania and Singapore.[4]

New Zealand: Used tyres are imported into NZ for reuse. The majority of used tyres are imported from Japan and the used tyre market in New Zealand is approximately 350-400 thousand units annually.[3]

Retread

In its most simplistic form the retreading of tyres is a process whereby the tyre casing is buffed to remove the remainder of the tread and a new tread is adhered to the casing.

International: Truck tyres as well as some passenger tyres are retreaded internationally. The market for passenger tyre retreading is declining however.[17] [18]

New Zealand: There are still a number of truck tyre retreaders but no longer any passenger tyre retreading.[3] During the retread process rubber buffings are created which are used in some matting products.

Civil Engineering

International: There are a number of ELT uses in civil engineering applications. Below are the whole tyre options;

- Tyres that are baled can be used for retaining walls, temporary roads or sea embankments.[5]

New Zealand: The civil engineering applications are the same as the international examples.

Farming

International: There are international examples of ELTs being used as weights on silage pits.

New Zealand: As illustrated in Scoping Report 1 ELTs are used to anchor silage pits on farms. The ELTs are laid on top of the pit cover to stop the cover from blowing away.

5.3 Fabricated/Cut Products

International: Scrap tyres may be recycled by cutting, punching, shredding or stamping them into various rubber products after removal of the steel bead. For example;

- Using the sidewalls of the tyre to create the base for traffic cones, as weights for silage pit covers or to be baled together for retaining walls.
- Using the tread area to build blasting mats.
- Tyres that are shredded can be used for backfill or drainage in culvert beds.
- Tyres with one side wall removed can have aggregate placed inside them to form a structural unit which can be used as a retaining wall or to build up quarries.

- A variety of other products include floor mats, belts, gaskets, shoe soles, dock bumpers, seals, muffler hangers, shims, slope stabilisation, sound barriers and washers.[34 5 35 43]

New Zealand: Some of the above are undertaken in New Zealand currently, those being the side walls as weights for silage pits, dock bumpers and the retaining wall applications.

5.4 Ambient and Cryogenic Material Recovery

Ambient and Cryogenic Processing

- Further use – Crumb as an <u>end use functional product</u>
- Further use – Crumb as <u>an additive in a product</u>
- Further Use – Crumb in <u>a secondary process</u>
- Further Use – Crumb in <u>a destructive process</u>

International: The process is called ambient because all of the processing of the ELT takes place at or near ambient temperatures where the tyres are processed through a series of shredders to produce the required size. This is in contrast to cryogenic processing which is a process whereby the tyres or tyre chips are cooled to -80 degrees C using liquid nitrogen. Below -80 degrees C rubber displays similar characteristics to glass in regards to its brittle nature. The reduction in size is then achieved by crushing or grinding the tyres or tyre chips.[10]

The crumb characteristics vary depending on the process undertaken; in ambient processing the crumb has rough edges whereas in cryogenic processing the crumb edges are smoother.

New Zealand: Currently there is only ambient processing with variable crumb size output; the size of the crumb is dependent on the required end use. The size is determined by the grinders and size of the mesh screens used in the processing equipment.

The above processing information applies to all of the sections that cover Ambient and Cryogenic material recovery.

Rubber crumb derived from an ELT can be used as an ingredient in further applications or products, or it can be used as a product on its own.

5.4.1 Further use - Crumb as an <u>end use functional product</u>

There are a number of end uses for varying sizes of rubber crumb used as a product on its own; these include garden applications, landfill engineering and equestrian arenas

<u>Garden Applications - Mulch</u>
As a decorative landscape cover, recycled rubber mulch has the same appearance as wood or stone mulch.[23]

Garden Applications - Lawn

Reinforcing rubber crumb for lawns is made from recycled passenger tyres, granulated to form small rubber crumbs. It can be used as a top dressing or mixed directly into a new surface.[24]

Landfill engineering

Shredded tyres can be used as a layer for landfill drainage in place of river gravel.[5 3]

Equestrian arenas

This surface is composed of a layer of granulates bound with resin and covered with a layer of loose granulates. It combines the qualities of shock absorption, flexibility and elasticity, allowing the horse good impulsion and reducing the risk of injury from falls. Unlike the sand usually used in indoor arenas, this surface does not produce any dust, does not need to be watered and makes possible considerable savings in terms of horseshoes. This product is operational and patented and has been commercially produced in France since 2008.[37 42]

5.4.2 Further use - Crumb as an additive in a product

Moulded Products

Once granulates are mixed with binders or resins, they have many applications in moulded objects. They can be transformed into speed ramps, curb ramps, wheel chocks, mats, cable guards, signalling posts, accessories for equipping cycle tracks. Additionally there are a number of landscaping applications such as stepping stones, cobblestones, rubber pavers, and tree guards.[42 33]

If granulates are shredded even more finely and then dried to remove all traces of humidity, they become tyre powder. This powder is combined with a vulcanisation agent and then homogenised in kneading machines. The resulting mixture is then poured into preformed presses and vulcanised in the form of bandages. In this way, it is possible to manufacture wheels for waste containers, as well as casters for scaffolding, wheelbarrows, hand trucks or high pressure cleaning equipment.[42 33]

There are various building and construction applications including a rubber roof tile which has 80% recycled content and looks like cedar shingles.[44] Carpet underlay is a further application which uses rubber crumb and is moulded into a new product.[5]

Adhesives

Recovered rubber can also be used to produce industrial adhesives, particularly as a tile adhesive. Rubber crumb is used in the manufacture of tile adhesives providing a range of product benefits such as weight reduction (bag weight), improved coverage, longer workability, flexibility and sound attenuation. The addition of rubber crumb in adhesives allows double the surface coverage of products sold in Europe or the United States. Interest in Tyre Derived product (TDP) use in adhesives is now spreading to Europe as manufacturers develop global formulations of products in keeping with international standards.[5]

Rubber crumb does also have disadvantages in this end use market however, primarily related to poor bonding into the adhesive matrix. Research indicates that this is because Styrene Butadiene Rubber (SBR) binders present in motor vehicle tyres generally do not bond as well as polymer additives, which are used specifically to improve adhesion and are substitute products to TDPs in adhesives. Rubber with higher proportions of natural and not synthetic rubber (as is the case for most motor vehicle tyres) generally has higher proportions of SBR. The use of surface modification to solve this difficulty and bond particles together better has proven to be too expensive in this end market use.[5]

Artificial turf (Sports Grounds)

Synthetic turf is composed of a mat of synthetic grass into which a bed of ballast is generally added, made of sand covered in a layer of loose granulates.

This technology makes it possible to use stadia in all weathers and all seasons as the covering is not sensitive to either frost in winter or drought in summer, nor is it sensitive to flooding caused by heavy rain. It requires a very limited amount of upkeep and does not need to be watered. Above all, synthetic turf surfaces feel very similar to playing on natural turf and studies have shown synthetic turf surfaces have no negative environmental or health impacts on those who use them.[42]

Sporting Arenas

The shock absorbing properties of used tyres make them an adequate material for manufacturing flexible sporting areas in the form of granulates bound together with resin to form a mat. There are many applications based on tyre granulates; athletics arenas and multisport platforms (traction, shock absorption, durability), indoor sports arenas, urban sports installations, weight-training rooms, tennis courts and stabilised soils.[42]

Rubber Asphalt

Rubber crumb obtained from used tyres can be incorporated into asphalt or associated with road coatings to improve the acoustic characteristics of the asphalt surface as well as its resistance to cracking during frosts and thaws. Similarly, such surfaces also encourage vehicle adhesion.

The textile fibres obtained from tyres can also be integrated into road surfacing materials, once the fibres have been cleaned and treated. Several studies have been carried out to verify the characteristics of this product and optimise the dosage. The result is that the incorporation of treated fibres makes it possible to improve the coating's stress resistance by 20%, thus resulting in an increase in the asphalt's life expectancy of several years.[10]

Concrete

Studies are currently in progress to assess the opportunities resulting from incorporating the granulates or textile fibres obtained from shredding used tyres into the mortars and concretes used as the basis for cement.

This incorporation means both lightening the concrete and increasing its performance (increased resistance to cracking and the deformation capacity of these materials). Beyond applications for which resistance to the cracking caused by deformation is a priority, the use of textile fibres is also an advantage for ground-strengthening techniques.[42]

5.4.3 Further use - Crumb in a secondary process

This section relates to crumb being broken down further for use in a secondary process.

Pyrolysis

Pyrolysis is a method to break down tyres – normally from crumb into potentially usable end products. Called by a variety of names, such as thermal distillation and destructive distillation, pyrolysis involves the heating of organic compounds (tyres) in a low oxygen environment which generates combustible gases, oil, and char products. The quantity and quality of each product depends on variables including temperature, pressure, and residence time.

The products derived from Pyrolysis can be used for the following applications;

- Oil recovered from the Pyrolysis process has many potential applications, including industrial lubrication, high value solvents, and alternative fuels.[21]
- Char products (Carbon Black) recovered from the pyrolysis process can be used in the manufacturing of inks, paint, dye, plastics, and rubber products.[22 21]
- Energy derived from Pyrolysis can be used to help power on-site generators, and eventually can provide some of the electricity needs of a pyrolysis plant.[21]
- Blended Diesel Fuel **-** There have been trials internationally using varying percentages of pyrolysis oil as a blend with diesel.[25]

Currently there is a trial pyrolysis plant being operated in Auckland.[3]

5.4.4 Further Use – Crumb in a destructive process

This section relates to crumb being consumed in a destructive process.

Mining

In Australia rubber crumb has been proposed for two mining applications; these are Stemming and Blasting Mix.

When blasting and charging is conducted in mines in Australia holes are commonly filled with explosives and then packed with stemming. Currently certain sized gravel is being used as stemming to plug the hole and ensure that the energy from the explosion goes back into the surrounding rock rather than back out of the hole. Trials have been undertaken that replace the gravel with ELT products.

The explosives in the holes are made from a mixture of ammonium nitrate and diesel; there is some proprietary work that has been undertaken whereby mixing a rubber crumb with the diesel reduces the required percentage of ammonium nitrate.[5]

Carbon and steel recycling – Foundries and Steel works

Since 2007, shredded used tyres have been used commercially in foundries in France, as a source of metal and carbon black. Their experience shows that loading shredded tyres into the hot blast cupola of the foundry alters neither the fusion processes nor the quality and properties of the cast iron produced, and decreases manufacturing costs. An important consideration is the standardisation of the tyre shedding process to determine the best size shred for these industrial processes.

Since 2004 shredded tyres have been used as a replacement for anthracite in electric arc furnaces as they contain large quantities of carbon. This is an efficient, economical and ecological process that is used in France and Belgium. The quality of the steel and the gas emissions and dust do not change when tyres are used as part of the fuel source[32].

Tyre Derived Fuel (TDF) – Cement Works, Pulp and Paper, Power Generation, Industrial boilers and Tyre Manufacture

Cement Works

Using TDF in cement kilns makes it possible to make savings in petroleum coke, coal and heavy fuel and also in carbon emissions. Using tyres occurs only under particularly strict and well-controlled conditions. In certain factories, the substitution rate for traditional fuels can be as much as 50% of the furnace's thermal consumption.

In France, Aliapur has been delivering whole or shredded tyres to cement makers since 2004.[30]

In the USA, 41% of ELTs are burnt as fuel in cement kilns which make clinker—a primary component of Portland cement. A cement kiln is basically a large furnace in which limestone, clay, and shale are heated at extreme temperatures and a chemical reaction transforms them into clinker. Clinker is ground together with gypsum to form Portland cement.

The use of whole tyres as kiln fuel is possible for some type of cement kilns. For these cement kilns, truck loads of whole tyres are delivered to the end of a conveyor. Tyres are manually unloaded from the truck onto the conveyor. The conveyor feeds the tyres to a mechanism that inserts one tyre at a time into the kiln at specified time intervals. The advantage of utilising whole tyres is that there are no costs to create rubber crumb. The removal of the steel is unnecessary since cement kilns have a need for iron in their processes. Rubber crumb may also be utilised because there is very little manual labour involved in handling crumb versus whole tyres, however, producing crumb from whole tyres increase costs.[30]

There are "add on" combustion devices available that allow some existing cement kilns to use TDF. An example of one of these is HOTDISC^{tm}. HOTDISC^{tm} allows a variety of solid wastes up to 1.2m in diameter to be utilised which means tyres from truck size and below can be combusted without being reduced to a crumb, this eliminates the step of shredding truck and passenger tyres prior to use in cement kilns. Rather than being shredded to a crumb, larger tyres could be reduced into pieces less than 1.2m to be able to be utilized.[39]

Pulp and Paper Industry

About 26 million tyres per year are consumed as fuel in boilers at United States pulp and paper mills. Pulp and paper mills have large boilers which are used to supply energy for making paper. This energy is normally supplied by wood waste; however, wood varies substantially in heat values and moisture content, so the mills often supplement the wood fuel with other fuels, such as coal or oil, to make the operation more stable. TDF is also used in many plants as a supplement to the wood because of its high heat value and low moisture content.

The main problem in using TDF in the paper industry is the need to use de-wired tyres. The wires often clog the feed systems. Also, the mills sometimes sell the resulting ash to farmers who require the ash to be free of iron. De-wired TDF can cost up to 50% more than regular TDF.[31]

Utility and Industrial Boilers

In the electric utility industry, boilers typically burn coal to generate electricity. TDF is often used as a supplement fuel in electric utility boilers because of its higher heating value, lower NOx emissions, and competitive cost as compared to coal. However, only certain types of boilers are conducive to burning TDF.

Cyclone boilers are the most used of all the utility boilers for burning TDF as they require no changes to be made to the boiler itself, thus reducing the capital investment. Therefore, the only additional equipment needed is a conveyer to transport the tyre pieces into the boiler. Cyclone boilers cannot accept whole tyres which increases the cost of obtaining the fuel (the optimum size of the tyre pieces is 1 inch x 1 inch and it must be de-wired). Stoker fired units are also economical with the residence time of the fuel being longer, larger tyre pieces can be used. The optimum size of these pieces is 2 inches square which reduces the cost of obtaining the fuel for Cyclone boilers and makes it more economical[31].

Tyre Manufacture

In Japan a number of tyre manufacturers use TDF in their tyre factories. The uses of TDF in a tyre factory are;

- A heat source for boilers
- Cogeneration in Grate Incineration
- Power generation in a Fluidized-bed Incinerator.[26 6 9]

5.5 Devulcanisation – Chemical, Ultrasonic, Microwave

International: Devulcanisation is a procedure in which tyre rubber is converted using either chemical, ultrasonic or microwave processes into a state in which it can be mixed, processed and then vulcanised again.

- For the chemical process to occur the rubber crumb is mixed in a reactor with a reagent to create a chemical reaction. At the conclusion of the reaction the remaining product is filtered and dried to remove undesirable chemical components.
- The ultrasonic process occurs when rubber crumb is fed into an extruder via a hopper and the rubber is mechanically pushed and pulled serving to heat the rubber particles and soften the rubber. The softened rubber then is transported through the extruder and is subjected to ultrasonic energy. The combination of these activities is enough to achieve varying degrees of devulcanisation.
- The microwave process applies thermal energy swiftly and uniformly to the rubber crumb. The applications for microwave devulcanisation are limited as the only rubber that can be successfully used is rubber with polar polymers. Polar polymers are not usually found in tyres.[36] [10] [17]

New Zealand: Currently in New Zealand there is no Devulcanisation occurring.

6.0 Alternative Uses for ELTs in New Zealand

6.1 Methodology for Creation "Ranking" and "Weighting" Beneficial End Use

This Section looks at the data and shows a ranking by:

a. Cost efficiency (e.g. economic, minimum feedstock required)
b. Resource Recovery effectiveness (environmental, social, other)

A weighting is then applied to the ranking; the process is explained below.

Firstly, the working group needed a method to ascertain which of the four processes identified in the previous section are in fact able to be implemented in New Zealand (or expanded upon if already here). A three staged approach to develop a ranking method was devised.

- Stage One: Establish a set of questions to extrapolate the data
- Stage Two: Create a Ranking to develop a meaningful assessment model
- Stage Three: Apply a Weighting based on the Waste Hierarchy

Stage One: Establish a set of questions to extrapolate the data

The first stage summarises the end uses in a table and establishes what questions were asked in order to break each of the four processes into;

a. Those uses that could be undertaken in New Zealand, and
b. Those that for a variety of reasons would not be able to be undertaken in New Zealand.

The questions we applied for Stage One were;

- Is there currently any processing in New Zealand to generate these types of products?
- Are the products derived from the process proven overseas?
- What is the minimum volume to be commercially viable?
- Does the technology exist in New Zealand to undertake the process?
- Does a market exist for the products derived from the process?
- What are the potential tonnes of ELT that could be utilised in this process?
- What would the investment be to implement the plant and/or equipment for this process?

The above methodology was then used to create a ranking for each type of ELT process under evaluation, and informs the working group what the most beneficial end use for ELTs would be within the constraints of information available at the time of preparing the report.

Stage Two: Creating the Ranking

In order to create a meaningful assessment model to determine the viability of the various ELT processes available internationally, and then be able to express what the working group considered to be the most beneficial end use in a New Zealand context (e.g. Ranking), we examined how "ranking" was approached in the various international product stewardship schemes investigated in Scoping Report 1, and then applied the waste hierarchy as illustrated in Page 11.

Reference material was sourced from:

- World Business Council for Sustainable Development developing new markets[7] [8]
- Ministry for the Environment's Waste Minimisation fund guide for applicants[2]
- Ministry for the Environment's A guide to Product Stewardship[1]
- The waste hierarchy used by the Basel Convention and the Ministry for the Environment[1] [10]

In order to demonstrate the cost efficiency (e.g. economic, minimum feedstock required) and resource recovery effectiveness (environmental, social and other), we then developed a second series of questions under two groupings:

1. Environmental
2. Economic

Within each of these groupings the series of questions were then ordered in terms of priority and given a score from 0 through 5 ("5" most relevant to NZ context through to "0" least relevant), this then gave us a "set" of questions for each grouping to inform the ranking criteria.

After the Environmental and Economic questions were applied a social summary was derived from these answers, and this then forms a Social Summary score.

Environmental Questions

1. Are there limitations on the types of tyres that can be processed? (Can all tyre types and/or different tyre conditions eg weathered/aged tyres be processed or are there restrictions)
   Score = 0 - 5

2. Will the process fulfill all the International, National and Local legislative requirements?
   Examples to fulfill are The Commerce Act, Basel Convention, Local Government bylaws, Resource Management Act, Health and Safety in Employment Act.
   Score = 0 – 5

3. Will the process create a reduction in the use and/or import of virgin materials or products in New Zealand?
   Score = 0 - 5

4. Does the process completely recycle all materials derived from the ELT?
   Score = 0 - 5

5. Will (or does) the process create any environmental hazards and/or emissions whilst being undertaken?
   Examples are; risk of discharge of hazardous waste to land or air, storage of hazardous materials on site
   Score = 0 - 5

Particular emphasis has been placed on determining what types of tyres could be processed and how much of the ELT was actually recycled during the processes assessed. A system that can process multiple types of tyres and to the lowest level of waste is likely to be more effective than a process that can only handle certain tyre types and leaves waste at the end of the process. It was also deemed important to assess the potential environmental impacts of any processing as well as compliance with regulatory requirements. Creating a reduction in the use and/or import of virgin materials is also desirable.

There are further environmental questions in Appendix 1 that were developed and considered in order to create the ranking.

Economic Questions

1. Is there potential market demand for the end use product in New Zealand?
   Score = 0 - 5

2. Is the market for the end use product viable and expected to continue in the long term?
   Score = 0 – 5

3. Is the ELT market large enough to sustain the process?
   Score = 0 – 5

4. Is the process self funded? i.e. revenue generated from the end use market covers the cost of collecting and processing the ELT v a subsidy from the ELT itself supporting the process.
   Score = 0 - 5

5. Could the processing improve existing infrastructure?
   Examples could be reduced transport costs, infrastructure aesthetics or amenities
   Score = 0 - 5

6. Will the processing be able to be located in a geographic location that is close to a significant volume of the ELTs?
   Score = 0 - 5

A key part of the rationale for the economic questions was to determine the size and potential demand of any market for the products derived from the processes assessed. Determining if the eventual volume of ELTs available for processing (considering volume and geographic aspects) is sufficient to support the process running at its optimal economic capacity will eliminate those processes that require ELT volumes in excess of those available in New Zealand. Creating a model that moves away from subsidies and is governed by the value of the product the ELT is eventually used in is preferable. The ability to geographically place processing in areas closest to the raw material will be rated higher compared to processes which may be currently (or planned) to be situated away from the raw material but still require significant volume of raw material from both islands in order to be economically viable. Being able to positively add to or compliment existing infrastructure is important.

There are further economic questions in Appendix 1 that were developed and considered in order to create the ranking.

Social

After the Environmental and Economic questions were applied, an assessment of the social impacts for each process/end use was undertaken. This is summarised following the environmental and economic questions.

<u>Stage Three: Development of a Weighting based on the Waste Hierarchy</u>

Along with the methodology developed in Stage One and Two above, each level of the Waste Hierarchy was assigned a weighting score which was also applied to each of the process groups.

Whilst reducing the waste generated has the highest weighting within the Waste Hierarchy it is unable to be applied to any of the alternative uses for ELTs within this report. This report identifies the alternative uses for ELTs and to do that it must be assumed that the waste has already been created. This means that the highest Waste Hierarchy weighting an alternative use can achieve is Reuse.

Action	Environmental Impact	Weighting Score
Waste Reduction	**Reduction** – lessening waste generation (eg not generating the waste in the first place)	40
Waste Diversion	**Reuse** – further use of products in their existing form for their original purpose or a similar purpose	30
	Recycling – reprocessing waste materials to produce new products	20
	Recovery – extraction of materials or energy from waste for further use or processing.	10
Waste Disposal	**Treatment** – subjecting waste to any physical, biological, or chemical process to change the volume or character of that waste so that it may be disposed of with no, or reduced significant adverse effect on the environment.	0
	Disposal – final deposit of waste on land set apart for the purpose eg Landfill	0

An overall ranking was then available by adding the score from each question and the waste hierarchy ranking together.

6.2 Tyre Processes Table: Available Internationally

The following table is the result of applying stage one of the methodology to each of the processes to determine which of these processes is possible in New Zealand.

Table 6.2 Tyre Processes Table: Available Internationally

Process	Current Scale in NZ Not all products within each process are considered to be at a commercial level	Products within each Process	Is the Alternative Use possible in NZ in the Future?						Investment Range	Is this a possible use for NZ?
			Proven overseas?	Type of ELTs that can be processed*	Minimum volume to be commercially viable?	Technology Exists in NZ?	Potential Market Exists for end product?	Potential Tonnes of ELT to this process?		
1) Whole Tyres	Commercial	Export of used tyres for reuse, Retread, Civil Engineering (Whole - Temp Roads, Baled - Retaining Walls, Temporary Roads, Sea Embankments)	Y	1, 2 & 4	0 + 2,400 to 100,000 ELTs	Y	Y	1,365 + 96 to 3,360	$0 - $10,000,000	Y
2) Fabricated/Cut products	Commercial	Traffic Cones, Baled together for Retaining Walls, Tread area to build Blasting Mats, Side wall removed to be used in retaining walls or quarries, Floor Mats, Belts, Gaskets, Shoe Soles, Dock Bumpers, Seals, Muffler Hangers, Shims, Slope Stabilisation, Sound Barriers, Washers	Y	1 & 2	N/A	Y	Y	32 based on US data on size of market[12]	N/A	N
3)Ambient and Cryogenic material recovery	Commercial	Varying sized crumbs with either an ambient or cryogenic finish.	Y	1, 2, 3 & 4	500,000 ELTs	Y Ambient Only	Y	100,000 as includes all possible further uses of crumb	$3,000,000+	Y
3.1) Further use - Crumb as an <u>end use functional product</u>	Commercial	Mulch, Gardens, Landfill Engineering, Equestrian Arenas, Civil Engineering	Y	1, 2, 3 & 4		Y	Y		$0 - $0	Y
3.2) Further use - Crumb as <u>an additive in a product</u>	Commercial	Moulded Products, Adhesives, Artificial Turf (Sports Grounds), Sporting Arenas, Rubber Asphalt, Concrete	Y	1, 2, 3 & 4	800 tonnes of crumb rubber	Y	Y	30,000 – 40,000	$260,000+	Y
3.3) Further use - Crumb in <u>a secondary process</u>	Feasibility	Pyrolysis (Oil, Char - Carbon Black, Energy, Blended Diesel Fuel)	Y	1, 2, 3 & 4	9,100 tonnes based on one Reklaim processing facility	N (trial)	Y	9,100 based on one Reklaim processing facility	$100,000 - $25,000,000	Y
3.4) Further use – Crumb in <u>a destructive process</u>	Not in New Zealand	TDF (Cement Works, Pulp and Paper, Power Generation, Industrial Boilers, Tyre Manufacture), Mining, Carbon and Steel Recycling (Foundries, Steel Works)	Y	1, 2, 3 & 4	Depends on size of cement kiln and clinker production	N	Y	35,000 based on one facility with HOTDISC	$7,600,000+ for HOTDISC	Y
4) Devulcanisation	Not in New Zealand	Devulcanised Compounds	N	N/A	N/A	N	N	N/A	N/A	N

*Key

1 Motorbike, Passenger, Light and Medium Commercials
2 Truck, Bus, Tractor, Industrial (Forklift)
3 Off Road (graders, forestry, earthmovers)
4 Aircraft

Note: At time of publishing this report, this table is incomplete – it is expected that over the course of the Tyrewise Project it will be populated as more information comes to hand regarding volumes and investment range

6.3 ELT Processes Table

As illustrated in table 6.2 there were two processes deemed not able to be implemented in New Zealand, being Fabricated/Cut products and Devulcanisation. For some of the remaining processes there is some capability already in New Zealand currently, in either small or large scale operations or as feasibility studies.

- **Fabricated/Cut Products**
  The United States market for fabricated/cut products has shrunk from 2.8% of ELTs in 2005 to 0.04% in 2009.[12] This would equate to 32 tonnes of ELTs based on New Zealand's total ELT figure of 80,000 tonnes.[3] Due to the small scale of the use it would not likely represent optimum resource value initially.

- **Devulcanisation**
  Devulcanisation was deemed not to be a future use for New Zealand, as products that have come from devulcanisation have limited applications due to the mechanical properties being inferior to those of the original rubber.[10] There are other concerns around the use of devulcanisation as it is reported to be both energy intensive and utilizes a range of chemicals that could harm the environment.[5]

Table 6.3 has the detailed scoring based on the methodology outlined in 6.1.

Table 6.3 - Tyre Processes Table: Possible in New Zealand

Alternative Processes for ELTs	Products within each process	Environmental					Economic						Social Rating	Waste Hierarchy	Total Score
		Are there limitations on the types of tyres that can be processed? (Can all tyre types and/or different tyre conditions eg weathered be processed or are there restrictions)	Will the process fulfill all the International, National and Local legislative requirements? Examples to fulfill are The Commerce Act, Basel Convention, Local Government bylaws, Resource Management Act, Health and Safety in Employment Act.	Will the process create a reduction in the use and/or import of virgin materials or products in New Zealand?	Does the process completely recycle all materials derived from the ELT?	Will (or does) the process create any environmental hazards and/or emissions whilst being undertaken?	Is there potential market demand for the end use product in New Zealand?	Is the market for the end use product viable and expected to continue in the long term?	Is the ELT market large enough to sustain the process?	Is the process self funded? I.e. revenue generated from the end use market covers the cost of procuring the ELT.	Could the processing improve existing infrastructure? Examples could be reduced transport costs, infrastructure aesthetics or amenities	Will the processing be able to be located in a geographic location that is close to a significant volume of the ELTs?			
Whole Tyres	Export of used tyres for reuse, Retread, Civil Engineering (Baled - Retaining Walls, Temporary Roads, Sea Embankments), Farms	2	3	2	4	4	2	3	4	3	2	4	4	30	67
Ambient and Cryogenic material recovery	Varying sized crumbs with either an ambient or cryogenic finish.	5	3	5	4	4	5	5	5	2	3	3	6	20	70
Further use - Crumb as an end use functional product	Mulch, Gardens, Landfill Engineering, Equestrian Arenas, Civil Engineering	5	3	3	3	5	3	3	5	2	1	5	4	20	62
Further use - Crumb as an additive in a product	Moulded Products, Adhesives, Artificial Turf (Sports Grounds), Sporting Arenas, Rubber Asphalt, Concrete	5	4	5	3	3	5	5	5	2	4	5	7	20	73
Further use - Crumb in a secondary process	Pyrolysis (Oil, Char - Carbon Black, Energy, Blended Diesel Fuel)	5	3	2	3	2	2	3	5	2	3	5	6	20	61
Further use – Crumb in a destructive process	TDF (Cement Works, Pulp and Paper, Power Generation, Industrial Boilers, Tyre Manufacture), Mining, Carbon and Steel Recycling (Foundries, Steel Works)	5	3	5	5	2	5	5	5	2	4	5	6	10	62

7.0 ELT Processes: Evaluation using Key Criteria

7.1 Whole Tyres

Environmental Assessment Rationale

1. *Are there limitations on the types of tyres that can be processed? (Can all tyre types and/or different tyre conditions eg weathered/aged tyres be processed or are there restrictions)*

   There would be limitations on the type of used tyres exported for reuse which would be governed either by the market receiving the tyre to be either used again or retreaded. The United States EPA stated that the downside to exporting scrap tyres is that the countries that receive the tyres may end up with a disproportionate amount of tyres in addition to their own internally generated scrap tyres.[28] There is also the decision to be made about what auditable trail and certification would be put in place as part of a product stewardship scheme for ELTs to ensure ELTs were not leaving New Zealand under the guise of a tyre for reuse only to be used as a fuel source in developing countries.

   Retreading in this report is being classed as a process that diverts a tyre from being an ELT; at the point of the end of its useful life the tyre would be assessed and either directed towards an end process or a retread process. There are limitations on the types of tyres that can be retreaded and industry contacts advised that since 2007 there have not been any retreading operations for passenger car tyres in New Zealand, however truck tyres do continue to be retreaded by a number of companies.[17 18] In the last 10-15 years the supply of cheap imported used tyres has made the market for passenger retreads in New Zealand uneconomical.[3] Passenger retreading has also been on an international decline for a number of years.[17 18]

   Weathered legacy tyres will be unable to be used as either retreaded tyres or exported as whole tyres.

   The Working Group has scored this as **2** out of 5

2. *Will the process fulfill all the International, National and Local legislative requirements? Examples to fulfill are The Commerce Act, Basel Convention, Local Government bylaws, Resource Management Act, Health and Safety in Employment Act.*

   Any export to another country would need to meet that countries import regulations and the Basel convention would only apply if that country was a signatory to the Basel convention. Some countries have banned the import of used tyres.

As both Bridgestone and Goodyear have truck retreading factories in New Zealand[3] it can be assumed that local and national legislative requirements are being met in regards to their processing facilities. This would need to be tested though.

The Working Group has scored this as **3** out of 5

3. *Will the process create a reduction in the use and/or import of virgin materials or products in New Zealand?*

From an export of used tyres perspective there would be no reduction in the use of virgin materials in New Zealand as the tyres are not being transformed into a different material form. However a retreaded tyre can be used 3-4 times[18] so this reduces the number of truck tyres that are imported into New Zealand.

The Working Group has scored this as **2** out of 5

4. *Does the process completely recycle all materials derived from the ELT?*

For those tyres that are reused whole or are retreaded the majority of the tyre is used again. The whole tyre that is exported is not transformed in any way so is sent in its entirety and a retreaded tyre is only buffed to remove the remaining tread.[18]

The Working Group has scored this as **4** out of 5

5. *Will (or does) the process create any environmental hazards and/or emissions whilst being undertaken? Examples are; risk of discharge of hazardous waste to land or air, storage of hazardous materials on site.*

Whole tyres that are exported are not transformed but sent whole, this indicates there is no process by which to create environmental hazards or emissions. The retreading process is undertaken currently in New Zealand and until recently the Bandag retread brand had ISO14001 accreditation which is an Environmental management system. It can be assumed that if the retreading process meets the criteria of ISO14001 any environmental hazards are appropriately managed.[18]

The Working Group has scored this as **4** out of 5

Economic Assessment Rationale

1. *Is there potential market demand for the end use product in New Zealand?*

   There is market demand for used tyres currently as illustrated in table 7.1, in 2011 New Zealand exported 136,485 tyres overseas, this places the number of tyres exported at 3% of total ELT volume.[3] An European Tyre & Rubber Manufacturers Association (ETRMA) report showed that the average percentage across 11 European countries of used tyres exported for reuse was 4%.[12 15] There might be the opportunity for a small amount of growth in this market but the available markets will be determined by any certification that might be implemented as part of a product stewardship scheme.

   There is market demand for retreaded truck tyres as they are more cost effective for transport operators to use than new tyres regardless of the size of their operation.[3]

   The Working Group has scored this as **2** out of 5

2. *Is the market for the end use product viable and expected to continue in the long term?*

   The market may not be viable in the future for used tyre exports as a number of countries have banned the import of used tyres. It would also be dependent on any certification requirements implemented as part of a product stewardship scheme.

   It is expected that domestic freight will grow by 75% between 2006 and 2030 and the proportion of the overall freight undertaken by road freight vs. rail and sea will stay close to the current split.[27] It can then be reasonably expected that truck use and subsequently tyre use will experience some growth. As retreaded tyres are determined as cost effective it would be expected to see growth in the market in the future.

   The Working Group has scored this as **3** out of 5

3. *Is the ELT market large enough to sustain the process?*

   The ELT market is large enough to sustain both the process of exporting whole tyres – currently 3% of ELTs as well as continuing with the retread truck tyre market.

   The Working Group has scored this as **4** out of 5

4. *Is the process self funded? I.e. revenue generated from the end use market covers the cost of collecting and processing the ELT v a subsidy from the ELT itself supporting the process.*

The whole tyre export market is funded by the sale of the tyre as well as a payment made by the tyre retailer to the collector. The retread process is self funded and the costs are covered by the purchase price of a retreaded truck tyre.[18]

The Working Group has scored this as **3** out of 5

5. *Could the processing improve existing infrastructure? Examples could be reduced transport costs, infrastructure aesthetics or amenities*

There would be limited improvement of existing infrastructure as whole tyre export does not require significant infrastructure. There are already 13 truck tyre retreading facilities in New Zealand and it would not be expected that there would be room for more.[3]

The Working Group has scored this as **2** out of 5

6. *Will the processing be able to be located in a geographic location that is close to a significant volume of the ELTs?*

The export of used tyres would be able to be located in any area that has suitable access to a port for export. Retreading truck tyres occurs in a variety of locations currently in New Zealand. The placement of these factories allows for good geographic coverage currently.[3]

The Working Group has scored this as **4** out of 5

Used Tyres exported from New Zealand 2008 to 2011					
Year	Used tyres for cars < 508mm	Used tyres - light commercial < 508mm rim	Used tyres for cars or light commercial > 508mm rim	Used tyres other vehicles	Total (units)
2008	16,453	485	5,633	150	22,721
2009	8,251	86	2,813	156	11,306
2010	117,332	98	1,158	24,756	143,344
2011	59,084	1,376	2,061	73,964	**136,485**

Table 7.1 – Used tyres exported from New Zealand 2008 - 2011[3]

Social Summary

The Basel Convention is very clear that the waste created by a country is managed by that country. The working group considered that exporting tyres to offshore processing applications which would otherwise legitimately operate in New Zealand (provided that evidence existed to support that this was in fact where the tyre ended up) would be a viable process and would be ranked higher than where evidence could not be provided.

There is an assumption that growth in the export market for whole tyres to be reused, as well as increased retreading offshore would lead to the creation of low to medium skilled jobs in New Zealand.

The Working Group has scored this as **4** out of 10

7.2 Ambient and Cryogenic Material Recovery

Environmental Assessment Rationale

1. *Are there limitations on the types of tyres that can be processed? (Can all tyre types and/or different tyre conditions eg weathered/aged tyres be processed or are there restrictions)*

   There are some limitations on the tyres that can be processed in individual applications but overall both different ELT types and different ELT conditions can be shredded for use in the varying applications. There are tyre processors in New Zealand who are able to handle varying sized tyres and in varying states. In some instances the larger off the road tyres may need to be reduced into smaller pieces before they can be shredded or transported for shredding.

   As noted in Section 3 there may be an expectation that removal of organic matter from tyres will have to occur prior to pickup or shredding. There would be cost implications if this is the case.

   The Working Group has scored this as **5** out of 5

2. *Will the process fulfill all the International, National and Local legislative requirements? Examples to fulfill are The Commerce Act, Basel Convention, Local Government bylaws, Resource Management Act, Health and Safety in Employment Act.*

   There are multiple tyre shredding operations within New Zealand[3] and it is assumed that these operations meet the local legislative requirements. However, verifying compliance is not part of this scoping report.

   The Working Group has scored this as **3** out of 5

3. *Will the process create a reduction in the use and/or import of virgin materials or products in New Zealand?*

   The process will certainly create a reduction in the use of virgin materials as the crumb that is derived from the shredded tyres can be used in a wide variety of end use applications (see section 5.4) that previously would have used virgin materials.

   The Working Group has scored this as **5** out of 5

4. *Does the process completely recycle all materials derived from the ELT?*

The level of recycling of the materials derived from the ELT is determined by the shredding process that is undertaken. For example, currently there is a shredding operation in New Zealand that shreds the tyre whole as the end use does not require the steel or textile removed. This means that the ELT is fully recycled.

There are other applications that do require both the textile and steel removed.

Textile would represent 3% of the total weight of ELT material collected but currently there are limited markets for the extracted textiles.[5] The extracted steel can be recycled by scrap metal recyclers.

The Working Group has scored this as **4** out of 5

5. *Will (or does) the process create any environmental hazards and/or emissions whilst being undertaken? Examples are; risk of discharge of hazardous waste to land or air, storage of hazardous materials on site.*

   There are no additives to the shredding process as it is simply the ELT being shredded. It could be expected that as there is no additive in the process there is no requirement for large scale storage of hazardous materials.

   There is water required in some shredding processes to either clean tyres or provide lubrication during the shredding process. There could be discharge issues with this contaminated water depending on the containment system at each individual facility. This would need to be assessed on a case by case basis.

   The Working Group has scored this as **4** out of 5

<u>Economic Assessment Rationale</u>

1. *Is there potential market demand for the end use product in New Zealand?*

   There is significant potential demand for crumb rubber as illustrated in the variety of end use applications in section 5.4.

   The Working Group has scored this as **5** out of 5

2. *Is the market for the end use product viable and expected to continue in the long term?*

   Due to the number of possible uses for crumb rubber as illustrated in section 5.4 the market is considered to be viable and expected to continue in the long term.

The Working Group has scored this as **5** out of 5

3. *Is the ELT market large enough to sustain the process?*

The ELT market would be large enough to sustain the process of shredding tyres into crumb rubber. As illustrated in table 6.2 the minimum feedstock for a shredding operation is determined as 500,000 ELTs which by volume is only 10% of the overall ELT volume.

The Working Group has scored this as **5** out of 5

4. *Is the process self funded? I.e. revenue generated from the end use market covers the cost of collecting and processing the ELT v a subsidy from the ELT itself supporting the process.*

Funding for the current ELT market is based on a price paid by the tyre retailer to a collector or processor to dispose of the tyre. The current market for crumb does not ensure sufficient revenue to cover the cost of collecting and processing the ELT.[3] Determining how an eventual product stewardship programme for ELT might impact on this market is not part of this scoping report.
The Working Group has scored this as **2** out of 5

5. *Could the processing improve existing infrastructure? Examples could be reduced transport costs, infrastructure aesthetics or amenities.*

Additional infrastructure to enable granulation of crumb rubber into a smaller mesh size would improve existing infrastructure for existing processors. Remote infrastructure that allows for the reduction in size of off the road tyres at source would improve transport efficiency to the processor.

The Working Group has scored this as **3** out of 5

6. *Will the processing be able to be located in a geographic location that is close to a significant volume of the ELTs?*

The process could be located at a number of different geographic locations within New Zealand. Thought would need to be given to remote infrastructure that can be implemented at sites throughout New Zealand that could reduce the size of tyres to smaller pieces that allows for transport efficiency to the full scale shredding plant.

The Working Group has scored this as **3** out of 5

Social Summary

The addition of shredding capacity would create medium level skilled roles as well as the development of support services for the infrastructure.

It would also be expected that the development in the use of crumb rubber in a variety of end use applications would create jobs as well as research and development opportunities in new markets.

The Working Group has scored this as **6** out of 10

7.3 Further use – Crumb as an end use functional product

Environmental Assessment Rationale

1. *Are there limitations on the types of tyres that can be processed? (Can all tyre types and/or different tyre conditions eg weathered/aged tyres be processed or are there restrictions)*

   There will be no limitations on the type of tyres used as they will already have been reduced to a crumb.

   The Working Group has scored this as **5** out of 5

2. *Will the process fulfill all the International, National and Local legislative requirements? Examples to fulfill are The Commerce Act, Basel Convention, Local Government bylaws, Resource Management Act, Health and Safety in Employment Act.*

   As there are already examples of crumb being used as a product in applications in New Zealand[3] (see section 5.4.1) it can be reasonably expected that this meets all the national and local legislative requirements. However, verifying compliance is not part of this scoping report.

   The Working Group has scored this as **3** out of 5

3. *Will the process create a reduction in the use and/or import of virgin materials or products in New Zealand?*

   The crumb uses as detailed in section 5.4.1 are likely to replace gravel, sand or dirt which are naturally occurring resources and are not imported. The use of crumb will enable these resources to be deployed into other applications or used less.

   The Working Group has scored this as **3** out of 5

4. *Does the process completely recycle all materials derived from the ELT?*

   The crumb that is being used in these applications will have had the steel and textile removed. As the textile is removed this becomes a waste due to the current limited markets for used textile.[5] The extracted steel is recyclable.

   The Working Group has scored this as **3** out of 5

5. *Will (or does) the process create any environmental hazards and/or emissions whilst being undertaken? Examples are; risk of discharge of hazardous waste to land or air, storage of hazardous materials on site.*

As the crumb is not subjected to any further processing due to it being an end use functional product in its own right it can be expected that there would be no environmental hazards or emissions in using crumb by itself. Supporting this is the fact that crumb is already used in a number of applications in New Zealand (see section 5.4.1) and it could be reasonably expected that these uses meet current environmental standards. However, verifying compliance is not part of this scoping report.

The Working Group has scored this as **5** out of 5

Economic Assessment Rationale

1. *Is there potential market demand for the end use product in New Zealand?*

There is potential market demand for the products but the market has yet to be tested in the case of mulch or lawn care for residential homes. Shredded rubber is being used in New Zealand as a drainage material[3] and crumb rubber is supplied to equestrian arenas.[37]

The Working Group has scored this as **3** out of 5

2. *Is the market for the end use product viable and expected to continue in the long term?*

The viability of the market for crumb to be used as mulch or lawn care has not yet been established so long term viability is difficult to ascertain. There are landfill and civil engineering applications along with equestrian arenas that provide a viable continuing market.

The Working Group has scored this as **3** out of 5

3. *Is the ELT market large enough to sustain the process?*

The volume of ELT is sufficient to sustain the process of crumb rubber as an end use functional product as a number of the uses are already in commercial existence in New Zealand.

The Working Group has scored this as **5** out of 5

4. *Is the process self funded? I.e. revenue generated from the end use market covers the cost of collecting and processing the ELT v a subsidy from the ELT itself supporting the process.*

   Funding for the current ELT market is based on a price paid by the tyre retailer to a collector or processor to dispose of the tyre. The current market for crumb does not ensure sufficient revenue to cover the cost of collecting and processing the ELT.[3] Determining how an eventual product stewardship programme for ELT might impact on this market is not part of this scoping report.

   The Working Group has scored this as **2** out of 5

5. *Could the processing improve existing infrastructure? Examples could be reduced transport costs, infrastructure aesthetics or amenities.*

   It is not likely that the use of crumb rubber will improve existing infrastructure as the processing occurs at the Ambient and Cryogenic material recovery stage. At this stage it is purely the application of the crumb rubber into the required end use.

   The Working Group has scored this as **1** out of 5

6. *Will the processing be able to be located in a geographic location that is close to a significant volume of the ELTs?*

   Any further processing would be able to be located in an area that works geographically for both inwards and outwards goods. As the ELT has already been crumbed before it is used in this process there are transport efficiencies with crumb rubber being transported instead of an ELT.

   The Working Group has scored this as **5** out of 5

Social Summary

The development of end use markets will create low level skilled roles in the use and application of crumb rubber. There would also be research and development opportunities identifying further products that crumb rubber could be used in, and then opportunities commercialising any newly developed products.

The Working Group has scored this as **4** out of 10

7.4 Further Use – Crumb as an additive in a product

Environmental Assessment Rationale

1. *Are there limitations on the types of tyres that can be processed? (Can all tyre types and/or different tyre conditions eg weathered/aged tyres be processed or are there restrictions)*

   There will be no limitations on the type of tyres used in the majority of applications as the tyres will already have been reduced to a crumb.

   The Working Group has scored this as **5** out of 5

2. *Will the process fulfill all the International, National and Local legislative requirements? Examples to fulfill are The Commerce Act, Basel Convention, Local Government bylaws, Resource Management Act, Health and Safety in Employment Act.*

   In a number of applications there is already New Zealand processing (e.g. matting and artificial turf) so it can be expected that all national and local legislative requirements would be met. However, verifying compliance is not part of this scoping report.

   Asphalt in roading has yet to be in used in New Zealand so the legislative requirements have yet to be tested. Based on a report generated by Transit New Zealand in 2006[14] there would be requirement to seek approval to use any rubber in roading applications from the New Zealand Transport Agency.

   The Working Group has scored this as **4** out of 5

3. *Will the process create a reduction in the use and/or import of virgin materials or products in New Zealand?*

   There would be a reduction in the materials used in the production of any products that have crumb rubber generated from ELTs in them. Graphs 7.3, 7.3a and 7.3b show a total of 11,654 tonnes of rubber was imported into New Zealand for further use. Some of this rubber may be able to be directly substituted by crumb rubber from ELTs. The use of crumb rubber in the binder of Hot Mix Asphalt (HMA) would reduce the volume of bitumen required, allowing this bitumen to be either used in other applications or not imported into New Zealand.

   The Working Group has scored this as **5** out of 5

4. *Does the process completely recycle all materials derived from the ELT?*

   The crumb that is being used in these applications will have had the steel and textile removed. As the textile is removed this becomes a waste due to the current limited markets for used textile.[5] The extracted steel is recyclable.

   The Working Group has scored this as **3** out of 5

5. *Will (or does) the process create any environmental hazards and/or emissions whilst being undertaken? Examples are; risk of discharge of hazardous waste to land or air, storage of hazardous materials on site.*

   There is anecdotal evidence that the wet mix HMA can generate fumes which create problems for mixing plants near built up residential areas. There is processing in New Zealand for a number of other products with crumb rubber as an additive, it could be assumed that as this processing exists currently that the relevant environmental requirements are met.[3] However, verifying compliance is not part of this scoping report.

   The Working Group has scored this as **3** out of 5

Economic Assessment Rationale

1. *Is there potential market demand for the end use product in New Zealand?*

   Approximately 1,000,000 tonnes of HMA is produced in New Zealand every year[13] with industry estimates of 150,000 – 200,000 tonnes of bitumen[20] used either in HMA or chip seal. California Transport Authority (Caltrans) indicates that 20% of crumb rubber[11] could be used as a replacement in the binder (bitumen). Based on these figures the market for rubber in roading applications could be 30,000 – 40,000 tonnes annually.

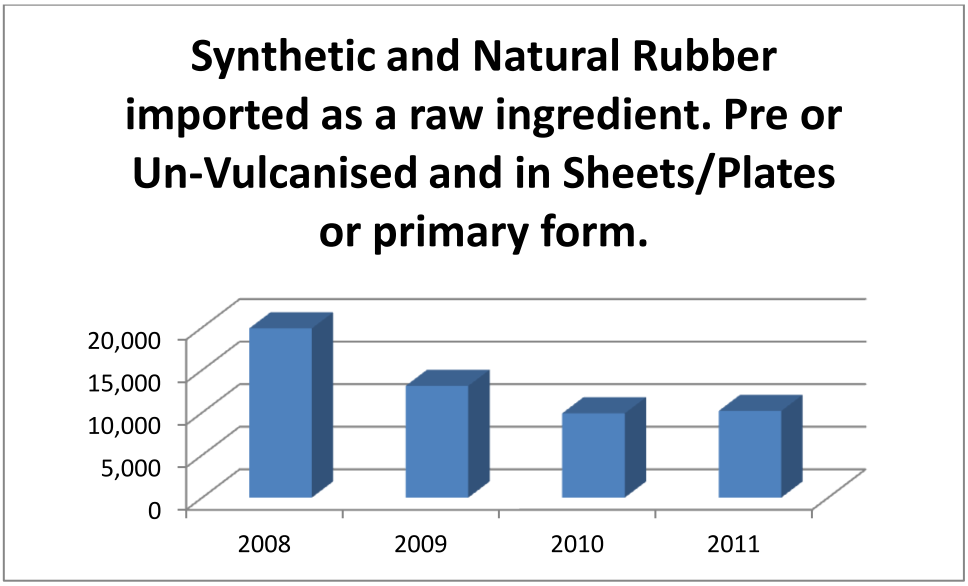
   The Working Group has scored this as **5** out of 5

2. *Is the market for the end use product viable and expected to continue in the long term?*

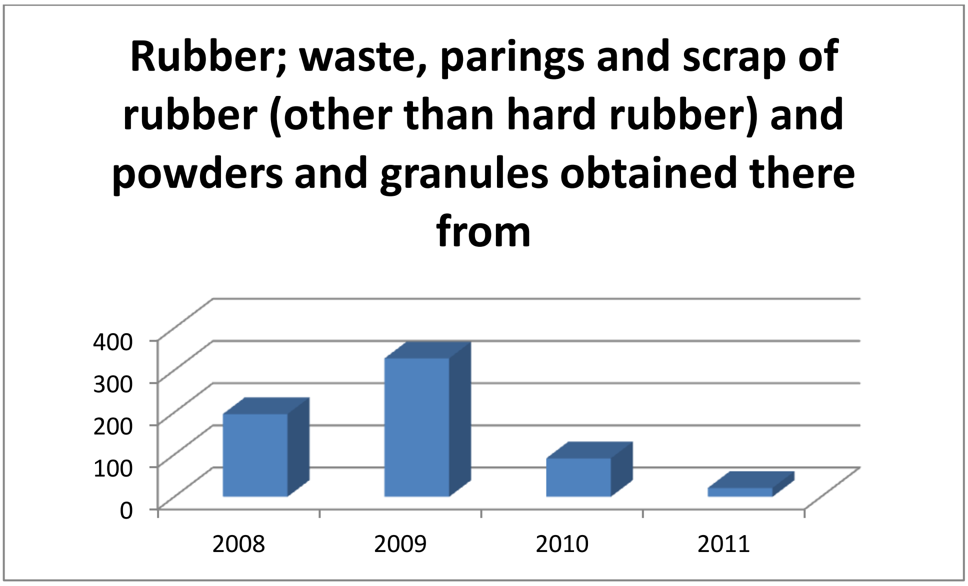
   Asphalt rubber products can be used wherever conventional asphalt concrete or bituminous surface treatments would be used, and provide better resistance to reflective cracking and fatigue than standard dense-graded HMA. The primary reason for using asphalt rubber is that it provides significantly improved engineering properties over conventional paving grade asphalt.[11]

As illustrated in graphs 7.4, 7.4a and 7.4b rubber is imported into New Zealand in a variety of different forms currently and it may be possible to substitute this imported rubber with crumb rubber.

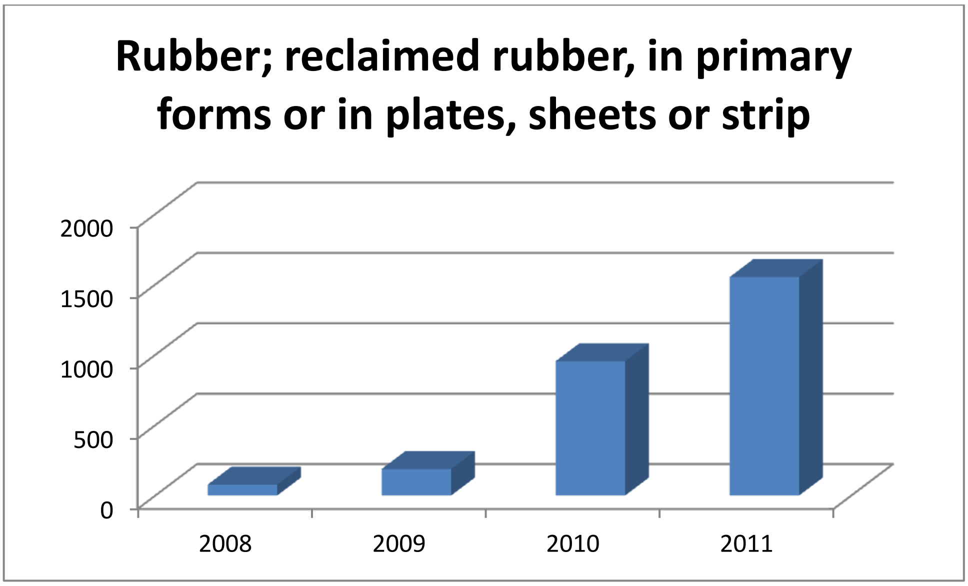
The Working Group has scored this as **5** out of 5



Graph 7.4 Synthetic and Natural Rubber imported as a raw ingredient (tonnes). Pre or Un-Vulcanised and in Sheets/Plates or primary form[4]



Graph 7.4a Imports (tonnes) of rubber; waste, parings and scrap of rubber (other than hard rubber) and powders and granules obtained there from[4]



Graph 7.4b Imports (tonnes) of rubber; reclaimed rubber, in primary forms or in plates, sheets or strip[4]

3. *Is the ELT market large enough to sustain the process?*

   Potentially the roading market can use 30,000 – 40,000 tonnes of crumb rubber annually. This is against a potential supply of 57,348 tonnes of ELT rubber annually, see table 3.0. This illustrates the volume of ELTs is sufficient to supply the potential demand from rubber in roading as well as a surplus of crumb rubber for other applications.

   The Working Group has scored this as **5** out of 5

4. *Is the process self funded? I.e. revenue generated from the end use market covers the cost of collecting and processing the ELT v a subsidy from the ELT itself supporting the process.*

   Funding for the current ELT market is based on a price paid by the tyre retailer to a collector or processor to dispose of the tyre. The current market for crumb does not ensure sufficient revenue to cover the cost of collecting and processing the ELT.[3] Determining how an eventual product stewardship programme for ELT might impact on this market is not part of this scoping report.

   The Working Group has scored this as **2** out of 5

5. *Could the processing improve existing infrastructure? Examples could be reduced transport costs, infrastructure aesthetics or amenities.*

   The use of crumb rubber as an additive in a product would improve existing processing infrastructure with the development of equipment and processes to blend crumb rubber into HMA or chip seal. There would also be the development of processing equipment for the other uses of crumb rubber in products.

   The Working Group has scored this as **4** out of 5

6. *Will the processing be able to be located in a geographic location that is close to a significant volume of the ELTs?*

   Any further processing would be able to be located in an area that works geographically for both inwards and outwards goods. As the ELT has already been crumbed before it is used in this process there are transport efficiencies with crumb rubber being transported instead of a whole or shredded ELT.

   The Working Group has scored this as **5** out of 5

Social Summary

There would be the development of medium to high level skilled jobs with the use of crumb rubber in products. This would be based on the technical skills required to be able to blend rubber crumb into HMA as well as the development of crumb rubber into other products.

There would also be the development of support services to any newly implemented processing facilities.

Crumb rubber used in roading results in noise reduction generated by traffic – an important social consideration for health and wellbeing of human beings who reside and/or work in built up areas. Noise reduction has been established by using rubber in roads in Sacramento.

> *"Immediately after paving the test roadways with rubberized and conventional asphalt, traffic noise decreased along all three roadways. However, once a sufficient amount of time had elapsed for the various roadways to be fully compacted, the roadways paved with rubberized asphalt still exhibited good traffic noise reduction, whereas the noise reduction of the conventional asphalt overlay was lost."*[88]

Whilst this is not an extensive trial there are a number of examples internationally of a reduction in noise.

The Working Group has scored this as **7** out of 10

7.5 Further Use – Crumb in a secondary process

Basel Convention revised technical guidelines on the environmentally sound management of used tyres (October 2011) states that pyrolysis has yet to be proven as an economically viable operation in the United States and has always failed in full scale operation. Some of the information below is taken from what appears to be a working pyrolysis plant in Boardman, Oregon (Reklaim). Tire Stewardship BC in their 21 years of operation have yet to have a pyrolysis plant register as a processor,[16] however they were aware that one of their crumb producers was looking to transport crumb rubber to Reklaim in Oregon hence the reason Reklaim information has been used below.

Environmental Assessment Rationale

1. *Are there limitations on the types of tyres that can be processed? (Can all tyre types and/or different tyre conditions eg weathered/aged tyres be processed or are there restrictions)*

   There will be no limitations on the type of tyres used in pyrolysis as long as the tyre has already been reduced to a crumb[19]. It is assumed but not yet trialled that weathered/aged tyres may have a lower yield in the gases generated by Pyrolysis but the yield of carbon black would be the same.[19]

   The Working Group has scored this as **5** out of 5

2. *Will the process fulfill all the International, National and Local legislative requirements? Examples to fulfill are The Commerce Act, Basel Convention, Local Government bylaws, Resource Management Act, Health and Safety in Employment Act.*

   As there is already a trial pyrolysis plant in Glendene Auckland[3] it can be assumed that the national and local legislative requirements for a trial pyrolysis plant are met. As there is currently no full scale operating pyrolysis plant in New Zealand it is not possible to test if the full national and local legislative requirements are met. However, verifying compliance is not part of this scoping report.

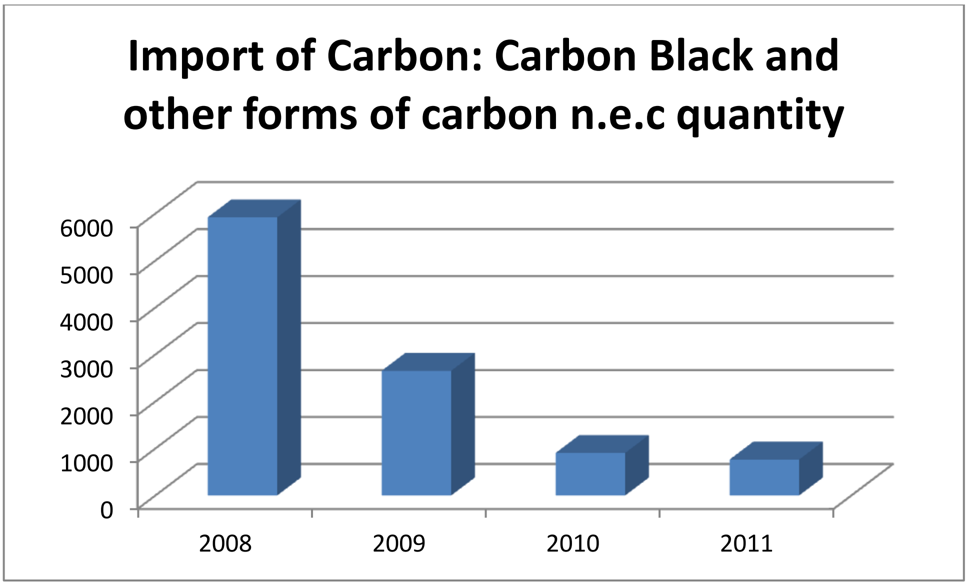
   The Working Group has scored this as **3** out of 5

3. *Will the process create a reduction in the use and/or import of virgin materials or products in New Zealand?*

   Approximately 30%[29] of a tyre by weight can be turned back into Char (Carbon Black). If all tyres went into a Pyrolysis process based on the total of 80,000 tonnes of ELT[3] available there would be approximately 24,000 tonnes of Char (Carbon Black) available which far exceeds the current import demand in New Zealand for

2011 as illustrated in graph 7.5. This would mean that the balance would have to be exported. The quality of the outputs of a Pyrolysis process differ depending on the type of Pyrolysis technology used.

The Working Group has scored this as **2** out of 5



Graph 7.5 Import of Carbon[4] (tonnes)

4. *Does the process completely recycle all materials derived from the ELT?*

The crumb that is being used in these applications will have had the steel and textile removed. As the textile is removed this becomes a waste due to the current limited markets for used textile.[5] The extracted steel however is able to be recycled.

The Working Group has scored this as **3** out of 5

5. *Will (or does) the process create any environmental hazards and/or emissions whilst being undertaken? Examples are; risk of discharge of hazardous waste to land or air, storage of hazardous materials on site.*

As there is currently no more than a trial pyrolysis plant[3] working in New Zealand it is not possible to ascertain if the process will create any environmental hazards or create emissions.

The Working Group has scored this as **2** out of 5

Economic Assessment Rationale

1. *Is there potential market demand for the end use product in New Zealand?*

   There is market demand in overseas markets for carbon black but due to concerns about the quality of the carbon black it has been difficult to secure long term contracts at attractive prices for the produced carbon black. In addition, end market users of the separated outcomes still regard new processes such as pyrolysis as relatively unproven and therefore risky.[5]

   The Working Group has scored this as **2** out of 5

2. *Is the market for the end use product viable and expected to continue in the long term?*

   A significant portion of the revenue (75%)[19] comes from the sale of carbon black. In a New Zealand context this makes the export market important to the viability of a pyrolysis plant in New Zealand.

   The Working Group has scored this as **3** out of 5

3. *Is the ELT market large enough to sustain the process?*

   Reklaim believe for a plant to break even using their technology the required throughput on a 24hr 7 day a week operation is 175 tonnes per week which is 9,100 tonnes per year or 11.37% of the overall ELT tonnage in New Zealand.[19]

   The Working Group has scored this as **5** out of 5

4. *Is the process self funded? I.e. revenue generated from the end use market covers the cost of collecting and processing the ELT v a subsidy from the ELT itself supporting the process.*

   Funding for the current ELT market is based on a price paid by the tyre retailer to a collector or processor to dispose of the tyre. The current market for crumb does not ensure sufficient revenue to cover the cost of collecting and processing the ELT.[3] Determining how an eventual product stewardship programme for ELT might impact on this market is not part of this scoping report. It is also not possible to determine the price for the oil, char and gases generated by Pyrolysis.

   The Working Group has scored this as **2** out of 5

5. *Could the processing improve existing infrastructure? Examples could be reduced transport costs, infrastructure aesthetics or amenities.*

   As there is currently only a trial Pyrolysis plant in New Zealand it could be expected that the implementation of a full scale plant would improve either an existing facility or the development of a new facility. There would also be the potential for electricity to be provided back to the grid from the Pyrolysis plant.

   The Working Group has scored this as **3** out of 5

6. *Will the processing be able to be located in a geographic location that is close to a significant volume of the ELTs?*

   It is possible that based on the volume required to have a viable Pyrolysis plant more than one plant could be implemented and placed in key geographic locations.

   As the ELT has already been crumbed before it is used in this process there are transport efficiencies with crumb rubber being transported instead of an ELT.

   The Working Group has scored this as **5** out of 5

Social Summary

The development of Pyrolysis technology in New Zealand would lead to the creation of medium to high level skilled jobs through the implementation and use of newly implemented infrastructure and technology.

There would also be the development of support services to a Pyrolysis plant as well as the development of end use markets for the resultant products and the opportunities which would exist to influence or inform prospective users of the technology offshore.

The Working Group has scored this as **6** out of 10

7.6 Further Use – Crumb in a destructive process

Environmental Assessment Rationale

1. *Are there limitations on the types of tyres that can be processed? (Can all tyre types and/or different tyre conditions eg weathered/aged tyres be processed or are there restrictions)*

   As TDF will use crumb there is no restriction on tyre type. Also HOTDISC™ allows tyres 1.2m and under to be fed in whole[39]. TDF can be a good use for stockpiles of contaminated tyres which are covered in dirt and water. Some of these contaminated tyres cannot be used for ground rubber and TDF can be a better option for the ELT.[6]

   The Working Group has scored this as **5** out of 5

2. *Will the process fulfill all the International, National and Local legislative requirements? Examples to fulfill are The Commerce Act, Basel Convention, Local Government bylaws, Resource Management Act, Health and Safety in Employment Act.*

   Currently there are restrictions on the use of ELTs primarily around the discharge of emissions with no resource consents issued to allow the burning of ELTs as a fuel source. The Basel Convention revised technical guidelines are clear that ELTs should be used to generate energy only in installations with adequate emission abatement equipment.[10]

   The Working Group has scored this as **3** out of 5

3. *Will the process create a reduction in the use and/or import of virgin materials or products in New Zealand?*

   Using ELTs as a fuel source would reduce the use of other fuels, primarily coal. When tyres are burned in a controlled environment the emission are no greater than those produced by other fuels, as demonstrated in table 7.6. The natural rubber content in tyres is regarded as carbon neutral, as rubber plantations sequester carbon from the atmosphere during their life time.[6]

   The Working Group has scored this as **5** out of 5

Energy content and Co_2 emissions from fuels			
Fuel	**Energy** (Gigajoule/tonne)	**Emissions**	
		$kgCO_2$/tonne	$kgCO_2$/Gigajoule
Tyres	32.0	2,270	85
Coal	27.0	2,430	90
Pet coke	32.4	3,240	100
Diesel Oil	46.0	3,220	70
Natural gas	39.0	1,989	51
Wood	10.2	1,122	110

Table 7.6 – Energy content and CO_2 emissions from fuels[6]

4. *Does the process completely recycle all materials derived from the ELT?*

   The crumb rubber or whole tyres used as TDF do not need to have the steel or textile removed. [6] This removes a step from the processing as well as ensures that the complete tyre can be recycled.

   The Working Group has scored this as **5** out of 5

5. *Will (or does) the process create any environmental hazards and/or emissions whilst being undertaken? Examples are; risk of discharge of hazardous waste to land or air, storage of hazardous materials on site.*

   As there are no facilities in New Zealand using ELTs as fuel it is not possible to ascertain if there would be any environmental hazards or potential emissions created.

   The Working Group has scored this as **2** out of 5

Economic Assessment Rationale

1. *Is there potential market demand for the end use product in New Zealand?*

   There would be potential significant demand for alternative fuel sources in New Zealand in the cement, electricity and pulp and paper industries. In 2007 7% of New Zealand's electricity was generated by coal.[40] In table 7.6a the volume of coal used in New Zealand is illustrated. Whilst it is not likely ELTs could be used in all applications there is certainly scale to reduce coal usage and replace with rubber crumb.

   There might be some economic implications reducing local coal usage but to put the volumes in context, in 2010 250,000 tonnes of coal was imported into New Zealand[41] and as the weight of ELTs generated is only 80,000 tonnes it may be expected that only the import market of coal would be effected. This would require some further exploration.

The Working Group has scored this as **5** out of 5

Coal Usage in New Zealand in 2010		
Type	**Tonnes of Coal**	**Percentage**
Electricity generation	1,012,500	37.5%
Transformation (mainly Steel making)	513,000	19.0%
Industrial Sector*	999,000	37.0%
Commercial Sector**	67,500	2.5%
Other***	108,000	4.0%
Total	2,700,000	100.0%

Table 7.6a - Coal Usage in New Zealand in 2010[41]

*mainly cement plants (Golden Bay Cement near Whangarei and Holcim's plant at Westport), lime and plaster, meat, dairy factories (particularly those at Clandeboye in South Canterbury and Edendale in Southland), wool, timber, and pulp and paper products
**heating accommodation and service buildings in central and local government, hospitals, rest homes, and educational institutions

***agricultural, transport, and residential sectors.

2. *Is the market for the end use product viable and expected to continue in the long term?*

   The market for rubber crumb to be used as a fuel source would be expected to be viable based purely on the scale of coal used currently in New Zealand. If all 80,000 tonnes of ELT were used to directly replace coal it would only be a reduction of 3% of coal used in New Zealand.

   The Working Group has scored this as **5** out of 5

3. *Is the ELT market large enough to sustain the process?*

   The potential tonnes of ELT to one HOTDISC™ facility are 35,000 which is less than the annual total volume of ELTs which is 80,609. Based on this the market of ELTs is large enough to sustain TDF.

   The Working Group has scored this as **5** out of 5

4. *Is the process self funded? I.e. revenue generated from the end use market covers the cost of collecting and processing the ELT v a subsidy from the ELT itself supporting the process.*

Funding for the current ELT market is based on a price paid by the tyre retailer to a collector or processor to dispose of the tyre. The current market for crumb does not ensure sufficient revenue to cover the cost of collecting and processing the ELT.[3] Determining how an eventual product stewardship programme for ELT might impact on this market is not part of this scoping report.

The Working Group has scored this as **2** out of 5

5. *Could the processing improve existing infrastructure? Examples could be reduced transport costs, infrastructure aesthetics or amenities.*

The implementation of a facility similar to HOTDISC™ would improve existing infrastructure by allowing other coarse materials to be used as alternative fuels.[39]

The Working Group has scored this as **4** out of 5

6. *Will the processing be able to be located in a geographic location that is close to a significant volume of the ELTs?*

The placement of a facility similar to HOTDISC™ would be geographically located to complement existing plants that require rubber crumb as an alternative fuel.

As the ELT has already been crumbed before it is used in this process there are transport efficiencies with crumb rubber being transported instead of an ELT.

The Working Group has scored this as **3** out of 5

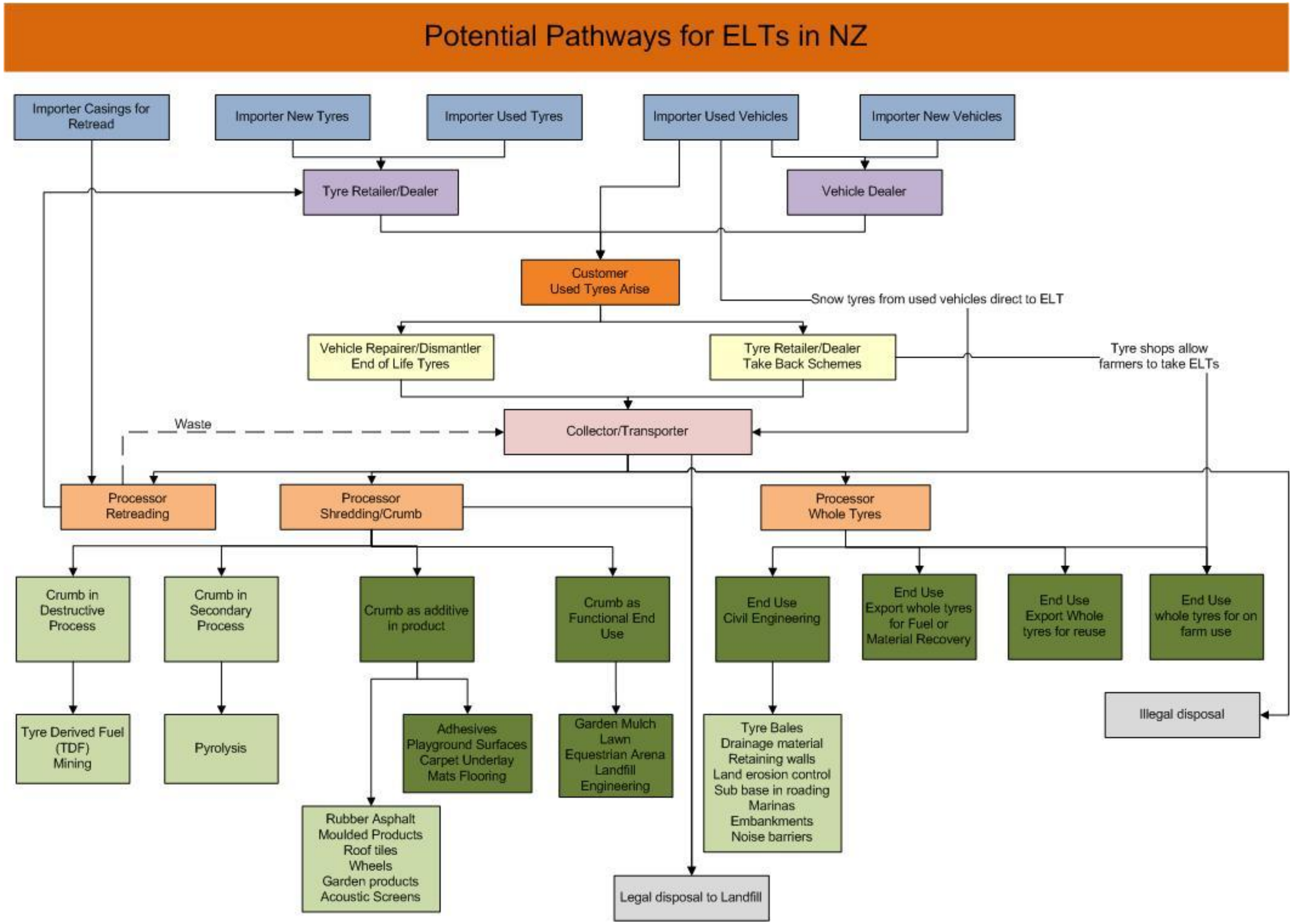
Social Summary

Being able to utilise crumb rubber as an alternative fuel in New Zealand would lead to the creation of medium to high level skilled jobs. This would be through the implementation of new infrastructure such as HOTDISC™ as well as the research and development around the use of rubber crumb as a fuel source. The potential to be able to use other alternative wastes in a system such as HOTDISC™ has other wider benefits as well.

The Working Group has scored this as **6** out of 10

8.0 Potential Pathways for ELTs in New Zealand

Those processes as determined as possible in New Zealand have been added to the Current New Zealand Situation – Tyre flows chart as documented in Scoping Report 1[3]. This has then formed a flowchart that shows the current New Zealand situation with possible end uses for the ELTs.


Potential Pathways for ELTs in NZ
Importer Casings for Retread
Importer New Tyres
Importer Used Tyres
Importer Used Vehicles
Importer New Vehicles
Tyre Retailer/Dealer
Vehicle Dealer
Customer
Used Tyres Arise
Snow tyres from used vehicles direct to ELT
Vehicle Repairer/Dismantler
End of Life Tyres
Tyre Retailer/Dealer
Take Back Schemes
Tyre shops allow farmers to take ELTs
Waste
Collector/Transporter
Processor
Retreading
Processor
Shredding/Crumb
Processor
Whole Tyres
Crumb in Destructive Process
Crumb in Secondary Process
Crumb as additive in product
Crumb as Functional End Use
End Use
Civil Engineering
End Use
Export whole tyres for Fuel or Material Recovery
End Use
Export Whole tyres for reuse
End Use
whole tyres for on farm use
Illegal disposal
Tyre Derived Fuel (TDF)
Mining
Pyrolysis
Adhesives
Playground Surfaces
Carpet Underlay
Mats Flooring
Garden Mulch
Lawn
Equestrian Arena
Landfill
Engineering
Tyre Bales
Drainage material
Retaining walls
Land erosion control
Sub base in roading
Marinas
Embankments
Noise barriers
Rubber Asphalt
Moulded Products
Roof tiles
Wheels
Garden products
Acoustic Screens
Legal disposal to Landfill

9.0 Conclusions

As illustrated throughout the report the alternative uses for ELTs are wide and varied and can be as simple as using a whole passenger car tyre to grow potatoes in the back yard, ranging up to a set of complicated chemical processes to break the tyre back down into its original components for use in further processing. The report grouped the alternative uses into the follow categories;

- Whole Tyres
- Fabricated/Cut Products
- Ambient and Cryogenic Material recovery
    - Further use – Crumb as an end use functional product
    - Further use – Crumb as an additive in a product
    - Further Use – Crumb in a secondary process
    - Further Use – Crumb in a destructive process
- Devulcanisation

These groupings were then assessed to see if they were viable in New Zealand and if so were scored against a set of predetermined questions to determine which grouping best met the environmental, economic, social and waste hierarchy requirements. The assessment of these groupings culminated in a hierarchy of end uses.

At the point the report was compiled, and based on the working group scoring, the alternative use that best met the environmental, economic, social and waste hierarchy requirements is reducing the ELT to crumb rubber and then using that crumb as an additive in a product. Whilst using ELT crumb rubber in a product might have scored the highest it is still accepted that there will be other sustainable uses for ELTs that will occur, for example the retreading of truck tyres.

One of the uses for crumb rubber in a product is as an additive in hot mix asphalt for roading applications. Roading is an end use for crumb rubber that satisfies a key part of developing end use markets within the Framework for Effective Management Systems for ELTs by the World Business Council for Sustainable Development (WBCSD). This is that establishing a large scale end use market such as crumb rubber in roading or TDF satisfies several necessary conditions, they allow for a continual intake of ELTs and provide a base market upon which all other end use markets can be developed.

In the future, and as new and emerging technologies are implemented, and as an ELT market gains maturity it would be expected that there would be growth and diversification in the end use markets for ELTs. The Framework by the WBCSD also identified that the greater the number of recovery routes established, the better the true value of all end markets can be recognised.[7]

10.0 References

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2. New Zealand Ministry for the Environment – Waste minimisation fund guide for applicants
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11.0 Appendix 1 – Extra Hierarchy Questions

Environmental

1. Will there be any regulation changes required for the type of processing to become operational?
   Examples for changes could be The Resource Management Act, Regional by-laws due to high land or water usage requirements
2. Can the product be recycled after its second useful life?
3. Will the process require extra land to be converted into a processing facility?

Economic

7. Will the process be owned/operated in New Zealand?
8. Are there local or national funds that will be invested in this type of processing?
9. Will funds derived from the processing be invested back into the New Zealand economy?
10. Will the process require continued investment in research and development?
11. Is the end use market local (within New Zealand)?
    As per the Tire Stewardship B.C. Scrap Tire Recycling Program priority must be given to serving the needs of New Zealand end users.
12. Is the process a full model (takes the entire tyre)?
13. Is the process a collaborative model (takes a by-product from another process)?
14. Does this process engage with current manufacturers (*perhaps a section in the report on current manufacturing in New Zealand*)
15. Is there any ability to have cross/inter sector collaboration?
16. Are there opportunities for businesses wanting to establish this type of processing to apply for WMF funding to implement the processing facility?
17. Is the process self powering with power back to the grid?
18. Will there be future development opportunities for this type of activity to process alternative wastes?
19. Is there existing collection infrastructure in place?