Treated Timber Waste Minimisation Project

Milestone 2: International Industry Trends

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Kaunihera Taiao ki Waitaha

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MINISTRY FOR THE ENVIRONMENT
WASTE MINIMISATION FUND PROJECT

TREATED TIMBER WASTE MINIMISATION

MILESTONE 2: INTERNATIONAL INDUSTRY TRENDS

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JUNE 2013

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1.0 EXECUTIVE SUMMARY

Current information on international trends and developments in utilising waste treated timber is difficult to obtain, possibly due to commercial sensitivity concerns and fears about public reactions to admissions of processing treated timber waste. Based on the information that has been obtained, the following conclusions are drawn as to technological advancements and emerging trends in the collection and reuse/recycling/recovery of waste treated timber internationally:

- CCA treated timber use is tightly restricted in most regions considered, and completely banned in some. CCA treated timber is considered hazardous waste in Europe and is handled accordingly. Bans on landfilling treated timber waste are increasingly common internationally.
- Production of CCA treated timber has sharply declined or ceased in most of the countries in which it has been historically utilised in large volumes, with other copper-based treatments being common alternatives.
- Despite production volumes declining, flows of CCA treated timber from demolition will continue for many years in countries that have utilised it historically.
- There are no widely used commercial applications for treated timber waste beyond landfilling and incineration, and no large scale commercial examples of chemical extraction processing were identified.
- Incineration is preferred in a number of countries because the hazardous treatment chemicals stay at the processing site to be disposed of (as filtered air emissions and ash), rather than producing contaminated fuels which will be further distributed.
- It is apparent that the limited availability of land has been a key driver in prompting a number of countries to restrict landfilling of treated wood waste and to consider waste management alternatives such as incineration. This provides a different context than that active in New Zealand.
- Processing multiple waste streams is common in waste incineration plants and allows them to operate at a larger scale, defraying capital costs. This also dilutes the treated timber waste, reducing the concentration of hazardous air emissions.
- Processing costs for all technologies identified, including incineration, appear very high.
- Waste to energy plants are becoming increasingly common throughout the world, but there are few examples of waste treated timber being a confirmed fuel source. It is apparent that 'clean wood waste' and municipal solid wastes are preferred, but reliable sources of clean wood waste are becomingly increasingly difficult to secure in some areas.
- Most waste to energy plants are producing and generating revenue from electricity and heat, with heat typically being supplied to district energy schemes for residential heating or industrial processes.
- Meeting air discharge requirements from any kind of thermal processing of waste treated timber is difficult and expensive, and even large plants with modern technology can have repetitive issues in meeting standards.
- Incineration of waste appears to produce strong and organised public opposition, highlighting the importance of flawless air discharge control, and the probability of opposition even if this is achieved.

- Use of waste treated timber in cement kilns is fairly common, but volumes are (or may potentially be) limited due to concerns about chromium content in cement.
- The most recent developments identified, being those based in Canada, have focused on the production of liquid biofuels from treated timber waste as these outputs have a relatively high value.
- Government subsidies for renewable energy generation appear to be becoming more common.

The following conclusions are drawn in terms of the impact of international trends and developments in utilising treated timber waste in New Zealand:

- While Milestone 1 rightly concluded that incineration of treated timber waste would be very difficult because of hazardous air emissions, almost any other option (other than use in a cement kiln) must be considered a relatively high commercial risk due to the lack of international precedent for such an operation at a commercial scale.
- Ensuring that fuels produced by other processes considered in this project (such as pyrolysis and biofuel production) are tested and shown not to be contaminated with treatment chemicals will be critical.
- Rigorous analysis and confirmation of processing costs for proposed options should be undertaken to ensure they are accurate and commercially sustainable.
- The air discharge management plans for proposed options must demonstrate with a high degree of certainty that they can adequately and appropriately handle volatilised arsenic and chromium.
- Landfilling of treated timber waste is easy and inexpensive for those seeking to dispose of waste in New Zealand compared to most other regions. This context makes achieving a commercially sustainable alternative for waste treated timber especially difficult.
- Use of treated timber waste in cement kilns appears to be a relatively low risk and viable option, albeit with limited potential for large volumes of waste utilisation, and a need to be sure that the behaviour treatment chemicals in the end products are well understood.
- Production of liquid biofuels from treated timber waste offers strong potential and is being embraced in Canada, but a lack of reliable information on the ability of these technologies to handle CCA treated timber waste suggests that this pathway should be approached with caution.
- Public opposition to any thermal processing of treated timber waste should be expected and prepared for.

2.0 INTRODUCTION

The Treated Timber Waste Minimisation project was launched on 4 March, 2013 with its overall goal being "to test the feasibility of, and subsequently develop a sustainable business model for the large scale collection and reuse, recycling and/or recovery of hazardous treated timber waste, with a particular focus on earthquake-related building and demolition waste."

This Environment Canterbury led project has received Ministry for the Environment funding of $144,900 towards the project's overall cost of $190,900, with the remainder coming from the project's governance group, consisting of:

- Environment Canterbury (ECAN) – Project owner
- Christchurch City Council (on behalf of the Canterbury Waste Joint Committee)
- BRANZ Limited
- Scion Research

The feasibility study has three key objectives:

- Identify and/or create a business case, supply chain and financial model, and end use for the collection, reuse, recycling and recovery of up to 20% (5,000 tonnes) of waste treated timber in Canterbury in such a way that it presents compelling economic and/or brand benefits to all participants in the supply chain (waste owners, processors, logistics providers and end users).

- Identify an appropriate, effective, easy to use and low-cost tool to be used by demolition companies and/or waste processors[1] for identifying treated timber on demolition and/or waste processing sites[2].

- Increase collaboration between timber waste minimisation stakeholders including demolition, timber and waste industries, Environment Canterbury, Canterbury territorial authorities, construction interest groups and the wider community to improve waste minimisation management of treated timber over its lifecycle.

Overall, the project is aimed at creating a sustainable and economically viable process or processes for the productive use of waste treated timber.

The project has been split into five key milestones:

1. **Industry Overview** (completed 10 May, 2013)

   A situation analysis and overview of the current waste treated timber industry and potential applications for treated timber waste.

2. **International Industry Trends** (due 14 June, 2013)

   An overview of key international trends and technological developments in the waste treated timber industry internationally and how the application of different elements of these might work in New Zealand.

[1] Target users are demolition workers, transfer station workers, builders and surveyors
[2] Primarily it would be used on the demolition site, but could also be used at transfer stations, landfills and re-use locations.

3. **Part 1 – Potential Scenarios** (due 16 August, 2013)

   A report detailing potential new waste treated timber collection and reuse, recycling and/or recovery systems for application in New Zealand, and the risks, financial implications and potential benefits of each scenario.

   Part 2 - Timber Identification Tool Development (due 16 August, 2013)

   A report providing an overview of international research related to waste treated timber identification on demolition and/or waste processing sites and undertake a feasibility study on the application of this research to create a tool or toolkit suitable for use in New Zealand.

4. **Detailed Business Cases and Stakeholder Collaboration** (due 4 October, 2013)

   Detailed business cases for each preferred scenario, including pilot trial plans.

5. **Pilot Trials** (due 20 December, 2013)

   A final report detailing pilot processes and outcomes, and scenario details and implementation plan for the preferred option or options.

This report addresses the requirements of the second milestone 'International Industry Trends' which are to:

- Research technological advancements and emerging trends in the collection and reuse/recycling/recovery of waste treated timber internationally.
- Review published research and presentations detailing successes and failures in the implementation of waste treated timber reuse/recycling/recovery systems.
- Explore the impacts that new technologies and systems could have on the collection and reuse/recycling/recovery of waste treated timber in New Zealand.

3.0 TRENDS IN TREATED TIMBER REUSE, RECOVERY AND RECYCLING

3.1 United Kingdom

In the United Kingdom, as with the rest of Europe, the use of CCA treated timber is restricted by European Community Directive 2003/2/EC. This directive requires that CCA treated timber only be used where skin contact with humans or animals is 'unlikely' such as highway fencing, power poles and bridges. Use in residential settings is explicitly prohibited, primarily due to arsenic content and related health concerns (EC, 2003). Although these regulations are relatively novel, CCA treated timber has not been as widely used in the UK and Europe as it has in Australia and New Zealand (Herinst, 2013). In the United Kingdom waste timber treated with CCA is classified as hazardous waste by the Department for the Environment, Food and Rural Affairs (DEFRA, 2012).

Because of its classification as hazardous waste, utilising treated timber for fuel becomes a very difficult proposition. Most activities that would seek to process treated timber waste are likely to come under the auspices of European Community Directive 2000/76/EC on the incineration of waste. This 'Waste Incineration Directive' (WID) is focused on the prevention of "pollution by emissions into air, soil, surface and groundwater, and the resulting risks to human health, from the incineration and co-incineration of waste" (EC, 2000). The directive applies to any 'incineration or co-incineration' of both hazardous and non-hazardous wastes. The WID specifically states that this includes "the incineration by oxidation of waste as well as other thermal treatment processes such as pyrolysis, gasification or plasma processes", but would not apply where all of the outputs and residues from these processes are productively utilised or landfilled (EC, 2000). The restrictions in the WID limit total average air discharge for copper, chromium and arsenic combined to 0.5 mg/m^3. This air discharge limit also applies to dioxins, which could result from incinerating pentachlorophenol (PCP) treated timber. This restriction would also apply to cement kilns utilising waste treated timber as a fuel (DEFRA, 2010).

Despite these tight restrictions on operation of plants for thermal processing of waste treated timber, the United Kingdom is relatively progressive in such operations. A report commissioned by the Waste and Resources Action Programme (WRAP) in the UK found that of the 3.0 Mt of wood waste generated in the UK only 0.6% was sent to landfill, with the remainder being productively utilised (DEFRA, 2012).

Figure 3.1 – Wood Waste Outcomes in the UK, 2008 – 2010 (DEFRA, 2012)

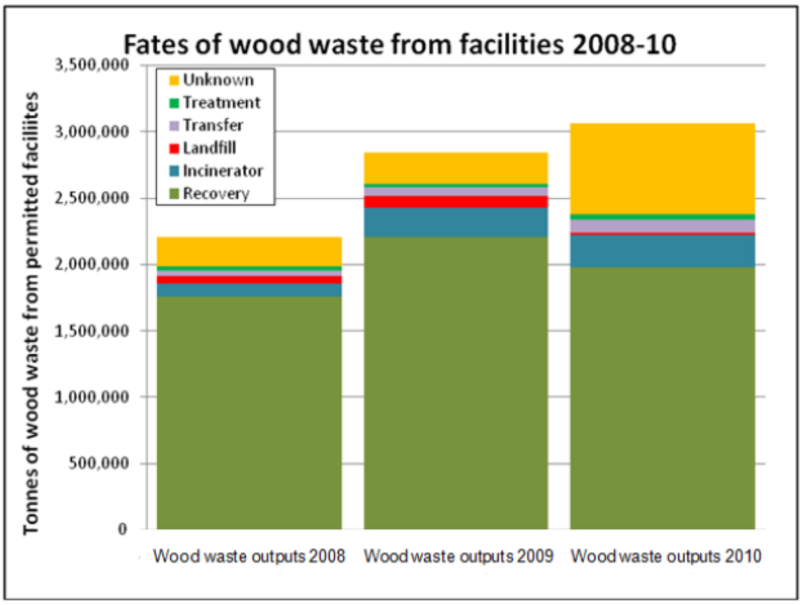
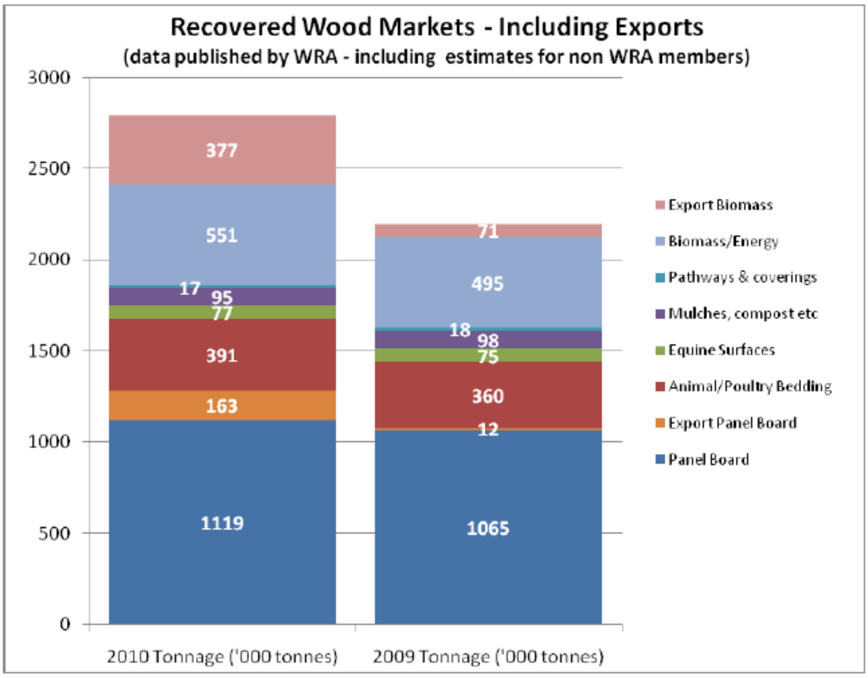


Figure 3.1 illustrates the high volumes of waste wood being recycled and utilised in the UK. Figure 3.2 shows that the main uses of this wood waste are as a raw material for panel board construction, and for use as biomass for waste to energy plants.

Figure 3.2 – Markets for Recovered Waste Wood, 2009 – 2010 (DEFRA, 2012)



Waste to energy plants in the UK appear to be becoming more common and the volume of wood waste being diverted to such operations is apparently increasing. Yet the ability to utilise *treated* timber is limited. When wood waste is recovered and sorted for use it is graded in accordance with the grades shown in Figure 3.3 as follows:

Figure 3.3 – Waste Wood Grades (Tolvik, 2011)

Grade	Typical Sources of Raw Material	Typical Materials	Typical Non-Wood Content Prior to Processing
Grade A – "Clean" Recycled Wood	Distribution. Retailing. Packaging. Secondary Manufacture e.g. joinery. Pallet Reclamation	Solid softwood and hardwood. Packaging waste, scrap pallets, packing cases, and cable drums. Process off-cuts from manufacture of untreated products.	Nails and metal fixings. Minor amounts of paint, and surface coatings.
Grade B – Industrial Feedstock Grade	As Grade A, plus construction and demolition operations and Transfer Stations.	May contain up to 60% Grade A material as above, plus building and demolition materials and domestic furniture made from solid wood.	Nails and metal fixings. Some paints, plastics, glass, grit, coatings, binders and glues. Limits on treated or coated materials as defined by Waste Incineration Directive
Grade C – Fuel Grade	All above plus Municipal Collections, Recycling Centres Transfer Stations And Civic Amenity Recycling sites	All of the above plus fencing products, flat pack furniture made from board products and DIY materials High content of panel products such as chipboard, MDF, plywood, OSB and fibreboard.	Nails and metal fixings. Paints coatings and glues, paper, plastics and rubber, glass, grit. Coated and treated timber (non CCA or creosote).
Grade D – Hazardous Waste	All of the above plus fencing, trackwork and transmission pole contractors.	Fencing Transmission Poles Railway sleepers Cooling towers	Copper / Chrome / Arsenic preservation Treatments Creosote

As the table shows, only non-CCA and non-creosote treated waste wood is considered suitable as fuel, while ‘Grade D’ (including CCA treated timber) is considered hazardous. Grades C and D wood waste can be utilised, but only in a WID-compliant processing facility, which requires expensive filtration systems (DEFRA, 2012).

Analysis of the UK’s main waste wood plants shows that waste treated timber is not a current source of fuel because of the difficulty in managing air discharge. There are at least seven large (greater than 10MW) wood biomass waste to energy plants in the UK that are currently operating (DEFRA, 2008). Of these, at least four use waste wood as a fuel source for cogeneration.

Figure 3.4 – Wilton 10 Power Station, Teeside, UK (Wikipedia)

The ‘Wilton 10’ plant in Teeside is a 42MW combined heat and power generation plant that utilises approximately 300,000 tonnes of waste wood annually. The plant cost £60 million (NZD114 million) to construct (about three times the cost of a typical power generation plant of this size) and provides 30MW of electricity; enough to power about 30,000 homes. The heat energy from the plant is utilised in a district heat energy scheme which is mainly used for industrial processing (Siemens, 2010).

When constructed in 2007 it was the UK’s first large scale biomass-only fuelled power station. This plant is typical of the type, scale and operation of the UK’s large cogeneration plants.

While utilising large volumes of waste wood, Wilton 10 can only handle ‘clean wood waste’ and has no ability to use treated timber of any kind. In fact, as most of the cogeneration plants in the UK are not fully WID-compliant, the trend has been to reject any kind of recycled wood due to fears over potential contamination (WRAP, 2007). These plants are instead focusing on forestry waste and other ‘virgin feedstock’. Some plants have also struggled to find required volumes of such waste locally and some have resorted to importing it (WRAP, 2007).

The key reason for favouring wood waste which has no risk of contamination is to ensure WID compliance, but Figure 3.5 also demonstrates some of the benefits that accrue for waste to energy plant operators from avoiding waste recycled wood:

Figure 3.5 – Features of Waste Wood vs. Forestry/Biomass Crops (DEFRA, 2008)

	Waste wood	Forestry / biomass crops
Fuel cost	Low	High
Moisture content	Low	High
Security of supply	Medium	High
Biomass content	Medium	High
Contaminants	High	Low

Even though waste wood offers some compelling benefits, some waste to energy plants have apparently assessed the risks as too high and appear to have increasingly avoided wood from waste streams. Other, newer waste to energy plants which have 'a degree of WID-compliance' are permitted to utilise up to 40% waste wood with 60% virgin feedstock (WRAP, 2007). Any waste wood can be burned except that classed as hazardous, which includes CCA treated timber.

Figure 3.6 – Dumfries Waste to Energy plant, Scotland (Herald Scotland, 2013)

Yet even when avoiding treated wood, the task is not a straightforward one for waste to energy plant operators. The challenges of operating a waste to energy plant can be seen in the experiences of Scottish energy company Scotgen in the operation of their plant near Dumfries.

Though it is not known exactly what sort of waste is being burned in this plant, its owners have struggled since 2009 to achieve successful operation, with only a fraction of its intended electricity generation output being reached. In addition, the plant has received a number of enforcement notices from the Scottish Environment Protection Agency (SEPA), which advises that the plant has breached air discharge standards over 200 times (for dioxin levels) since being commissioned (Herald Scotland, 2013).

The incineration plant, like many in the United Kingdom and Europe, has attracted large protests because of air emission concerns, and public opposition to such waste to energy plants appears to be growing in intensity. Organised environmental groups are currently seeking to scuttle plans for similar waste to energy plants in "Glasgow, Lanarkshire, Renfrewshire, Lothian, Perth, Aberdeenshire and Invergordon" (Herald Scotland, 2013). It is clear that, despite the potential environmental benefits from appropriately incinerating waste for energy recovery, public support is far from automatic.

Despite this, one of the evident driving forces behind the increased use of waste wood is a system of incentives offered by the UK government for renewable power generation. Electricity suppliers are able to earn Renewable Obligation Certificates (ROCs) if they provide evidence of sourcing power from renewable generation. These ROCs are worth about £50 (NZD95) per MWh. A plant the size of Wilton 10 may attract as much as £18 million (NZD34 million) in ROC incentives a year (WRAP, 2011).

ROCs are awarded on a sliding scale based on the type of technology in use. Cogeneration from waste earns one ROC per MWh, whereas the use of 'advanced gasification and pyrolysis' technologies generates two ROCs per MWH (WRAP, 2011).

These incentives have clearly assisted utilisation of waste wood but, following the UK government's setting of a target from obtaining heating from renewable sources of 20% by 2020, a need for an additional incentive was realised and the Renewable Heat Incentive (RHI) scheme was introduced in 2011 (WRAP, 2011).

The RHI "pays participants of the scheme that generate and use renewable energy to heat their buildings" (UK, 2013). The scheme includes the use of biomass as a qualifying renewable energy source, provided heat is in the form of hot water or steam. Large biomass heat generators (greater than 1MW) can earn 1p (NZD0.02) per kWh of heat generated, which could easily equate to hundreds of thousands of pounds in subsidies annually (UK, 2013).

Yet, despite these incentives, there is currently no outlet for waste timber treated with CCA in the United Kingdom (WRAP, 2011). Furthermore, the UK government has identified that "wood waste arisings labelled as hazardous, such as that treated with chromated copper arsenate (CCA) and creosote, are forecast to continue to increase for the foreseeable future" (DEFRA, 2012). This situation will be exacerbated by the moves in both the English and Scottish governments to seek a ban on landfilling of all waste wood (Tolvik, 2011). Such a ban was recently rejected by DEFRA with a focus instead on steadily increasing landfill taxes, but it is likely that calls for banning wood waste from landfills in the UK will continue to be made (Bioenergy, 2013).

It would be reasonable to conclude that this situation would give rise to greater innovation and consideration of more 'marginal' technologies as waste treated timber becomes more difficult to dispose of. Yet in this regard the Renewables Obligation Certificates (ROC) schemes may actually work as a disincentive. ROCs are lost (for the entire month) when lower grade wood waste is utilised at a plant that also burns higher grade fuel (DEFRA, 2008). Even if some form of chemical processing could be used to render CCA treated timber 'non-hazardous' its use would potentially put substantial subsidies at risk.

Pursuing such a risky fuel source seems unlikely for the UK in the foreseeable future. The UK government's own analysis identifies strong disincentives to consider any large scale cogeneration solution, let alone one that risks loss of subsidies or potential legal action by considering the use of anything other than the best quality waste wood fuel. Of particular concern in considering such plants are the following points:

- "Plants which produce in excess of 3MW may find it difficult to find an offtake for heat as the range for heat is typically 1-2km.
- Development costs and grid connection costs are high, with the latter potentially costing up to £500,000. A plant must be sufficiently large to benefit from the economies of scale.
- Proximity to fuel – larger plants will require a larger catchment area for wood fuel, which becomes less economical the further they are located from a plant.
- Fuel security – there is a higher risk associated with the availability of larger tonnages of wood fuel." (DEFRA, 2008)

In 2005 WRAP undertook a study to look at the different options for utilising waste treated wood and assessed the risks involved in each (WRAP, 2005). The report suggested that the options for re-use and recycling of treated wood were underdeveloped, but that there are strong barriers to greater activity including low market value for outputs and low current costs of disposal. Recycling into products such as particleboard was considered, but using CCA treated timber would require tight restrictions on volumes (less than 1% of raw materials) to meet hazardous waste requirements, meaning quantities used would not be large. Thermal processing technologies were also considered, including gasification and pyrolysis, and these were seen as relatively straightforward and attractive from a technical viewpoint, but contingent upon processing costs coming down and effective filtration of arsenic being undertaken. Other emerging technologies, including chemical treatment, were largely dismissed as being "too far from market" to be taken seriously as viable options (WRAP, 2005).

3.2 Europe and Scandinavia

Like the United Kingdom, European endeavours involving waste treated timber must follow the European Waste Incineration Directive (WID), which now applies to all existing thermal processing plants (WRAP, 2005). In addition to setting very tight emissions standards for hazardous waste (which includes CCA and creosote treated timber) the WID also requires careful handling of ash residues.

Throughout Europe there are many waste to energy plants that handle a wide range of different waste streams and are equipped with complex air filtration systems (including wet scrubbers) that would appear to be sufficient to handle emissions from treated wood waste. Yet almost no information is available on the exact wastes these plants process, and there is very little information on most of them that would indicate whether or not they can handle treated wood waste. Thus while observations can be made about the trends in waste to energy plants (mainly incineration with cogeneration supplying district energy schemes) these trends cannot necessarily be extrapolated to the processing of treated wood waste.

Figure 3.7 – Waste to Energy Plants Worldwide (ISWA, 2012)

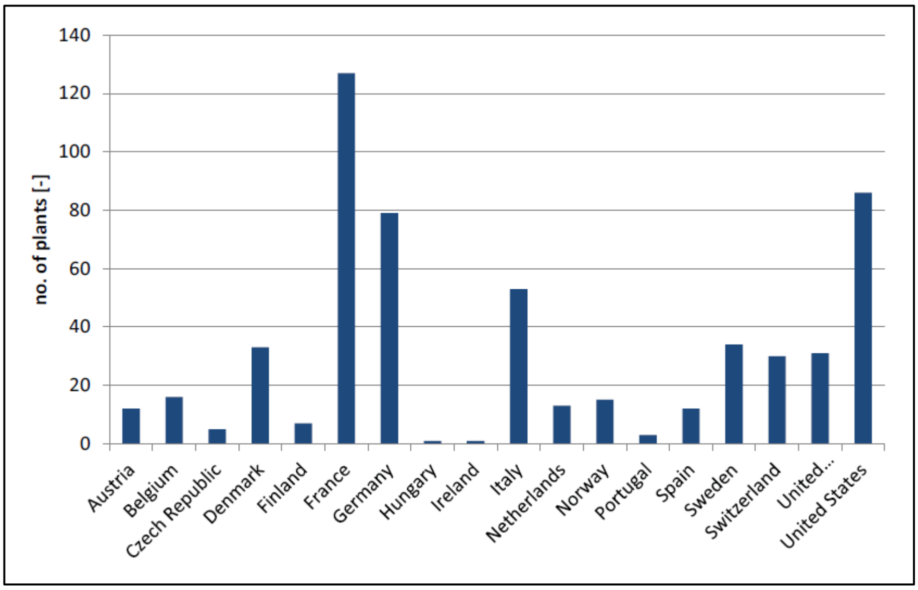


Figure 3.7 shows that the country with the most waste to energy plants worldwide is France, with an average plant processing capacity of about 16 tonnes of biomass per hour (ISWA, 2012).

Incineration is evidently the most common outlet for treated timber in France, with an estimated processing cost of between £103 and £309 (NZD196 – 588) per tonne for CCA and creosote treated timber waste (WRAP, 2005). Usage in cement kilns is also common, with up to 400,000 tonnes of waste treated timber utilised in this manner. Usage of treated timber in European cement kilns is tightly controlled by the EC Chromium (VI) Directive which limits the level of chromium in cement to 2ppm. This limitation, introduced in 2005, restricts the use of CCA treated timber in cement kilns and has likely increased the volume being incinerated (WRAP, 2005).

Beyond incineration, one of the most well-known and frequently cited examples of a productive use of treated timber waste is the 'Chartherm' process owned by French company Thermya. Thermya say that the Chartherm 'wood waste recycling system' can process any kind of wood waste regardless of contamination type or severity (Hery, 2004). The process crushes the wood, thermally treats it (low temperature pyrolysis) and separates out the residues to create 'carbon black', a high value multi-use product that is worth about US$1.00 (NZD1.25) per kilogram. Thermya state that their plant is able to recycle 1,500kg of wood waste an hour, and produce 280kg of 'clean carbon' per tonne of waste wood, indicating an annual revenue stream of about US$2.8 million (NZD3.5 million) if operating at capacity (Hery, 2004).

Yet up to date details on the Chartherm process and operations are difficult to obtain (the Chartherm website appears to have been disabled), and some are sceptical of the process and its outputs. The UK-based Waste and Resources Action Programme (WRAP) reviewed the technology in 2005 and found that the pilot plant was not operating anywhere near its capacity and that there was no independent data to support its claims around handling of arsenic emissions (WRAP, 2005). The WRAP report also found estimates of the Chartherm processing costs as between £103 and £309 (NZD196 – 588) per tonne, potentially exceeding the revenue from carbon black sales. An Australian government report estimated Chartherm processing costs at between A$250 and A$750 (NZD300 – 903) per tonne (Haynes et al, 2007).

More recently, Thermya's focus seems to have shifted to new technologies. The Charspyd process, based on Chartherm, is designed to produce high-carbon charcoal from agricultural and forestry waste (WMW, 2007). Thermya have also constructed three biomass torrefaction plants - two in France and one in Spain – to produce biocoal from local forestry residues (not treated wood waste) using their new 'TORSPYD' technology (Biomass, 2011). In fact, almost all the recent mentions of Thermya in industry publications relate to torrefaction, suggesting both the importance of torrefaction as an emerging technology for the production of biocoal, and a probable shift in focus for Thermya.

Yet, ultimately, Thermya consider that the Chartherm process is "the only process worldwide that is able to handle at an industrial scale, hazardous CCA-treated (chromated copper arsenate) wood waste in an environmentally friendly manner" and does not appear to use treated wood as a feedstock for any process other than Chartherm (WMW, 2007).

Figure 3.8 – Sidenergie charcoal (Sidenergie)

Another novel French technology for processing treated timber is known as Sidenergie. The process utilises only creosote treated timber from railway sleepers, processing some 18,000 tonnes of wood waste a year to produce charcoal for domestic use (Sidenergie, 2013). The process combusts the wood at about 380°C, converting the creosote to a gas. Estimates suggest it costs roughly €120 (NZD194) per tonne of wood to process through the technology, with 1 tonne of waste wood generating 220kg of charcoal.

As with a number of other European waste to energy initiatives, there has been strong opposition to Sidenergie's process from environmental groups. French environmental group Robin des Bois has accused Sidenergie of producing charcoal contaminated with dioxins, but the company has denied this and maintains the charcoal has been independently verified as safe (WRAP, 2005).

In Belgium, a 2005 study produced by researchers from the University of Leuven considered all the available options for managing CCA treated timber waste (Helsen et al, 2005). This report cast doubts on the claims of pyrolysis proponents that arsenic does not volatilise at the temperatures used for the process, and instead asserted that the behaviour of arsenic is unpredictable and must be a primary consideration of any treatment process. Pyrolysis was viewed, however, as preferable to incineration or gasification. In the short term, the report authors considered that using CCA treated timber in low concentrations with other fuels such as coal offered the best outcomes, provided air discharge standards could be met (Helsen et al, 2005).

In Switzerland, the landfilling of all waste was banned in 2000, with incineration remaining as the only option for non-recycled waste (BAFU, 2009). CCA treated timber has been banned for sale and use in Switzerland for over a decade (Beder, 2003). The primary disposal methods for waste treated timber in Switzerland are cement kilns and special incinerators, which must be regularly monitored to ensure compliance with air discharge requirements (WRAP, 2005).

In Germany waste wood must either be recovered or disposed of using some manner of thermal processing (Love, 2007). This has contributed to a rapid increase in the number of waste incineration plants in Germany since the 1960s as illustrated by Figure 3.9:

Figure 3.9 - Waste Incineration Plants in Germany since the 1960s (Umwelt, 2008)

Year	Number of plants	Waste throughput in 1000 t/a	Average throughput per plant in 1000 t/a
1965	7	718	103
1970	24	2.829	118
1975	33	4.582	139
1980	42	6.343	151
1985	46	7.877	171
1990	48	9.200	191
1995	52	10.870	202
2000	60	13.900	230
2005	66	16.000	242

Like those in most of Europe, waste incineration plants in Germany have faced strong public opposition, leading to increased air pollution monitoring and standards. This public pressure has led to a forced improvement in the environmental performance of such plants “without regard to cost and energy consumption”, suggesting that profitability may have been negatively impacted as higher standards have been set (Umwelt, 2008). It is understood that the performance of these plants has now resulted in publically acceptable “emission control standards, dioxin, dust and heavy metals emissions” even as waste incineration has greatly increased in Germany (Umwelt, 2008).

In Spain, a company called Procontrol has developed ‘electrocoagulation’ technology for wastewater treatment and believes their technology may be suitable for processing waste treated timber. The system uses an electrochemical process to extract metals from waste and, if waste treated wood were processed and dissolved in hot water, electrocoagulation may be able to extract cooper, chromium, arsenic and other treatment chemicals from the ‘pulp’ (Procontrol, 2013).

Procontrol state that their processing costs are relatively low, but it is clear that substantial water and energy input would be required, and the output wood fibre sludge would need to be dried before being applied to any other use. It is unlikely that this would be an economic option and, to date, the system has not been tested with CCA treated timber to determine feasibility.

In Finland, the use of CCA treated wood has become increasingly restricted and in 2004, the government banned the use of CCA treated wood in several areas such as residential areas, playing grounds or any other areas frequently exposed to human contact (Sipila et al, 2007). Two years later the use of CCA as a wood preservative became completely prohibited in Finland. Despite this, it has been estimated that there is around 7,000,000 m^3 of CCA treated wood in Finland which will eventually require disposal (Sipila et al, 2007).

In response to this need, the Finnish Wood Preservation Association created a company called Demolite Oy to provide a service whereby treated wood can be returned to the stores where new wood is purchased (Ottesen et al, 2004). This service has been considered "the only true [Extended Producer Responsibility] scheme for treated timber in the world" (Love, 2007).

The scheme is partly funded by fees paid when timber is purchased and partly by disposal fees for larger quantities, although disposing of up to one cubic metre is free (Love, 2007). Demolite Oy process the timber into wood chips and the chips are incinerated, and energy recovered by another company, Ekokem Oy (Sipila et al, 2007).

Figure 3.10 - Ekokem Cogeneration Plant, Riihimäki, Finland (Metso, 2008)

Information is available on a number of different Ekokem waste to energy plants, but none of this identifies which plants are equipped to incinerate treated timber waste.

Most of these (such as one constructed in Riihimäki near Helsinki) appear to be cogeneration plants, with electricity being supplied into the national grid and heat being supplied into local district energy schemes for residential heating (Metso, 2008).

Interestingly one Finnish company also undertook a trial of CCA treated wood as a fuel in a copper smelter (Torvik, 2012). It was claimed that almost all of the copper and arsenic in the wood was recovered and reused, and that the chromium residues were treated to leave them insoluble in the smelter slag. No up to date information could be found to determine whether treated wood is still being utilised in this way in Finland.

Considerable research has been undertaken in Finland in the last decade considering the best ways to deal with treated timber waste. The conclusions of one notable report (Sipila et al, 2007) appear to well represent Finnish views on the issue of treated timber waste: "all in all, it seems there are only two widely spread ways of managing treated wood waste today, one is simple landfill disposal and the other one is incineration, both of which cause environmental problems". This report concluded that dilution and incineration of CCA treated timber waste with municipal sewage sludge offered the best outcomes and that this combination reduced arsenic volatilisation (Sipila et al, 2007). While information relating to Ekokem's operations is limited, it appears this may be part of their operational practice.

In Sweden, the Swedish Waste Decree requires that most treated wood be separately handled as hazardous waste and sent to specially licensed incineration plants (Krook, 2006). Yet one report (Krook, 2006) suggests that the process for sorting treated wood waste out from untreated wood waste is flawed, and that significant volumes of treated wood waste end up being processed in unlicensed facilities. Yet the author of this report concludes that this is not necessarily a negative phenomenon, as this treated timber waste ends up being highly diluted with untreated waste and used in plants supplying heat to Sweden's numerous district heating schemes. This dilution means that the plants do not exceed air discharge limits and suggests that utilising treated wood waste in this way may offer the best outcome (Krook, 2006).

3.3 North America

Along with Australia and New Zealand, the United States has been one of the three largest users of CCA treated timber per capita in the world (Beder, 2003). This use is already in decline, however, due to the fact that, in 2002, the United States Environmental Protection Agency announced a voluntary agreement with industry to phase out CCA treated timber for most non-industrial applications, including decking, by 2004 (Arch, 2007). This is understood to have been a response to the fear of lawsuits from those who might be negatively affected by contact with hazardous chemicals within the wood.

Yet, in the USA CCA treated wood is still not considered to be hazardous waste, and the US Environmental Protection Agency specifically prohibits CCA treated timber being defined as such (EPA, 2009). Perhaps as a result of this, the most common disposal method for waste treated timber in the US continues to be landfilling along with other construction and demolition wastes (Sipila et al, 2007). In California and Florida, as in many other states, these landfills are unlined. While internationally this is largely seen as an unwise course of action, research by an American timber preservative industry lobby group suggests leachate concerns are largely unfounded (WPSC, 2008).

According to the International Solid Waste Association there are 86 waste to energy plants in the United States, compared to 455 in Europe (ISWA, 2012). The state with the largest number of waste to energy plants (11) is Florida.

The University of Florida's Bill Hinkley Center for Solid and Hazardous Waste Management, which has produced a substantial proportion of the US-based research on the handling and disposal of CCA treated timber over the last decade, has produced a 'Best Practice Management' guide for treated timber in the US (CCAR, 2012). This guide focuses on sorting waste treated timber from other C & D waste streams (using fairly complex methods) to ensure it is not inadvertently processed using incorrect methods. The guide recommends disposing of treated timber in a lined landfill, and states "generally, little treated wood goes to [Waste to Energy] WTE facilities. The emissions from the de minimis amounts in the waste stream are believed to be adequately handled by each facility's air pollution control equipment. However, the impacts from large-scale burning of treated wood in WTE facilities have not been tested, and it is not known how much treated wood can be safely burned. Therefore, the use of WTE facilities for large-scale bulk disposal of treated wood is not recommended" (CCAR, 2012).

Despite this recommendation Koppers, a Pennsylvania-based company which produces treated wood products for industrial use (particularly railway sleepers), operates a cogeneration plant which they describe as "the only cogeneration facility in the world totally dedicated to the proper disposal of used treated wood as an energy feedstock” (Koppers, 2013). The plant uses approximately 100,000 tonnes of used creosote-treated wood waste each year to produce power for 700 local homes. Heat from the plant is used in a nearby Koppers wood treatment plant (Wikimapia, 2013). This plant does not process CCA treated timber waste.

Whereas there appears to be little recent and published development in productively utilising treated wood in the US, endeavours in Canada appear to be more advanced.

Canadian company PWS Technology, based out of British Columbia, has developed a technology they call ‘Hogwash’ which uses fibres in waste treated timber to create bio-coal. The process is also known as Counter Current Extraction and the particular form in use is patented by PWS in Canada and the US. The PWS website says “Counter-Current Extraction (CCE) technology was originally developed in Australia to gently extract juice from fruit using diffusion extraction. It is used by Ocean Spray in the USA to produce cranberry products and also in Australia and several other countries in fruit juice extraction applications” (PWS, 2013).

It is understood this technology has been well tested conceptually, and a large scale plant is under construction on Vancouver Island to handle contaminated wood waste. This will be the first commercial scale plant constructed using the Hogwash technology which will have the ability to handle treated timber waste. This plant has a processing capacity of 250,000 tonnes of wood a year, and it is estimated it will cost CDN$7.5 million (NZD9.0 million) to complete. The output bio-fuels have a market value of about CDN$200 (NZD241) per tonne in the local market.

Peter Smith, who has led development of the technology in Canada believes that a plant could be built in New Zealand to handle earthquake-related and ongoing wood wastes, including ‘most’ treated timber waste, and that the technology would be particularly suitable for the situation in Christchurch. This plant could potentially handle 60,000 tonnes of waste wood annually and could be built in New Zealand or pre-fabricated and shipped from Canada.

Smith says that the timber treatment chemicals would be stripped from the wood waste as it is processed into an ‘aqueous mixture’ which could then be separated and recovered, although it is acknowledged that the latter process is complex and costly. The overall capital expenditure that would be required for a plant in New Zealand is not yet known, and there would still be some ‘engineering feasibility work’ to be done to ensure the process would work.

Figure 3.11 - Enerkem’s Westbury Plant, Quebec, Canada (Enerkem)

Another innovative solution to treated timber waste has been developed by Montreal-based Enerkem. The company, named as one of Fast Company magazine’s 50 Most Innovative Companies in 2011, has developed technology to create biofuels from diverse waste streams (FC, 2011).

One of Enerkem’s two biofuels plants is located adjacent to a saw mill in Westbury in Quebec and began operation in 2009.

The saw mill recycles creosote treated power poles by removing 'the middle part' to use as construction timber. The remaining wood is chipped and sent to Enerkem's plant to be converted into ethanol (Biomass, 2013).

The treated timber is converted into a synthetic gas "consisting mostly of carbon monoxide and hydrogen-through a chemical gasification process" at a temperature of about 700 °C (Biomass, 2013). This gas is, according to Enerkem, ready for conversion into liquid fuel and is suitable for "either industrial grade products or fuel additives" (Biomass, 2013). The plant commenced production of methanol in 2011 and has been producing ethanol since 2012, with an annual capacity of 5 million litres (Enerkem, 2013). Enerkem say they can make strong returns where they are able to charge tipping fees for treated timber (around US$50 or NZD62 per tonne), and acceptable returns when the fuel source is provided free of charge (Biofuels, 2012).

Unfortunately there is no information indicating whether CCA treated timber is acceptable in Enerkem's process.

In Joliette, Quebec GCSL (which is part of Holcim Cement and owned by the same international group as Holcim Cement New Zealand) has been using CCA treated timber as a cement kiln fuel since the mid-1990s (Cooper, 1999). The plant has a permit allowing burning of up to 90,000 tonnes of treated wood per year, regardless of treatment type. It is estimated that if all cement kilns in Canada accepted CCA treated wood, approximately one third of the current production of spent CCA treated wood in Canada could be productively utilised in this way (Cooper, 1999). In 2006 Holcim expanded its alternative fuels capacity and created a new 'Alternative Fuels Platform' in Joliette, including the ability to utilise formaldehyde treated particle board as a fuel (GCSL, 2007).

3.4 Australia

In 2007 the Australian Government's Forest and Wood Products Research and Development Corporation (FWPRDC) commissioned a report from the University of Sydney on an appropriate solution for thermal processing of 'end of life' CCA treated timber products (Haynes et al, 2007). The report was based on the fact that, while CCA treated timber is not considered hazardous in Australia, the authors estimated that 130,700 tonnes of such waste is being sent to landfills in Australia each year. This has evidently led to a growing concern about CCA treated timber.

In 2005 Australia's Pesticides and Veterinary Medicines Authority (APVMA) issued a report expressing particular concern at potential leaching from treated timber in landfills (APVMA, 2005). In 2012 the APVMA further restricted CCA treated timber usage, classifying it as a 'restricted chemical product' meaning that it can only be sold to 'suitable trained and qualified people', it must be clearly labelled as CCA treated and it may not be used in 'high contact areas' (AVPMA, 2012).

The FWPRDC report focused on the difficulties associated with handling copper, chromium and arsenic air discharges and focused on the technology they believed would best handle these hazardous chemicals. They concluded that while arsenic volatilisation is likely to occur with any form of thermal processing of CCA treated timber, combustion was the preferred option because it would concentrate these chemicals at the processing site, whereas other processes such as pyrolysis and gasification would create other fuel outputs (such as biochar) which would also potentially be contaminated (Haynes et al, 2007). The report also highlighted the energy capture potential from utilising waste treated timber as a combustion fuel source, although it did not consider what form this would take (such as cogeneration) nor its economic feasibility.

The report considered the potential of using CCA treated timber waste as a fuel source for cement kilns in Australia, as was considered in this project's Milestone 1 report, and noted that the Adelaide Brighton Cement Company was several years into a project examining the feasibility of treated timber as a fuel source in partnership with the South Australian Environmental Protection Agency (SAEPA). At that stage tests with CCA treated timber in use as 10% of the overall feedstock in a cement kiln did not exceed air discharge limits in the area. The authors of the report were not aware as to whether the cement kiln was actually utilising CCA treated timber following the trials, and no subsequent documents could be found that mentioned its usage. The cement company appears to be utilising construction and demolition waste as a fuel source, but a 2008 SAEPA document on potential uses for CCA treated timber waste does not mention use in a cement kiln as an option (SAEPA, 2008).

Ultimately, the FWPRDC report concluded that if the European Union limits on chromium in cement (2ppm) were applied in Australia, only 5,000 tonnes of treated timber would be utilised; a volume too low to be of much value to their efforts (Haynes et al, 2007).

The conclusion of the report was that a 'grate-firing combustion' system would be the best outlet for waste CCA treated timber, due to lower capital expenditure outlay and operating costs. This technology places large 'chunks' of timber on a vibrating grate and burns it with air being fed from below, and is noted in the report as being a common technology for waste incineration throughout the world.

Attention in the report then turns to the control of air emissions, with an acknowledgement that "complete capture of the arsenic oxide vapour is very difficult to ensure" and suggesting that flue gas treatment will be necessary to eliminate arsenic emissions (Haynes et al, 2007). The report authors advise that chemical sorbents, bag filters and wet gas cleaning or active carbon filters would be required. These systems would likely prove very expensive. It is also proposed that contaminated ash be sent to local copper smelters who would have the expertise to extract the chemicals contained therein.

An earlier report from the FWPRDC (Stewart et al, 2004) focused on incineration as the preferred thermal processing method for CCA treated timber, and considered the optimum conditions, such as combustion temperature, for processing the waste. The report found that, after processing, all of the copper, more than 90% of the chromium and between 20% and 80% of the arsenic originally in the timber waste was contained in the ash. It was concluded, as is now well known, that temperature impacts arsenic volatisation markedly, with lower temperatures resulting in lower levels of volatisation. Rather than providing a prescribed design for the 'best' way to process CCA treated timber by combustion, the report concluded that the optimum method depended on the priorities in implementing a system, with energy recovery working best at high temperatures with excess oxygen and greater metals stability in the ash at lower temperatures with lower oxygen concentrations (Stewart et al, 2004).

From a commercial perspective, as a 2007 Sustainability Victoria report concluded, the "economic viability of alternative waste management options such as production of heat or energy or production of composite products is significantly impacted in Australia by the geographic dispersion of the waste product. Ensuring a consistent supply of product would require significant efforts in separating, collecting and transporting the material from the hundreds of building sites, demolition yards, farms, vineyards and backyards of users of treated timber across Australia" (SV, 2007).

One very recent development however, is the approval of a A$12 million (NZD14.4 million) gasification waste to energy plant in Port Hedlund, Western Australia. Construction will begin within the next few years, and the plant is expected to process 255,000 tonnes of municipal solid waste and C & D wastes per annum, including wood, and generate 15.5 MW of electricity (Enviroinfo, 2013). The plant will include a Materials Recovery Facility to remove any recyclable resources, and process all other wastes so that landfilling is completely avoided. New Energy Corp, which will operate the plant, says that “at the request of industries operating in the region, New Energy is considering the possibility of accepting some waste oil and solvents but hazardous substances such as asbestos and waste pesticides will not be accepted” (New Energy, 2013).

A question and answer panel held by New Energy for the local community in August of 2011 received a question enquiring whether the plant would be able to receive creosote treated timber. The response was: “Yes, that’s absolutely fine. Our process takes all the organics and puts them into the gas, and then burns the gas very efficiently. So any organics, like creosote, will just be volatilised or gasified and burnt in the syngas burner, completely destroying them” (New Energy, 2011). There is no information available, however, as to whether the plant will accept other forms of treated timber.

3.5 Asia

CCA-treated wood has been banned altogether in several Asian countries including Vietnam and Indonesia and severely restricted in others such as Japan (Beder, 2003).

Japan is the largest user of thermal treatment for municipal solid waste for waste to energy plants in the world, processing some 40 million tonnes a year (WMW, 2007a). Japan has historically been a heavy user of CCA treated timber, with some 300,000m^3 being produced each year in the 1990s.

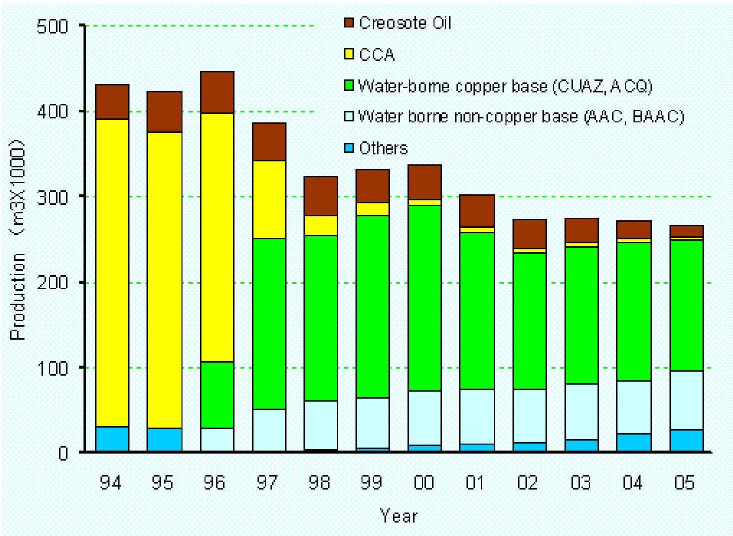


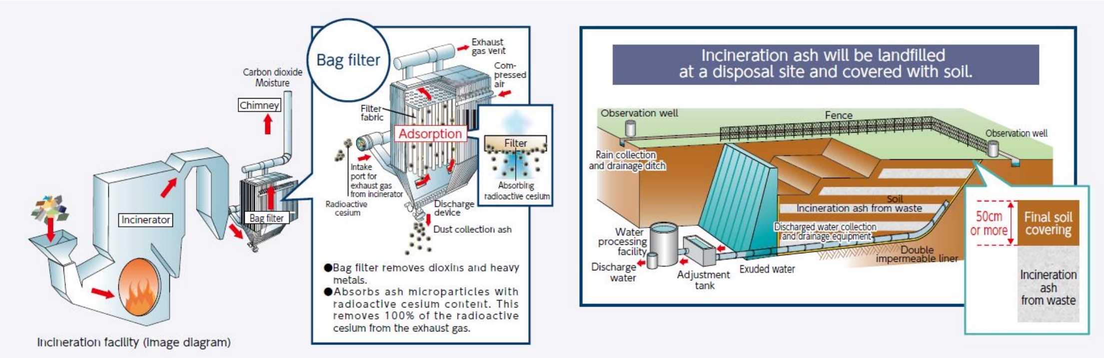
Figure 3.12 – Japanese Production of Treated Wood (1994 – 2005) (Mokuzaihozon, 2011)

In 1997 the Water Pollution Prevention Act was passed in Japan, which resulted in most companies ceasing production of CCA-treated timber and production volumes almost disappearing, as shown in Figure 3.12 (Mokuzaihozon, 2011). Although production of CCA treated timber has essentially ceased, an estimated demolition flow from residential homes of 200,000 m^3 per annum still remains, most of which is incinerated (Hata et al, 2002).

On March 11, 2011 a magnitude 9.0 earthquake struck the Tohoku and Kanto regions of Japan, triggering a giant tsunami which killed more than 16,000 people (JME, 2012). In addition, 129,855 buildings were completely destroyed and another 257,739 buildings substantially damaged, resulting in approximately 18 million tonnes of waste (JME, 2012).

Faced with a massive waste clean-up, it appears that the Japanese government has ordered the majority of the non-recyclable tsunami-related waste, including treated timber, to be disposed of by incineration (JME, 2012).

No information is available as to concerns around air emissions, but it is apparent that the primary public concern the Japanese government is endeavouring to alleviate is around radioactive material and so it has published information highlighting the filtration technology in use in waste incinerators being deployed to process tsunami-related waste streams.



(Bag filter) (Landfill disposal of incineration ash)

Figure 3.13 – Japanese Tsunami Waste incineration technology (JME, 2012)

It is probable that such filtration technology, which includes a specific focus on removing 'heavy metals' via bag filters, would at least prevent a substantial proportion of arsenic and chromium-contaminated air discharge.

Figure 3.14 - Fuzhou Hongmiaoling waste to energy plant, Chongqing, China (WMW, 2012)

In China, an increasing focus has been placed on deriving energy from waste to energy plants, with the Chinese government offering subsidies of up to US$30 (NZD37) per MWh for electricity derived from 'non fossil fuel' generation and the number of waste to energy plants doubling in the last decade (WMW, 2012). Most of these plants use incineration, utilising the grate combustion process favoured by the FWPRDC report in Australia, and include complex filtration systems to avoid toxic air discharges (WMW, 2012).

In April, 2013 the Asian Development Bank made US$200 million (NZD250 million) in loans available to a state-owned Chinese development company to build waste to energy plants in small and medium-sized Chinese cities in response to China's status as the world's second largest producer of solid waste with 220 million tonnes created annually (ADB, 2013). The ADB says its loan "will help build at least nine plants capable of converting up to 6,300 tons of municipal solid waste daily into electricity…[and] generate around 610 gigawatt-hours of electricity a year by 2018, using clean technologies (ADB, 2013).

None of the available information relating to waste to energy plants in China notes whether treated timber is processed in the plants, but the extent of the filtration technology in use suggests this may be the case, at least at low volumes.

In addition to an emphasis on deriving energy from renewable sources, waste to energy plants, China is also focusing on the use of alternative fuels in manufacturing processes. China is the world's largest manufacturer of cement with 44% of global production originating in its more than 5,000 cement plants (Murray et al, 2008). While few Chinese cement kilns currently use alternative fuels, the Chinese Ministry of Construction has required such plants to achieve a lower environmental impact. One of the pathways being considered in China is the use of widely available biomass as a co-firing option for cement kilns. However, at this stage, only agricultural and forestry wastes are being considered, and not construction and demolition wastes (Murray et al, 2008).

4.0 CONCLUSIONS AND POTENTIAL APPLICATION TO NEW ZEALAND

Finding current and comprehensive information relating to international trends in the actual commercial utilisation or disposal of treated timber waste has proven extremely difficult. Where information on waste to energy technology is available, it is unusual for there to be any mention of treated timber waste in order to include or exclude it as a waste able to be processed. It is suspected that the lack of this information is due to a number of factors:

- The latest developments in the commercial sphere are likely to be commercially sensitive
- Information on novel commercial technology applications is unlikely be publically released until proven and stable
- Revealing that treated timber is being processed may attract negative public attention, due to pollution concerns

As a result, while there is ongoing academic and experimental dialogue around processing of treated timber waste, mapping the latest trends in the commercial sphere requires some level of assumption and extrapolation of available information.

Based on the information that has been obtained, the following conclusions are drawn as to technological advancements and emerging trends in the collection and reuse/recycling/recovery of waste treated timber internationally:

- CCA treated timber use is tightly restricted in most regions considered, and completely banned in some. CCA treated timber is considered hazardous waste in Europe and is handled accordingly. Bans on landfilling treated timber waste are increasingly common internationally.
- Production of CCA treated timber has sharply declined or ceased in most of the countries in which it has been historically utilised in large volumes, with other copper-based treatments being common alternatives.
- Despite production volumes declining, flows of CCA treated timber from demolition will continue for many years in countries that have utilised it historically.
- There are no widely used commercial applications for treated timber waste beyond landfilling and incineration, and no large scale commercial examples of chemical extraction processing were identified.
- Incineration is preferred in a number of countries because the hazardous treatment chemicals stay at the processing site to be disposed of (as filtered air emissions and ash), rather than producing contaminated fuels which will be further distributed.
- It is apparent that the limited availability of land has been a key driver in prompting a number of countries to restrict landfilling of treated wood waste and to consider waste management alternatives such as incineration. This provides a different context than that active in New Zealand.
- Processing multiple waste streams is common in waste incineration plants and allows them to operate at a larger scale, defraying capital costs. This also dilutes the treated timber waste, reducing the concentration of hazardous air emissions.
- Processing costs for all technologies identified, including incineration, appear very high.

- Waste to energy plants are becoming increasingly common throughout the world, but there are few examples of waste treated timber being a confirmed fuel source. It is apparent that 'clean wood waste' and municipal solid wastes are preferred, but reliable sources of clean wood waste are becomingly increasingly difficult to secure in some areas.
- Most waste to energy plants are producing and generating revenue from electricity and heat, with heat typically being supplied to district energy schemes for residential heating or industrial processes.
- Meeting air discharge requirements from any kind of thermal processing of waste treated timber is difficult and expensive, and even large plants with modern technology can have repetitive issues in meeting standards.
- Incineration of waste appears to produce strong and organised public opposition, highlighting the importance of flawless air discharge control, and the probability of opposition even if this is achieved.
- Use of waste treated timber in cement kilns is fairly common, but volumes are (or may potentially be) limited due to concerns about chromium content in cement.
- The most recent developments identified, being those based in Canada, have focused on the production of liquid biofuels from treated timber waste as these outputs have a relatively high value.
- Government subsidies for renewable energy generation appear to be becoming more common.

These trends and developments highlight the challenges for the reuse, recycling or recovery of treated timber in New Zealand. Specifically, the following conclusions are drawn in terms of the impact of international trends and developments in utilising treated timber waste in New Zealand:

- While Milestone 1 rightly concluded that incineration of treated timber waste would be very difficult because of hazardous air emissions, almost any other option (other than use in a cement kiln) must be considered a relatively high commercial risk due to the lack of international precedent for such an operation at a commercial scale.
- Ensuring that fuels produced by other processes considered in this project (such as pyrolysis and biofuel production) are tested and shown not to be contaminated with treatment chemicals will be critical.
- Rigorous analysis and confirmation of processing costs for proposed options should be undertaken to ensure they are accurate and commercially sustainable.
- The air discharge management plans for proposed options must demonstrate with a high degree of certainty that they can adequately and appropriately handle volatilised arsenic and chromium.
- Landfilling of treated timber waste is easy and inexpensive for those seeking to dispose of waste in New Zealand compared to most other regions. This context makes achieving a commercially sustainable alternative for waste treated timber especially difficult.
- Use of treated timber waste in cement kilns appears to be a relatively low risk and viable option, albeit with limited potential for large volumes of waste utilisation, and a need to be sure that the behaviour treatment chemicals in the end products are well understood.

- Production of liquid biofuels from treated timber waste offers strong potential and is being embraced in Canada, but a lack of reliable information on the ability of these technologies to handle CCA treated timber waste suggests that this pathway should be approached with caution.
- Public opposition to any thermal processing of treated timber waste should be expected and prepared for.

Overall the international research has demonstrated that, while there is a vast amount of academic discourse on different technologies for processing waste treated timber, there is very little evident commercial uptake of this research. Certainly it would be expected that there would be a lag between undertaking research and commercialising that research, but there is also the probability that some of this research is focused simply on *what can be done* with little consideration as to its economic sustainability or applicability to 'real world' conditions. There is also little agreement in academic research over the best methods for thermally or chemically processing waste treated timber and the risks of these processes. The behaviour of arsenic and chromium in thermal processing is a particular point of disagreement, and it seems prudent to assume that the 'deportment' of these elements in such processes is unpredictable and that 'real world' testing of potential solutions will be required.

Despite an apparent disconnect between academic and commercial endeavours, as the number of waste to energy plants continues to grow, especially in Asia and Europe, and supplies of clean wood waste become harder to reliably access, waste treated timber may become a fuel source that must be more seriously considered. If restrictions on landfilling become more stringent and increasing volumes of CCA treated timber enter the demolition waste stream, its consideration internationally as a fuel source may intensify further. A number of the research papers considered in this report suggest that dilution of treated timber waste with other waste streams results in more acceptable air emissions, and this may be a solution that is increasingly adopted internationally. These trends may drive further innovation and research into practical and economically viable solutions for handling treatment chemicals in thermal processing.

Overall, it is evident that creating an environmentally and economically sustainable business model for utilising waste treated timber in Christchurch will be difficult, and the challenges faced in international endeavours demonstrate this clearly. While small volumes can be disposed of in proven outlets, such as cement kilns, any larger scale pathway will require a substantial degree of commercial risk and capital expenditure. The primary conclusion from considering international trends in handling treated timber waste is simply that managing hazardous air discharges is a very difficult proposition that drives and dominates technology selection. It cannot be assumed that any technology that promises 'on paper' to avoid volatilisation and discharge of treatment chemicals will necessarily do so, and achieve it in an economically viable way.

While it is intended that developments in the application of Canadian firm PWS' technology will be monitored to determine applicability and appropriateness for use in Christchurch, none of the other options evaluated during Milestone 2 are considered to meet the requirements of this project's objectives in terms of feasibility, and hence they will not be advanced to Milestone 3 for further analysis. Incineration of waste treated timber, which is a prevalent solution internationally was rejected in Milestone 1 because of the difficulties in managing air emissions; a conclusion which the research undertaken in this report has affirmed. Even if air discharge is appropriately managed, which would be economically and technologically challenging, the only real energy recovery option is cogeneration, which was also rejected in Milestone 1, for lack of a suitable end use for heat produced. Incineration should only be considered for Christchurch if a cost-effective method for managing air emissions can be identified, and a compelling demand for heat energy emerges. These outcomes are not considered likely.

A final note must also be made regarding the handling of CCA treated wood internationally versus how it is managed in New Zealand. It is very clear that processing of CCA treated timber waste is a very difficult proposition and that landfilling is also less than desirable. The response to these difficulties internationally has tended to be to severely restrict or ban CCA treated timber production and use and, in many countries, to ban landfilling of waste CCA treated timber. It is clear that, on a continuum of restriction of CCA treated timber use and disposal internationally; New Zealand is very much at the 'hands-off' extreme. Unfortunately, this both ensures that there is an abundant supply of CCA treated timber waste and, by making landfilling relatively easy, provides a disincentive for the development of processing technologies for the waste.

Considering and promoting alternatives to CCA treated timber, designing waste out of CCA treated timber use and implementing tighter restrictions on landfilling of CCA treated timber would be logical responses to the challenges around dealing with CCA treated timber waste in New Zealand. Although these suggestions fall beyond the scope of this project, it is hard to escape the conclusion that avoiding or minimising the production of a potentially hazardous waste is preferable to figuring out how to deal with it once it is created.

5.0 NEXT STEPS

Milestone 1 of this project has focused on trends and developments that are currently active in New Zealand and Milestone 2 has focused on international trends and developments and their implications for the New Zealand context.

Milestone 3 returns the focus to the five potential options identified in Milestone 1 and seeks to develop feasible business models around these options including consideration of risks, financial implications and potential benefits of each scenario. This milestone will include:

- Risk analyses on potential scenarios, including any potential environmental risks.
- Creation of broad supply chain and financial models for each scenario based on stated assumptions and risks and initial feasibility analyses for each scenario.
- Revision of projected reuse/recycling/recovery target volumes (20% of total waste treated timber) and estimates of total treated timber which is recyclable.

Milestone 3 also includes a research phase, to be undertaken by BRANZ and Scion, which provides an overview of international research related to waste treated timber identification on demolition and/or waste processing sites and prepares a feasibility study on the application of this research to create a tool or toolkit suitable for use in New Zealand. This research will include:

- An analysis of the appropriateness, effectiveness, ease of use and cost acceptability of the tool for use by demolition companies and/or waste processors for identifying treated timber on demolition and/or waste processing sites in Canterbury.
- Detail of any further research required to develop the tool, if necessary.

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