Whiteware Sector

Product Stewardship Study

Prepared for the Ministry for the Environment and Sector Group Representatives

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Prepared by Product Ecology Pty Ltd in association with
Responsible Resource Recovery Ltd

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Preamble

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Contents

Figures

Tables

Abbreviations

ABS	Acrylonitrile butadiene styrene
CfC	Chlorofluorocarbon
DfD	Design for Disassembly
DfE	Design for Environment (also known as EcoDesign)
DfR	Design for Recycling
EDA	Exclusive Dealer Arrangement
EHP	Electrolux Home Products (a division of Electrolux New Zealand Ltd)
EPHC	Environment Protection and Heritage Council (Australia & New Zealand)
EPR	Extended Producer Responsibility
EPS	Expanded Polystyrene
EU	European Union
F&P	Fisher & Paykel Appliances
HCFC	Hydrochlorofluorocarbon
KPI	Key Performance Indicators
LCA	Life Cycle Assessment
MfE	Ministry for the Environment (New Zealand)
RoHS	EU Directive on Restriction of Hazardous Substances
SPR	Shared Product Responsibility
VOCs	Volatile Organic Compounds
WEEE	EU Directive of Waste Electrical and Electronic Equipment

Executive Summary

The need to effectively and efficiently address end-of-life waste arising from electrical and electronic products is acknowledged as an important priority in need of industry, government and community action. Evidence and activity worldwide is highlighting the need to develop sustainable solutions that can significantly reduce the life-cycle environmental impacts associated with production and consumption. This imperative has been acknowledged through the Ministry for the Environment's discussion document on product stewardship and water efficiency labelling.

It is understood this project may contribute to the Ministry's policy development process with a view to developing a coherent product stewardship policy for various product categories and waste streams in New Zealand, including whiteware. The project objectives and terms of reference as outlined in the project brief were extensive and challenging. In particular, the project aimed to: "*Study the issues associated with the environmental impact of the whiteware sector, case study any existing product stewardship schemes to address this and establish what assistance a national product stewardship policy could offer.*"

Within the context of life-cycle thinking and the need to pursue sustainable production and consumption, the widely accepted definition of 'product stewardship' provided the guiding concept for the project ie *"Product Stewardship is the term used to describe an approach whereby producers, importers, brand owners, retailers, consumers and other parties involved in the life cycle of a product accept a responsibility for the environmental impacts of the products through their life cycle."*

Whiteware is made predominantly of steel. The steel component varies according to the appliance type, ranging from 90% for clothes dryers and cookers to less than 60% for dishwashers. The presence of metal is a major factor in the economic viability of whiteware recycling. Steel yields a relatively small price (less than NZ$200/tonne) while non-ferrous metals have significant monetary value.

An estimated 600,000 whiteware units are sold in New Zealand every year.[1] More than half of the whiteware sold in New Zealand is imported. In 2005, approximately 330,000 units were imported into New Zealand, representing 55% of the total market. The New Zealand whiteware market is characterised by a single, dominant domestic manufacturer and distributor (Fisher & Paykel Appliances Ltd) whose products represent as much as 50% of the total whiteware market. Overseas studies have found that whiteware represents approximately 60–70% of the e-waste stream by weight.[2] This indicates that whiteware could represent between 48,000 and 56,000 tonnes of waste every year in New Zealand.

In relation to municipal activity, local authorities have responsibility for managing domestic waste and recycling in their geographical areas. Some councils divert resalable whiteware through stores at their recycling centres. Others simply collect quantities of whitegoods at their collection sites and a scrap metal dealer will visit, crush the appliances with a mobile crusher, and pay the council a price according to the market rate for scrap.

The re-use and/or recycling of whiteware is considered environmentally preferable compared to landfilling for several reasons. Landfilling results in the loss of valuable materials including ferrous and non-ferrous metals. To extract from landfill, process, assemble and transport these materials involves enormous amounts of resources. In addition, whiteware can contain some hazardous substances. Major appliances contain fewer hazardous substances than other electronic and electrical equipment. Nevertheless, appliances (particularly older products) do contain various toxic and hazardous substances. These substances include lead, cadmium, hexavalent chromium, CFCs, HCFCs, brominated flame retardants, as well as oils and greases from refrigerators and other major appliances.[3]

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1 Market research information, provided by Fisher & Paykel Ltd.

2 Data average from: Network Recycling (2003) *CA Site WEEE Capacity in the UK: An Assessment of the Capacity of Civic Amenity Sites in the United Kingdom to Separately Collect Waste Electrical and Electronic Equipment*; and Industry Council for Electronic Equipment Recycling (2005) *Interim Status Report on WEEE in the UK*; January 2005.

3 Environment Australia (2001) *Major Appliances Materials Project*.

Most whiteware in New Zealand is not ending up in landfill. There is no reliable data on the quantities that are ending up in landfill, however, the opinion of the waste and recycling industry and local authorities is that up to 95% of whiteware waste is being recycled in New Zealand, at present. Overall, the environmental impacts of whiteware disposal in New Zealand appear to be relatively low because there is currently a high rate of diversion of product for recycling. The resulting shredder floc has the potential to be an environmental concern, however publicly available evidence is currently lacking in New Zealand.

It is widely acknowledged that Design for Environment (DfE) has a key role to play in maximising overall environmental performance. More specifically a DfE strategy that follows the waste management hierarchy has the potential to reduce end-of-life whiteware waste, including shredder floc. While there is evidence of DfE related environmental improvements in imported whiteware, there does not seem to be any information about end-of-life collection and recycling schemes operating in New Zealand.

This report describes the two noteworthy whiteware product stewardship schemes currently underway in New Zealand ie Fisher & Paykel and Electrolux. A range of views, concerns and perspectives is also presented. Beyond the activities of these two companies there is no compelling evidence or widely promoted information that any other whiteware importers or suppliers are proactively pursuing a product stewardship approach to the life-cycle management of the products they supply in New Zealand.

The environmental and economic benefits resulting from whiteware product stewardship in New Zealand are not insignificant, particularly in relation to Fisher & Paykel's scheme.

- The take-back scheme contributes to materials recycling and resource conservation by diverting end-of-life from landfill. Approximately 32,000 whiteware units diverted from landfill were recovered and recycled during 2004.
- DfE contributes to waste avoidance, materials efficiency and reduced use of hazardous substances.
- The take-back scheme helps to safely recover and control hazardous and toxic substances that might otherwise lead to human health or ecosystem impacts.
- Recovery of materials back into the economy eg reuse and/or recycling of metals and plastics.
- Cost reduction related to Fisher & Paykel's waste management activities for post-industrial waste.
- Costs savings of materials efficiency improvements in product development and manufacturing.
- Costs savings to whiteware retailers through participation in Fisher & Paykel scheme.
- Broader economic benefits of facilitating the removal of inefficient whiteware from the energy grid.

While regulatory interventions are potentially valid and necessary in some cases, there is scope for environmental change and improvement through other, non-regulatory means. The success of non-regulatory measures would depend significantly on the level of voluntary commitment, foresight and resourcing from the sector, the Government and other relevant stakeholders. In relation to regulatory and non-regulatory interventions and incentives, a diverse range of options was canvassed in regard to:

- DfE;
- consumer education and information;
- market development for recovered materials;
- end-of-life management – collection and processing.

Government policy, together with a proactive whiteware sector, could drive and support a range of very specific measures that would target different aspects of the whiteware life cycle with a view to maximising waste avoidance and resources recovery in a cost-effective manner. Several options were considered in concept form and provide a sense of what may be relevant and possible within New Zealand:

- Option 1 – Status quo: industry driven and voluntary schemes (not recommended by the consultants)
- Option 2 – Industry-led schemes with free-rider regulation (recommended by the consultants)
- Option 3 – Mandatory approach to product stewardship (not recommended by the consultants)
- Option 4 – Voluntary and regulatory mix of approaches (strongly recommended by the consultants)
- Option 5 – Mandatory refund system (strongly recommended by the consultants).

Several specific issues emerged from the project including *lessons learned* that should inform ongoing product stewardship policy formulation in New Zealand. These observations and conclusions are accompanied by specific recommendations aimed at real-world solutions and action.

1 Introduction

1.1 Background

The need to effectively and efficiently address end-of-life waste arising from electrical and electronic products is acknowledged as a significant imperative in need of industry, government and community action.

Evidence and activity worldwide is clearly indicating the need to develop sustainable solutions that can substantially reduce the life-cycle environmental impacts associated with the production and consumption of electrical and electronic products. This has been acknowledged through the Ministry for the Environment's discussion document on Product Stewardship and Water Efficiency Labelling.

It is expected that this project will contribute to the Ministry's policy development process with a view to developing a coherent, effective and enduring product stewardship policy for various product categories and waste streams in New Zealand, including the whiteware sector.

Product Ecology Pty Ltd (in association with Responsible Resource Recovery Ltd) was commissioned by the Ministry for the Environment to undertake the study.

1.2 Purpose and scope of the study

Based on the project brief:

> *"The Ministry for the Environment wants to reduce the amount of waste both generated and disposed of in New Zealand (refer The New Zealand Waste Strategy, 2002). Amongst other tools, it has recommended "product stewardship" to aid this, whereby producers, retailers and consumers take more responsibility for the amount of waste generated in a product's lifetime. The approach to date has been to encourage voluntary, industry-led product stewardship schemes.*
>
> *In August 2005, the Ministry released a discussion paper to investigate modifications to this approach to assist the effectiveness, stability and uptake of these and future schemes. Before making recommendations to the Government on the adoption of a product stewardship policy, the Ministry wants to better understand the implications of the proposals for existing and potential schemes."*

The project brief also clarifies the overall scope including key definitions:

> *"Priority for this case study is working through the performance and policy issues, rather than quantifying the problem or exact costs and benefits. "Whiteware" is defined as: (domestic) refrigerators/freezers, clothes dryers, washing machines, dishwashers, ovens, stoves, rangehoods, waste disposers, air conditioners/heat pumps, dehumidifiers and microwaves. Potential improvements should focus on the environmental consequences of the product's life in New Zealand, and design, manufacture, distribution, use and disposal options for which New Zealand industry or Government can reasonably influence.*
>
> *This report will not address issues concerned with the energy or water efficiency policy. This report should highlight areas where refrigerant recovery requirements will potentially have an influence. The potential, approach or costs of any proposed scheme or scheme changes suggested by the report will not be binding for the sector or the Government."*

1.3 Project objectives and terms of reference

The project objectives and terms of reference as outlined in the project brief are extensive and provided a very challenging set of activities given the timeline and resources. In particular, the project aimed to:

- under guidance of a sector group, study the issues associated with the environmental impact of the whiteware sector, case study any existing product stewardship schemes to address this and establish what assistance a national product stewardship policy could offer;
- formulate a process that results in a policy well matched to the needs of industry and assists industry groups in understanding what the implications are, if any, of that policy proposal for existing schemes.

Guided and informed by the sector group, the project was to address the following terms of reference:

- description and quantification of the environmental impact of the whiteware sector and the stakeholders involved;
- description of any current product stewardship schemes to address this problem;
- evaluation of how the current schemes perform (against policy objectives listed below) and their long-term stability (in the current policy environment);
- estimation of the potential performance and stability of the schemes (in the current policy environment) and the environmental and economic benefits (or costs) from achieving this potential;
- assessment, design and cost of the tools needed to achieve this potential;
- assessment of whether the availability of regulatory tools could further increase the potential performance and stability of the schemes and the environmental and economic benefits (or costs) from achieving this potential;
- if the potential improvement justifies it, the cost, timing and enforcement of any regulatory intervention.

1.4 Project methodology

The methodology adopted reflects a consultative approach. It aimed to facilitate the whiteware sector group to identify, discuss and analyse key policy issues affecting the development of product stewardship schemes and programmes for whiteware in New Zealand. The key elements of are:

- desktop review of literature and data;
- face-to-face interviews/meetings;
- focused follow-up;
- synthesis and analysis;
- draft report development including sector group feedback;
- final report preparation.

1.5 New Zealand policy context

The policy context for the conduct of the project is informed by three key Ministry for the Environment documents.

i) The New Zealand Waste Strategy, 2002.

ii) Product Stewardship and Water Efficiency Labelling, Discussion Document, 2005.

iii) Project Brief: Whiteware Sector Product Stewardship Study, 2006.

Collectively, these three documents provide the policy context within which the project has been undertaken. The Strategy provides the overarching rationale and goals as well as critical information and criteria in relation to prioritising action on waste avoidance and resource recovery.

The discussion document further explores the options and possibilities with a particular emphasis on the relevance, role and potential for applied product stewardship.

Most importantly, the discussion document provides a guiding definition for product stewardship as well as generic options for potential intervention.

The project brief outlines specific study objectives underpinned by the terms of reference, which provide further direction for the study's conduct and focus.

The elaboration of the term 'product stewardship' as per the discussion document represents a critical and guiding definition, which directly informed the study and served to focus the study process and content:

> *"Product stewardship is the term used to describe an approach whereby producers, importers, brand owners, retailers, consumers and other parties involved in the life cycle of a product accept a responsibility for the environmental impacts of the products through their life cycle. This can include upstream impacts from the choice of materials and the manufacturing process, through to downstream impacts from the use and disposal of products.*
>
> *Product stewardship aims to encourage producers and other parties to internalise a substantial proportion of the environmental costs arising from the final disposal of their products. Internalising involves creating schemes that help to shift the costs of managing wastes from ratepayers and taxpayers to the producers and consumers. This ensures the costs of wastes get considered when purchase and production decisions are made. Product stewardship schemes can contribute to reduction in waste and to the recovery of materials from the waste stream."*

2 Overview of the Whiteware Sector in New Zealand

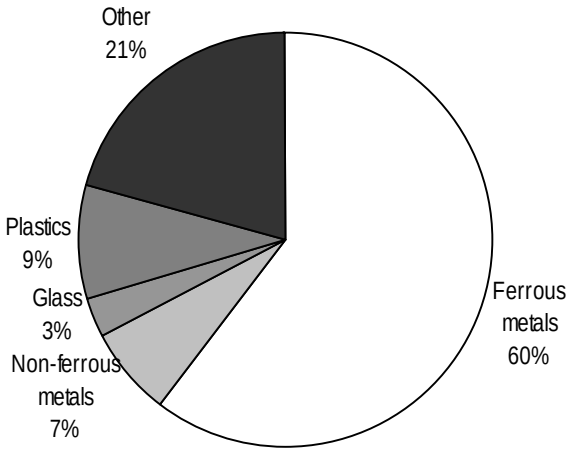
2.1 About the product category – whiteware

For the purposes of this study whiteware is defined as domestic versions of:

- refrigerators and freezers;
- clothes dryers;
- washing machines;
- dishwashers;
- ovens, stoves and rangehoods;
- waste disposers;
- air conditioners/heat pumps;
- dehumidifiers;
- microwave ovens.

Whiteware is made predominantly of steel, as can be seen in Figure 1, below. This steel component varies according to appliance, ranging from 90% for clothes driers and cookers to under 60% for dishwashers. The presence of metal is a major factor in the economic viability of whiteware recycling. Steel yields a relatively small price (less than NZ$200/tonne) while non-ferrous metals have significant monetary value. Copper, one of the common non-ferrous metals in whiteware, has a current market price in excess of NZ$5,000/tonne and is continuing to become more expensive due to a global shortage in supply.[4]

Figure 1. Material composition of whiteware



Source: ICER, 2000.[5]

[4] See for example: *Copper, Zinc Climb to Records in London Amid Supply Concern*, from www.bloomberg.com 10 April 2006.

[5] Industry Council for Electronic Equipment Recycling (ICER) (2000) UK Status Report on WEEE; London.

The material composition of whiteware shown in Figure 1 is for equipment at the point of disposal. The data therefore represents the composition of older products. There has been a trend towards greater use of plastics in whiteware for many years and it is, therefore, likely the levels of plastic in end-of-life whiteware will change considerably in future years. For example, it is approximately 40 years since plastic liners replaced porcelain enamel liners in refrigerators. In fact, the trend towards greater use of plastic has probably slowed down significantly in the last five to ten years. The industry reports this move towards greater use of plastic has just about run its course because there is a technical limit to the quantities of plastic that can be used in items of whiteware. The percentage level of metals in products has remained approximately the same apparently, indicating that it is other materials that have been substituted with plastic eg glass shelves in refrigerators being replaced by plastic shelves in many designs, although glass is making a resurgence in current models. Electrolux has moved from wire-coated shelves in refrigerators to glass shelves. The primary reason, according to Electrolux, relates to consumer benefits in food safety. The use of glass may reduce the overall plastics content and introduces another recyclable material. Electrolux noted that anecdotal evidence suggests plastic shelves can become brittle and are prone to cracking, necessitating replacement.

In relation to overall product life span and average age of whiteware an Australian study on major appliances (Environment Australia, 2001: iv) outlined a range of estimates:

Appliance	Average life span
Refrigerators	10–25 years
Freezers	20+ years
Dishwashers	10–20 years
Washing machines	5–15 years
Clothes dryers	15+ years
Electric stoves/cookers	15–20 years
Microwave ovens	5–15 years
Hot water heaters	5–30 years
Air conditioners	20 years

The Australian Major Appliances Materials Project noted that:

> *"These are estimates of the age of appliances when discarded. There is no information on the age of appliances that are recycled or landfilled. However, anecdotal evidence suggests that many appliances that are discarded have reached the end of their useful life and cannot be reused. The life spans quoted do not take into account 'storage' time; it is estimated that between 5% and 33% of broken of replaced appliances are stored for a round two years for use as a 'spare' or merely because people do not know what else to do with them."*

2.2 Scale of the market

An estimated 600,000 whiteware units are sold in New Zealand every year.[6] Sales of whiteware have grown significantly over the last five years. Total sales have risen from 400,000 units in 2001, representing a 50% growth. This sales growth has been due to population growth, a new housing boom and the strong economic conditions in New Zealand over the period.

It should also be noted that the market is not saturated in some categories eg dehumidifiers, heat pumps, air conditioners and, probably, range hoods. Note that range hoods are made in New Zealand by Robinson Industries (Robinhood) and possibly other manufacturers also.

Approximately eight million items of whiteware are now owned by New Zealand households.[7]

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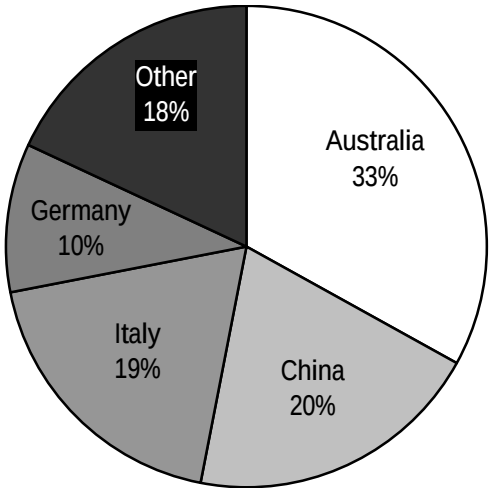
6 Market research information, provided by Fisher & Paykel Ltd.

7 Statistics New Zealand, Household Economic Survey 2003–2004.

2.3 The geography of production – local manufacture and imports

More than half of the whiteware sold in New Zealand is imported. In 2005, approximately 330,000 units were imported into New Zealand, representing 55% of the total market.

Figure 2. Country of origin for New Zealand imports of whiteware



One-third of whiteware imported into New Zealand came from Australia; 20% from China; 19% from Italy, and the remainder from elsewhere in the world.

2.4 Brand owners – the competitive landscape

The New Zealand whiteware market is characterised by a single, dominant domestic manufacturer and distributor (Fisher & Paykel Appliances Ltd) whose products represent as much as 50% of the total whiteware market. Fisher & Paykel also imports and distributes Whirlpool appliances and some appliances from other manufacturers that are re-branded Fisher & Paykel.

Many other brands represent the other 50% of the market, including (but not limited to):

> *AEG, Ariston, Asko, Atlas, Baumatic, BSH/Bosch, Carrier, Daikin, DeLonghi, Electrolux, Fujiair, Fujitsu, Haier, Ilve, Jennaire, Lemair, LG, Liebherr, Maytag, Miele, Mitsubishi Electric, Panasonic, Rangemaster, Samsung, Sharp, Simpson, Smeg, Teba, Telmann, Vestfrost, Viking, Westinghouse.*

Electrolux (and the other brands it owns) have a physical company representation in New Zealand, although all whiteware is imported. All other brands are imported and distributed by third party companies, or appliance import groups. A more recent trend in the market has been retailers direct importing, relabelling appliances and selling under a brand name they own.

There are four different models for appliances entering the market in New Zealand.

i. Fisher & Paykel exclusive dealership agreements

Fisher & Paykel represents as much as 50% of the domestic whiteware market. Fisher & Paykel holds exclusive dealership agreements (EDAs) with approximately half of all appliance retailers in New Zealand. Under these agreements, retailers are restricted to only selling Fisher & Paykel and Whirlpool-brand washers, dryers, dishwashers and refrigerators.

This is a unique arrangement and gives Fisher & Paykel significant leverage over the retailing of its products. In Auckland, Fisher & Paykel delivers appliances directly from its plant in East Tamaki to consumers that have purchased appliances through EDA retailers. This provides an excellent opportunity for Fisher & Paykel to reduce logistics costs and enables easy return of their customers' end-of-life equipment.

ii. Manufacturer import and distribution of own brands

Some manufacturers have a presence in New Zealand, but do not manufacture here. Companies in this category include Electrolux, Bosch and Haier. These companies import their own brands of whiteware and distribute them to retailers. Currently, Electrolux's primary method of distribution is through the retailer network, however, the home delivery service is offered in Auckland with a view to expanding it through other major centres. This reduces handling costs and provides an opportunity for the company to easily return its customers' end-of-life equipment.

iii. Appliance importer and distributor

The majority of the rest of the whiteware brands are imported and distributed by third parties. These are specialised importers or buyers groups that act on behalf of a group of retailers. For example, the Applico Group imports, while Appliance Connexion is a retailer buying group (not an importer of whiteware). Other examples of such groups include Monaco (Mitsubishi), Rankins (LG) and Southfort (Miele).

iv. Retailer direct import

Some retailers, including supermarkets, have begun importing whiteware directly to their stores. The Warehouse, for example, now imports a small number of its own-branded whitegoods (Telmann). Other examples of retailers importing whiteware directly include K-mart (Mistral and other brands), Mitre 10 (Nouveau, and Countdown).

The actual market share of companies in the whiteware sector varies according to the different appliances. Overall market rankings for products to market are estimated by industry sources as:

1. Fisher & Paykel;
2. Electrolux NZ (includes Westinghouse, Simpson, and AEG);
3. Applico Group (SMEG, Baumatic, Classique, St George, Viking);
4. Bosch;
5. other producers and suppliers.

There is no official market data to confirm these rankings, however, it is estimated that:

- Fisher & Paykel Appliances holds approximately 45% of the market in New Zealand;
- Electrolux New Zealand holds approximately 20% of the market in New Zealand;
- the remaining producers, suppliers and brand owners collectively represent approximately 35% of the market in New Zealand.

While these figures may be slightly elastic, the proportions indicate a sense of how the market is divided. Importantly, it could be concluded that approximately 35% of the market in terms of producers, suppliers and brand owners, do not have any recovery and recycling-related product stewardship activities in place. This represents a significant figure in terms of non-activity among producers in the New Zealand whiteware sector and thus offers considerable scope for improvement and change.

2.5 Local authorities

Local authorities have responsibility for managing domestic waste and recycling in their geographical areas. There are two ways in which local authorities collect whiteware from households:

- separation at recycling centres/refuse transfer stations/landfills;
- collection at annual kerbside inorganic waste events.

Some councils divert resalable whiteware through stores at their recycling centres. A particular example is the SuperShed operated by Christchurch City Council. Others simply collect quantities of whitegoods at their collection sites and a scrap metal dealer will visit, crush the appliances with a mobile crusher, and pay the council a price according to the market rate for scrap. The collection of scrap metal, including whiteware, often brings in revenue for councils, although this depends on geographical location. After they have collected and crushed the whitegoods, scrap metal dealers will sell the material to Sims Pacific Metals Ltd for shredding.

In many council areas an annual, or biannual, inorganic kerbside collection is run by the council. Inorganic collections provide an opportunity for scavenging of whiteware by the community, either for reuse or for scrap metal value. Any whiteware remaining when the council collects is diverted for recycling as with the whiteware collected at recycling centres.

There is no data available on the number of councils that collect whiteware for recycling, or on the total quantities collected.

2.6 Recyclers

There are only two shredders in New Zealand capable of processing scrap whiteware. Both of these shredders are owned by Sims Pacific Metals Ltd – the largest metal recycling business in New Zealand. Because whiteware uses a relatively light grade of steel, it is mixed with heavier grade items such as whole car bodies and processed through the shredders. Ferrous and non-ferrous metals are separated for recycling. The remaining material is known as "fluff" or "floc" and is made up of non-metal materials, such as plastics, wood, glass and rubber. It is estimated that 28–30% of the total material entering the shredders is floc, which is subsequently landfilled. Given current processing infrastructure and material values, this co-mingled and sometimes contaminated residual waste is not being recycled. While the constituent material types (eg glass, plastics, wood) might be technically recyclable, their co-mingled nature does not allow cost-effective recycling.

Sims Pacific Metals estimates 70% of whiteware entering its shredders comes from local authority collection programmes.[8] The remainder comes from producers' take-back systems. Sims Pacific Metals does not have data on the quantities of whiteware processed through its shredders. This is because whiteware usually arrives mixed with other metal waste.

2.7 Summary of observations

There are some key differences in the way that brands are distributed in New Zealand that may influence the way product stewardship for whiteware is established. Fisher & Paykel manufactures domestically and, in the Auckland region, delivers directly to households. This direct delivery allows the company to easily return equipment to its plant for recycling. Electrolux also uses a home delivery model throughout New Zealand, providing the same opportunity to collect old equipment from its customers.

There are also significant differences in how brands are retailed. The unique conditions of the Fisher & Paykel exclusive dealership agreements give the company an opportunity to collaborate with retailers on how products are handled and associated logistics issues concerning collection of end-of-life whiteware.

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8 Charlie Carlyon, Sims Pacific Metal Ltd, personal communication.

It appears that the single most significant avenue for collecting whiteware at present is through local authority initiatives. It is estimated that as much as 70% of recycled whiteware is collected through local authorities.

There is no data available on the total quantities of whiteware collected in New Zealand. However, all industry sectors and local authorities believe that as much as 95% of all whiteware is being recycled in New Zealand. This is a relatively high recovery rate and compares favourably even with mature sectors – such as cardboard and paper – for recovery purposes. The key factor determining this high rate is the market value of metals in whiteware. It should also be noted that these percentages may look very different should sub categories of whiteware be further investigated. For example, it is unknown whether the recovery rate for microwave ovens or domestic air conditioners would be as high.

It is also highly likely that second-hand dealers and whiteware service and repair businesses feature along the whiteware life cycle, and that they also provide a source of end-of-life product for recovery and metal recycling. However, data about volumes being processed through such routes is not currently available.

3 Environmental Issues Related to Whiteware

3.1 Environmental issues and impacts

Up to 80,000 tonnes per annum (and growing) of e-waste is potentially disposed of yearly to landfill in New Zealand.[9] This figure is not further broken down to describe what proportion is represented by end-of-life whiteware.

Overseas studies have found whiteware represents approximately 60-70% of the e-waste stream by weight.[10] Based on an estimated total potential e-waste arisings of 80,000 tonnes per annum, this indicates that whiteware could represent between 48,000 and 56,000 tonnes of waste every year in New Zealand. The reliability of this estimate is untested. There are other models for calculating arisings that suggest whiteware may be as low as 24,000 tonnes. There is no definitive data on the quantities of e-waste arising in New Zealand.

The reuse and recycling of whiteware is considered environmentally preferable to landfilling because landfilling:

- results in the loss of valuable materials including ferrous and non-ferrous metals. To extract from landfill, process, assemble and transport these materials involves enormous amounts of resources;
- places pressure on landfill space. Landfilled whiteware uses up land area;
- can contain some hazardous substances. Major appliances contain fewer hazardous substances than other electronic and electrical equipment. Nevertheless, appliances (particularly older products) do contain various toxic and hazardous substances. These substances include:[11]
  - lead and lead compounds are found in solder, notably in printed circuit boards;
  - cadmium has been used as a stabiliser in plastics and is found in some pigments/paints, and formerly in some plating, brazing alloys and bearing metals;
  - hexavalent chromium is widely used as a passivator (corrosion inhibitor) on most galvanised steel (including all corrugated iron roofing);
  - chlorofluorocarbons (CFCs were the refrigerant and the gas in the cells of the insulation in refrigerators and freezers pre-1995);
  - hydrochloroflurocarbons (HCFCs are the refrigerants used in air conditioners which are only being phased out now);
  - brominated or halogenated flame retardants are used in plastic enclosures serving as a fire safety measure for electrical equipment inside appliances;
  - oils and greases from refrigerators and other appliances.

  There is the risk that these substances may leach into surrounding aquatic and terrestrial ecosystems, causing both health and environmental problems. Fires at landfill sites can also result in the emission of toxic dioxins and fumes into the atmosphere from flame-retarded plastics. The presence of toxic materials also presents problems for the future remediation of landfill sites.

Most whiteware in New Zealand is not ending up in landfill. There is no reliable data on the quantities that are ending up in landfill but the opinion of the waste and recycling industry and local authorities is that up to 95% of whiteware waste is currently being recycled in New Zealand. This means that only 5% (10% to 15% at worst), and a further 30% as shredder floc, is being disposed of to landfill.

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9 MfE (2005) *Product Stewardship & Water Efficiency Labelling – New Tools to Reduce Waste. Discussion Document*. July 2005.

10 Data average from: Network Recycling (2003) *CA Site WEEE Capacity in the UK: An Assessment of the Capacity of Civic Amenity Sites in the United Kingdom to Separately Collect Waste Electrical and Electronic Equipment*; and Industry Council for Electronic Equipment Recycling (2005) *Interim Status Report on WEEE in the UK*; January 2005.

11 Environment Australia (2001) *Major Appliances Materials Project*.

Shredder floc

Shredder floc is typically comprised of plastics, rubber, wood, paper, textiles, glass, composites, automotive fluids, refrigerants, sand, dirt, stones, ferrous and non-ferrous metals. One of the issues or concerns with floc is its heavy metal content and the potential to be mobilised through leachate in landfills. Some UK research from the late 1980s and 1990s (Warren Spring Laboratory, 1992: 28) concluded *"that the levels were comparable to those from domestic refuse and hence should not cause problems at properly managed sites".* The same study also reported on material studies conducted in the USA with a view to using the plastics-rich floc in polymer concrete. Although the trials showed technical promise, commercialisation was unlikely.

It is also worth noting that the current landfilling of floc fails to effectively recover a range of high-priced materials, some of which have high levels of embodied energy. There is a view among some researchers and policy makers that this loss of material and embodied energy – in addition to the cost of landfilling, the inevitable tightening of regulations, long-term viability concerns and shrinking landfill space – demands new solutions or alternatives for better managing floc.[12]

The potential recoverability of shredder floc is currently low due to the presence of a wide mix of plastics, including flame-retarded plastics. The equipment necessary to separate materials in shredder floc is being developed elsewhere in the world,[13] but is unlikely to be economically viable in New Zealand due to the relatively low throughput of material and immature markets for recycled plastic.

It is widely acknowledged that DfE has a key role to play in maximising overall environmental performance. More specifically, a DfE strategy that follows (where practicable) the waste management hierarchy and embeds relevant waste avoidance and resource recovery features in the product has the potential to reduce end-of-life whiteware waste, including shredder floc. Design for Disassembly (DfD) and Design for Recycling (DfR) features in consumer durables are well advanced among many of the appliance, computer and consumer electronics producers. Computer modelling and specific DfD and DfR software has been commercialised to support and review product development decisions that have end-of-life implications such as floc.

In simplistic terms, if the appliance design process was chiefly driven by floc reduction then the outcome would be environmentally beneficial. However, a multitude of other drivers and design considerations dictate appliance priorities ie functionality, energy and water efficiency, cost, price and aesthetics. In other words, while DfE can help optimise what is possible and realistic, the critical phase, given current processing methods and technologies, remains the disassembly stage. Many DfE features are unable to deliver environmental gains unless the product is actually subjected to an end-of-life process, be it disassembly or otherwise.

The current scenario in New Zealand, and that for the near future, indicates the most effective way of significantly reducing floc from the whiteware shredding process is to undertake some form of initial disassembly and materials recovery pre-shredding. This would enable some of the major floc-contributing materials to be removed early in the process with a view to accumulating larger quantities of uncontaminated plastics, which, in turn, would be more appealing to plastics recyclers. The initial whiteware disassembly process underway at Fisher & Paykel's Auckland site reflects this approach.

Lifespan

A noteworthy aspect raised by Electrolux New Zealand is the issue of shortened product life span and the negative solid waste impacts associated with the non-repair of whiteware. According to Electrolux, the premature disposal of whiteware is an unnecessary outcome that can be directly attributed to business practices that lack any product stewardship objectives. While Electrolux and Fisher & Paykel use authorised service centres to repair products, there is a view that some whiteware importers are simply swapping products rather than repairing and extending product life. This is a concern to Electrolux as the service network (including spare parts availability) is offered as a *"significant and necessary support for the consumer and ensures appliances are not disposed of after a short life"*.

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[12] Pacific NW Pollution Prevention Resource Centre. http://www.pprc.org/pprc/rpd/fedfund/doe/doe_oit/automobi.html

[13] Environmental Science & Technology Online (2006) Expanding automotive recycling to include plastics; 22 March 2006. http://pubs.acs.org/journals/esthag/index.html