New Zealand Lighting Industry Product Stewardship Scheme

PHASE 1
Assessment and Review

January 2008

Report prepared by:

STEWARDSHIP SOLUTIONS

for

Lighting Council New Zealand
&
The Electricity Commission

STEWARDSHIP SOLUTIONS

Po Box 51995
Pakuranga
Auckland
New Zealand

Jaquetta (Ket) Bradshaw
(+64) 21 369 495
Simon Wilkinson
(+64) 21 944 992
www.stewardship.co.nz

CONTENTS

FIGURES

1 EXECUTIVE SUMMARY

There were 32 million lamps imported into New Zealand in 2006. 8.7 million of these were mercury-containing lamps.

The lighting market is complex, with different technologies and a wide range of end users. There have also been government interventions in the market that have or will change the technology in use in New Zealand. These include the Electricity Commission subsidising compact fluorescent lamps and EECA introducing Minimum Energy Performance Standards (MEPS) for linear fluorescent lamps and incandescent lamps (proposed).

The use of mercury helps to make lighting more efficient. A mercury-containing compact fluorescent lamp is up to 80% more efficient than a standard incandescent lamp for example. The majority of environmental impacts from lighting occur during the use of a lamp, through the consumption of electricity. Therefore, while mercury is a potentially dangerous substance it offers environmental benefits that outweigh its impacts. This is the 'mercury dilemma' of lighting.

This study has estimated that in 2007 approximately 5.6 million lamps entered the waste stream in New Zealand, equating to 717 tonnes. Of these 5.6 million lamps, just 500,000 were collected and recycled, meaning 91% of lamps were disposed of to landfill.

Lighting represents a small portion of solid waste generation in New Zealand – just 0.02%. Lighting is a relatively minor source of mercury arising from products. The total load of mercury from gas discharge lamps [linear fluorescents, compact fluorescents and high intensity discharge] is currently (2007) estimated to be 45kgs. It is expected to almost double in the next 5 years. This increase will result from the compact fluorescent lamps already in use.

Lighting is highly visible to consumers and therefore becoming of increasing public concern. Lighting is seen as a readily controllable source of mercury in our environment and the industry has come under closer scrutiny from customers and government to take action to address mercury-containing lamp waste.

There are no mercury-containing lamps manufactured in New Zealand and there are a limited number of importers – 8 importers represent 93% of the gas discharge lamp market. This market dynamic offers good opportunities for the

development of a simple product stewardship solution with reduced opportunity for freeriders.

Our key recommendation is that the 8 companies that represent 93% of gas discharge lamps imported into New Zealand begin a process to develop a voluntary product stewardship scheme for their products. This scheme needs to incorporate labelling, a commitment to reducing mercury content, public education and raising awareness about the safe handling of mercury-containing lamps. It also needs to involve ongoing collection of industry information on all lamps.

We have also recommended that the mercury flows of New Zealand are researched and that the lighting technology scenarios are re-modelled once the Electricity Commission announces the successful proposals from the Efficient Lighting Programme.

GLOSSARY

Ballast – A component of conventional control gear. It controls the current through the lamp, and is used with discharge lighting, including fluorescent, sodium, mercury and metal halide lamps. The term is sometimes used loosely to mean control gear. Also called a choke.

CFL – compact fluorescent lamp

CFL-e – CFL with non-integrated, or external, ballast

CFL-i – CFL with integrated ballast

Colour Rendering (Ra) is the ability of lamps to render colours faithfully. It is measured on the Ra index. The index runs from zero (0) (indicative of severe colour distortion) until 100 (no colour distortion).

Colour temperature – Light sources are assigned a colour temperature, measured in degrees Kelvin (K). This gives an indication of the warmth or coolness of the colour appearance of the light source.

Control gear – A 'package' of electrical or electronic components including ballast, power factor correction capacitor and starter. High frequency electronic control gear may include other components to allow dimming etc.

Discharge lamp – A lamp that produces illumination via electric discharge through a gas, a metal vapour or a mixture of gases and vapours.

EC – Electricity Commission

EECA – Energy Efficiency and Conservation Authority

Efficacy – the effectiveness of the lamp

e-waste – electronic/electrical waste, used interchangeably with WEEE.

Filament lamp – A lamp which produces illumination by heating a filament until it glows

Gas discharge lamps – the family of lamps that include fluorescent and high intensity discharge lamps

GLS – general lighting service (an incandescent lamp)

HID – high intensity discharge lamp

HPS – high pressure sodium lamp

LCA – life cycle analysis or assessment

LCNZ – Lighting Council New Zealand

LED – light emitting diode

LFL – linear fluorescent lamp

LPS – low pressure sodium lamp

Lumen output (lm/W) is the amount of light emitted by a lamp. It is measured in lumen (lm) for each Watt (W) of power consumed. The efficacy is the key indicator for efficient power consumption.

Lumen – is the metric/measure for the amount if light emitted from a light source.

Luminaire – A light fitting and lamp including all components for fixing and protecting the lamps, as well as connecting them to the supply.

Lux – is the illuminance, equal to one lumen per square metre.

MED – Ministry of Economic Development

MEPS – minimum energy performance standards

MfE – Ministry for the Environment

MH - metal halide lamp

MV – mercury vapour lamp

WEEE – waste electronic and electrical equipment

2 INTRODUCTION

This report is the output of phase one in the development of a product stewardship approach for lighting in New Zealand. This report has been commissioned by the Lighting Council and the Electricity Commission, with project support from the Ministry for the Environment. It fills a current gap in coherent information available on lighting, its impact on the environment, and the need for a lighting stewardship strategy to be developed in New Zealand.

Information for this report has been gathered from a wide range of sources, including:

- Interviews with key stakeholders
- Market information from the New Zealand lighting industry
- Lighting Industry workshop on 5 November 2007
- Interviews and emails with international lighting organisations
- Literature review
- Desktop research

We believe that the contents of this report will inform the development of policy in New Zealand and assist in the planning of a product stewardship programme for lighting, if this is the route taken by the sector.

The lighting industry in New Zealand is complex because there are:

- a range of technologies on the market
- constant changes in that technology, including complete product shifts (e.g. incandescents to compact fluorescents)
- a full spectrum of end users of lighting
- a number of different ways in which lighting is installed in the marketplace
- a number of different pieces of legislation and policy that impact on the sector

Because of these complexities we have tried to illustrate data and information through diagrams and matrices wherever possible. Matrices allow for easier analysis of complicated, inter-related variables.

3 LIGHTING TECHNOLOGY

There is a wide variety of lighting technology available on the market. This variety of technology means that some lighting products have impacts on the environment in different ways to others. For example, a standard incandescent lamp contains no mercury, but is considerably less energy efficient than a fluorescent equivalent that does contain mercury.

Also, some types of lighting are suited to a particular use. It is not just a simple matter of replacing one type of lamp with a more efficient technology. Consideration must be given to the way in which that lamp is going to be used, as well as the suitability of the fitting in which that lamp will sit.

3.1 What is Lighting?

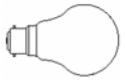
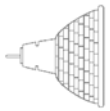
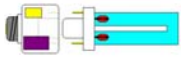
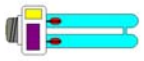
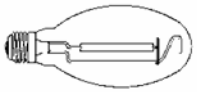
It seems like a simple question. However, it is important to define what we mean by lighting in the context of this report.

This report has not considered lamps that are integrated into other products. For example lamps in fridges, lamps that backlight LCD screens, and lamps in projectors, have been excluded from the analysis in this study. Some of these lamps do contain mercury and their end-of-life management needs to be considered. However, their management is being dealt with elsewhere through product stewardship for electronic products.

Lighting is not just about the lamp. A luminaire is a term used to encompass a light fitting and all its components. A luminaire is made up of the lamp, the lamp housing (reflectors) and the associated control gear.

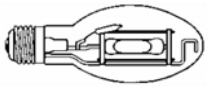
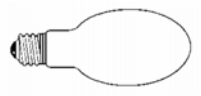
3.2 Lamps

The table below summarises the lamp technology considered by this study.

Lamp family	Lamp type	Diagram[1]	Main uses	Brief description
Incandescent	General Service Lamps (GLS)[2]		Residential	Electric current is passed through a coiled tungsten filament contained in a glass envelope that is filled with an inert gas. The filament is heated by the electric current and consequently emits electro magnetic radiation.
	Tungsten halogen		Residential Commercial	Halogen lamps are also filament lamps. Halogen is added to the fill gas to prevent evaporated tungsten from the filament condensing on the inside of the lamp envelope. This feature means higher filament temperatures can be reached and the size of the lamp envelope can be significantly reduced.
Fluorescent	Linear fluorescent lamp (LFL)		Commercial Industrial	Uses electricity to excite mercury vapour in argon or neon gas, resulting in a plasma that produces short-wave ultraviolet light. This light then causes a phosphor to fluoresce, producing visible light. The blend of phosphors controls the colour of the light, and along with the bulb's glass, prevents the harmful UV light from escaping.
	Compact fluorescent lamp CFL (external ballast and integral ballast)	CFLe   CFL- i	Commercial Residential	Operate on the same principles as linear fluorescent, above. A compact fluorescent lamp may have a conventional ballast located in the fitting (CFLi) or they may have a ballast integrated in the lamp, allowing them to be used in fittings normally used for incandescent lamps.
High Intensity Discharge (HID)	High pressure sodium (HPS)		Public lighting Industrial	Uses sodium in an excited state to produce light. An amalgam of metallic sodium and mercury lies at the coolest part of the lamp and provides the sodium and mercury vapour in which the arc is drawn. Because of the extremely high chemical activity of the high pressure sodium arc, the arc tube is typically made of translucent aluminium oxide (alumina).

[1] Images taken from Greenlight Australia (2004) Discussion Paper for Improving the Efficiency of Lighting in Australia 2005-2015

[2] For this report incandescent reflectors(ICRs) are included in this category as they have a similar build and use profile

Lamp family	Lamp type	Diagram[1]	Main uses	Brief description
	Metal Halide (MH)		Industrial	An electric arc is passed through a mixture of gases. The compact arc tube contains a high-pressure mixture of argon, mercury, and a variety of metal halides. The mixture of halides affects the nature of light produced, influencing the correlated colour temperature and intensity.
	Mercury Vapour (MV)		Industrial	The arc discharge is generally confined to a small fused quartz arc tube mounted within a larger borosilicate glass bulb. The outer bulb may be clear or coated with a phosphor; in either case, the outer bulb provides thermal insulation, protection from ultraviolet radiation, and a convenient mounting for the fused quartz arc tube.
LED	Light emitting diode (LED)			A solid-state semiconductor device that converts electrical energy directly into light.

3.3 Luminaires/fittings

An important part of a lighting system is the fitting, or housing, in which the lamps sit. The fitting is critical to the performance of the lamps contained within it. The matching of appropriate fittings to particular types of lamps is something often overlooked when the lamp is changed to gain energy efficiency. The fitting must be suited to the lamp in order to ensure the lamp delivers effective lighting to the end user.

Figure 1. Examples of typical light fittings: Recessed fluorescent ceiling trough (left); fluorescent batten (centre) and high-bay HID (right). Photos from Thorn Lighting www.thornlight.co.nz

The materials used in luminaires vary widely, but are usually a mix of plastic, glass and metal.

The metal types used in luminaires and enclosures are selected for application and suitability of purpose. They can be made of light gauge steel or of commercial grade aluminium.

3.4 Control Gear

Gas discharge lamps (fluorescent lamps and HID lamps) require control gear to regulate current.

The simplest sort of ballast is generally referred to as a magnetic, or electromagnetic, ballast. A basic inductor consists of a coil of wire in a circuit, which may be wound around a piece of metal.

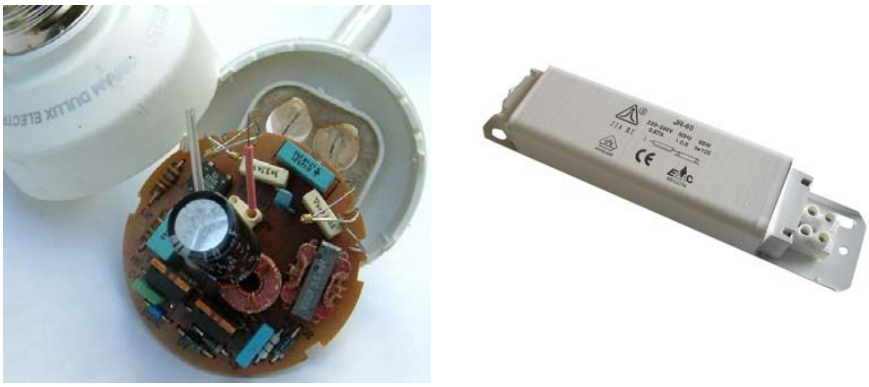


Figure 2. Examples of lighting control gear. Left: the electronic control gear inside an integrated CFL (source: www.wikipedia.com); Right: an electromagnetic ballast

Magnetic ballasts modulate electrical current at a relatively low cycle rate of mains frequency 50Hz, which can cause a noticeable flicker. Magnetic ballasts may also vibrate at a low frequency and can cause the audible humming sound people associate with fluorescent lamps.

Modern ballast designs use advanced electronics to more precisely regulate the current flowing through the electrical circuit. Since they use a higher cycle rate of 30 KHz, you don't generally notice a flicker or humming noise coming from an electronic ballast.

The lighting industry estimates that about 80-90% of control gear currently sold in New Zealand is electromagnetic and only 10-20% is electronic.

3.5 Material Composition

Identifying a standard composition for lighting products is extremely difficult. There is a wide variety of lamps and luminaires available on the market each with a different mix of materials. We have made some assumptions on average composition based on similar studies conducted overseas, as well as information supplied by the New Zealand lighting industry.

The materials used in lamps are related to the physical and chemical requirements for efficient light production.

Components used in lamp construction can be divided into three main categories:

- Lamp structure (lamp envelope, metal support parts, cap)
- Metal-electrical parts (electrodes, filaments, wiring, ballast)
- Lamp envelope additives (inert gas, getter, emitter, mercury, sodium, metal-halides, fluorescent powder).

Filament Lamps are typically made of:

- Glass
- Filament (often tungsten)
- Inert gas

Gas discharge lamps are typically made of a selection of the following basic materials:

- Glass
- Quartz
- Ceramics
- Electrodes
- Mercury
- Sodium
- Metal-halide

Using an average material composition of lamps is problematic because of the wide variety of designs and technologies available. Some example compositions are presented in the table below[3]. Within the HID lamps group there are many different lamp types and only two have been given as examples below (MHL = metal halide; HPS = high pressure sodium).

Lamp Group	*Example*	*Weight [g]*					
		Total	*Glass*	*Metals*	*Electronics*	*Plastics*	*Rest*
GLS	60W	33	30	3	--	--	0.01
Halogen	35W	2.5	2	0.5	--	--	0.01
Fluorescent	36W	120	115	3	--	--	2
CFL-integral	11W	120	65	4	25	25	1
CFL-non-integral	13W	55	40	3	--	10	2
HID	MHL400W	240	195	42	--	--	3
	HPS150W	150	105	44.5	--	--	

Source: European Lamp Companies Federation (www.elcfed.org)

[3] *European Lamp Companies Federation (www.elcfed.org)*

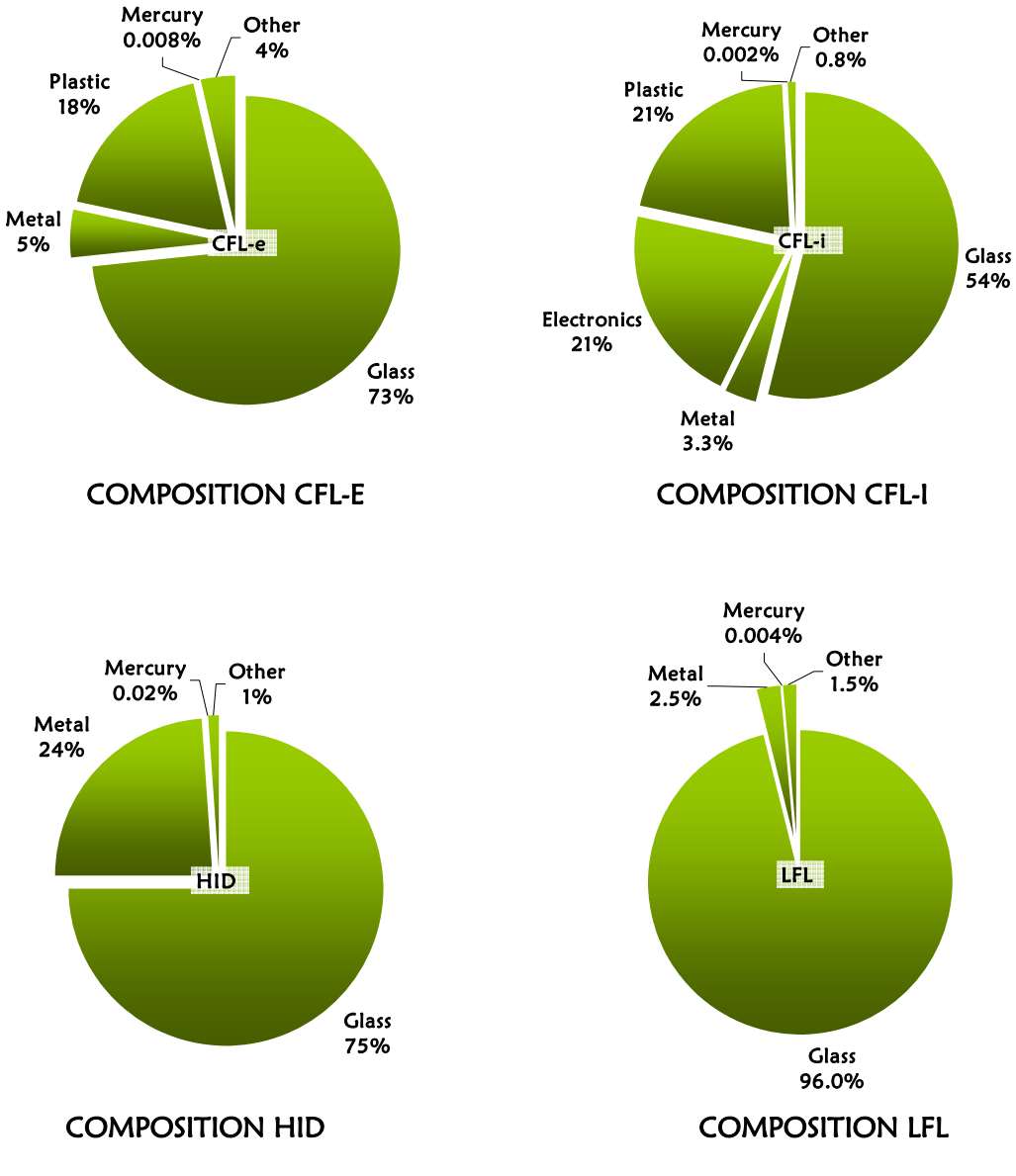


Figure 3. Composition of each different gas discharge lamp technology

4 THE NEW ZEALAND LIGHTING MARKET

Information on the nature of the New Zealand lighting market has been gathered from sources including government statistics, research, and interviews with key market players.

4.1 Lighting by End Use

There are four main categories of lighting end use and each uses a unique mix of lighting technologies. The main use categories are: commercial, industrial, residential and public lighting.

a. Commercial

Linear fluorescent lamps (LFLs) dominate the lighting in commercial buildings, accounting for two-thirds of lighting technology in this sector overall[4]. Incandescent lamps account for a further 20%.

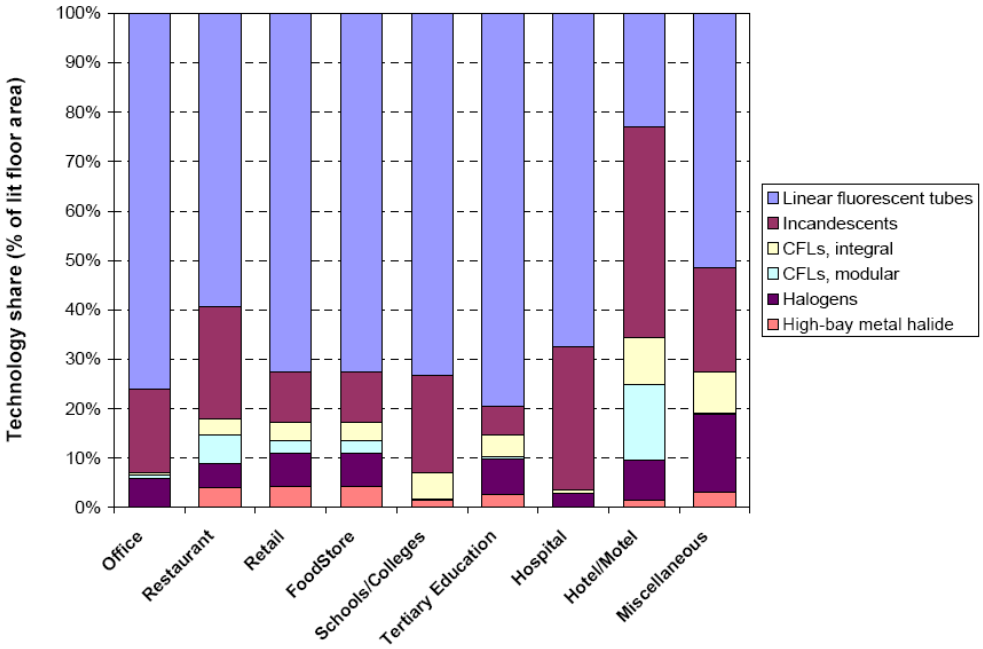


Figure 4. Self-Reported Shares of Major Lighting Technologies in Commercial Buildings, from KEMA (2007)

[4] ***KEMA (2007)*** *New Zealand Electric Energy-Efficiency Potential Study for the Electricity Commission. Published 28 September 2007*

b. Industrial

We are unaware of information that characterises the lighting technology mix for industrial facilities. However, interviews with lighting companies and experience suggests that industrial lighting is dominated by HID lamps and fittings, with some use of linear fluorescent lamps (LFLs). New CFL lamps are beginning to be introduced onto the market as replacements for HID lamps in some industrial uses.

c. Residential

Figure 5 shows that in residential buildings, incandescent lamps are still the most dominant lighting technology, representing 86% of lamps in households[5]. Growth in sales of CFLs in recent years is likely to have shifted this mix somewhat, although there are varied opinions on how great this shift has been to-date.

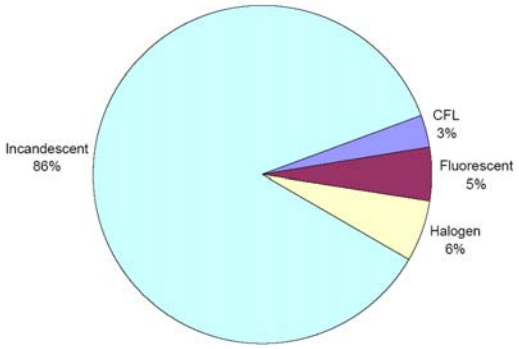


Figure 5. Distribution of Lamp Types in New Zealand residential buildings Source: KEMA (2007), data from BRANZ (2006)

d. Public lighting

Public lighting is dominated by HID technology. A study of street lighting was conducted by EECA in 2001[6]. The study surveyed New Zealand local councils (Territorial Local Authorities, or TLAs). As *Figure 6* shows, that 95% of street light technology is high pressure sodium, fluorescent and mercury vapour lamps.

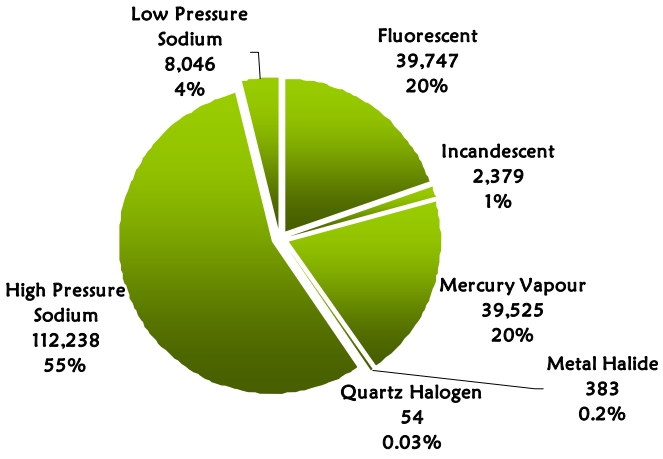


Figure 6. Street lighting technology in use in New Zealand (EECA 2001)

[5] ***KEMA (2007)*** *op. cit.*

[6] ***Energy & Technical Services Ltd (2001)*** *EECA Street Lighting Energy Efficiency Study. Published by the Energy Efficiency and Conservation Authority (EECA)*

4.2 Volumes Sold

For the purposes of this study we have relied on two sources of information to estimate sales of lighting in New Zealand: a survey of members of the Lighting Council of New Zealand in November 2007 and import statistics collected by Customs. There is no manufacture of lamps in New Zealand so import data should translate directly into sales.

Customs Import data

Import statistics are gathered using the New Zealand Harmonised System Classification (NZHSC)[7]. Data is supplied to the New Zealand Customs Service by exporters and importers, or their agents, and then on to Statistics New Zealand. This harmonised system is designed to ensure that New Zealand's data is comparable worldwide.

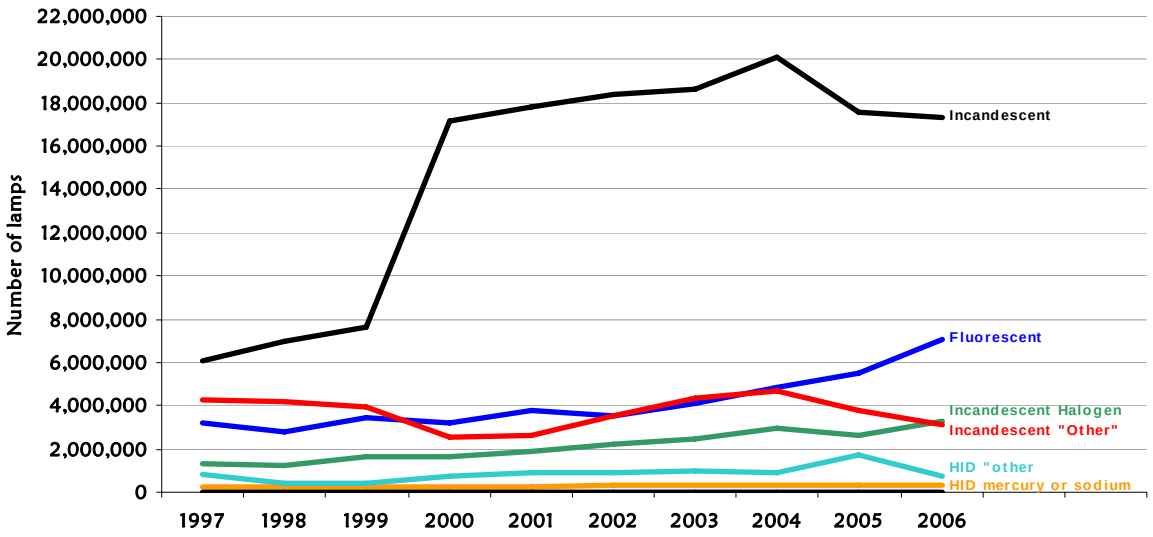


Figure 7. Imports of lamps to New Zealand 1997-2006. Categories are limited to the categories used by NZ Customs. Source: Statistics NZ

The data from Customs has two limitations:

1. it is reliant on the accuracy of reporting by companies and import agents
2. the categories may not give sufficient levels of detail

[7] *Statistics New Zealand www.statistics.govt.nz*

Due to uncertainties over the robustness of the customs import data, the Lighting Council of New Zealand conducted a survey of its members to establish import levels.

Industry Survey

Members of the Lighting Council of New Zealand completed a confidential market share survey in November 2007. The survey covered all types of gas discharge lamps. Returns on the survey were limited to members of the Lighting Council. The Lighting Council estimates that its membership represents 60-70% of the lighting market in New Zealand. We have used data supplied by lighting companies outside the LCNZ membership base, together with market knowledge to extrapolate a total lamp market size.

In addition to lamps, we have estimated volumes of luminaires and control gear based on information supplied by key companies in the sector.

Category	Estimated total annual market size[8]	Percentage of market size represented by LCNZ members [9]
LFL	3,500,000	93%
CFL-i	4,000,000	46%
CFL-e	700,000	96%
HID	475,000	95%
TOTAL mercury-containing lamps	**8,675,000**	
Incandescent GLS	17,700,000	
Incandescent halogen	3,300,000	
TOTAL incandescent lamps	**21,000,000**	
Luminaires	approx 1,000,000	
Control gear	approx 1,000,000	

[8] *Based on discussions with non-members of LCNZ and industry estimates*
[9] *Based on 2007 LCNZ survey response.*

4.3 Market Share

Potential for companies to freeride an industry-wide product stewardship solution is an important issue when considering how a product stewardship scheme might work in New Zealand. The potential to freeride is largely driven by the size of the market that is not "round the table", or is unable to be identified.

The New Zealand gas discharge lamp market is dominated by a handful of key players. *Figure 8* shows that the top 8 importers of gas discharge lamps represent 93% of the market in New Zealand. All but two of these companies are members of the Lighting Council of New Zealand.

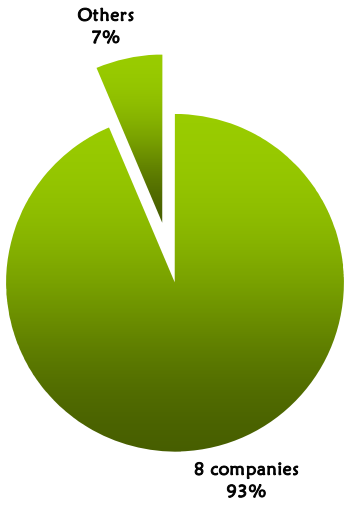


Figure 8. Market share (by number of lamps) of the top 8 importers of gas discharge lamps to New Zealand

4.4 Countries of Origin

The source of lamps being imported into New Zealand has changed significantly over the last decade. The increased dominance of Chinese and South East Asian manufacturing means that gas discharge lamps made in China and Thailand now represent 75% of imported product.

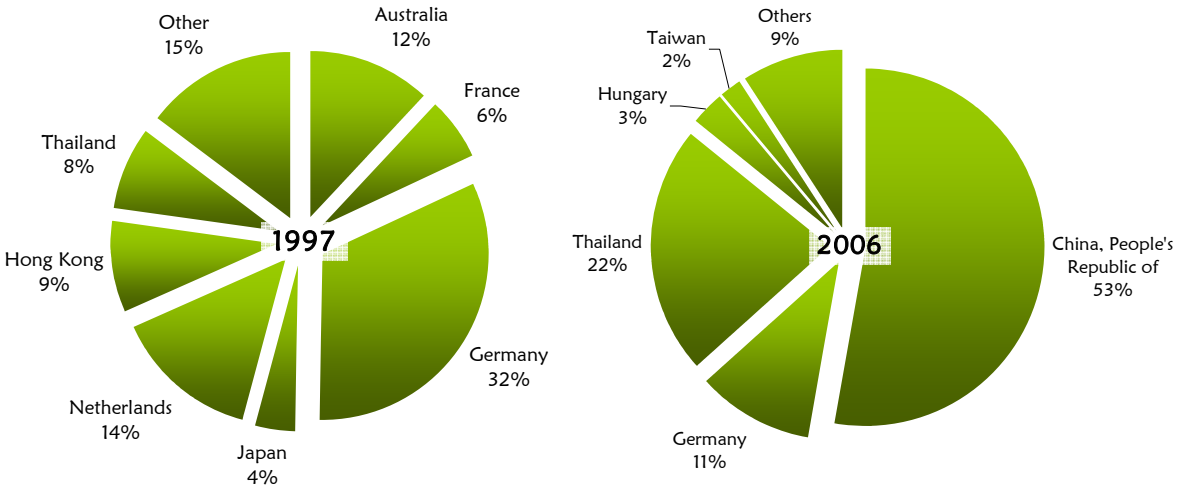


Figure 9. 1997 and 2006 Gas discharge lamp imports by Country of Origin. Data from Statistics New Zealand

4.5 Future Technology Trends

Lighting technology is constantly changing. Determining the environmental impact of lighting, and therefore the appropriate stewardship response, needs to consider any future lighting technology changes. The discussion below on potential technology changes is based on literature research and discussions with key players in the New Zealand lighting industry.

Linear fluorescent lamps (LFLs) are likely to be an enduring technology. LFLs dominate lighting in commercial buildings. Changes are being made in the design of LFLs that impact on their environmental footprint. Firstly, the mercury content of LFLs is being steadily reduced. Average mercury content 20 years ago was around 50mg. Now the levels of mercury in each lamp is below 5mg.

Secondly, there is a gradual move away from T8 fluorescent lamps to smaller, more efficient, T5 lamps. This process will be gradual because new T5 lamps

cannot be retrofitted to T8 fittings[10], they require new fittings. The shift to T5 lamps delivers environmental benefits because they are more efficient than T8 lamps and they use less material in their manufacture. However, T5 lamps do contain slightly more mercury than T8s (around 1mg per lamp more).

A major discussion point in the lighting market revolves around the potential phase-out of incandescent lamps. The New Zealand government has signalled that it will follow the lead of Australia to mandate minimum energy performance standards for incandescent lamps. This will effectively ban the sale of GLS incandescent lamps (in their current form) from 2009. This gives rise to the question: what will replace GLS incandescent lamps?

Since 2004 there has been a major push on householders to change GLS incandescent lamps for compact fluorescent lamps (CFLs). The sale of CFLs has been subsidised by the Electricity Commission.

There is uncertainty over what will replace GLS incandescent lighting after MEPS in 2009. One scenario is that CFLs will completely replace them and then continue to dominate the home lighting market. However, recent technology developments could see two or three alternative technologies become available in the next 5 to 10 years. These are light emitting diodes (LEDs), higher efficiency halogen lamps and high efficiency incandescent lamps. LEDs use only one-eighth of the power of traditional bulbs and less than half that for CFLs. They also last a very long time – up to 50,000 hours, and therefore offer an attractive potential future lighting solution.

Both LEDs and high efficiency incandescent lamps are technologies under development and not yet available as viable alternatives to household GLS lamps. Considerable research and development is being undertaken on higher efficiency halogen lamps that may provide an alternative to CFL-i technology. None of these technologies under development contain mercury.

There is a good potential that future lighting for households will be made up of a mix of all these types of technology – CFL, LED, higher efficiency halogen and high efficiency incandescent.

[10] New "adaptor" technologies do exist that allow T5 lamps to be retrofitttted to T8 fittings, but this adaptor technology is new and the benchmarks for quantifying the energy savings in the promotional material has been questioned.

Table 1. Summary of technology trends and their potential environmental implications

	Market	Changes	Market change drivers	Implications
LFL	Mature	Gradual shift from T8 to T5 lamps		Material reduction
CFL-i	Strong growth	Scenario 1: complete replacement of GLS with CFL Scenario 2: complete replacement of GLS with CFL for 5 years then gradual replacement with LED/high efficiency incandescent Scenario 3: complete replacement of GLS with mixed CFL/halogen/LED/high efficiency incandescent	MEPS Govt market intervention	Scenario 1: increased mercury waste Scenario 2: temporary mercury increase, historical waste issue for product stewardship Scenario 3: slight increase in mercury waste
CFL-e	Growth		MEPS	
HID	Historically mature	Possible shift away from HID to 1) High-bay fluorescent systems 2) Streetlighting metal halide replace mercury vapour 3) Shopfit compact low watt metal halide displace halogen	Government procurement guidelines	1) High-bay fluorescent systems – decrease in mercury 2) Streetlighting – reduced mercury waste 3) Shopfit – increased mercury waste
GLS	Potential complete replacement	Complete phase out from 2009	MEPS	
Halogen	Possible high growth	Replacement for GLS High wattage changing to low wattage	MEPS	Reduction in overall mercury waste
LED	Possible high growth	Replacement for GLS	MEPS Technology development	Reduction in overall mercury waste
High efficiency incandescent	Possible high growth	Replacement for GLS	MEPS Technology development	Reduction in overall mercury waste

4.6 How the Market Works

The lighting market has changed significantly over the last decade. Ten years ago the market was predominantly a cost driven commodity market, dominated by a small number of key players. These players influenced and effectively provided financial packages to the lighting market. At this time specialist lighting companies made up approximately 10% of the lighting market.

In 2007 the market make-up is estimated to be 60% commodity and 40% specialist lighting. This has resulted in more purpose designed lighting and less "crashing of the specs" to reduce the upfront costs of installing lighting in new buildings. Key influences for this change have been the introduction of the energy saving lighting standard NZS 4243[11] in 2007, MEPS and the Greenstar rating system (refer Section 7). "Crashing the specs" refers to the situation where the initial upfront cost of the lighting is significantly reduced by using less expensive gear than in the specifications. There are flow on effects, such as the lower performance than the originally specified equipment and reduced energy efficiency over the whole of life.

In 2005 the Electricity Commission and Energy Trusts entered and heavily influenced the market by subsidising compact fluorescent lamps. This brought new lamp importers/brand-owners into the market and helped to set minimum standards for the mercury content in compact fluorescent lamps.

Figure 10 shows the six distinct stages of the lighting life cycle in New Zealand.

1 Import and manufacture

Overseas Manufacturers - lamps only
Role in market: Since the closure of the Osram/Philips lamp manufacturing plant in 2000 all lamps are imported predominantly from China, Thailand and Germany.
Number of companies: 7 main brand owners
Key brands: Philips, Osram, Sylvania, General Electric, Radium, EnergyMad, e-lite.

NZ Manufacturer - luminaries and control gear

[11] *New Zealand Standard **NZS 4243**: Energy efficiency – large buildings. Part 2: 2007 Lighting*
This Standard sets lighting power density limits for different building uses, and provides an alternative method to calculate limits for individual spaces within a building. NZS 4243 has been updated to reflect current good design practices and the use of modern lighting technology that is readily available.

Role in market: OEMs or original equipment manufacturers assemble luminaries, lamps and control gear from a combination of imported and NZ-made components.
Number of companies: 4

Importers/distributors

Role in market: This mix of importers and distributors is dominated by the lamp brand owners who import and distribute and the importers of luminaries already fitted with lamps. In the market map importers and distributors are in both the import & manufacturer and distribution & sale phases of the market. From a product stewardship perspective this is the narrowest point in terms of the numbers of companies active in this part of the supply chain.
Number of companies: 8

2 Distribution and sale

The distribution and sale stage is dominated by the electrical wholesalers who handle the bulk of the lighting market. Significant volumes of lamps and luminaries are sold through supermarkets, lighting stores and the big format DIY chains (Warehouse, Bunnings, Placemakers, Mitre 10 etc.). An increasing volume of lamps, luminaries and control gear is now imported directly by developers and through the internet. These two channels have dotted lines because they are emerging and need to be watched as potential high growth sources of lighting.

Electrical wholesalers

Role in market: The electrical wholesalers are dominated by three main groups which are an amalgamation of a number of companies over the years. The significant growth in outlets over the last 10 years has increased competition.
Number of companies: Three major general electrical wholesalers groups with 240 outlets throughout NZ plus an estimated 20 totally independent wholesalers giving 250 to 260 outlets[12]. Of the 438 electrical distributors listed in the Yellow Pages around 50% are specialists.
Key players:
Crane Distribution Group
- MasterTrade Electrical Supplies – 49 outlets
- Corys Electrical Supplies – 21 outlets

Redeal Group
- Ideal Electrical Supplies – 47 outlets
- Rexel Electrical Supplies – 26 outlets

[12] *Pers comm. Richard Ponting, CEO Lighting Council of NZ*

Powerbase Group

11 independent companies with a common buying policy - total 97 outlets e.g. J A Russell, Stewarts Powerbase, Simpson Powerbase

Independent wholesalers

e.g. Trade Electrical Supplies Ltd, Cetnaj Electrical Supplies Ltd

Retail

Role in market: Retail shops provide an outlet for the householder and DIY as well as small commercial buildings. Electrical wholesalers and in some cases importers/distributors provide the point of sale for electrical contractors, in-house electricians and maintenance contractors.

A number of the DIY companies have trialled take-back systems for fluorescent lamps as part of the Electricity Commission funded projects. Many of the DIY companies and the supermarket chains are members of the New Zealand Retailers Association.

Number of companies: Six major retailers dominate the market followed by a number of specialist lighting shops.

Key players by product purchased:

Lamps only – Progressive Enterprises, Foodstuffs supermarkets, petrol stations

Lamps and luminaries and controls

Household/ DIY/small commercial – Bunnings, Placemakers. Mitre 10, The Warehouse, retail lighting (e.g. Lighting Direct), electrical wholesalers

Contactors – purchase from electrical wholesaler and/or from importers/distributors

3 Installation – who installs the lamps, luminaries and control gear

Five major groups install lighting. The first two are the householder/DIY and the small commercial office/business where the owner or staff will change the lamps. This sector of the lighting industry is dominated by three distinct groups of electricians:

Electrical contractors

Role in market: it is estimated by the Electrical Contractors of New Zealand that there are 1600 electrical contractors. They undertake the majority of installation and there are a number of large companies with 50 to >300 staff. These companies tend to specialise in one part of the sector (e.g. streetlighting) or one part of New Zealand (e.g. Auckland). One national chain has 9 branches plus key national accounts (e.g. banks, malls) with relamping programmes that will generate a significant proportion of their annual lamp sales.

Many contractors are supplied by the electrical wholesaler "rep" who brings the lighting hardware to the contractor.

In-house electricians

Role in market: In-house electricians are a distinct group who undertake their work for a council, manufacturing plant or commercial building complex. They have been identified separately because they handle a significant volume of gas discharge lamps with mercury content and decide how the lamps and lighting equipment are treated at the end of their life.

Maintenance contractors

Role in market: This is another significant group of electrical contractors who contract to maintain lighting in a range of commercial and industrial settings as well as public lighting. This group includes the Facilities Managers (FM) such as Spotless Services, PAE and United Gooder that handle significant volumes of gas discharge lamps on behalf of their Key Account Customers or Holders.

4 Use – where the lighting is installed

The widest part of the supply chain is found in the use phase. There are numerous uses from residential and small commercial buildings to specialist lighting that includes garden, architectural and horticultural lighting. By far the biggest use covers the Key Account Customers.

Key Accounts Customers

Role in market: These companies and organisations directly purchase significant quantities of lamps, luminaries and control gear either from importers and distributors or electrical wholesalers who keep up their inventory. In this use category there are retail buildings, office buildings, public buildings (including hospitals, libraries, prisons, schools and institutions), industrial buildings and public lighting. Public lighting includes city and street lighting as well as sports grounds, airports etc.
Number of companies: numerous
Key players: Government Stores Board; Facilities Managers, banks, malls

5 De- installation

This is the same group as described in installation with the addition of a new player, the demolition contractor, who frequently reuses or recycles the scrap metal content of the luminaries and sends the lamps to landfill.

6 End-of-life

As the lighting life cycle comes to an end there are three options available. The first is recycling where the householder, DIY and small commercial operator are able to take their used lamps to a council transfer station for recycling. The second is commercial recycling where businesses, councils, electrical wholesalers pay a commercial recycler to recycle lamps. The third option is to landfill as described in Section 6.5

7 Lighting designers and specifiers

Lighting designers are key players in the market. While they do not appear in the product flow diagram they are a key influencer sharing this role with the lamp importers, electrical wholesalers and the electrical contractors. They specify the type of lighting and are increasingly taking the whole of life impacts of the lighting into account.

Each major lighting company has in-house lighting designers and provide this as a free service for their customers. A number of the specialist lighting companies also have in-house lighting designers and it is these companies that are increasingly "pushing the envelope" and implementing best practice lighting design. The more expensive the lamps and hardware, the more likely a lighting designer is involved.

Working against the lighting designers specifications are cost conscious developers who downgrade the specification, often referred to by the industry as "crashing the specs", without thought to the downstream impacts of these decisions.

Engineering and architectural firms also influence lighting design and the importers and distributors seek to influence their decisions, particularly for specialist lighting. The electrical wholesalers also have a large influence on specifications depending on the lamps, luminaries and control gear they chose to stock. The electrical contractors and wholesalers we interviewed were particularly loyal to specific lamp and hardware brands. This is, in part, due to the financial and/or travel incentives for attaining specific sales targets with the particular supplier.

In terms of introducing new technology the street lighting and public lighting sector were concerned about the reliability of the technology. Changing a lamp in these situations takes considerably more resources than replacing a bulb at home. For this reason they sought out proven rather than leading edge technology.

4.7 Product Flows

Figure 11 to *Figure 13* show the flow of lamps through their New Zealand life cycle. These diagrams attempt to illustrate, approximately, the major flows of lamps onto and off the lighting market. No diagram has been completed for CFL-e lamps as these follow very similar pathways to LFLs as their dominant use is in commercial buildings.

These diagrams do not show every pathway for lighting on the market, as this would over-complicate things. For example, demolition contractors de-install lamps from every part of the market so we have not shown product flows through this channel. Instead, the diagrams are intended to show dominant routes for lamps onto and off the lighting market.

Linear Fluorescent Lamps

Figure 11 shows that LFLs are imported into New Zealand and follow three major routes to their end use:

1. direct to electrical contractors
2. through electrical wholesalers
3. via OEM manufacturers/assemblers of luminaires

Major end uses of LFLs are in: office buildings, public buildings and to a lesser extent retail and industrial buildings. LFLs become waste through relamping procedures and are predominantly handled by electrical contractors, maintenance contractors and in-house electricians. More recycling of LFLs is taking place than for other lamp types, although the majority are still being landfilled.

Compact Fluorescent Lamps

Figure 12 shows that market route for CFL-i lamps is much simpler, as they are predominantly sold into the residential sector. Lamps are imported and sold to consumers through a wide variety of retailers. CFL-i lamps are fitted by householders and removed by householders at the end-of-life. Almost all lamps are currently being disposed of to landfill.

High Intensity Discharge Lamps

Figure 13 shows that HID lamps flow onto the market in a similar way to LFLs – either directly to contractors or via wholesalers and OEMs. Lamps are put in place by in-house electricians, maintenance contractors and electrical contractors. Major users are industrial buildings and public lighting, with some also used in large retail. Lamps are taken out by the same contractors and in-house electricians and are largely disposed of to landfill.

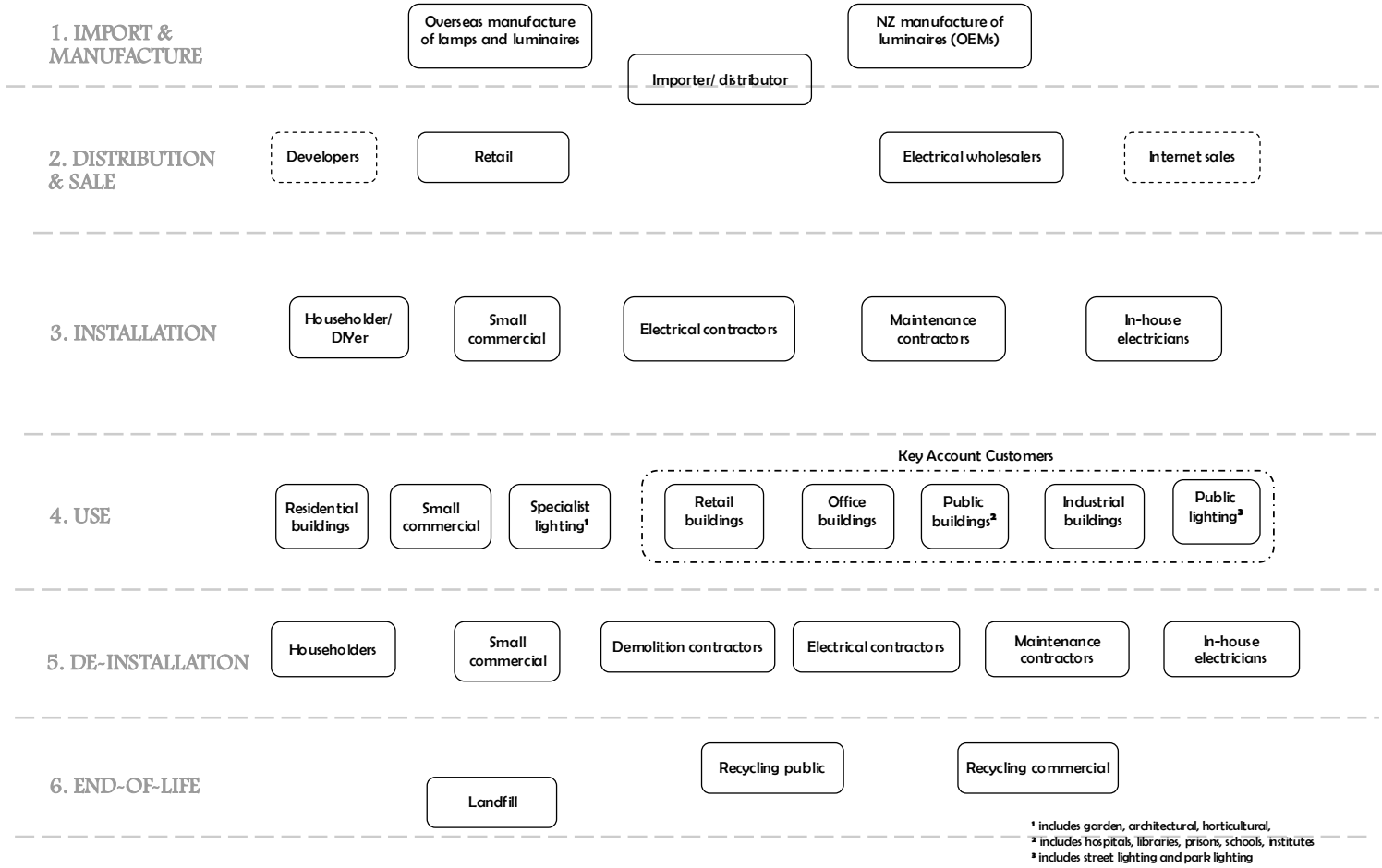


Figure 10. Key stages in the life cycle of lighting in New Zealand, and the stakeholders involved in those stages

LINEAR FLUORESCENT LAMPS

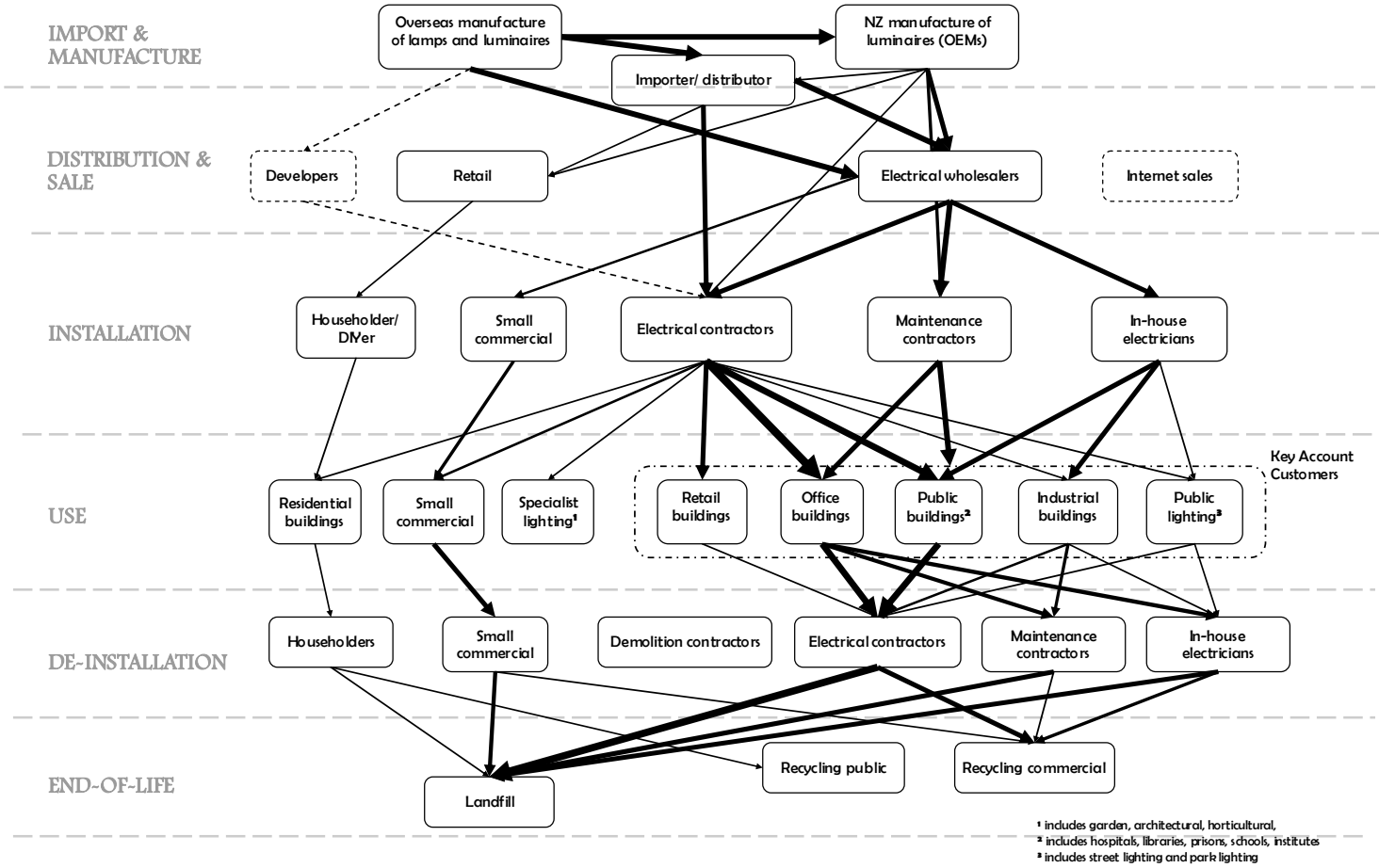


Figure 11. Key stages in the life cycle of linear fluorescent lamps in New Zealand, and the stakeholders involved in those stages

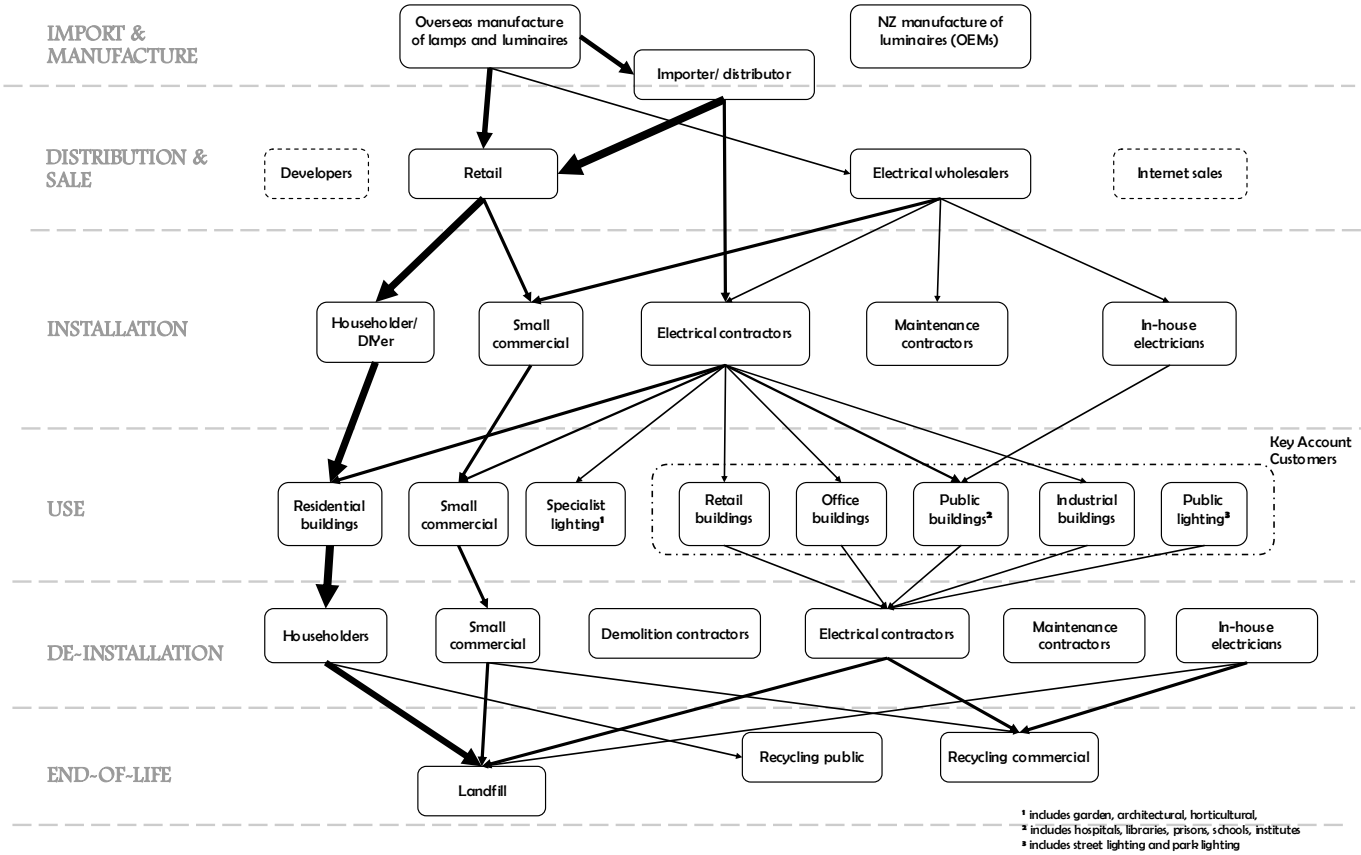


Figure 12. Key stages in the life cycle of compact fluorescent lamps (integrated control gear) in New Zealand, and the stakeholders involved in those stages

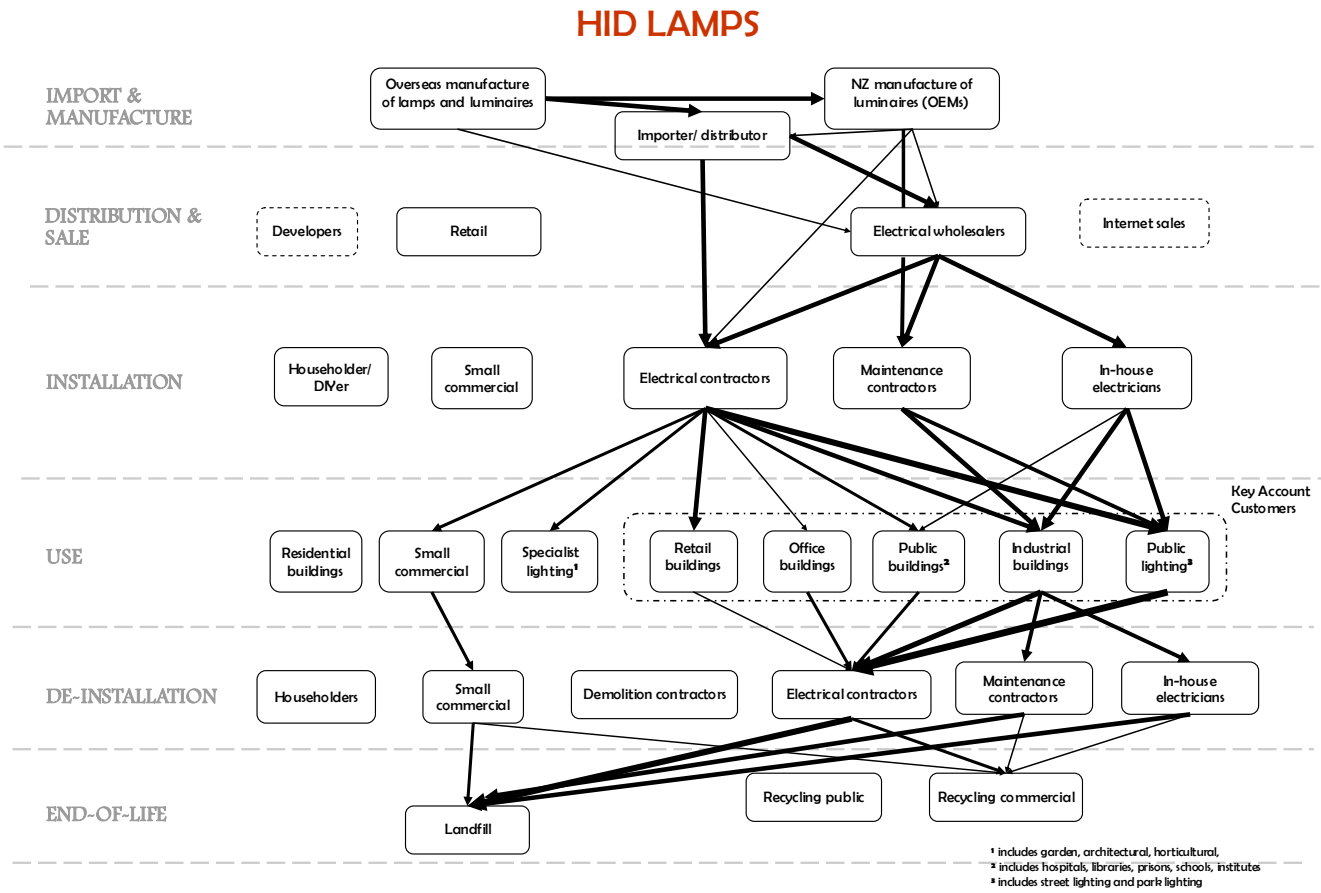


Figure 13. Key stages in the life cycle of high intensity discharge lamps in New Zealand, and the stakeholders involved in those stages

4.8 Membership of Industry Associations

Lighting Council New Zealand (LCNZ)

LCNZ represent lighting industry organisations with a membership of around 30 companies that represent 60-70% of the market in terms of lamp numbers and considerably more in terms of value. The Lighting Council represents key stakeholders in the lighting industry. It has an influence on the design and implementation of lighting throughout New Zealand by advocating for its members on commercial and regulatory matters. LCNZ has recently agreed to cooperate with the lighting industry associations of Australia and China to further promote and develop the lighting industry in their respective countries.

Illuminating Engineering Society of Australia and New Zealand (IESANZ)

The Illuminating Engineering Society of Australia and New Zealand Limited is an organisation comprising six Chapters which are located in the Australian States (New South Wales, Queensland, South Australia, Victoria and Western Australia) and New Zealand.

The aim of the Society is the advancement of the art and science of illumination and the dissemination of knowledge to all interested parties. The Society's diversified membership includes engineers, architects, educators, students, contractors, manufacturers and designers. There are two types of membership available: individual and corporate (or company) and many LCNZ companies are members in both categories.

Members of this society directly influence and undertake lighting design in New Zealand. A number of LCNZ members are members of the Illuminating Engineering Society, both corporately and individually. The Illuminating Engineering Society offers both Lighting Design and Luminaire Design Awards.

Electrical Contractors Association of New Zealand (ECANZ)

ECANZ have 1600 members who employ 7000 electrical workers. Members range from self-employed electricians to companies with a large number of vans on the road. It is estimated that ECANZ represent 70% of the companies listed in the Yellow Pages. With 10 branches throughout NZ, ECANZ members operate under the MASTERelectrician brand and own the Electrical Training Company.

In the latter part of 2008 ECANZ are looking to offer a “green electrician” scheme to the public and 70 members have already expressed an interest in this. Between 10 to 15% of members are expected to take part. These “eco electricians” will be trained to offer energy efficiency and lighting advice, energy audits and recycling.

At this stage environmental considerations are not included in the New Zealand Qualifications Authority (NZQA) framework for electricians. The "green electrician" scheme would run in parallel with the NZQA.

Energy Management Association of NZ (EMANZ)

The Energy Management Association of New Zealand (Inc.) works to ensure that a continuing high standard of expertise in energy management and energy efficiency is available to industry, commerce and the public of New Zealand.

EMANZ membership is open to all people and organisations in the energy management industry whatever their backgrounds, as well as catering for professional engineers. It is a Collaborating Technical Society with the Institution of Professional Engineers New Zealand (IPENZ).

5 LIGHTING WASTE

Due to the potential environmental effects of mercury in lamps (discussed in Section 8 of this report), the modelling of waste arisings has focused on mercury-containing lamps (LFLs, CFLs and HIDs).

With no quantitative data on the levels of waste lamps in New Zealand it was necessary to develop a model to calculate predicted waste arisings.

5.1 Waste Model Assumptions

In order to model the quantities of waste arising from gas discharge lamps in New Zealand we have had to make some assumptions on average product lifespan, average composition, and average weights. These assumptions are based on a review of similar studies conducted elsewhere in the world and information provided by members of the Lighting Council of New Zealand. The assumptions are detailed in the table below.

Lamp	Import volume	Average weight	Average mercury content[13]	Average life expectancy (hours)[13]	Average life expectancy (years)[13]
Linear fluorescent lamp (LFL)	3.5 million	120g	T8 = 4mg T5 = 5mg	8,000 hrs	3 years
Compact fluorescent lamp integral (CFLi)	4.0 million	120g	5mg	10,000 hrs	3 years
Compact fluorescent lamp non-integral (CFLe)	0.7 million	50g	5mg	12,000 hrs	4 years
High pressure sodium (HPS)	0.475 million	150g	50mg (20-145mg range)	20,000 hrs	4 years
Metal Halide (MH)		240g	50mg (25-225mg range)	20,000 hrs	4 years
Mercury Vapour (MV)		220g	50mg (25-225mg range)	20,000 hrs	4 years

[13] *It is important to note that these are <u>averages</u> used in this study to allow for a simplified lamp waste model to be developed. There is considerable variation in mercury content and life expectancy within each lamp category.*

5.2 Waste Arising Model

Figure 14, below, shows imports of all mercury-containing lamps into New Zealand from 1997 to 2006. Levels of imports in 2006 were 8.7 million lamps.

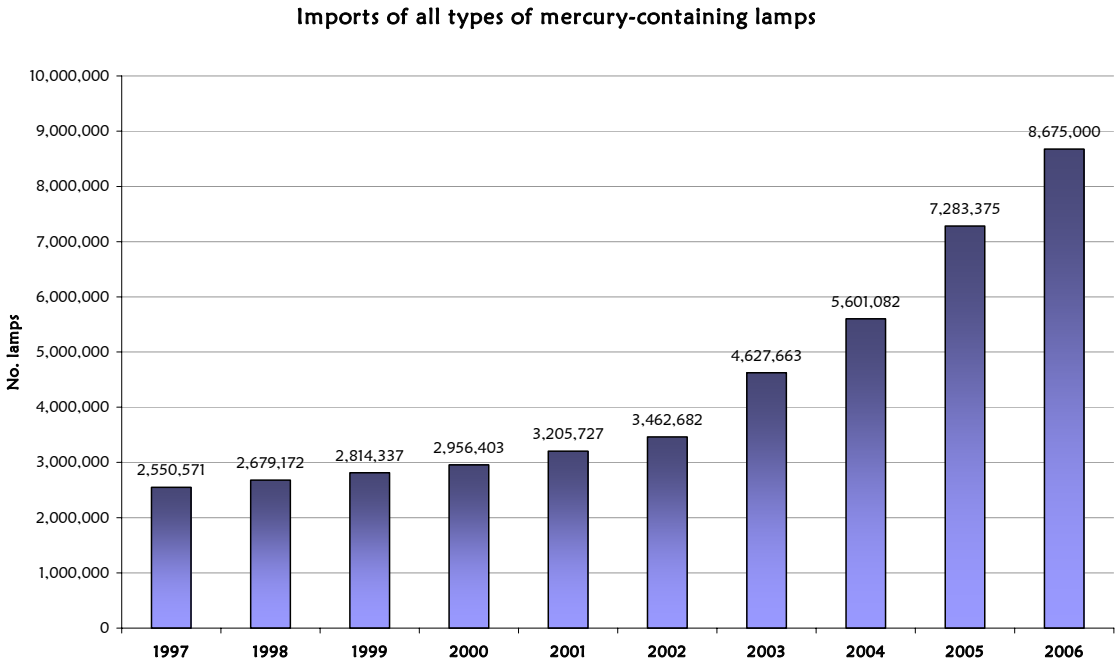


Figure 14. Imports of mercury-containing lamps to New Zealand. Based on Customs data and a lighting industry survey

Using the import data shown in *Figure 14*, and applying some of the assumptions on lamp weight, and lamp life expectancy detailed in Section 5.1, above, we have estimated the tonnages of lamps arising as waste through to 5 years from present. *Figure 15* shows a steady increase in the tonnages of waste arising from lamps in New Zealand.

The current (2007) level of waste is estimated at 5.6 million lamps, equating to 717 tonnes. By 2012 this is predicted to have risen to 9.5 million lamps or 1174 tonnes of waste.

717 tonnes of waste equates to approximately 0.02% of total municipal solid waste (MSW) in New Zealand[14].

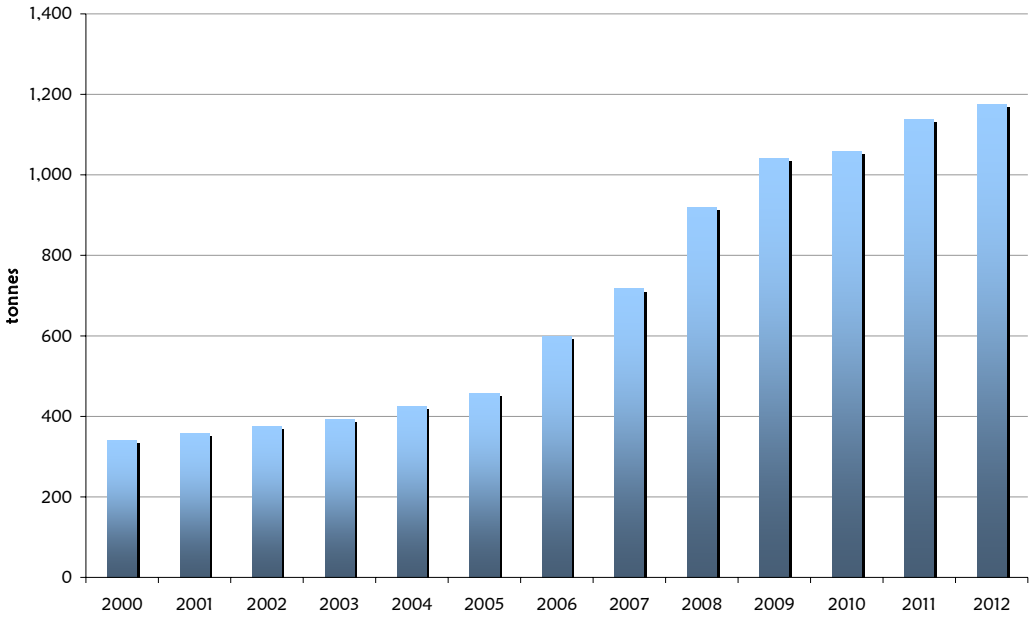


Figure 15. Tonnes of gas discharge lamps arising as waste

[14] *Based on estimated MSW of 3.6 million tonnes per annum (Ministry for Environment 2007 http://www.4million.org.nz/climatechange/takingaction/work.php)*

5.3 Waste Composition

The standard material composition of different lighting technologies has been detailed in Section 3.5 of this report. For each technology we have used average composition data together with the waste arising modelling to predict the overall composition of gas discharge lamp waste in New Zealand. *Figure 16* shows an overall composition for lamp waste arising in 2007.

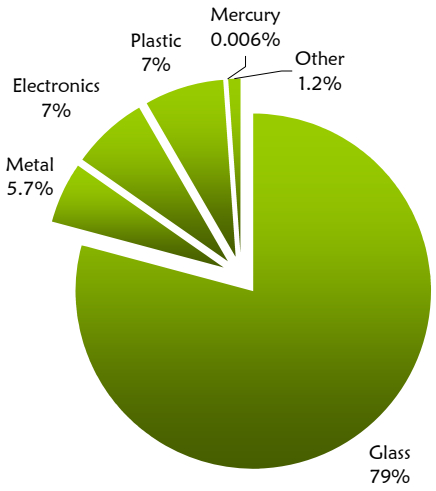


Figure 16. 2007 overall estimated waste composition for gas discharge lamps in NZ

Table 2, below, shows details of the quantities of material arising from waste lamps each year in New Zealand. *Figure 17* shows these results graphically.

Table 2. Estimated quantities of materials arising from waste gas discharge lamps in New Zealand

	Materials arising (kg)						
YEAR	Glass	Metal	Electronics	Plastic	Mercury	Other	*TOTAL*
2000	310,992	24,818	0	0	28	4,714	*340,551*
2001	326,429	25,826	0	0	29	4,950	*357,234*
2002	342,645	26,877	0	0	30	5,198	*374,750*
2003	359,680	27,972	0	0	32	5,458	*393,141*
2004	384,055	29,507	2,520	2,520	33	5,828	*424,463*
2005	409,334	31,091	5,040	5,040	35	6,211	*456,752*
2006	493,884	36,278	30,240	30,240	40	7,474	*598,155*
2007	566,473	40,727	50,400	50,400	44	8,559	*716,603*
2008	685,472	47,995	88,200	88,200	50	10,333	*920,250*
2009	766,325	53,122	100,800	107,100	56	12,424	*1,039,827*
2010	783,987	54,388	100,800	107,100	57	12,693	*1,059,025*
2011	834,696	57,674	113,400	119,700	60	13,452	*1,138,982*
2012	864,627	59,782	113,400	122,400	63	14,281	*1,174,553*

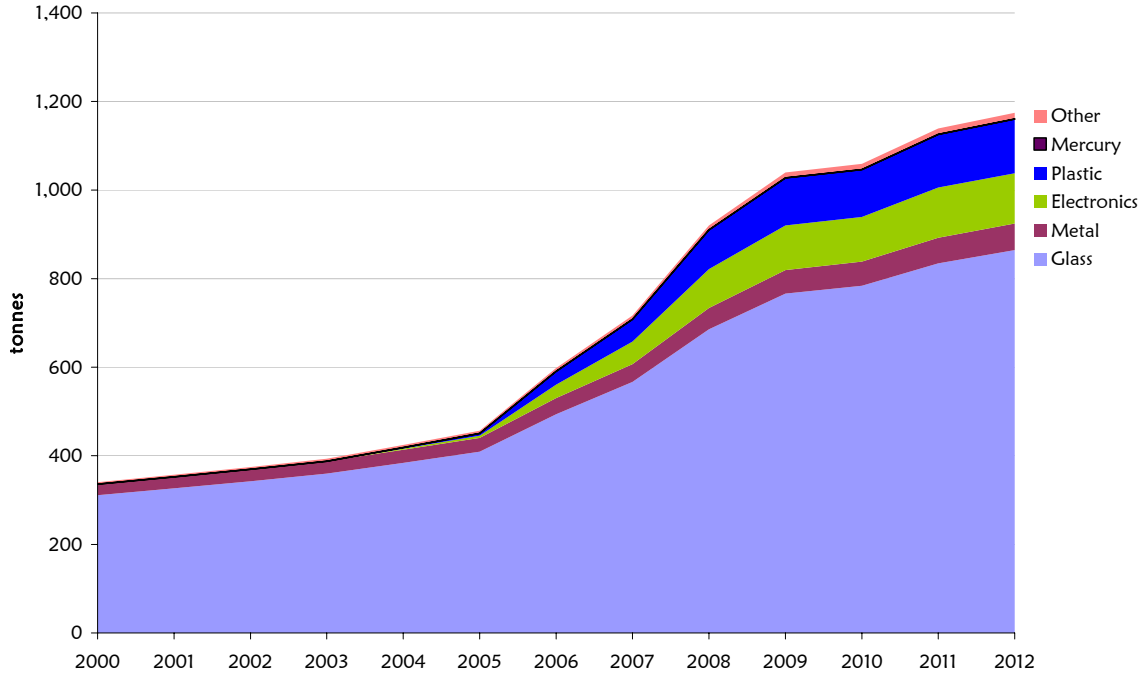


Figure 17. Materials arising from waste discharge lamps between 2000 and 2012

5.4 Mercury Arising

Based on import data and the waste arising model outlined above, we have estimated the volume of mercury from end-of-life lamps in New Zealand. We estimate that there is currently (2007) 45kg of mercury arising in lamp waste. *Figure 18* shows that this rises to almost 70kg in 2012, largely due to increased quantities of CFLs becoming waste.

NOTE: The reduction in mercury into the environment as a result of a reduction in coal burning for electricity generation has not been taken into account in the following 4 graphs. See Section 8 for more detail.

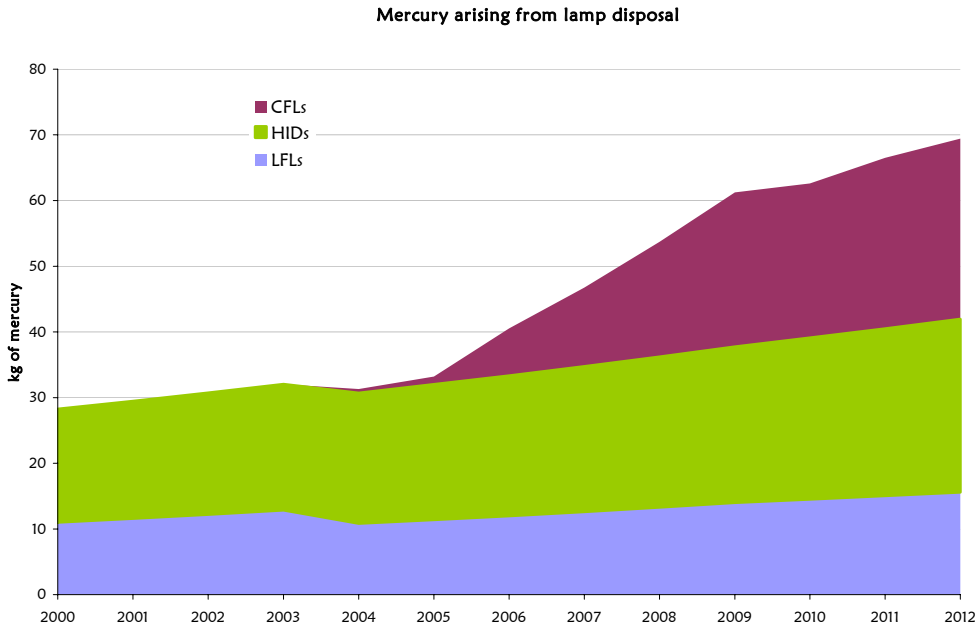


Figure 18. Mercury arising from gas discharge lamps

The impact of compact fluorescent lamps on the levels of mercury arising in the next 5 years is clear. The introduction of minimum energy performance standards (MEPS) in 2009 has the potential to dramatically increase the uptake of CFLs as replacements for GLS lamps. Figures 16 to 18, model three different lamp trends based around the introduction of MEPS in 2009.

Scenario 1 (*Figure 19*) shows a 15 year trend that continues current growth rates for LFL and HID technology (3.5% and 3.7% per annum respectively), and predicts a growth in CFL technology to replace GLS lamps.

Scenario 2 (*Figure*) shows the same initial trend for CFLs to grow strongly as they replace GLS lamps after MEPS, but predicts mercury arising if CFL technology is then replaced by a non-mercury-containing lamp technology such as LEDs or high efficiency incandescent lamps.

Scenario 3 (*Figure*) illustrates the levels of mercury arising from end-of-life lamps based on an even mixture of CFLs, LED and high efficiency incandescent lamps replacing GLS lamps in the market place.

Technology trends are extremely difficult to predict with any accuracy. These models should be regarded as indicative estimates, rather than absolutes. The predictions are intended to stimulate discussion rather than predict with accuracy the levels of future mercury arisings. Other aspects such as significant reductions in the mercury content of any of the lamp technologies will significantly alter these predictions.

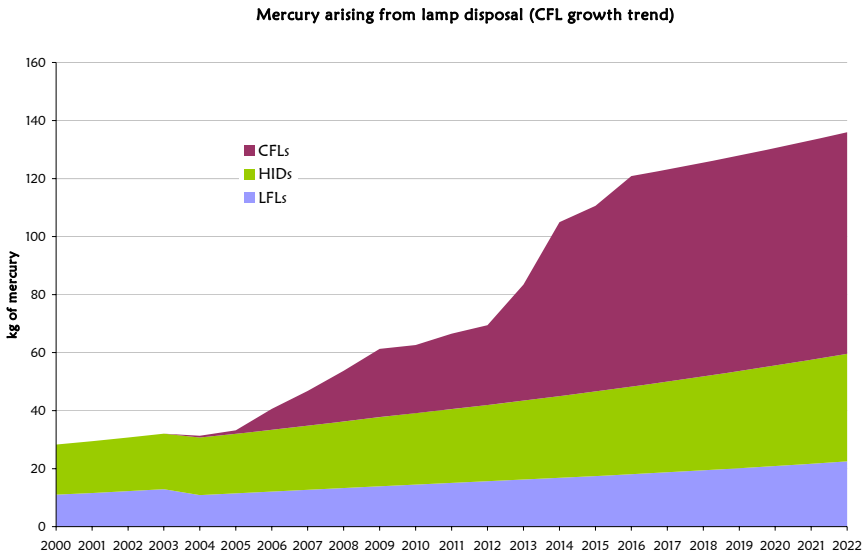


Figure 19. Scenario 1: 15-year predicted mercury arisings based on CFLs completely replacing GLS lamps following MEPS in 2009

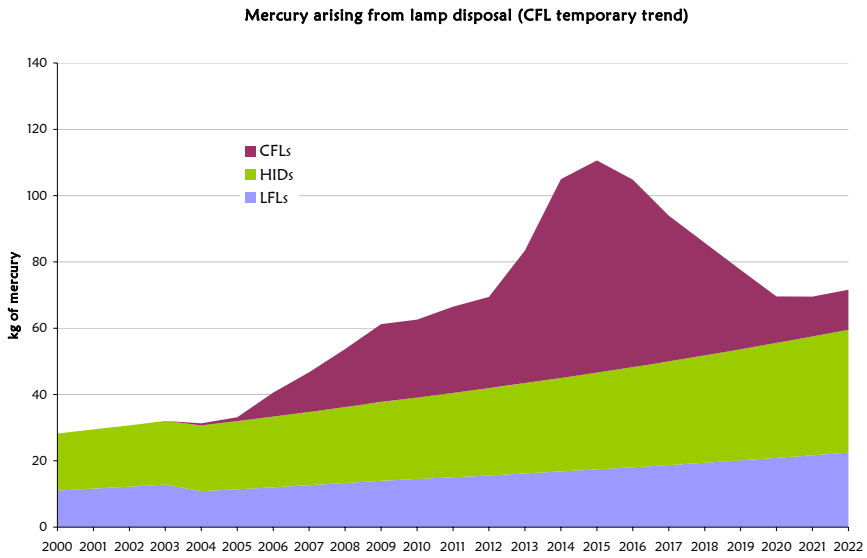


Figure 20. Scenario 2: 15-year predicted mercury arisings based on CFLs completely replacing GLS lamps following MEPS in 2009, followed by the gradual replacement of CFLs with an alternative technology such as LED or high efficiency incandescent lamps after 5 years.

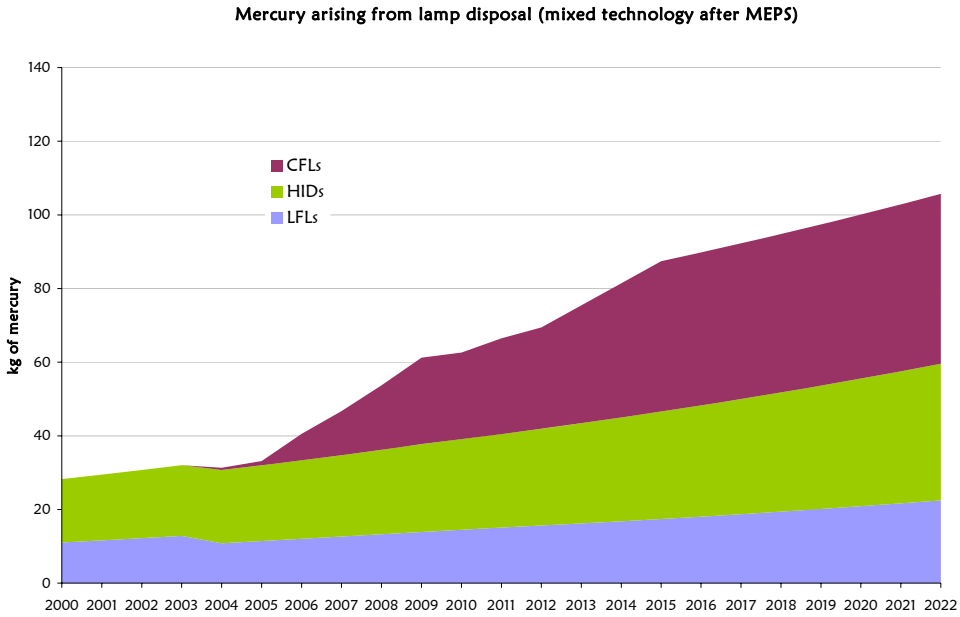


Figure 21. Scenario 3: 15-year predicted mercury arisings based on a mix of lighting technologies replacing GLS lamps following MEPS in 2009.

6 END-OF-LIFE PATHWAYS

There are three pathways for end-of-life lamps in New Zealand:

1. Council recycling facility (including Hazmobile)
2. Business-to-business recycling (Currently Interwaste is providing this service)
3. Landfill – some landfills are banning the disposal of LFLs

6.1 Council Recycling Facilities

From a survey through the NZ Waste email group it appears that most councils do not provide recycling collection facilities for household use. The councils that do provide a service either have hazardous goods facilities at the transfer station/resource recovery park or use a hazmobile (see below).

There is a mix between councils that charge to take lamps for recycling and those that provide a free service and use ratepayer funds to have the lamps collected for recycling. Councils use a number of ways to fund recycling; user pays; general rates; cross subsidy within the waste account; proposed waste levy.

These councils have an arrangement with Interwaste (see Section 6.3). The charge out rate is 50 cents for CFLs and $1 for LFLs. A number of councils commented that the public accepted paying to have expanded polystyrene recycled and may accept paying to have their fluorescent lamps recycled in an environmentally responsible way.

Results from NZ Waste Group email survey

Council	Transfer Station	Hazardous waste collection (Hazmobile)	CFL Price	LFL Price	Comment
North Island					
Hamilton	No				Planning a council funded collection service in 2008
South Waikato	No				
Raglan	Yes		50 c	>$1	
Tauranga	No	Yes	Free	Free	Very few collected at yearly hazmobile event
Gisborne	No				Ask householders to wrap lamp in paper, Target TV programme backlash against CFLs
New Plymouth	No				

Hutt City	No	Yes	Free	free	Hazmobile collection in August 2007 – 200 lamps Trialling free (council funded) collection boxes in 20 Hutt City retail shops
South Island					
Marlborough	Yes		Free	Free	Store in hazardous goods shed – council pays for householder Commercial customers pay $1 at local electrical wholesaler
Kaikoura	No				Crush lamps with other glass
Waimakariri	No				Expect more lamps in 2 years after the Wa$ted TV programme, push for energy efficiency and awareness that they contain mercury
Selwyn	No				Will consider once hazardous goods area constructed. May use proposed waste levy to cover recycling costs
Queenstown	No				Looking at options at transfer station
Invercargill	No				Electrical businesses (EIA) offered service to public

Some councils, mostly in the North Island, use a 'Hazmobile" service to collect hazardous waste from residents on a regular basis. The Hazmobile service operated by all Auckland Councils (except Waitakere) collects LFL and CFL lamps from residents for free and recycles them through Interwaste.

Hazmobile managers report that in 2006/07 levels of CFLs were only about 10% of lamps being collected. In 2007/08 this has increased to around 20%[15].

Councils without a facility will not accept lamps for recycling because of the "*difficulty of preventing careless handling, the high breakage potential and the potential harm to the public and transfer station staff from the mercury and broken glass*".

Interestingly a number of councils and educational institutions indicated that there was in-house recycling of fluorescent lamps from all council buildings and facilities.

6.2 Building Demolition

Building demolition is considered the major source of end-of-life fittings. Because of the durability of the fittings they are not often replaced during a buildings life.

[15] *Pers. comm. Patricia Blütner, HazMobile Programme Coordinator for the Councils of the Auckland Region*

This means the main way light fittings enter the waste stream is when buildings are demolished.

During building demolition both lamps and luminaires are removed together and disposed of or recycled. Contact with demolition contractors suggests that fittings from commercial and industrial buildings are largely removed and resold or recycled due to their metal content. One contractor estimated that as much as 50% of the LFL fittings are resold. The resell figure is much higher for the more expensive HID fittings from the demolition of industrial buildings.

The common shallow trough LFL fittings from commercial buildings are typically made of light gauge steel that can be readily recycled for a small value. These are removed and sold to scrap metal dealers.

Lamps and low value fittings are scrapped along with other residual materials from a demolition job. Lamps are only recycled if it has been specified in the demolition tender and the contractor can therefore allow for the additional cost of labour to remove the lamps and costs of recycling.

6.3 Business-to-Business Recycling

There is currently (November 2007) only one lamp collection and recycling service operating on the market, and this is provided by International Waste Ltd (Interwaste). Since October 2007 a new service was being advertised called the "Bulb-eater". Both of these services are explained further below.

Interwaste

Interwaste (www.interwaste.co.nz) are a specialised waste management company that has set up mercury lamp collection and processing throughout New Zealand. Interwaste also manage quarantine, medical and secure wastes.

Interwaste collect lamps from all over New Zealand and transport them to their main processing facility in Auckland. Lamps are crushed into a vacuum-sealed drum. When a drum is full it is sealed closed and stockpiled. Once sufficient volume has been achieved Interwaste are also looking at establishing facilities in Christchurch.

Interwaste does not recycle lamps in New Zealand. They crush the collected lamps (glass, ballasts, plastic and all) into a sealed drum using a vacuum. These sealed drums are exported to Australia for recycling by Advanced Recycling Australia.

Interwaste use a system of prepaid boxes that a company can use to collect 50 or 100 linear fluorescent lamps. The boxes have a standard advertised pricing structure that works out at approximately 95c per tube. The Interwaste system also processes CFLs. Prepay system of boxes either in stores or electricians vans. For larger relamps collection will be/has been by the container load.

The majority of lamps collected by Interwaste come through electrical wholesalers and large corporates, through their electrical contractors. These two avenues combined make up about 60% of the lamps currently recycled. Other small avenues are waste companies and councils.

Crushed lamps are exported to CMA Ecocycle (formerly known as Advanced Recycling Australasia (ARA)) in Melbourne. CMA Ecocycle use a Swedish MRT mercury distiller that can recover mercury from a wide range of mercury-containing wastes (e.g. dental amalgam, batteries, and lamps). According to ARA, the MRT machine has a capacity of 3-4 tonnes per day, and this means that it is capable of recycling "every end of life fluorescent tube and mercury containing light produced in Australia and New Zealand, with capacity to spare". The CMA Ecocycle facility in Melbourne is licensed by the Victorian EPA.

Interwaste report that there has been strong growth in the levels of lamp recycling in the last 12 months. The company is currently processing between 500,000 and 600,000 lamps per annum and this level is still growing.

"Bulb-Eater"

A technology called the "Bulb-Eater" from the USA is a lamp crushing unit that seals onto the top of a drum. Interwaste offer this technology to some of their larger clients.

Companies pay between $600 and $800 (the price is still being decided) for a full drum to be collected. A full drum can hold around 1000 lamps, meaning a cost of 60-80c per lamp.

Drums of crushed lamps are stockpiled and when there is sufficient quantity they plan to export to Australia.

6.4 New Zealand Markets for Recycled Materials

The materials recycled from lamps are shown in Figure 22. Glass dominates the materials. Overseas, the glass recycled from fluorescent lamps is used in the manufacture of secondary products such as glass-wool insulation. The recycling of the glass into new lamps is possible but problematic due to variations in the quality and chemical composition of the glass provided by the recycler to the manufacturer[16]. Contaminants can include lead within the glass, metal components, ceramics and wires.

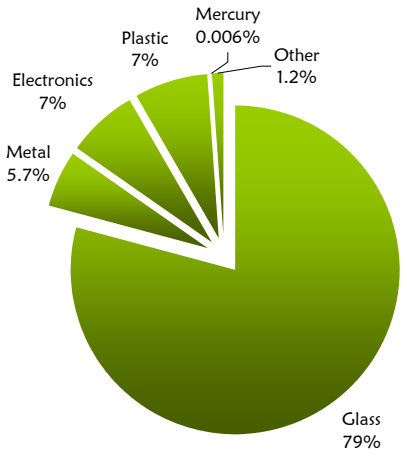


Figure 22. Estimated composition of waste gas discharge lamps in NZ

The New Zealand glass recycling market has encountered difficult times over the last 2 years with a dramatic decrease in prices paid for cullet due to a lack of capacity for the material. Glass recyclers are already seeking alternative end uses for glass cullet and are unlikely to be interested in the glass from recycled lamps if it has potential contamination issues.

Overseas, mercury is distilled and recycled into dental amalgam and other mercury-containing products. There appears to currently be a lack of markets for recycled mercury in New Zealand[17].

The lack of markets, coupled with the significant capital expense of a mercury recycling facility, mean that a New Zealand recycling operation is unlikely to be viable, even if larger volumes were collected.

Advanced Recycling Australasia reports that it has sufficient capacity for all the lamps in New Zealand and Australia and more. Offshore recycling, with consolidation and crushing in New Zealand is likely to remain as the main recycling option.

---

[16] ***WRAP (2003)*** *The Development of a Methodology for Recycling Lamp Glass, Overcoming Technical and Practical Barriers to Recycling. Waste and Resources Action Programme (WRAP) UK*

[17] *Lincoln Falconer, Interwaste pers. comm.*

6.5 Landfill

Based on the information available on numbers of gas discharge lamps being recycled (500,000), and the number of lamps estimated to be arising as waste (5.6 million), it is a logical conclusion that the majority of lamps (91%) are disposed of to the 60 landfills[18] that currently operate in New Zealand. Over half of these landfills have an engineered liner in place to prevent leachate, and over three-quarters of landfills collect leachate.

6.6 End-of-Life Summary

New Zealand currently has a mercury-containing lamp recycling rate of 9%. This means that 91% of lamps are being disposed of to landfill in New Zealand.

2007 waste gas discharge lamps (estimated)	5,600,000
Recycled	500,000
Landfilled	5,000,000
Lamp recycling rate	9%
Luminaires and control gear	Up to 50% salvaged/ recycled at demolition

[18] ***Ministry for the Environment (2007)*** *The 2006/07 National Landfill Census; available at* *http://www.mfe.govt.nz/publications/waste/2006-07-national-landfill-census-oct07/index.html*

7 REGULATORY AND NON REGULATORY DRIVERS FOR CHANGE

7.1 Current and Proposed Regulation of Lighting in New Zealand

7.1.1 Minimum Energy Performance Standards (MEPS)

Products must be registered and tested before being placed on the market.

Equipment	Measure	Status	Implementation date
Linear fluorescent lamps	MEPS sets out a minimum luminous efficacy in lumens per Watt for various lamp sizes. There are also requirements for minimum Colour Rendering Index.	Implemented	
Ballasts for fluorescent lamps	Ballasts must be marked with their energy efficiency by way of their Energy Efficiency Index (EEI). Ballasts must be designed to comply specific international performance requirements.	Implemented	
Compact fluorescent lamps		Proposed	2008/2009
Incandescent lamps		Proposed	2009
Halogen lamps		Proposed	2010
HID lamps		Proposed	2010
HID lamp ballasts		Proposed	2010
Fluorescent luminaires		"Being explored"	

Of particular significance is the proposed MEPS for incandescent lamps. This MEPS would essentially 'ban' traditional incandescent lamps (at their current level of efficiency) from the New Zealand market, resulting in a wholesale switch to a replacement technology.

7.1.2 Building Code and Associated Standards

The New Zealand Building Code (NZBC) Clause H1 Energy Efficiency was amended on 13 August 2007 and incorporates the New Zealand Standard NZS 4243:- Energy efficiency – large buildings. Part 2: 2007 Lighting. This Standard

sets lighting power density limits for different building uses, and provides an alternative method to calculate limits for individual spaces within a building. NZS 4243 has been updated to reflect current good design practices and the use of modern lighting technology that is readily available.

7.1.3 Waste Minimisation (Solids) Bill

The Local Government and Environment Select Committee is currently considering a government sponsored supplementary order paper (SOP) which seeks to make significant changes to the bill. It proposes using four main criteria when assessing which products are placed on a priority waste list. These are cost to society, volume of the product, harm to the environment, and areas of public concern. Products on the priority list would be expected to have a product stewardship programme in place.

This threat of legislation is frequently a driver for change as product owners prefer to shape any product stewardship scheme rather than being forced into a mandatory and potentially more costly scheme.

7.2 Non Regulatory Drivers for Change

7.2.1 Government Procurement Guidelines[19]

The Sustainable Government Procurement Project Category Reviews - Standards, guidelines, and targets for core Public Service departments was published in August 2007. These procurement guidelines assist government departments to improve their sustainable procurement practices and set out what core Public Service departments must consider when purchasing goods and services in the following categories: paper, timber and wood products, travel and light fittings.

Lighting accounts for one-third of the energy used in commercial spaces. About half of the lighting is wasted either through inefficient bulbs, poor design or improper maintenance.[20] The guidelines set target for lamps and tubes, lighting control equipment and luminaries.

The government departments aiming to become carbon neutral by 2012 are active participants in Central government's Govt³ programme. Govt³ is part of a package of initiatives designed to improve environmental sustainability and address climate

[19] http://www.med.govt.nz/upload/51276/category-reviews.pdf

[20] MfE "Lighting": http://www.mfe.govt.nz/publications/sus-dev/office-fitouts-dec05/html/page12.html

change. The programme helps more than 40 government agencies to become more sustainable in their practice regarding buildings, transport, waste management and procurement.

A number of councils throughout New Zealand are also improving their environmental sustainability and have systems in place to recycle their hazardous waste, including gas discharge lamps. There is also an increasing trend towards energy managers in large companies and institutions.

7.2.2 Efficient Lighting Strategy

Since 2004 the Electricity Commission has offered significant funding which has driven changes in the lighting market. To date there has been an emphasis on compact fluorescent lamps. The effect of this intervention can be seen in *Figure 18* where there is a sharp increase in mercury as the CFLs sold from 2005 onwards reach the end of their life.

The November 2007 Electricity Commission Efficient Lighting Programme request for proposal (RFP) aims to enhance the electricity efficiency of lighting in New Zealand by promoting the uptake of in 6 key areas; eliminating inefficient incandescent, halogen, fluorescent, mercury vapour and street lighting, and increasing the use of efficient lighting design and controls.

The programme is based on the Efficient Lighting Strategy and the KEMA report, a study on the electrical potential in New Zealand commissioned by the Electricity Commission. As a response to the Electricity Commission's decision to inject significant funding into the lighting industry, the Lighting Council of New Zealand, EECA and the Electricity Commission have formed a partnership to prepare the Efficient Lighting Strategy.

7.2.3 New Zealand Emissions Trading Scheme (NZETS)

Announced in October 2007, the NZETS is expected to increase electricity prices by 5 to 10% from 2010 onwards. Electricity generators will pass on these increased costs to the consumer. Carbon emissions from burning coal at the Huntley Power Station (which contributes up to 20% of New Zealand's power supply) will be the largest contributor to the price increases.

This price increase is expected to drive both the commercial and domestic sectors towards energy efficiency, particularly in the lighting area. Up to one half of each local council's power consumption is used in public place lighting, including street lighting. These councils have every incentive to become more efficient.

7.2.4 Environmental Policies for Key Account Customers

In response to a changing market and increasing customer demands, the Key Account Customers are preparing and implementing environmental policies. Electrical contactors are reacting to this trend and assisting their clients to implement energy efficiency policies.

7.2.5 New Zealand Green Building Council

The World Green Building Council, of which the New Zealand Green Building Council is a member, aims to be the peak global not-for-profit organisation working to transform the property industry towards sustainability. Member countries are Australia, Canada, India, Japan, Mexico, Taiwan, United States and the United Arab Emirates and now New Zealand. Green Building Councils are also emerging in Brazil, Chile, Greece, Guatemala, Israel and the United Kingdom and some 30 other countries are actively considering forming their own.

The New Zealand Green Building Council recently announced the certification of New Zealand's first two Green Star NZ – Office Design buildings. The Meridian building, owned by Dominion Funds on Wellington's waterfront and 80 Queen St, Auckland owned by Multiplex have both achieved a 5 Star Green Star NZ rating, representing New Zealand excellence.

This voluntary movement is taking hold in Australia and New Zealand and is a driver for change. The Green Star NZ[21] is New Zealand's first comprehensive environmental rating system for buildings. Green Star NZ – Office Design v1, is used to assess the environmental impact of offices. It was released in April 2007 after extensive industry and public consultation. Green Star NZ evaluates building projects against eight environmental impact categories, plus innovation. Within each category, points are awarded for initiatives that demonstrate that a project has met the overall objectives of Green Star NZ and the specific criteria of the relevant rating tool credits. Points are then weighted and an overall score is calculated, determining the project's Green Star NZ rating, see figure 23.

[21] http://www.nzgbc.org.nz/index.php?option=com_content&task=blogcategory&id=80&Itemid=75

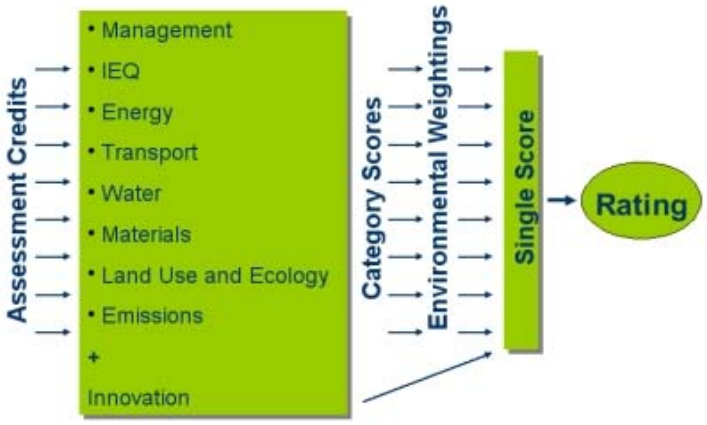


Figure 23. The Green Star NZ eight environmental categories and weighting

7.2.6 Public Concern

There is increasing public concern about mercury in CFLs, some of this is a result of the Target TV programme early in 2007. A number of councils we interviewed suggested that, as a result of increasing public concern and the hazardous waste from the mercury in fluorescent lamps, that these lamps should be listed on the priority list in the Waste Minimisation Bill.

7.2.7 International Best Practice

As an importer of lamps the New Zealand lighting market is influenced by changes in the European market. An example of a driver for change in this market is the EU Energy Using Products Directive 2005/32/EC. It is based on Design for the Environment principles and aims to reduce and minimise energy consumption at the design phase of the energy using product. Studies on street lighting products and projects on dark sky eco-labelling indicate that this area of the lighting industry is about to see significant changes.

Other examples include the waste electronic and electrical equipment Directive (WEEE) and the restriction in the use of hazardous substances (RoHS) (refer Section 10).

8 ENVIRONMENTAL AND HUMAN HEALTH ASSESSMENT

The objective of this part of the study is to understand the environmental risk and human health impacts from the design, use and disposal of lighting. Our analysis has demonstrated that mercury is the material of concern and in this section we discuss;

- the mercury content in lamps and other products in New Zealand
- pathways into the environment
- load on the environment
- lighting impacts on human health

8.1 The Life Cycle Impacts of Lighting

Life cycle analysis (LCA) has revealed that fluorescent lighting delivers clear environmental gains when compared against traditional incandescent lighting[22]. A compact fluorescent lamp, for example, consumes about 20% of the energy used by an incandescent lamp for the same light output. The resulting savings in electricity deliver savings in pollution, global warming potential, human health and every other environmental aspect.

> *"Surprisingly, in light of common perceptions, the impact of the mercury in CFLs which may be released on disposal, is not a major problem relative to other factors nor relative to the amount of mercury released from the burning of some coals."*
>
> Parsons (2006)[23]

Similar studies in the United States have also shown that the introduction of CFLs results in a net reduction in the mercury load on the environment because less coal is used to generate the electricity and this results in lower air emissions of mercury.

---

[22] *See, for example,* ***Parsons, D (2006)*** *The Environmental Impact of Compact Fluorescent Lamps and Incandescent Lamps for Australian Conditions; in The Environmental Engineer, Vol 7 No. 2 Winter 2006*

[23] *Parsons, D. (2006) op. cit.*

This argument is slightly less relevant to New Zealand, where energy is mostly generated from renewable sources (see *Figure* 24 below) and therefore less mercury is emitted from electricity generation. However, Parson (2006) in an Australian life cycle assessment (LCA) of compact fluorescent lamps examined results for the state of Tasmania, where renewable electricity generation dominates. The LCA still found that mercury emissions were reduced by switching to CFLs, probably because some fossil fuel is used as part of the process of hydroelectric generation.

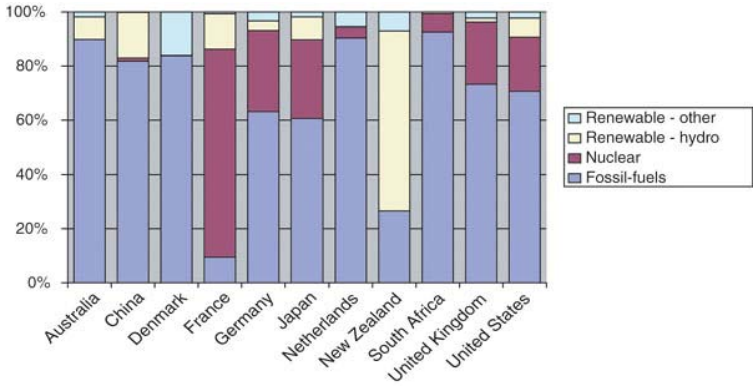


Figure 24. Comparison of electricity generation sources in 11 countries. (Source: CIA World Factbook, 2002)

More detailed analysis is required to map mercury emissions from various sources into the New Zealand environment[24]. Such an analysis could be combined with the data presented in this report to quantify more exactly the overall mercury reductions that gas discharge lamps are providing over incandescent alternatives.

Despite the overall reduction in mercury emissions due to the use of gas discharge lamps, the problem of mercury discharges from end-of-life lamps into the environment remains an important one.

8.2 Mercury in Lighting

Mercury is used in small amounts per lamp in a number of different types of discharge lamps, with fluorescent tubes and compact fluorescent lamps (CFLs) the most common examples. Levels of mercury vary greatly depending on the lamp type. Some examples of average content are:

- Linear fluorescent lamp – 5mg
- Compact fluorescent lamp – 5mg
- High intensity discharge lamp – 50mg

[24] *There has been no mercury flow modelling conducted in New Zealand to date*

The levels of mercury used in lamps has decreased significantly over time and continue to decrease as technology is improved. Figure 25 shows the steady decrease in the average mercury content of a T8 linear fluorescent lamp since the 1980's.

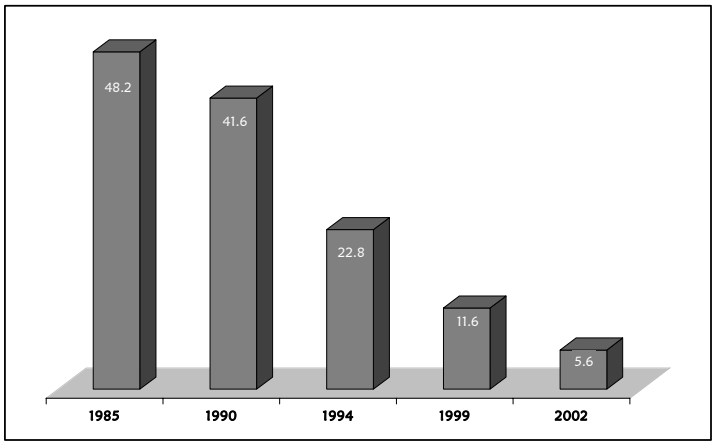


Figure 25 Average mercury content of a T8 fluorescent lamp in the USA. Units are milligrams of mercury per lamp (Source: Goonan, 2006[25]; using data from NEMA)

Global reviews of mercury sources have acknowledged that there is an environmental benefit presently associated with the use of mercury. For example, the UNEP Global Mercury Assessment notes that, in the case of energy efficient fluorescent lamps, as long as there are no competitive substitutes that do not contain mercury, it is generally preferable from a product life-cycle perspective to use a mercury-containing energy-efficient lamp rather than to use a less efficient standard incandescent lamp containing no mercury.

Mercury consumption globally has been estimated at 3675 tonnes[26]. Use of mercury is dominated by gold mining, chlor-alkali plants and batteries. Lighting represents just 2.6% of mercury use on a global basis (Figure 26).

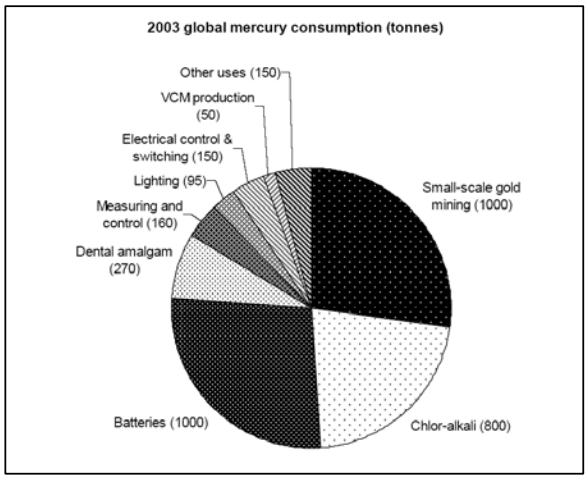


Figure 26. Global mercury consumption in 2003 (from Maxson, 2005)

When considering mercury contained in products there is no information available on sources in New Zealand. Information from product analysis in the United States (Figure 27) suggests that lighting represents less than 10% of mercury in products.

---

[25] *Goonan, T. (2006) Mercury Flow Through the Mercury-Containing Lamp Sector of the Economy of the United States; US Geological Survey Scientific Investigations Report 2006-5246*

[26] ***Maxson, P. (2005)*** *Global mercury production, use and trade. Chapter in: Dynamics of Mercury Pollution on Regional and Global Scales – Atmospheric Processes and Human Exposures around the World (eds: Pirrone and Mahaffey)*

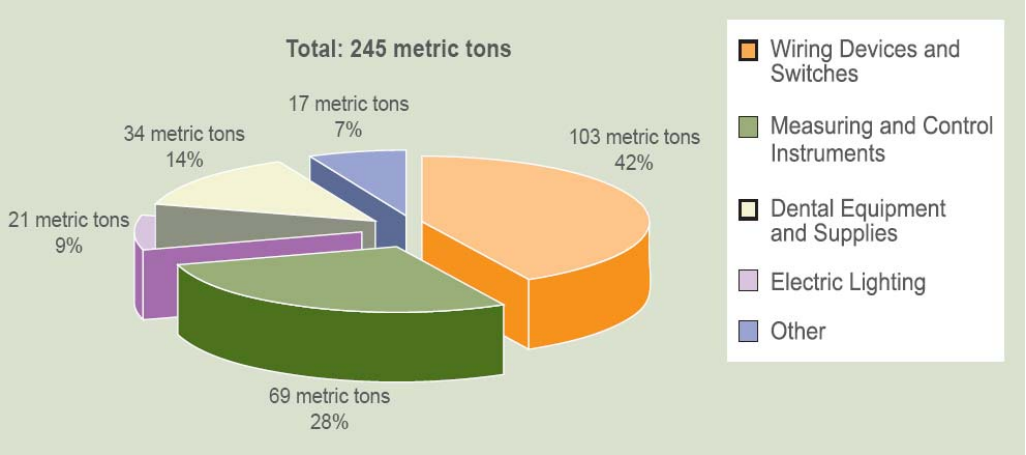


Figure 27. Total 2001 United States Mercury Use in Products (US EPA, 2006)[27]

8.3 Pathways into the Environment

Despite the fact that lamps represent a small portion of mercury from anthropogenic (human) sources and that they are a small portion of mercury used in products, there remains serious concerns about the fate of the mercury in the environment when lamps are broken and also when they are disposed of to landfill.

Lamps are one of the few mercury-containing products that the public is exposed to on a day-to-day basis and therefore much more aware of.

Forms of mercury

Elemental mercury. Relatively poorly absorbed and can be readily removed from the body. High exposures can be harmful.

Monomethylmercury. Much more readily absorbed and excreted more slowly. A neurotoxin and can affect the immune system.

Dimethylmercury. Rapid penetration and highly toxic in small amounts.

When products containing elemental mercury break in the waste stream, the mercury is released and begins to evaporate. Gaseous mercury can then be emitted as air pollution at various stages of the solid waste disposal process, although some studies suggest there are two main pathways; the working face and landfill gas vents. Once buried, some of the inorganic mercury in the landfill is converted by bacteria living there into a more toxic form, called organic or methylated mercury. Organic mercury

[27] ***US EPA (2006)*** *EPA's Roadmap for Mercury; downloaded from* *http://www.epa.gov/mercury/roadmap.htm*

can be released into the atmosphere from landfills in the same way that inorganic mercury is released.

Mercury at Landfills

Mercury is emitted from landfills in both elemental and methylated forms. Most mercury emitted from landfills occurs at the working face and about 99% of this mercury in gas is elemental mercury vapour. Landfill workers may be exposed to elemental mercury at the working face of the tip site, although overseas studies have found levels commonly below thresholds for continuous exposure.

The conversion of mercury into the more toxic methylated forms is the greatest concern for landfill operations. Both monomethylmercury and dimethylmercury are emitted in landfill gas, with dimethylmercury the more common species. There are no threshold levels set for methylated mercury but one study has found that vented landfill gas has dimethylmercury concentrations 1000 times that of any dimethylmercury concentration ever recorded in open air[28].

Landfill gas flaring and collection of landfill gas reduces mercury emissions and helps to convert dimethylmercury to the less toxic elemental mercury. In New Zealand just 22% of landfills have landfill gas collection systems in place[29].

Mercury is also a concern in landfill leachate that reaches the aquatic environment because it bioaccumulates in the food chain. Most modern, lined landfills collect and treat leachate. In New Zealand 54% of landfills have engineered liners to prevent leachate escape, and 77% of landfills have leachate collection systems in place[30]. This means the threat of contamination is reduced, but still exists as no collection system offers failsafe protection. It is for this reason that the 'precautionary principle' is applied to potential mercury pollution in overseas jurisdictions.

---

[28] ***Lindberg, S. et al (2005)*** *Gaseous methyl- and inorganic mercury in landfill gas from landfills in Florida, Minnesota, Delaware, and California; in Atmospheric Environment Volume 39, Issue 2, January 2005, Pages 249-258*

[29] ***Ministry for the Environment (2007)*** *The 2006/07 National Landfill Census; available at* *http://www.mfe.govt.nz/publications/waste/2006-07-national-landfill-census-oct07/index.html*

[30] ***Ministry for the Environment (2007)*** *op. cit.*

8.4 Lighting Impacts on Human Health

In this assessment and review phase of the product stewardship scheme we have focused on mercury as the main health and environment issue. However, there are other lighting related health issues that should not be ignored.

Light is an important influential factor in human development and in our daily sense of well-being[31]. Both our physical and mental health can be affected by light, especially the "colour temperature" of light, Colour temperature[32] is a measure of how "warm" or "cool" the light is. A numeric representation for the desirable properties has been developed. The colour temperature number 830 (3000 K) or 850 (5000K) is often printed on the bulb or on the packaging.

There can be distinct regional preferences for colour temperature. In Invercargill there are preferences for 865 (cool), Nelson 830 (warm) and in Auckland the range is 840 – 865 (warm to cool). Blue light, which has a high colour temperature, affects our circadian clock such that blue light is used to prevent sleepiness.

For many consumers it is an accepted fact of life that fluorescent lamps can flicker and hum and women appear to be more susceptible to and aware of flicker than men. The good news is that the electronic ballasts are flicker free. With an increasing trend for the electronic ballasts to replace the electromagnetic ballasts, our exposure to flicker will decrease.

In many cases our factories are not well lit and often we have too many or too few lumens in our offices. This is all part of lighting design and as noted elsewhere in this report, good lighting design has many benefits for human health.

9 PUBLIC INFORMATION

In this section we have assessed the extent of information available to the public on the end-of-life options for lighting and identified areas of concern and opportunities for improvement.

---

[31] *European Lamp Companies Federation Position Paper*

[32] ***Colour temperature (CT)*** *Colour temperature, which is measured in Kelvin, indicates whether a lamp has a warm, midrange or cool colour appearance. "Warm" light sources have a low colour temperature (2000-3000K) and feature more light in the red/orange/yellow range. The standard incandescent bulb is 2700 K and the colour of quartz halogen lights is 3000 K. Light with a higher colour temperature (>4000K) features more blue light and is referred to as "cool."*

We have taken a snapshot of the information on the websites of the seven brand owners with mercury lamps and main organisations, government departments and agencies involved in lighting. The New Zealand Google key search words were mercury or amalgam and the brand or organisation e.g. "mercury Ministry for the Environment".

The results are as follows:

Website	Information on home page?	Mercury content identified	Other
Philips[33]		"a small amount"	Update 1 June 2007
Impel - Osram	Not found with search	No	
CDB Consumer Products – e-lite	Not found with search	No	Mercury content identified on packaging
EnergyMad - EcoBulb[34]	Click here to read the Consumer Magazine Report on Energy Saving Bulbs[35]	"Very low amalgam content used"	Technical information referenced in Green Party Press release
General Electric	Not found with search	No	
Sylvania	Not found with search	No	
Crane Distribution – Radium[36]	No, in Cory's magazine on line	Yes	
Ministry for the Environment[37]	The safe use and disposal of household lamps page - unsuccessful search for "mercury" on website	No	Need Google to find webpage
Energy Efficiency and Conservation Authority[38]	On EnergyWise website -successful search on "mercury" on the rightlight.govt website	Yes	Links back to MfE website
Lighting Council New Zealand	Not found with search	No	Referenced on MfE website
ElectricityCommission[39]	Compact Fluorescent Lightbulbs (CFLs) Fact Sheet unsuccessful search for "mercury" on	yes	Need Google to find webpage Fact sheet Refers

[33] http://www.lighting.philips.co.nz/nz/en/Portal?xml=about/news&fldr_id=101&fid=7817&cid=193443

[34] http://www.ecobulb.com/nz/index.html[35] http://www.ecobulb.com/Files/Media_Consumer_LightingReport_030907.pdf

[36] http://www.radiumlamps.co.nz/MAG_CURRENT/index.php?edition=24&article=329

[37] www.mfe.govt.nz/publications/waste/disposal-household-lamps-mar07/index.html

[38] http://www.energywise.govt.nz/how-to-be-energy-efficient/your-house/lighting/types-of-efficient-light-bulbs#cfl and http://www.rightlight.govt.nz/residential/general-lighting-info/myths

Deleted: q

	EC website		back to MfE website

Our conclusion from this Google search is that consumer information is difficult to find. The EcoBulb and Energy Efficiency and Conservation Authority websites were the most informative and provided useful information. Only the EcoBulb website references the Consumer magazine's report on energy saving bulbs (www.consumer.org.nz/internallink.asp?topic=Energy%20efficient%20lighting%7CIntroduction). For most websites the Google search engine was far more effective than the website search engines to find the information.

A number of websites link back to the MfE website yet this information can only be found using Google.

Google searches on energy saving lightbulbs brought up the Energy Efficiency and Conservation Authority, Electricity Commission and Consumer websites. There is good information on energy efficiency for lighting on a number of websites but very little available on end-of-life options.

Public awareness about the life cycle of lighting products is low and with the current website information is unlikely too improve. The recent Target TV programme and the Press Release from the Greens Party have helped to begin to raise awareness. A far greater effort will be required to encourage the DIY/householder and other "de-installers" to do the right thing and recycle mercury-containing lamps rather than put them in the rubbish or the skip. There is much that New Zealand can learn from international programmes.

A first step would be to have a comprehensive "lighting and the environment" source of information in New Zealand with links to the same information on each website. A number of the people interviewed who were using this information to encourage their key account customers to "do the right thing" asked for access to a single source of comprehensive information, including a PowerPoint presentation.

[39] *http://www.electricitycommission.govt.nz/pdfs/opdev/elec-efficiency/programmes/lighting/further-info/Mercury-Factsheet.pdf*

Better information on 'eco lights' critical – Green Party Press Release 20 July 2007

The Green Party is calling for better consumer information to be provided on how to deal with the mercury content of compact fluorescent lights (CFLs).

"People have a right to know that CFLs contain tiny amounts of mercury (about the size of 1-3 grains of salt, depending on the brand) and what they should do if one breaks, or finally wears out," Green Party Co-leader Jeanette Fitzsimons says.

"The Electricity Commission is funding a large scale change from incandescent lights to CFLs because they use only a fifth of the electricity to give the same light, and last many years. The energy savings are very worthwhile, but consumers aren't being given the information they need to use and dispose of them wisely.

"I have been getting emails from concerned members of the public who want to do the right thing by using energy efficient lights, but have been scared by reports circulating on the internet about the toxicity of mercury.

"Mercury is a toxic substance, but you can avoid being exposed to it if you know what to do. If a light breaks, never vacuum up the pieces. Vacuuming will heat the mercury particles and vapourise them, and they could be breathed in. Instead carefully sweep the glass pieces into a plastic bag and seal it inside another one before putting in the rubbish. If the mercury has formed a visible droplet use an eye dropper to remove it, then put the dropper into a plastic bag sealed inside another one.
The Greens also want to see safe disposal systems in place for used lights. "Just as with computers, batteries, motor oil and other hazardous waste householders need to be able to safely dispose of mercury, and recycling programs must keep pace," Ms Fitzsimons says.

"Fortunately we have some time to get this right, as the lights last so long there will be very few needing disposal right away, and they can be sealed in a plastic bag and put in the landfill. There are a number of valuable materials in the ballast at the base of the lamp and by the time New Zealand has large numbers of used lights needing disposal, I would like to see comprehensive recycling systems operating at main outlets.

"Other much larger household sources of mercury include thermometers and barometers, which should be treated with even more caution if they break. Coal fired power stations also emit mercury into the environment. Energy efficient lights reduce the burning of coal for electricity generation thereby reducing mercury pollution from this source," Ms Fitzsimons says.

Further information is available at
http://www.ecobulb.co.nz/Technical_Safety.htm

10 INTERNATIONAL APPROACHES TO LIGHTING STEWARDSHIP

Different approaches to the stewardship of lighting have been taken throughout the world. We have briefly reviewed a cross section of these approaches in the sections below.

10.1 EU WEEE Directive

Product stewardship for lighting in the European Union has been largely driven by the Waste Electrical and Electronic Equipment (WEEE) Directive.

The WEEE Directive came into effect in February 2003. The Directive required the 25 EU member nations to transcribe its requirements into their national laws by August 2004.

The WEEE Directive contains the following key requirements[40]:

- Covers all types of electronic and electrical equipment including IT, consumer equipment, whiteware, lighting, tools, and medical equipment.
- Household consumers must be able to recycle equipment for free
- Producers (definition includes importers) finance the collection and treatment of e-waste.
- Producers can set up individual or collective takeback systems as long as they meet the objectives of the Directive.
- Distributors (retailers) must take back equipment from household consumers free of charge on an old-for-new basis (note: can be excluded from national regulations as long as this does not make things more difficult for householders to recycle).

Categories of lighting covered by the WEEE Directive

- Luminaires for fluorescent lamps with the exception of luminaires in households
- Straight fluorescent lamps
- Compact fluorescent lamps
- High intensity discharge lamps, including pressure sodium lamps and metal halide lamps
- Low pressure sodium lamps
- Other lighting or equipment for the purpose of spreading or controlling light with the exception of filament bulbs

- Sets minimum treatment standards.
- Sets recycling and recovery targets (e.g. for gas discharge lamps, the rate of component, material and substance reuse and recycling shall reach a minimum of 80% by weight of the lamps).

[40] *The text of the WEEE Directive can be viewed at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0096:EN:HTML

Prior to the EU WEEE Directive several European countries had implemented legislation to manage mercury-containing lamps. In particular; Sweden, Finland, Norway, Denmark, Germany, Netherlands and Switzerland have declared mercury-containing lamps as hazardous waste and implemented collection programmes[41].

After two years a national lamp recycling programme in the Netherlands exceeded a 50% lamp collection rate.

A national German programme with extensive collection infrastructure was collecting 70-80% of used lamps in 1994.

Programmes in place in Switzerland and Austria prior to the WEEE Directive achieved collection rates of 50-70% of lamps placed on the market[42].

10.2 EU RoHS Directive

In parallel with the WEEE Directive, a Directive restricting the use of certain substances in electronic products was also passed (the RoHS Directive). This directive controls the use of hazardous substances in electronic and electrical equipment.

The RoHS Directive has restricted mercury levels in lamps to the following levels:

- 5mg per lamp in compact fluorescent lamps
- 10mg per lamp in straight halophosphate fluorescent lamps
- 5mg per lamp in straight triphosphate fluorescent lamps with normal lifetime
- 8mg per lamp in straight triphosphate fluorescent lamps with long lifetime

Other countries around the world are introducing, or have introduced, similar RoHS regulations, including China, South Korea, Japan, and California.

10.3 EU Energy Using Products Directive

European legislation has been passed on the ecodesign of Energy-using Products (EuP). The Directive as adopted by the European Parliament and the Council in

---

[41] ***Hilkene & Friesen (2005)*** *Background Study on Increasing Recycling of End-of-Life Mercury-Containing Lamps from Residential and Commercial Sources in Canada; report to Natural Resources Canada*

[42] ***Hilkene & Friesen*** *op. cit.*

July 2005[43]. The Directive sets rules for analysing all aspects of a products environmental performance with an aim to improving that performance.

The Directive does not apply automatically to all energy using products, rather it sets priority products based on prioritisation criteria such as important environmental impact and volume of trade in the internal market and clear potential for improvement. Potential products are currently being shortlisted and a working plan for implementing the Directive is being developed[44].

10.4 EU Stewardship Schemes

Many different product stewardship schemes have been set up by manufacturers/importers throughout the 25 EU member states to meet their obligations under the WEEE Directive. The majority of schemes that manage lighting products have been set up to manage all types of e-waste on behalf of producers.

Most schemes set up in European states in response to the WEEE Directive have been set up with similar structures[45]. Producers, usually through their industry association, establish a product stewardship organisation (PSO). This PSO operates on a not-for-profit basis. The PSO coordinates takeback and recycling activities on behalf of the producers. The PSO is typically governed by a Board made up of representatives from the industry. Collection of waste equipment usually takes place at three points:

- retail, on an old-for-new basis
- local council recycling depots
- on a business-to-business basis

Recycling of waste equipment is always free-of-charge for consumers with costs being met by fees collected from producers.

The PSO contracts transport and recycling service providers to deliver the logistics of the system. The PSO coordinates waste collections, provides public education and reports to central government on behalf of the producers.

---

[43] http://ec.europa.eu/enterprise/eco_design/index_en.htm

[44] *See* http://www.epta.gr/xar/index.php/eco *for further information*

[45] *European product stewardship schemes for WEEE have been further examined in a recent study on E-waste in New Zealand:* **CANZ (2006)** *e-Waste in New Zealand – Taking Responsibility for End-of-Life Computers and TVs. Available to download from* http://www.canz.org.nz/e-waste.htm

The following European product stewardship schemes include lighting in their collection portfolio[46]:
Amb3E, Portugal
Appliances Recycling SA, Greece
Ecolec, Spain
Eco-RAEE's, Spain
Eco-Systèmes, France
Ecotrel, Luxembourg
EES Ringlus, Estonia
Electro-Coord, Hungary
ElektroEko, Poland
Elker, Finland
El-Kretsen, Sweden
Lightcycle, Germany
NVMP, Netherlands
Recolight, UK
Recupel, Belgium
Rema, Czech Republic
Retela, Czech Republic
Sens, Switzerland
Serty, Finland
Sewa, Slovakia
UFH, Austria
WEEE Ireland, Ireland

An umbrella organisation, the WEEE Forum, has been set up by many of these schemes as an industry association. The forum has been set up to facilitate the most efficient operating of European collective e-waste take-back systems. It does so by collecting and disseminating information between members to benchmark performance.

Figure 28, below, shows the various levels of collection achieved by the different schemes that are members of the WEEE Forum. The average level of lighting collection is around 0.2 kg/inhabitant/year.

[46] *Information provided by Pascal Leroy, Secretary General, WEEE Forum (pers. comm.). See http://www.weee-forum.org/ for further information.*

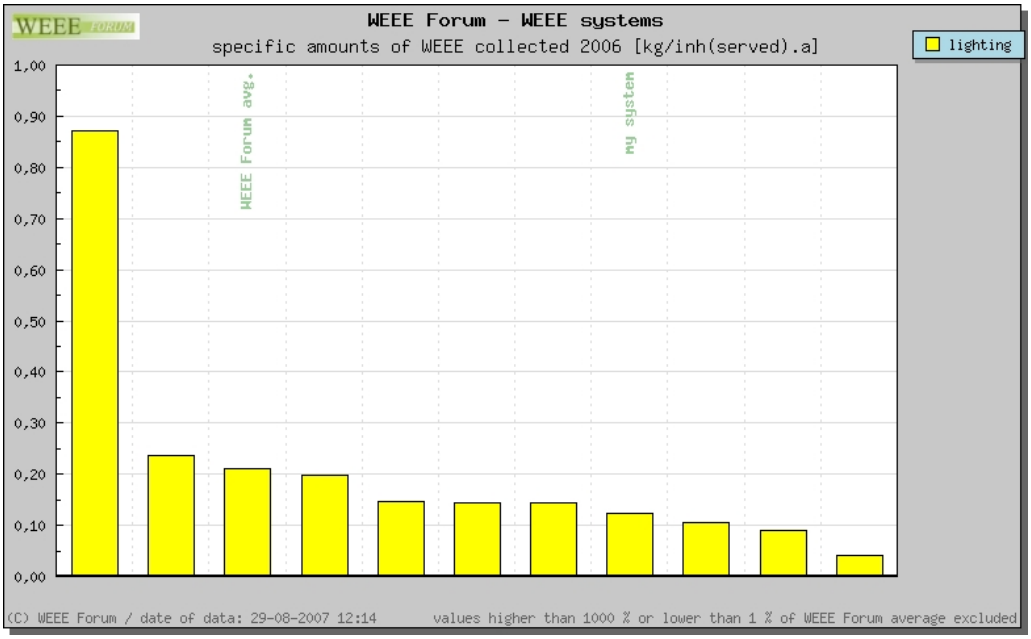


Figure 28. Kilograms per inhabitant of lighting waste collected by different European product stewardship schemes. Source: WEEE Forum, pers. comm. (October 2007)

Figure 29 provides a breakdown of costs for each European product stewardship scheme that is a member of the WEEE Forum. Apart from one scheme, the majority have total costs of between 50 eurocents and €2.00 per kilogram collected and processed.

It is possible that the scheme with the abnormally high costs in Figure 28 is also the scheme with the highest level of collection shown in Figure 29.

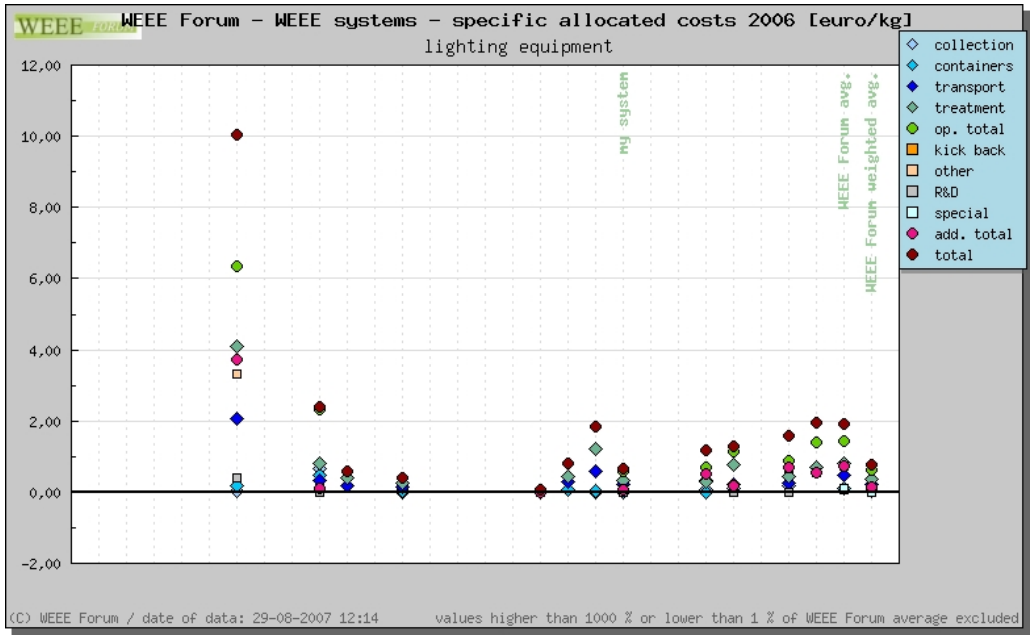


Figure 29. A breakdown of costs per kilogram of lighting equipment handled by EU product stewardship schemes. Source: WEEE Forum pers. comm. (October 2007)

10.5 Ireland

Ireland makes a useful comparison with New Zealand because it has a similar population (4.2 million), has a similar urban/rural population distribution, and is an island nation.

Regulations were passed in 2005 to satisfy the requirements of the EU WEEE Directive[47]. From 13 August 2005, all Producers and Distributors (Retailers) of EEE must comply with the WEEE Regulations 2005.

Producers are responsible for financing the take-back of WEEE and have responsibilities regarding collection, recycling and treatment targets, the preparation of a Waste Management Plan and reporting to the EPA.

Producers must register with the National Registration Body; The WEEE Register Society and report to the Black Box the amount in units and weights (kg) of EEE placed onto the Irish market on a monthly basis.

A company placing EEE on the market in Ireland can join one of the two compliance schemes in Ireland to help meet their collection, recycling and reporting requirements specified in the Regulations. The two schemes in Ireland are "WEEE Ireland" and "European Recycling Platform (ERP)". WEEE Ireland is the only scheme in Ireland that handles lighting.

WEEE Ireland and Lighting[48]

WEEE Ireland is a not-for-profit compliance scheme working on behalf of Producers[49] to meet the recycling targets for household WEEE in Ireland. WEEE Ireland invoices Producer members on a monthly basis for environmental

---

[47] Waste Management (Waste Electrical And Electronic Equipment) Regulations 2005 Downloaded from http://www.epa.ie/downloads/legislation/waste/weee/name,13657,en.html

[48] Information provided by Leo Donovan, CEO, WEEE Ireland, (various phone calls and emails)

[49] 'Producer' under the Irish regulations means any person who, irrespective of the selling technique used, including by means of distance communication:

- *manufactures and sells electrical and electronic equipment under his or her own brand*
- *resells electrical and electronic equipment produced by other suppliers under his or her own brand*
- *imports electrical and electronic equipment on a professional basis into the State*
- *exports electrical and electronic equipment on a professional basis from the State to another Member State of the European Union, or*
- *distributes electrical and electronic equipment from a producer who is deemed not to be registered under the provisions of article 12(2)*

management costs due on the EEE sold into the Irish market during the previous month.

WEEE Ireland has been collecting lighting since August 2005. All lamps and luminaires are collected under the scheme.

A visible fee of 50 eurocents (approx NZ$1) is placed on every gas discharge lamp placed on the market. No fee is imposed on luminaires. The lamp fee is charged at point of sale and is used by WEEE Ireland to pay for the transport and recycling of collected lighting.

There are approximately 500 collection sites for lamps throughout Ireland. Four hundred of these collection sites are electrical wholesalers and 100 are local council recycling centres. WEEE Ireland manages pick-up, transport and recycling beyond these collection sites. Collected lamps are delivered to one of two recyclers contracted to WEEE Ireland.

WEEE Ireland is collecting about 2 million lamps per annum at the moment. They collected 1.3 million in the first year of the scheme operating.

The majority of lamps are being collected through electrical wholesalers. Wholesalers are provided with boxes to collect and store lamps on their premises.

Table 3. Estimated routes for collection of lamps (WEEE Ireland pers comm.)

Collection route	No. lamps	%
Wholesalers	1,200,000	60%
CA Sites	800,000	40%
TOTAL	2,000,000	100%

The total gas discharge lamp market in Ireland is around 6 to 7 million lamps per annum. Therefore, the national compliance scheme is collecting about 30% of what is being placed on the market.

Very few of the 2 million lamps being collected are CFLs. Scheme managers believe this is probably due to CFL market growth only in recent years, their life expectancy, and because they are easy to dispose of with general rubbish. WEEE Ireland is currently designing an advertising campaign aimed at improving awareness of lamp recycling.

10.6 USA

Used mercury-containing lamps are regulated as hazardous waste in the United States. In 1999 mercury-containing lamps were added to the federal list of "universal wastes" in order to streamline their handling under the hazardous waste rules. Handlers of mercury-containing lamps must manage lamps in a way that prevents releases of any mercury to the environment.

Some individual states in the US have banned mercury-containing lamps from their landfills, including Minnesota, California, Wisconsin and Florida.

Education

The US Environmental Protection Agency (EPA) started a large scale education and "outreach" programme in 2002 to promote the recycling of fluorescent lamps. The programme involved cooperative agreements between key agencies. For example one cooperative agreement was between the EPA, the Association of Lighting and Mercury Recyclers (ALMR), the National Electrical Manufacturers Association (NEMA) and the Solid Waste Association of North America (SWANA). These cooperative agreements are to develop educational/outreach materials such as factsheets, databases, websites, CDs and public service announcements[50].

Figure 20. Lamp Recycling Outreach Project CD containing information for: Building Owners and Managers, Contractors, Distributors, Specifiers, Solid Waste Industry, Local Government Agencies, Environmental Groups

The recycling rate for mercury-containing lamps in 1990 was 2%. In 2004 this recycling rate was 24% and much of this increase in recycling has been attributed to the Outreach programme[51].

---

[50] *See http://www.almr.org (Association of Lamp and Mercury Recyclers) for more details on the outreach programme*

[51] ***Hilkene & Friesen (2005)*** *Background Study on Increasing Recycling of End-of-Life Mercury-Containing Lamps from Residential and Commercial Sources in Canada; report to Natural Resources Canada*

Voluntary Mercury Reduction

The lamp manufacturers in the US are developing a voluntary standard for maximum mercury doses in CFL-i lamps[52]. The commitment is being developed by the National Electrical Manufacturers Association (NEMA). Mercury limits are set out below:

Lamps that are rated with input wattages of 0 - <25 Watts	5mg total mercury
Lamps that are rated with input wattages of 25 - <40 Watts	6mg total mercury[53]

The commitment period started on 15 April 2007. NEMA will maintain a website where CFL manufacturers can be listed as conforming to the voluntary declaration. To be listed, all products sold by the manufacturer must be covered. The total mercury content of the lamp will be measured by a new laboratory test method being developed by the International Electrotechnical Commission (IEC).

11 ASSESSMENT MATRIX

The following table assesses the different aspects of the lighting market and their implications for the development of a product stewardship scheme in New Zealand. This matrix summarises the findings that have been discussed throughout this report and focuses on mercury and non mercury-containing lamps, luminaries and control gear.

[52] ***NEMA (2007)*** *Voluntary Industry Commitment to Limit Mercury Content in Self-Ballasted CFLs Sold in the U.S.; downloaded from www.nema.org*

[53] *Slightly higher threshold required due to higher U.S. light levels/power levels and the slightly higher level of mercury needed to operate a lamp at these wattages*

	Volume (2006)	Potential hazardous material harm	Public concern	Market dynamic	Current Main uses	Point of Obligation (free riders)	Takeback points	Product stewardship implications
Mercury-containing								
LFLs	3.5 million sold 360 tonnes waste arising	High potential	Med	Mature Gradual shift from T8 to T5 lamps	Commercial Industrial	4 importers /brand owners have 87% market share	Wholesalers Contractors Key account holders Council recycling	
CFLs	4 million CFL-i 144 tonnes waste arising 0.7million CFL-e 34 tonnes waste arising	High potential	High	Strong growth Household uptake of CFLi to CFLe Influenced by govt intervention – EC/MEPS	Household (CFLi) Commercial (CFLe)	CFL-i: 3 importers/ brand owners have 88% market share CFL-e: 5 importers/ brand owners have 95% market share	Retail Council recycling	Householders involved therefore many users Easy disposal Temporary market entrants Historical waste if CFLs replaced New market entrants create freerider issue
HIDs	0.4 million sold 94 tonnes waste arising	High potential	Med	Historically mature Changes taking place in 1) high-bay fluorescent systems 2) updated streetlighting mercury vapour to new metal halide 3) shopfit compact low wattage metal halide displace halogen Influenced by govt intervention – EC/MEPS	Industrial Commercial Public Increasingly shop fit	4 importers/ brand owners have 66% market share	Wholesalers Contractors Key account holders	New market entrants create freerider issue Halogen to MH in commercial market Extent of freeriders

	Volume (2006)	Potential hazardous material harm	Public concern	Market dynamic	Current Main uses	Point of Obligation (free riders)	Takeback points	Product stewardship implications
Non mercury-containing								
Incandescent - GLS	17.7 million sold 705 tonnes waste arising	Low potential	Low	Historically mature Likely complete displacement of GLS due to MEPS	Household		Retail Council recycling B2B	
Incandescent - Halogen	3.5million sold 8 tonnes waste arising	Low potential	Low	Historically mature Likely displacement of halogens due to low wattage MH	Commercial Shop fit Household		Retail Council recycling B2B	
Luminaires	1 million approx sold	Low potential	Low		Commercial Industrial	4 companies represent 90-95% of commercial luminaire market 2 companies represent majority of domestic luminaire market	Demolition	
Control gear	1 million approx sold	Low potential	Low	Shift from electromagnetic to electronic (current sales 20% electronic). Expected to increase to 50% in 5 years	Commercial Industrial	4 companies have majority of market Supply to luminaire manufacturers	Contractors Demolition	

12 OBSERVATIONS & RECOMMENDATIONS

OBSERVATION 1:
Mercury is the main environmental issue surrounding the environmental impact of lamps in New Zealand. There is growing public concern over mercury in lamps, including calls for lamps to be a priority under Waste Minimisation Bill.

Levels of mercury arising from lamp waste in New Zealand is predicted to rise from 45kg in 2007 to around 70kg by 2012 and up to 120kg by 2022 (upper projection of 3 modelled scenarios).

RECOMMENDATION 1:
Concentrate efforts on mercury as the main environmental and health issue for lamps. Product stewardship efforts for end-of-life lamps should focus on mercury-containing lamps (LFLs, CFLs, HID).

PRIORITY: High

RESPONSIBILITY: all stakeholders with leadership from the Ministry for the Environment, lamp brand owners, lamp retailers, Lighting Council New Zealand, Electricity Commission, lamp recyclers and waste industry.

……..

OBSERVATION 2:
The environmental aspects of lighting are poorly understood due to inconsistent labelling and lack of product standards for mercury. There is inconsistent mercury content in lamps. There is also a lack of labelling of lamps being placed on the market – with regards end-of-life options and mercury content.

Consumer confusion is resulting in misinformation and this is giving rise to growing consumer concern.

RECOMMENDATION 2:
Develop a New Zealand Product Stewardship Agreement for Lighting. A NZ lighting industry product stewardship agreement (covenant/accord) should include:

- labelling
- mercury reduction in line with RoHS
- efficacy (lumens/watt)
- public information

A stewardship agreement needs to be extended to include all those key to the life cycle management of lighting, including designers, users, recyclers, and councils.

PRIORITY: High

RESPONSIBILITY: Lamp brand owners, lamp retailers, Lighting Council New Zealand, Electricity Commission, lamp recyclers and waste industry and Ministry for the Environment.

……..

OBSERVATION 3:
There is good potential for a simple product stewardship solution for end-of-life gas discharge lamps in New Zealand. This solution needs to focus on lamp takeback and recycling. Key to the solution are the following groups:

- A group of 8 importers of gas discharge lamps into New Zealand represent 93% of the lamps placed on the market
- There are 3 main wholesaler groups that place the bulk of the product onto the commercial lighting market
- Councils throughout New Zealand appear keen to provide facilities for collecting lamps
- There is already a core recycling service in place

RECOMMENDATION 3:
Set up a workshop starting with the 'eight' importers round the table to work through the findings of this study and begin discussing a product stewardship solution for lamps. There needs to be an initial awareness raising within the industry of what product stewardship might mean for lighting companies in a practical sense.

PRIORITY: High

RESPONSIBILITY:

- 8 importers of gas discharge lamps into New Zealand
- 3 main wholesaler groups
- Local councils
- Recyclers

……..

OBSERVATION 4:
There is a lack of awareness about improving the environmental performance of lighting throughout the various stakeholders involved in the life cycle of lighting.

Information about lighting best practice, including availability of lamp recycling in New Zealand, is currently only available from disparate sources including; individual lighting companies, lobby groups, media, and recyclers. This information needs to be pulled together and presented in an objective way.

RECOMMENDATION 4:
Develop a coordinated multi-stakeholder strategy to provide information and education for:

- lighting industry
- public
- waste industry
- resource recovery industry

Develop a "Lighting and the Environment" information package for these multiple users on how they can reduce the environmental impact of lighting.

The package might include a CD of information, a series of promotional material for point-of-sale, and an independent information website co-funded by (for example) Lighting Council, EC, EECA, MfE.

PRIORITY: Medium high

RESPONSIBILITY: all stakeholders with leadership from the Ministry for the Environment, lamp brand owners, lamp retailers, Lighting Council New Zealand, Electricity Commission, lamp recyclers and waste industry.

……..

OBSERVATION 5:
There is poor awareness and a lack of drivers for lamp separation at the relamping and demolition stages.

RECOMMENDATION 5:
Improve drivers for lamp separation. This can be done through the promotion of MED procurement guidelines that include lamp recycling in contractor and demolition specs through local government and central government. Raise

awareness through local government and through green building movement of the end-of-life options for gas discharge lamps.

PRIORITY: Medium

RESPONSIBILITY: Electrical contractors, demolition contractors, local and central government (specifications and consents), Ministry for the Environment, Electricity Commission, New Zealand Green Building Council.

……..

OBSERVATION 6:
There has been poor and variable information available about the nature and size of the NZ lamp market. This information has been improved by conducting this investigation, but will need to be updated as the market changes. It is important that the industry is able to measure in order to manage future issues.

RECOMMENDATION 6:
Improve the collection of industry data on lamp markets. The industry, through the Lighting Council, should collect industry information on all lamps on an ongoing basis.

PRIORITY: High

RESPONSIBILITY: Lighting Council New Zealand, lighting industry and Energy Efficiency and Conservation Authority.

……..

OBSERVATION 7:
There is a lack of information about mercury flows through the New Zealand economy and into the environment. This lack of data hampers policy-making and creates uncertainty about potential environmental impacts.

RECOMMENDATION 7:
Conduct a study of mercury flows in New Zealand.

PRIORITY: Medium

RESPONSIBILITY: Ministry for the Environment

……..

OBSERVATION 8:
The request for proposals from the Electricity Commission issued in November 2007 has the potential to significantly alter the characteristics of some parts of the lighting market in New Zealand. Consequently the models of waste and mercury levels will need to be reassessed.

RECOMMENDATION 8:
The model scenarios developed for this study are re-run once there is clarity around the Electricity Commission interventions in the lighting market place.

PRIORITY: Medium high

RESPONSIBILITY: Lighting Council New Zealand and Electricity Commission

13 CONTACTS

Contact	Organisation	Method
Bryan King	Lighting Council	Meeting/emails
Rob Tomkies	Lighting Council	Meeting
Helen Bolton Georgina McLeod	Ministry for the Environment	Meeting, email and phone
Gordon Wiffen Anthony Verkley Brian Brandford	Philips NZ	Meeting
Leo Donovan	WEEE Ireland	Phone call/emails
Vivienne Morley	Ministry of Economic Development	Meeting
Lance Woodward	Thorn Lighting NZ Ltd	Meeting
Nick Locke	Department of Building and Housing	Meeting
Terry Collins Alastair Childs	Energy Efficiency and Conservation Authority	Meeting/emails Phone call/emails
Richard Ponting	Lighting Council	Meeting/emails
Lincoln Falconer Roger	International Waste Ltd	Meeting/emails Meeting
Paul de Knegt	TridonicAtco NZ Ltd	Meeting
Dean Adolph Owen Thomas	Sylvania Lighting Australasia Ltd	Meeting
Peter Leong	Impel NZ	Meeting
Neville Simpson Carl Rankin	Electrical Contractors Association of NZ	Meeting/emails
Stuart Ross Jane Boardman	Electricity Commission	Meeting/emails
Randal Owles	Ward Demolition	Phone call/emails
Pascal Leroy	WEEE Forum, Brussels	Emails
Raj Valera	Shirji Holdings Ltd	Phone call
Andrew Springford	CDB Products	Phone call/emails
Rachel Montejo	EnergyMad	Meeting/emails
Wayne Reddecliffe	Crane Distribution	Meeting/emails
Craig Palmer	GE Consumer and Industrial Lighting	Meeting
Alastair Gee Graeme Findlay	NewPower Electrical	Meeting
Bill Heaps	Strata Energy Consulting	Meeting/phone calls
Jim Forsman	TerraNova (Waste exchange)	Phone call
Sandy Beathcroft	Hutt City	Email
Howard Mackey	Lighting Council	Meeting/email
Paul Henare	Dickson Gray	Meeting
Mike Dilger	Betacom (Streetlighting)	Meeting
Ronald Mair	Statistics NZ	Phone calls
Barry Helberg	New Zealand Retailers Assocation	Meeting
Mike Wotherspoon	Customs	Phone calls