

INTERNATIONAL WATERS PROJECT



of the Pacific Islands

# Rubbish is a Resource!

A Waste Resource Kit for  
the Pacific Islands

*This Handbook is part of the  
Resource Kit and should be used in  
conjunction with the DVD*



Global  
Environment  
Facility



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Programme



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Environment  
Programme

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## Introduction

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### **Welcome to 'Rubbish is a Resource!'**

The world is being swamped by mountains of rubbish. This is a problem everywhere, and no more so than in the small island nations of the Pacific. The challenge is to deal with all this rubbish. This Resource Kit aims to assist those working in waste management to deal with the rubbish problem, by showing how to extract resources from the waste stream while keeping costs down.

For, if we look at the waste stream as being full of resources, then the approach to dealing with it changes completely. The issue then becomes how to capture and use those resources. This approach is particularly challenging in the Pacific Islands, where shipping costs are high, recyclable material flows are small, and the environment for operating machinery is challenging. But there are ways in which things can be made much easier, and a main aim of this Kit is to share the experiences of others in the Pacific who have found solutions to some of these problems.

We must also remember the costs of not doing anything. Poor waste management costs governments, businesses and the public significant money, for example in extra health care costs and losses in fishing from polluted waters, from mosquito-borne diseases, and loss of tourism revenue, to name but a few areas. Litter causes a loss of community pride and creates a general unease about the ability of the government to deliver on services.

There are sound political reasons for managing waste better. This Kit will not only help do that but also shows ways to generate employment and economic development from the potential mine that is your waste.

This book is designed to be used in conjunction with a DVD that contains all the additional information that these pages refer to. This Kit is like a website on waste, but you only need to go online to get additional resources. Look in the book to find out what you need to know, use the disc in a computer to take you to the information, and check for updates on [www.sprep.org](http://www.sprep.org)

## Overview of the Kit

This Kit comprises a wide range of information ranging from practical help with the nuts and bolts of recycling different materials, all the way through information about toxic wastes and landfills, to Deposit Refund systems for collecting recyclables, legislation and planning waste strategies. Also included are tips on public awareness campaigning, recycling equipment, and the road to a Zero Waste world. Inevitably, not all of this will be of interest to everyone, but people working on waste issues in Government, NGOs, recycling businesses and education should all find useful information here. Some of these subject areas are huge in themselves, and this Kit will only touch on them. The real aim of this work is to provide comprehensive information in the areas of recovering resources from the waste stream.

When you put the disc in your computer, the disc opening page, shown on the previous page, has four main headings. Click on the titles of these headings, and you will be led to pages with headings covering handling and processing rubbish, as below:

**RECYCLING:** Has information on recyclable materials.



**WASTE MANAGEMENT:** The practicalities of collecting handling and processing rubbish.



**WASTE STRATEGIES:** Public awareness, legislation, planning, deposit/refund systems and zero waste.



**REFERENCE LIBRARY:** A wide range of rubbish photos, keywords, useful contacts, and related internet resources.



These pages are similar to the pages in this book that start each section. As before, access the subject you want by clicking on the subject text with the mouse, and you will find yourself on a written Directory Page which will give an overview of the issue, provide tips on working in that area, and describe the document resources available. The fourth layer of resource materials, the library aspect of the Kit, is seen by clicking on the links (in blue) within the text. These links may also show video clips, or sound clips.

All the Directory Pages are printed out in this Handbook, as a book can be easier to browse, and it provides access to information where computer access is limited.

## Finding Your Way Around

These electronic files can also be accessed by looking at the DVD in a File Browser mode, and navigating around just as if it were a set of files on your computer. In this mode, the files can be copied, printed and emailed. The files can be copied from DVD to your computer hard disk if that seems to be useful. But it is a large amount of information, several gigabytes, and so make sure you have plenty of free space on the hard disk if you want to do this.

It can be easy to get lost in the network of this Kit, so it is important to know how to find your way around. Several ways of navigating your way through the information are provided. At the top of each Directory Page (the written pages detailing a particular subject) you will find a small icon showing the "child" from the Start - first- page. Clicking on this will take you back to the Start page. A second icon will show a small version of the previous main subject page. Also by using the drop-down file menu that is in the top left-hand corner, you can find, at the bottom, a list of the last pages visited. Clicking on these can take you back where you want to go.

Please make sure you read the **Introduction** when opening the DVD, as this has a full set of instructions.

## Using Adobe Reader

Nearly all the files are Adobe Acrobat Pdfs (portable document format). You must have the Adobe Reader programme installed on your computer to read them. A copy is provided right at the beginning when the DVD is inserted if you need to install it. Adobe Reader is very useful software as many documents on the Internet are in this form and it is a universal standard for document exchange.

In Adobe Reader, you will find **Navigation Arrows** on your toolbar that can help you get forward or back (just like on the Internet). If these are not showing you need to go to the top menu heading: Window, then: Toolbars, then: Navigation and click there so that they appear on your top toolbar.

Adobe Reader also has a very useful feature called **Bookmarks**, which allows you, with a simple click, to move around a document. At the top left side of an Adobe Reader file, you will see a little tag that says **Bookmarks**. Click on this, and a small window opens at one side of the document you are looking at. Shown will be the titles of the various sections of the document, and so by clicking on the name of the section, the page will change to show that part. This is particularly useful in long documents, and can save a lot of scrolling up and down looking for the right part. Get familiar with using Bookmarks and it will save you a lot of time. Remember too that the quickest way to the top of a document will be by clicking on the bookmark of the title. You can adjust the width of the bookmark side window by picking up the dividing strip with your mouse and dragging it to the left or right.

You can also use the tools on Adobe Reader to copy and paste parts of the documents, such as text and photos; this will help you build your own documents and materials. A [tutorial for using Adobe Reader](#) (click on the blue text to read the tutorial) is included to help you use the programme. This tutorial was developed for the Waigani Handbook produced by SPREP in 2002, and published on CD-ROM in January 2003.

## Future Additions

There will always be things that you want to know and cannot find. You may also come across items that you know to be factually incorrect. SPREP would be interested to hear from you on any areas that you think need correction or more work, and also any materials that you think might be good for inclusion in future editions. Contact SPREP (see the publishing information page for details) if you have materials to include. And if the information you need is not in this Kit, contact Mark Ricketts [markr@sprep.org](mailto:markr@sprep.org) for assistance. Any corrections should also be notified to the compiler, Alice Leney, [aliceleney@clear.net.nz](mailto:aliceleney@clear.net.nz). Updates may be found on the website [www.sprep.org](http://www.sprep.org)

## Notes for using the Disc:

- You will need a DVD drive to view the disc;
- The Kit will work faster if Adobe Reader is installed to computer, although you can run the programme from the disc;
- Right-click on the DVD drive (e.g., D:\ ) to explore the disc (double click will open the Start page in Acrobat Reader);
- You need to have Autoplay enabled when running on Windows 98. If Autoplay is not running, explore and open *acro.exe* if you do not have Adobe Reader installed; or click on *acrobat.exe* to install Adobe Reader and then open the Start page. If you have Adobe Reader installed simply click on *Start.pdf*.



**Aluminum  
Cans**

**Glass**

**Plastics**

**Batteries**

**Scrap  
Metals**

**Paper and  
Cardboard**

**Equipment**

**Shipping**



## Aluminium Can Recycling

*This section includes material adapted from the SPREP 2003 Draft Recycling Directory.*

### Overview

Many Pacific Island countries collect aluminium cans for recycling. These operations in most countries are conducted by private businesses, indicating that recycling of aluminium cans is profitable; usually, aluminium cans are the most easily recycled material, with the most profit potential.

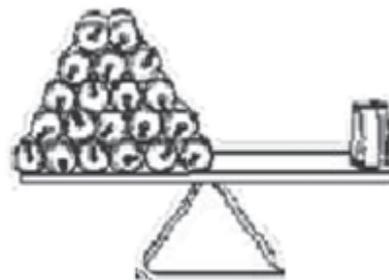
Aluminium is used in many every-day products including beverage cans, window frames, cars, outboard engines, cooking utensils and roofing materials. Aluminium collected for recycling in the Pacific Islands usually comes from beer and soft drink cans. Recycling is both economically and environmentally effective, as it requires a lot less energy to recycle than it does to mine, extract and smelt aluminium ore. See the [Impact of Waste](#) fact sheets to get some numbers on the savings. Aluminium exposed to fires at dumps can release poisonous gases and cans dumped in the environment can harbour mosquito breeding.

A crusher or baler is required to flatten the cans to reduce volume, enabling shipping to be cost-effective and also put the crushed cans in an easily transportable block form. A variety of baler sizes are available, and a suitable baler will be determined primarily by the volume of cans to be handled. Contamination of the cans needs to be minimized so that the highest price will be paid and can shipments will not be rejected.

### Health and Environmental Impacts

The environmental consequence of discarding aluminium cans is primarily a visual one, however, the cans harbour mosquito breeding. Aluminium can disposal is also a waste of a valuable resource.

Aluminium is easily recyclable and requires only 5% of the energy used to make primary aluminium. When metal is exposed to excessive heat, on fire at a dump, for instance, fumes given off by molten metal are extremely poisonous. Aluminium contamination has been linked to increased incidence of Alzheimers disease.



*Figure adapted from Alcoa Australia. The amount of energy needed to make one new aluminium can is the same that needed to recycle 20 cans.*

### Equipment

The most effective method of transporting cans is by compressing crushed cans into a block, or bales, using a baling press and shipping them in containers. The facility that accepts the crushed cans requires sufficient space and adequate staff to fill containers with bricks of cans. There are many suppliers that offer a wide range of crushing and baling equipment. The section on [recycling equipment](#) will provide information regarding suppliers. Equipment will generally be sourced from the United States, New Zealand or Australia. Some recyclers in the Pacific rinse down the cans after compacting so that they are clean which also has the dual purpose of minimizing cockroach problems.

## Quality Control

Recycled materials must be kept as clean as reasonably possible and free from dirt and contaminants. Dirty shipments may well result in rejection at the smelter and extra cost to the recycling business. Aluminium cans should not be mixed and crushed with other types of aluminium, as there are different grades and alloys of aluminium metal. Aluminium parts of old outboard engines and cars are also worth recycling, but must be stockpiled and shipped separately and not crushed in with drink cans. Containers of mixed can blocks and other aluminium scrap may be acceptable to your buyer overseas, but this should be arranged before shipping.

Cans should not be bought by weight, as this encourages people to place heavy materials, such as sand, inside cans. Most can recyclers buy cans with a volume measure that equates either to a specific number of whole, uncrushed cans, or to an expected weight of clean cans. Recyclers should specify and advertise that cans should not be crushed before being brought in for recycling. A simple steel-framed wire cage can be used for measuring cans by volume, and a [how to make a volume can measure](#) description is included, with materials and dimensions required.

## Storage Facilities

Aluminium can bales may need to be stored for some time before there is an adequate number to fill a shipping container. Where shipping containers are not available for ongoing filling, an old container should be used as a storage place. When the container is full, an empty one can be ordered for filling and taking to the wharf. This way the old container acts not only as a storage place, but also an indicator of when a container full has been crushed. This also ensures that cockroaches and rats that may have moved into the container during filling are not exported, with the ensuing quarantine problems. Best practice is to fill the containers direct, to avoid double handling, if the blocks are produced fast enough. This requires a large yard area big enough to have containers waiting to be filled. This may also require an arrangement with the shipping company to hold containers for a period. Where container turnover is reasonably brisk, this should be negotiable, and is the best option. Keep all doors shut when not required to be open, to avoid rats, mice cockroaches, and other animals moving in.

## Economics of Aluminium Recycling

Material value of aluminium cans was typically A\$1,350 - A\$1,400 per tonne, in Australia, in 2005. The economics of an individual operation will be very dependent on many other factors. A feasibility study may be required to see if exporting aluminium cans as scrap is economically viable, but aluminium is usually the most economic material to ship, and there are few places where it would not prove economic under any arrangement. An [example of a study](#) in the Marshall Is., which also looked at other materials, is included for reference. See also the Case Studies section of the Kit.

## Shipping Issues

Aluminium cans crushed with a small press such as the Mini Baler from New Zealand will achieve a density of around 300 kilograms per cubic metre (kg/cu.m), or about 10 metric tonne (mt) per 20-foot (ft) container. A larger press that gives 15 mt per container will give around 500 kg/cu.m. These figures are dependent on how old the machine is, and how crushed the cans were when they went into the crushing machine. It is also very important to pack the container with the bricks of cans produced by the press, carefully, to fill the container up as much as possible. Using a larger press, densities up to 16 mt are achievable; however, to get the density higher considerably greater force is required, and the presses become much larger, more expensive to buy, and also use much more electricity to operate. This factor is very important to consider when first sizing a press for an operation. Densities greater than 16 tonnes are unlikely to be found using equipment appropriate for small Pacific Islands. See the [Shipping](#) Section for more information.

### How Many Aluminium Cans in a Tonne?

Aluminium cans usually come in two sizes: cans from Australia, New Zealand and the South Pacific will usually be 375 ml. Cans from the Asian countries are usually 330 ml. Many USA-produced cans are 12 fl oz. or 355 ml. The actual size is not so important as the weight of the cans, as this is what determines how many cans are in a tonne. Unfortunately different cans are different weights, although cans of the same brand, from the same country (and production plant) are usually very similar in weight. An aluminium drink can of the sizes described above would typically weigh between 13 and 16 grams. Bigger cans are not necessarily heavier, for example, in Kiribati it is found that Australian VB beer cans of 375 ml are typically

14 g each, whilst the same size XXXX beer can, also from Australia, are 15g each and Tiger beer cans of 330 ml from Asia are 16g each. The weight also depends on the manufacturing plant that presses out the cans.

When calculating weights of aluminium from numbers of cans, a figure of around 66,000 cans per tonne should give a good result. This figure was found to be suitable in Kiribati, where most cans were VB or XXXX. Depending on the product mix in a country, a figure of 60,000 to 67,000 will be found to be suitable.

### Quarantine

Container doors must be kept closed when not in use to prevent rats and mice moving in. Dirt should be kept out of them as well, so that the bales are not unnecessarily contaminated, and also to avoid problems with Quarantine Officials in New Zealand and Australia. Obvious soil on can blocks may well result in impoundment of shipments at import, especially if imported into Australia or New Zealand. Containers that have stood in a yard should be checked to ensure that plant material is not stuck in doors or stuck to the base; this will likely result in problems in Australia or New Zealand. If available, it may be wise to have containers fumigated once full, prior to shipping. Contact your importer overseas on this issue. Containers impounded by quarantine rapidly become very expensive to deal with, and any profit can disappear within days as port and mitigation measure charges build up. Take Care! This applies to any recyclables shipments, not just aluminium. Check [Quarantine requirements in New Zealand](#) and [Australia](#) (or any country you are exporting to regularly) to avoid problems.

### Packing Declarations

Shipments will usually require [Packing Declarations](#). This document is a declaration that the shipment is clean. In particular, pallets should not be used if possible, when exporting into Australia or New Zealand, as these can create a quarantine problem. Pallets are not usually required when shipping aluminium, unless the blocks are very heavy. Wooden pallets and any wood or straw packing will attract attention by Quarantine Officials as these materials can bring in pests easily.

### Export and Import

There are usually no export or import permits required for shipping aluminium cans. However, Export Entries will be required to be made, usually prior to shipping. These will require a Tariff number. The international Harmonized System nomenclature, called the HS Tariff, uses common numbers across many countries. The HS Tariff for waste aluminium cans is 7602 0000. The local number should be checked to ensure that it is used in case a non-HS number is still in use. Countries with computerized Customs Entries will almost certainly use this number.

Aluminium for recycling will usually be sent to either Australia or New Zealand from South Pacific Island countries, whilst those countries in the North Pacific may find that Asia or the USA is a better option. The determining factor is usually the cheapest shipping link, as the price of aluminium can scrap is fairly constant around the world. A [list of Buyers](#) of recycled materials is included.



## Glass Recycling and Uses for Waste Glass

*This section is adapted from information provided in the SPREP Recycling Information of 2003, and from the New Zealand Ministry for the Environment website.*

### Overview

Glass is present in the waste stream everywhere. It can be directly recycled or used for other purposes. Glass is an important industrial material, with its main uses in glazing and packaging of drinks and foodstuffs. Glass waste occurs in both the domestic waste streams (principally containers) and industrial wastes (principally flat glass from construction and demolition). Not all types of glass can be economically reprocessed at present and the available markets for each glass type vary considerably. In most Pacific Island locations, glass for recycling will largely come from glass bottles and jars. The document in this Kit [Glass Recycling and Alternate Uses](#) provides a good technical overview of the nature of glass and some other uses for waste glass.

Glass is being most effectively used in some Pacific Island countries by reusing beer and soft drink bottles at local breweries and drink distributors. Glass bottles can be re-used a number of times before becoming waste, whilst waste glass is produced from other product packaging. Glass is one recyclable material that is unlikely to pay for itself, but recycling should still be considered as a means of minimizing the costs and other adverse effects associated with disposal to landfill.

Glass is a heavy, low-value material that is difficult to handle. There is generally an excess of glass, as of 2005, in recycling facilities in Australia and New Zealand. See the report by Envision New Zealand into the [Glass Mountains](#) in Otago, in the South Island of New Zealand. Glass is more readily *Downcycled* in the Pacific Island Countries (PICs), where the most ready use is as some form of aggregate substitute. Glass bottles sent for recycling into new glass bottles must be sorted into different colours, and need to have very low levels of contaminants to avoid shipment rejection.

### Health and Environmental Impacts

The potential environmental impacts of glass include taking up valuable landfill space, and the direct physical hazards from broken glass (cuts, etc.). The environmental benefits of reusing glass containers include reduced requirements for raw materials in making new containers, and also reduced energy costs. Glass is very easy to recycle fully, i.e. back into a product similar to the original. The environmental benefits of recycling glass (i.e. incorporating used glass as a replacement for raw materials in glass manufacture) include:

- ❖ **Reduced Demand** on natural resources; recycled glass is the same quality as glass sourced from virgin materials,
- ❖ **Energy Savings** as recycled glass melts at a lower temperature than the virgin raw materials (soda ash, limestone and sand),
- ❖ **Reduced Air Emissions** as the used cullet (pieces of broken glass) has already been through the fusion process and is close to the final product quality,
- ❖ **Public Health** hazard of broken glass containers, especially beer bottles is reduced,
- ❖ **Landfill Space** requirements are reduced.

Some Pacific Island municipalities and nations have used bans and tariffs to discourage glass drink containers. Ebeye Island, in Kwajalein Atoll, Marshall Islands, has a ban on beer in glass containers due to public health issues over broken glass. In Kiribati, an import tariff of approximately three times that put on beer in cans has meant that very few beer bottles are imported, and those that are, are usually drunk in hotels or private houses.

## Glass Processing Equipment

A glass crusher, or *pulveriser*, can be used to minimize the volume of glass bottles to allow glass transportation to be more cost-effective.

Examples of Glass crushing equipment can be found in the [Recycling Equipment](#) directory. Glass pulverisers crush the glass into gravel or sand-size pieces so that the material can be used in construction projects. The units are suited for remote areas where recycling back into bottles is not economical. This is likely to be the case in many Pacific Island country locations. Some glass pulverisers can pulverise all glass, including ceramic and window glass. The associated benefits include no longer needing to colour-sort the glass or to be concerned about colour and ceramic contamination. The crushing equipment is often similar to that used for crushing rocks, but smaller. Some glass-crushing equipment made for large catering businesses will have a capacity suitable for small PIC locations. Even if glass was crushed prior to landfilling, considerable landfill space could be saved.

Glass can be broken by hand, but this is a dangerous business and not advisable for large quantities. If conducted, *Eye Protection Must Be Worn* as glass shards fly everywhere. Heavy earth-moving machinery can be driven over glass piles, but again, care must be taken with flying glass, as bottles can explode. This method will produce a very uneven size of cullet, but may be useful where glass is used as construction fill material in a one-off situation.

## Management Options

There are three options for reusing and recycling glass in Pacific Island countries. These options are detailed below.

### Return Glass for Re-use

Many Pacific Island countries re-use glass beer and softdrink bottles. This should be a cost-effective approach for PICs and the preferred method of glass re-use, as it saves a lot of energy and requires a minimum amount of effort in comparison to other options. The key requirement is that the bottles be thoroughly cleaned prior to re-use. Beer bottles can be used approximately 10 times with this approach before disposal to landfill, or other re-use/disposal means (see below). After a bottle has been used to its capacity, Pacific Island countries should consider crushing the glass and either shipping for recycling or re-use as sand substitute, rather than landfill disposal. Re-use should also be encouraged for other glass

containers such as food jars and other drink bottles. This option is most likely to be applied at the householder level, by using the jars as storage containers, for example. However, it may also be suitable for small cottage industries, such as honey and jam making, noni juice production, and coconut oil for skin use.

## Crushing Glass for Re-use

It is possible for glass to be pulverized into material that has no sharp edges, for use as a gravel or sand replacement in drainage trenches, pipe laying and for road bases. See [Using Glass as a Granular Base Material](#) where detailed technical information on this use is contained. The substitute gravel material can also be used in tar and stone mixtures for asphalt on roads, or in non-structural concrete. See also the document [Using Glass in Asphalt and Concrete](#) for a detailed explanation of this process. In the case of using glass for roading, the small pieces of glass that migrate off the road will provide a reflective surface for the road shoulder. Note that where glass is used in concrete, some properties of the interaction of glass and different types of cement (for example Portland Cement) mean that glass may not be suitable for structural and load-bearing applications (such as columns and beams).

Pulverized glass has also been used in soft clay soil as a base for dirt roads. As the soft clay and glass mix dries in the sun it becomes hard and firmly packed. When it rains the clay-glass base stays compacted and resists the moisture longer, much like an asphalt-hard surface. Pulverized glass, sand and gravel mix do sparkle, making an interesting decorative feature. It can be used as a cover for bare parking lots to hold down the dust and provide a firmer base. It can also be used in beautification projects such as addition of the fine mix to wet paint for reflectivity.

## Collecting Glass for Recycling

### Export

Glass needs to be carefully sorted for recycling and the different-coloured glass separated. Bottles and jars must be exported for recycling as whole containers, sorted by colour. This makes the preparation of exporting glass expensive, and minimizes density gains in container filling through crushing.

Certain materials, if placed with glass bottles and jars for recycling, can lead to the rejection of thousands of bottles and jars. The following items must not be included with glass bottles and jars intended for recycling: china, ceramic bottles, window glass or

foreign objects such as pieces of metal or stones. The following is a typical specification for acceptance of glass by a glass recycling operation:

### Colour

- i) Flint (clear) Minimum: flint glass 99%, maximum glass of other colours 1% of which not more than 0.1% (1kg/tonne) may be green or blue glass.
- ii) Amber (brown) Minimum: amber glass 90%, maximum glass of other colours 10% of which not more than 5% may be green glass and not more than 5% may be blue glass.
- iii) Green Minimum: green glass 90%, maximum glass of other colours 10% of which not more than 1% may be blue glass.

### Contaminants

- ❖ Ceramics which include stones, plates, china cups, ovenware and bricks are not to exceed 25gm/tonne
- ❖ Essentially free of aluminium, plastic and steel containers (not to exceed one container per 2.5 tonne sample)
- ❖ Essentially free of other non-glass material - a moderate number of bottle caps (steel or aluminium) attached to bottles are acceptable.

### Size

Glass should not be crushed. Typically, pieces should not be less than 60mm across (approximately the size of a stubby bottom).

You must check any specifications from an identified suitable recycling facility before designing any recycling project, as the quality requirements will have a strong influence on any project design. *Be aware that glass is a low value item that will often require subsidy to ship from most PIC locations.*

### Economics

A 20 ft container of glass generally weighs between 15 to 20 tonne. Currently (2006), in New Zealand there is an oversupply of glass for recycling, as detailed in the *Glass Mountains* report and large stockpiles exist, waiting recycling. This situation may change. If you are intending to recycle glass for export from the Pacific Islands, it is very important to research the issue carefully first, and contact potential buyers in the receiving country. You will not likely be able to sell direct to the smelter.



# Plastics

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## Overview

Plastics are very common in our waste streams, and have become much more so in the last 20 years. Plastics are nearly always made from oil-based petrochemicals, although they can be made from plant-based materials. The plastics in a Pacific Island waste stream are primarily from bottles, packaging for food and consumer goods, and plastic shopping bags. Large pieces of plastic are also recoverable from cars being stripped for recycling. As plastic materials come in such a variety of types, it is very important to know how to differentiate these materials from one another.

## Recycling Plastics from PICs

Plastics are typically still fairly low value for export from PICs as they are light, and high shipping container densities cannot be obtained without increasingly expensive equipment. See the [Shipping section](#) for some indicators on shipping. That said, both PET and HDPE plastics (numbers 1 and 2) have ready markets. PET is very common as soft drink and water bottles. Most bleach, washing liquid, shampoo and similar, also milk when in plastic bottles, are packaged in HDPE. PET is easy to recover from CDL based refund systems. HDPE types, apart from milk-based drinks, are not much used for beverages, and are best recovered from curb-side recycling pick-up systems, or public collection points. Much of the large plastic parts of modern cars are made of PP (number 5), and should be *marked as such*. Some manufacturers have large quantities of PP plastic items in their products. These materials would best be recovered through programmes targeting car workshops and wreckers. With the large number of second-hand vehicles coming into most PICs from Japan (or the USA) this is a significant source of material. Also, the vehicle-based PP can be very large heavy pieces, which may help get container densities up if packed carefully.

## Different Types of Plastic

If plastics are to be recovered from the waste stream, sorting them into the different types of plastics is likely to be an essential first step. Plastic bottles are usually marked, often on the base, with a triangle and a number indicating the type (see table on opposite page).

From the New Zealand Ministry for the Environment we find [Main Types of Plastic](#) in the Waste Stream is a very useful tool to assist identification. The [Plastics Identification Code](#) has this information represented in a table, and is on the [www.mfe.govt.nz](http://www.mfe.govt.nz) website, along with much other useful information.

Plastic bottles should have their tops removed, as usually the top is of a different material to the bottle.

Again from the New Zealand Ministry for the Environment there is an excellent sheet called: [Reprocessing Technologies for Plastics](#) that gives a very detailed look at the technical aspects of the types of plastics in our waste stream.

## Plastic Disposal

**Plastics should not be burnt!** When plastics are burnt they may well release toxic fumes. In particular, where plastic compounds containing a class of chemicals called chlorinated compounds are burnt alongside organic chemical compounds (chemicals that contain carbon molecules), extremely toxic chemicals called [Dioxins and Furans](#) may be produced. See the section on POPs for more information.

Plastics are fairly inert in landfill, but can leach nasty chemicals slowly over time. The biggest immediate problems are that plastics are very light and tend to float or blow around in the wind, particularly a problem at windward shore landfill sites where trade winds

predominate. A good chain-link fence around a landfill is essential to contain plastic wastes. When plastics lie around they block drains, litter the high-water mark on beaches, and plastic bags are often mistaken by turtles and some fish for jellyfish dinners. Pigs are often found to have got sick or died from eating plastic bags that have blocked up their insides.

Householders can be encouraged to wash plastics that have food on them, such as food wrappers and disposable plates, and then, with other plastics, put them inside plastic shopping bags, crushing to fill the bag up as much as possible before tying it and putting in the rubbish. This can help with some of the loose plastics problem in landfills.

## Processing Plastics for Recycling

Plastics can be difficult to bale when small volumes are involved, as a large press is needed to get a good bale compaction and so get container weights up. Carefully look into [equipment](#) and [shipping](#) and costs and markets before planning which plastics will be viable to collect in your location. PET is almost sure to be collectable and recyclable. A press that may be good for plastics may be useful for other materials, such as cardboard. The availability of capital to buy a press in the beginning is a crucial factor. Be sure to consult with potential overseas buyers when designing a plastics recycling system.

TYPE OF PLASTIC		PROPERTIES Incl. Specific Gravity	APPLICATIONS: Virgin Grades	APPLICATIONS: Recycled grades MAJOR USE / minor use
 PETE	Polyethylene Terephthalate <b>PET</b>	Clear, tough, solvent resistant. Used for rigids, sheets and fibres. Softens: 85° C SG = 1.38	Carbonated soft drink bottles, fruit juice bottles, pillow and sleeping bag filling, textile fibres	<b>BEVERAGE BOTTLES</b> Clothing, geo-textiles, bottles for detergents etc., laminated sheets, clear packaging film, carpet fibres
 HDPE	High Density Polyethylene <b>HDPE</b>	Hard to semi-flexible, waxy surface, opaque. Softens: 135° C SG = 0.96	Crinkly shopping bags, freezer bags, milk bottles, bleach bottles, buckets, rigid agricultural pipe, milk crates	<b>FILM, BLOW MOULDED CONTAINERS</b> Agricultural pipes, pallets, bins for compost and kerbside collections, extruded sheet, crates, garden edging, household bags, oil containers, pallets
 V	Unplasticised Polyvinyl Chloride <b>UPVC</b>	Hard rigid, can be clear, can be solvent welded Softens: 70 - 100° C SG = 1.40	Electrical conduit, plumbing pipes and fittings, blister packs, clear cordial and fruit juice bottles	<b>PIPE, FLOORING</b> Pipe and hose fittings, garden hose, electrical conduit, shoes, road cone bases, drainage pipes, electrical conduit and ducting, detergent bottles
	Plasticised Polyvinyl Chloride <b>PPVC</b>	Flexible, clear, elastic, can be solvent welded Softens: 70 - 100° C SG = 1.35	Garden hose, shoe soles, cable sheathing, blood bags and tubing, watch straps, rain wear	
 LDPE	Low Density Polyethylene <b>LDPE</b> Linear: <b>LLDPE</b>	Soft, flexible, waxy surface translucent, withstands solvents Softens: 115° C SG = 0.92	Garbage bags, squeeze bottles, black irrigation tube, silage and mulch films, garbage bins	<b>FILMS: BUILDERS, CONCRETE LINING and BAGS</b> Agricultural pipe, nursery & other films
 PP	Polypropylene <b>PP</b>	Hard, flexible, translucent (can be transparent). Wide property range for many applications, good chemical resistance. Softens: 165° C SG = 0.90	Film, carpet fibre, appliances, automotive, toys, housewares, crates, pails, bottles, caps and closures, furniture, rigid packaging	<b>CRATES, BOXES, PLANT POTS</b> Compost bins, garden edging, irrigation fittings, building panels
 PS	Polystyrene <b>PS</b>	Clear, glassy, rigid, brittle, opaque semitough, melts at 95°C. Affected by fats and solvents. Softens: 90° C SG = 1.06	Refrigerator bins & crispers, stationery accessories, coat hangers, medical disposables. Meat & poultry trays, yoghurt & dairy containers, vending cups	<b>INDUSTRIAL PACKAGING, COAT HANGERS, CONCRETE REINFORCING CHAIRS</b> Moulded products, coat hangers, office accessories, spools, rulers, video cases and printer cartridges
	Expanded Polystyrene <b>EPS</b>	Foamed, light weight, energy absorbing, heat insulating Softens: 90° C SG = 0.90 - 0.93	Drinking cups, meat trays, clamshells, panel insulation, produce boxes, protective packaging for fragile items	<b>SYNTHETIC TIMBER</b> Picture frame mouldings, under slab void pods for buildings
 OTHER	<b>OTHER</b> : Includes all other resins and multi materials (laminates) acrylonitrile butadiene styrene (ABS), acrylic, nylon, polyurethane (PU), polycarbonates (PC) and phenolics		Automotive, aircraft and boating, furniture, electrical and medical parts	<b>AGRICULTURAL PIPING</b> Furniture fittings, wheels and castors. Fence posts, pallets, outdoor furniture and marine structures.



# Lead-Acid Batteries

*Parts of this section are adapted from the SPREP recycling information of 2003.*

## Overview

Lead-acid batteries are imported in large numbers into PICs and are widely used in cars, trucks, boats, motorcycles, tractors and a range of other mechanical equipment requiring power. Batteries are also used in solar energy systems. Lead-acid batteries contain sulphuric acid and large amounts of lead. The acid is extremely corrosive and is also a good carrier for soluble lead and lead particulate. Lead is a highly toxic metal that produces a range of adverse health effects, particularly in young children.

Although the acid can be cleaned and re-used, the lead is the valuable component in the battery to be recovered by Pacific Island countries. The appropriate controls are often not taken by Pacific Island recyclers, thus putting themselves and their environment at risk of contamination. Batteries can be shipped to Australia or New Zealand with the acid in, where the lead can be recovered and re-used. The price obtained should usually be sufficient to cover the costs of shipping from PICs.

## Battery Types

There are many types of batteries and they are categorized as primary or secondary cells. The primary batteries include: carbon-zinc, alkaline-manganese, lithium, zinc, air, silver and mercury-oxide. These are usually the small batteries in things like radios. The secondary cell batteries include lead-acid, nickel-cadmium, rechargeable alkaline, nickel-metal hydride. This information refers to the lead-acid battery, as found in vehicles and solar systems. Some lead-acid batteries are sealed gel-cell batteries, where the acid is in a gel form. These are commonly found in UPS computer back-up power supplies, and some solar systems.

## Health and Environmental Impacts

Lead-acid batteries contain sulphuric acid and large amounts of lead. The acid is extremely corrosive and also a good carrier for soluble lead and lead particulate. If the acid leaks onto the ground, it may contaminate the soil which will become a source of lead particulate as it dries out; and the lead becomes incorporated into soil particles that may be blown by wind or enter waters. Exposure to excessive levels of lead can cause brain damage; affect childrens growth; damage kidneys; impair hearing; cause vomiting, headaches, and appetite loss; and cause learning and behavioural problems. In adults, elevated lead levels can increase blood pressure and can cause digestive problems, kidney damage, nerve disorders, sleep problems, muscle and joint pains. Fetuses, infants, and children are especially vulnerable to lead exposure compared with adults, since lead is more easily absorbed into growing bodies. Also, the tissues of small children are more sensitive to the damaging effects of lead. Recyclers in the Pacific need to take special care that adequate precautions are taken to protect themselves and their environment from lead contamination. Lead recovery is also practised at a domestic level in some PICs e.g. for making fishing sinkers and weights for diving belts. However, this practice should not be encouraged because of the potential environmental and human health hazards.

### Safe Handling

When handling batteries that still contain acid, appropriate Personal Protective Equipment (PPE) should be worn. This includes coveralls, protective glasses and gloves. An eye-wash station should be on hand. See the [Safe Handling of Batteries](#). Batteries collected for recycling are often referred to as either ULAB: Un-drained Lead Acid Batteries (also termed wet batteries), or DLAB: Drained Lead Acid Batteries (also termed drained batteries).

## Undesirable Practices When Handling Batteries

- ❖ emptying of acid in batteries to the ground and waterways;
- ❖ lead recovery at a domestic level to make fishing sinkers and weights;
- ❖ storage of batteries outside and uncovered.

## Collection

As with other items, the best form of collection is through a deposit/refund system. Kiribati has removed a vast number of batteries from the local environment (three times the annual imports were removed from Tarawa in 11 months) through a \$5 deposit at import that is fully refundable on return. See the [Kiribati Case Study](#). Another approach is an exchange system where all buyers of new batteries are required to bring in an old battery before a new one can be purchased. This usually means that most times people will be happy to exchange and get rid of their old dead battery when buying the new one. Those times when an old battery is not being replaced will encourage the purchaser to look for a discarded battery before buying the new one. Collection centres can be located at battery retailers, service stations and other places where new batteries can be purchased. In this way disused batteries can be collected. A collection point at landfill sites should also be maintained so that people bringing batteries to landfill can place them aside and prevent them going into the landfill. At the collection centre the disused batteries need to be stored so as to minimise leakage. Ideally, storage in an acid-resistant container is preferred, although this is often not possible due to cost. Collection points must not sell their batteries to local smelters for fishing sinkers and the like, as these backyard operations are some of the biggest generators of lead contamination in the Pacific Islands, both to people and the environment.

## Safe Storage Facility

Batteries should be stored under cover and in a bunded area. A bund is a concrete wall built all around the area and designed to contain all the liquid likely to be spilled within the area. For battery containment, a bund wall at least 10 cm high would be expected. All bunded areas should be covered to prevent rainfall intrusion. Storage should preferably be in the temperature range specified by the batteries. Particularly in high humidity or temperatures common in the Pacific, batteries may deteriorate, causing leakage or corrosion of the metal parts. Any storage place should ideally not accumulate large amounts of batteries and must not be considered as a permanent storage facility. Limiting the quantity

of batteries decreases the chances of environmental and workplace accidents. Batteries can give off explosive gases, although this is principally when they are charging. However, it is always good to treat batteries with great respect, even if they appear very old and dead.

Store collected batteries in a safe storage facility clearly marked as a **Battery Storage Area**, with restricted access, with the correct *Corrosive* sign, and with the appropriate *safety sheet* on display.

## Transporting and Packing

Batteries should be held a while before packing on pallets to ensure that they are not leaking. Batteries should be strapped to pallets for transportation. Batteries prepared for export will need to be packed on wooden pallets, PLASTIC strapping (not steel, to avoid short-circuits) and pallet wrap film wrapping. A forklift will also be required to move the packed pallets and fill the containers. Usually ten pallets can be packed onto a container floor, with another ten on top. Batteries can only be packed two layers to a pallet, with only one pallet on top due to weight. Some [Examples of Battery Packing](#) are provided by ARA of Sydney in the S.E.C Report. Photos showing packing of batteries in great detail are also available in the [Photo Library](#) section of this Kit. Batteries packed as above will need each pallet to have a *Class 8 label*, and an international *MSDS label*. Layers of thick cardboard are placed between the two layers of batteries and on top, to prevent battery terminals punching holes in the cases of the batteries above, and also to shield the battery terminals from any potential short-circuit that might cause a fire.

Insurance will be essential before any Basel Permit will be issued. Make sure that the shipping container company knows that the proposed cargo is old batteries, so that only older containers are used, and not food-grade containers. Equipment which is suitable for cleaning battery spillage accidents should be carried on board the transportation vessel. The people used to transport the batteries should be trained in use of the equipment, particularly in Emergency Preparedness Procedures. This should also include PPE (personal protective equipment). A transportation schedule should be composed and the route picked to avoid environmentally sensitive areas (e.g. creeks, wetlands) and populated areas (e.g. heavily urbanized areas).

The Technical Working Group of the Basel Convention adopted, in May 2002, the *Technical Guidelines for the Environmentally Sound Management of Waste Lead-Acid Batteries*. The guidelines recommend that

a battery should not be drained at a collection point because the drainage of the sulphuric acid electrolyte may pose several threats to human health and to the environment as:

- (a) it contains high lead levels, as soluble ions and particulate forms;
- (b) its acidity is very high and may cause burns and damage if accidentally spilled;
- (c) it requires special acid-resistant containers for storage;
- (d) its drainage requires workers to be protected in order to minimise any risk of injury, etc.

Thus, battery drainage may be considered a potentially hazardous activity that demands special tools, containers and safety equipment, but also trained personnel. If separation of the contents is to be conducted, this should only be attempted by professional personnel, and undertaken in a safe storage facility as detailed below. Those islands that have sensitive ground waters, should not consider battery separation.

## Export and Import Permits

For the movement of lead-acid batteries from any Pacific Island country to New Zealand or Australia, Basel and /or Waigani Hazardous Waste Movement permits will be required. The processing of applications can take up to 2 months so adequate planning is important. A company from the importing country needs to make application for the permit. The *Basel Permits Guide* from Australia gives full details on the

process; an example of a *Basel Notification Form* for batteries is included. The code for Waigani would be Y31 on Annex I (for Basel it would also be Y31 with it further classified as A1160 on Annex VIII - this would correspond to the OECD amber code of AA170). Also, the Waigani Handbook has an example of the steps required, and a summary of what to do in the *Example Table* to export batteries from a PIC.

## Recycling Facilities

Recycling and facilities are available in both Australia and New Zealand. Exide Ltd is the New Zealand recycler [www.exide.co.nz](http://www.exide.co.nz) in Lower Hutt near Wellington, and a description of their process is at *How batteries are Recycled*. Australian Refined Alloys (ARA) is the Australian recycler, in Sydney. A description of their facility is included here, extracted from a report on a *Visit by the Kiribati Solar Energy Company* to the Facility. This report includes details on correct packing procedure.

## Economics

Lead-acid batteries can generally be exported economically, if the collection and packing is done in conjunction with other activities. Prices vary, but usually will be in the range of \$150 - \$200 per mt or perhaps more; with the prices of all metals climbing, prices can be expected to slowly improve.



# Scrap Metal, Vehicle and Associated Materials Recycling

*Includes materials from the SPREP Recycling Guidelines of 2003*

## Overview

This section considers a variety of materials associated with vehicle recycling, that is: scrap metals, tyres, waste oil and plastic car parts. Whilst the materials themselves are quite varied, in a Pacific Islands context with often fairly low volumes to handle, they are all best dealt with by a facility that is handling discarded vehicles.

Scrap metals are increasing in value on world markets, particularly as energy costs rise, because mining and processing raw materials for metals is very energy-intensive. The recycling of scrap metals is a very old and well-developed industry. The challenge in Pacific Islands is to recover the materials from remote locations at a low cost, and maximise the value of the scrap metals by providing a clean and sorted product to the scrap metals buyer. The other big challenge is to pack and export the material efficiently.

Scrap metal is one of the most recyclable products. Most metals only have to be melted down and then reformed into other products, making the life cycle potentially endless. Recycling makes a substantial saving on landfill space requirements and it helps conserve world resources. For example, melting down one tonne of recycled steel cans uses only around 25% of the energy needed to melt enough ingredients to make one tonne of all-new steel. For every tonne of scrap steel recycled, around 1.5 tonnes of iron ore, one tonne of coke and half a tonne of limestone are saved in the production of a tonne of virgin steel.

The largest scrap metal resource for PICs is old vehicles (these are also referred to as End-of-Life vehicles, or EOL). Many Pacific Islands have large numbers of dead cars lying around in the environment, especially on islands that are more developed. Another sizable waste stream of steel is tin cans that held food. The third main area is of White Goods, that is washing machines, fridges and freezers, and air conditioners.

## Vehicle Dismantling

Old cars and trucks contain a large amount of recyclable materials. A large yard area is required to work on vehicle dismantling effectively. Tyres, oil, battery, radiator and perhaps engine, will need to be removed and the petrol tank holed. Vehicles should be stripped of glass windows, seats, carpets on floors, and any vinyl or similar material linings in the interior. Large pieces of plastic can be removed and stockpiled and sold once a container full is accumulated. FSP Kiribati conducted a simple study on a typical crashed car in Tarawa in 2004. The car was first stripped of useful parts that could be sold as second-hand spares, and then the non-metal parts described above were removed. Next phase was to try and recover non-ferrous parts (such as aluminium housings and radiators, or any brass, copper and stainless steel parts) that are more valuable than the steel. Each phase was timed, and also the tools required noted. This [study on car dismantling](#) is useful for anyone looking at the feasibility of setting up a dismantling system. Recovery of useful spare parts is seen to be essential in places where overseas shipping costs are high and labour costs low, as car spare parts are often comparatively expensive too. The non-ferrous parts will usually be worth 4-5 times more than the steel per kg, and are thus well worth recovering.

To maximise the value of the scrap steel in a car, it must be cleaned of all non-steel parts as far as possible. Some of this material will have to be landfilled, but glass windows can be saved as spare parts, because broken windows and windscreens are a common problem; seats may be sold off cheaply to people who may want to re-use them. The most useless parts will be small pieces of trim from inside the vehicle. Unused glass windows may well find a use for some people as windows set in concrete walls, or used to make plant frames in mountainous country where cold weather can damage some vegetable seedlings and plants.

Once a vehicle has been stripped of all non-steel parts, it can be placed whole into a car crusher, should one be available. There are *mobile car crushers* that are mounted on trucks or on skids, and units such as these could be used within the Pacific Islands. Small countries will have a problem in that the number of cars to process will be too small to justify the purchase of a large crusher. In this case, the vehicle bodies will require cutting up with tools such as hydraulic shears, disc saws, grinders and LPG gas. Details of such equipment are provided in the *Recycling Equipment* section. These smaller pieces can be fed into a smaller baling press and turned into bales of scrap.

Larger items will almost certainly be required by the buyer to be cut up into smaller pieces. Typical specifications are that heavy steel items should be no more than 1m wide by 1.5m long. As with any recycled material, it is very important to contact the buyer and agree to the size and specification of materials to be exported before processing is decided on. Some buyers are able to take materials to different specification, and it may well be worth looking around as one buyer may pay less for your material but take it in a form that saves you a lot of money in processing costs. It will be much better to ensure that your scrap is well sorted and clean rather than shipping mixed materials that have a lower value. Shipping essentially worthless materials such as car windows, and odd bits of plastics at great expense makes no sense.

### Automotive Plastic Parts

Modern vehicles have a large number of plastic parts in or on them. These parts usually of uniform types of plastic and may well be recyclable. Due to laws coming into force in nations such as Germany and Japan, the recyclable content of cars is increasing; in Germany, carmakers are being required to recycle ever-higher percentages of the vehicles they produce, as the years go by. This is forcing the designers of the vehicles to include recyclable components in the cars. A *paper from Toyota describing the cars' recyclability* is provided to show some of the progress in this area.

In Toyotas, the bumpers and other larger, rigid plastic interior trim parts will be made from Polypropylene, and these are marked as PP somewhere, usually on the inside (non-visible side). Car plastic parts should be marked using the Society of Automotive Engineers (SAE) marking systems. A document with the full set of marking systems for plastics used can be downloaded from the SAE website [www.sae.org](http://www.sae.org) but it must be paid for. These plastic parts are quite heavy, and a container full may amount to sufficient for export, depending on shipping costs. It may be possible to put them through a large chipper of the truck-towed sort (see the recycling *equipment* section) to increase density.

### Waste Oil

All vehicles will generate used oils. These are a problem: waste oil very easily becomes a big pollution problem, for one litre of oil can contaminate up to one million litres of water, as the oil spreads across its surface. Any recycling of vehicles will result in having to deal with waste oils. A *fact sheet on waste oil* adapted from one produced by Zero Waste, in South Australia gives some ideas of the problem. In South Australia, oil collection points have been set up. A much more in depth look at the issue is provided by the *Guidelines for Handling of Used Oils*, produced by the New Zealand Ministry for the Environment. These guidelines are very comprehensive, and of particular help may be the sections detailing with setting up *public collection points*, and *construction and use of collection tanks*. Appendix 3 also contains details on what to have in an *oil spill kit*, for use when spills occur.

Waste Oils are a big problem. In small island nations in particular, such as atolls, there is a very good case that the importer of engine oils should also export them. Usually in the smaller nations there is only one oil company, and arrangements should be made that the company remove the waste oil collected when their tanker makes a port call. This way, the oil can be aggregated with other waste oils to produce viable amounts that can be reprocessed. Waste oil can be re-refined into new engine oils, and this is done in New Zealand and some other countries. This product is usually not expensive and quite suitable for older vehicles that may be burning oil.

**Waste oil must NOT be tipped onto the ground, poured down drains or thrown into the sea or creeks.** This can cause a great deal of contamination to groundwater, and very bad effects to people's health and the local environment. Where cars are being dismantled, they should be stripped over a place with a concrete floor that has a low wall of about 15 to 20 cm high (called a bund) around it (a course of concrete blocks for example). This ensures that oil spills can be contained. When processing cars for wrecking, it is best to drain engine oils as the very first step in the wrecking process.

### Tyres

Every car has at least four tyres, and huge numbers of tyres build up over time. They are also a big problem, and to process them effectively requires large machines. They can be ground up, the steel reinforcing removed, and the rubber crumb produced can be used in a variety of products, such as ground coverings for playgrounds and horse arenas, some moulded rubber products, aggregates for drainage, or Tyre Derived Fuel (TDF) which is where tyres are burnt as a furnace fuel, a questionable practice.

There is also a system that bales tyres so that they can be used for sea walls and under roads over swamps. See [www.GlobalZyme.com](http://www.GlobalZyme.com) - World Wide Road Construction with Perma-Zyme, for details.

In an island context, tyres are best used for some purpose that involves little processing. Tyres are very strong and once a sizable quantity is collected, people start to find uses for them. One use is as *markers along the side of roads*, where they are painted and set into the ground. Tyres can also be used to make walls, when stakes are put down the holes in the middle, and the insides are filled with earth, sand or concrete. There are even houses with walls built of tyres. They can be used as steps when set into the side of a hill, pegged and filled in the middle, whilst the outside forms a strong edge.

Another good use for tyres for places with poor soil, or in towns, is to make tyre gardens. Several tyres (three to five) are placed on top of each other, and good soil placed inside (mixed with some of that compost made from the organic waste perhaps), and flowers, or other plants can be grown off the top. This system can also be useful for growing root vegetables such as potatoes, as the depth of the tyre garden is good for these plants. Harvesting is done by taking the tyre pile to pieces.

## Scrap Metals

Metals containing a high proportion of iron, such as steel, are termed *ferrous*. The three types common in the Pacific will be steel tin cans, used for food, light gauge panel steel, such as used in car bodies, white goods (see below), and heavy steel, for example from construction equipment, and building frames. Other metals are termed *non-ferrous*, and these are usually of higher value.

To prepare scrap metal for shipment for recycling, the metal will usually need to be reduced in size by cutting, shredding or by crushing. Shredders are used for large pieces of metal and are effective for vehicles where large numbers are being processed, but this level of processing will probably not be reached in the Pacific Islands, and the equipment is very expensive. The most common equipment for metal preparation is a heavy baling press, of double or triple compression type. The *Recycling Equipment* section of the Kit gives some indication of suitable equipment. The metals must also be clean to reduce the chance of requiring fumigation upon arrival at the receiving country port. See the shipping section of this Kit.

## Steel Food Cans (Tin Cans)

Tin cans are easy to recycle, particularly these days where the quantity of tin in the average can is so low that a de-tinning process to remove the tin is not required. Tin cans can be baled in a similar baling press as that used to crush aluminium cans, especially if it is a larger one. The bales produced are easy to put into shipping containers. It is advisable that cans collected should be clean where they are exported into New Zealand or Australia to avoid quarantine problems. However, leaving cans in a pile for a week or two in the open before crushing may mean that the ants can do the work for you. However, be careful that the ants do not go into the container with the cans! It may also be possible to export to Asia direct. Buyers in Australia may be able to help arrange this.

## Heavy Steel

Heavy steel consists of abandoned and derelict construction equipment (bulldozers, draglines, cranes, etc.) shipwrecks and stranded barges, old structural steel, engine blocks and parts. This thick steel needs to be cut or broken down into manageable size pieces for shipment to the recycler. The steel needs to be sound, and not too rusty. Often this kind of material is found on the seashore, where it has been pushed into the sea as a wave break or just as a convenient dump. If it is very rusty, the metals buyer will not be interested, and prices will be low, so beware before going to great lengths to recover such materials. That said, heavy steel could often be in good shape even if the surface is quite rusty. Consult with the metals buyer on this score; ideally, get them to come and look at samples of scrap so that it is clear on both sides what is acceptable. For issues concerning shipping of scrap metals please look at the *Shipping Recyclables* section.

## White Goods

White Goods is the term given to household appliances such as washing machines, refrigerators, air conditioners, microwaves, gas and electric cookers with ovens, and dishwashing machines. By weight, white goods are mostly ferrous metals, with steel panels and perhaps frame, making up the bulk of the weight. Where they contain an electric motor, such as in fridges or washing machines, the motor will also be a heavy component. However light-weighting and technology changes in white goods mean they are now complex scraps. The panel steel commonly used in white goods is termed light gauge.

If white goods are carefully dismantled, a good variety of non-ferrous metals such as copper and aluminium can be recovered. Fridges, freezers and air conditioners will often have copper or aluminium radiators. Electric motors will have copper. The steel panels, when packed flat together in a container can give very good container weights. And, as with vehicle dismantling, useful spare parts can be recovered for local repairs and sale.

It makes good sense to combine any car recycling with a white goods recycling section, as the resulting materials recovered enter the same recycling streams, and in many places, there may not be a large enough quantity of white goods available to keep a business running effectively. This is exactly where the Materials Recovery Facility model of handling several materials at one location comes into its own.

## Non-ferrous Metals

The most common non-ferrous metals are Aluminium, Copper, Brass, Stainless Steel and Lead. Aluminium has been well covered under the [Aluminium Recycling](#) section, as aluminium is a common, and high-value material. Be aware that some aluminium alloys, for example those found in outboard engine casings and some car wheels, may be of high value, and can be processed in with aluminum recycling; but keep the piles separate when shipping with other types of aluminium to gain good prices.

### Lead

Lead is most commonly found in lead-acid batteries and detailed information is provided in the Battery Recycling section. Lead can also be found in some older building roofs as flashings: this comes in soft strips. Some roofing ridge capping can have a strip of lead along the edges as a flashing, and this can be recovered from such materials, with the stripped capping going into the steel pile.

### Stainless Steel

Stainless steel is common in marine fittings and equipment. Small amounts may be found on some white goods, or some furniture. Do not confuse chrome-

plated materials for stainless steel. Stainless usually has a sheen finish, and is a light strong metal. It also comes in different grades, with 304 and 316 being the most common. Generally not present in large quantities, as it is expensive, but well worth recovering for its high scrap value. Stockpile until a good load is collected.

### Copper

A very common source of copper is electrical wiring. Some scrap processors will burn wires to remove the plastic coating. This is a highly polluting activity, and will likely release dioxins into the air (highly poisonous chemicals that cause cancers) as most coverings are PVC insulation. Wire should be shipped with the insulation on, where it will be stripped by the processor overseas. It is still quite possible to reach the container weight limit before actually filling the container, with the insulation still on the wire. Burning the wire is a pointless exercise, yet very poisonous to anyone who breathes the fumes.

Electric motors usually contain a lot of copper wire. They should be dismantled and the copper cut off, with the steel parts separated out to achieve maximum value. Many items contain electric motors: most household appliances, as well as cars with electric windows. Copper is sourced from telephone cables, most metal domestic water pipes and fittings, some doorknobs, locksets, some car radiators, air conditioners, and there are small amounts in other major appliances such as refrigerators and clothes washers. It is also used in sheets on some old wooden boat hulls.

### Brass

Brass is sourced from brass house fittings such as doorknobs and handles, water pipes and fittings and some car radiators, although many will be aluminium, in modern cars. Car radiators need to be emptied of the contained coolant before they are sent for recycling. To dispose of appropriately, coolant should be released onto an absorbent medium, such as sawdust, before being landfilled. Brass items can often be found amongst ship fittings.



## Paper and Cardboard

### Overview

Both paper and cardboard are technically easy to recycle, with the material being turned into paper pulp and used to make new paper products. However, higher value papers, such as photocopier papers, cannot be made out of lower grade materials such as cardboard boxes.

### Paper Types Suitable for Recycling

In general, the following types of paper and cardboard are suitable to collect for recycling:

*Photocopier paper, bond stock, writing paper, note paper and envelopes, binder dividers, manila folders, computer print out, reports and forms, cardboard cartons, cardboard packets and packaging, magazines, newspapers.*

The following paper-based items are not generally suitable for recycling:

*Carbon paper, gummed labels, chocolate and foil wrappers, facial tissues, waxed paper, cigarette packets, paper cups and plates, paper towels, lunch bags, window envelopes (unless you tear out the windows), milk and drink cartons (liquid paper board, or LPB).*

Uncontaminated white office paper is a sought after, valuable product, but the problem is always to keep it clean and of the high quality paper type. Recycling paper saves a large amount of virgin materials and energy, as an [educational fact sheet on paper](#) from the Auckland Regional Council clearly explains.

Cardboard and paper needs to be baled, as it must be exported offshore from the Pacific Islands for reprocessing in a paper mill. Paper and cardboard are heavy materials, being made essentially from wood; but it requires a large machine to *compress the material* into solid enough blocks that container weights are likely to reach anywhere near the level required to make export viable. Where there is a large population of paper users, such as in Fiji, paper recycling can be quite viable. It is the small nations that will have difficulty keeping the volume flows consistently high enough.

Bearing in mind that the vast majority of items that are imported into the islands will arrive in a cardboard box of some type, there is a lot of cardboard out there to be collected. Where there is room to have some covered storage where bales can be stockpiled without getting wet, it may well be possible to export some of that waste. Remember that every cubic metre of cardboard kept out of the landfill is a saving of a cubic metre of landfill space; it may well be that where the economics do not add up on the face of things, with a full-cost-accounting approach it is worth shipping that waste off-shore.

### Collecting Waste Paper Products

Where it seems that a sufficient quantity of paper-based material might be recoverable, collection should be carefully targeted at major paper waste producers: large stores and importers of consumer goods, and offices that produce waste paper. Waste office paper collection can be combined with a document destruction service, so that the customer is getting two services for the price of one. Doing this might allow for collections to be subsidised by the customer paying for paper shredding, whilst the recycler gets the material on top. Cardboard is best collected from large bins placed at the rear of large store yard areas. Store staff must be trained to flatten boxes before placing into the bin (typically a bin of 1-2 cu.m). Stores will usually have to pay for the removal of their wastes, so

again a service to the store can be provided whilst the recycler gets the material at little or no cost.

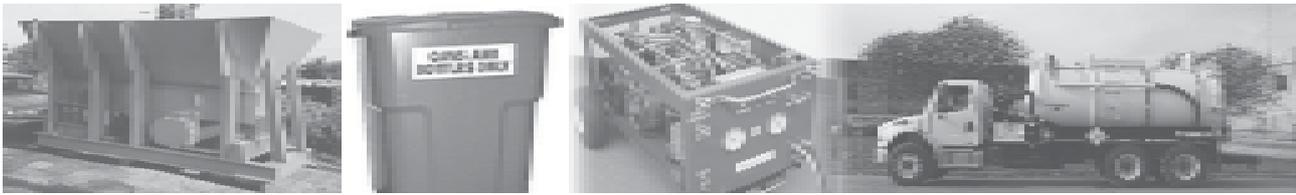
In Kiribati, the recycling project shipped four containers of cardboard to investigate the economics of the situation and to experiment with collection systems for cardboard. The first container was hand-packed and managed to get 2.5 tonnes into a 20-ft container. Later, using a small baling press, around 5 tonnes per container were achieved. Shipping costs vary enormously for different island nations, so paper recycling needs to be looked at carefully before entered into.

Paper will be easy to sell to buyers in both New Zealand and Australia, and also the USA or Asia. However, paper, and cardboard boxes in particular, are readily invaded by cockroaches and other insects, and most importing countries will require recycling exporters to

take care that their paper is kept clean. Also, wet paper products will be rejected as the weight of wet paper and cardboard is far greater than dry, and buyers will not be happy to buy water at paper prices.

### **Liquid Paper Board (LPB)**

Liquid paper board is the name of the material used to make cardboard drink cartons. There is some recycling of this material in some places, but it requires large volumes of recyclable material, and generally these types of drink containers are not present in large numbers. The most common uses are for Long Life milk and fruit juice. It is a composite material, often involving plastic films and/or aluminium foils. Difficult to clean out, it will often smell bad unless processed quickly.



# Recycling Equipment

## Overview

Any recycling system will require equipment to process the materials collected. Whilst some of that equipment might be general in nature, such as forklifts and pallet trucks, some will be specialist equipment. A common problem that is found in the Pacific is that the quantities of materials handled are usually comparatively low. This can make it hard to find equipment of a suitable size for the quantities processed.

## Material Flows

Typically, the smaller island states will be dealing in annual flows of a particular recyclable material in the order of perhaps 100 tonnes per annum. For example, Kiribati (pop. about 100,000), with a very high proportion of aluminium cans in the waste stream, might crush about 80 tonnes of aluminium cans in a year. The Republic of the Marshall Islands might generate about 75 tonnes of aluminium cans and 40 tonnes of PET bottles. At 80 tonnes per year, assuming 200 working days per year, that equates to 400 kg per day. A commercial sized aluminium can baling press might handle that much in an hour, meaning that it would only take 5 weeks at 40 hours a week to bale the aluminium cans of an entire year. At this, the machine would spend much time sitting around unused, and unused machinery often goes rusty very quickly in the Pacific. Thus it is very important when looking at machinery to have some idea of the quantities to be handled. The other major consideration is the density of bales of material, as a shipping container (in which most recyclables will be shipped) has a fixed cost for shipping. A low-density bale will decrease the value of the materials, as shipping costs per tonne will be higher. A piece of equipment that can handle more than one material in such low volume situations is also a vital consideration.

That said, below is a review of a variety of machinery that is used for processing recyclable materials. The equipment presented below does not imply any

endorsement whatsoever of any of these machines, or the manufacturers or suppliers. These examples are provided purely as examples, to help anyone looking into these areas have a better understanding of the sort of equipment available. Only the briefest of information is provided, and interested people must contact manufacturers and suppliers and check any specification or other information provided here. Website addresses are provided where possible to assist you in contacting suppliers directly. It is advisable to obtain some professional advice before deciding to purchase any large piece of machinery. It is important to consider availability of spare parts and servicing as well as price. Shipping links to your country are an important consideration as transshipping a large machine may be a very expensive process.

The Tonga Solid Waste Management Project conducted a [study visit to New Zealand recyclers](#) in late 2005, and this is very useful as it describes the processes used by various recyclers in New Zealand. This report gives a good indication of the kind of equipment required by different sizes of operations, and will be very helpful to indicate what sizes of machinery might be needed at your location.

## Baling Presses

A baling press is perhaps the most essential specialist piece of equipment for the recycler. Balers can be used to process aluminium and steel cans, plastics and cardboard/paper. Presses and balers are sized to suit the level of compression required, and a simple indicator initially is the number of compressions. A single compression unit is usually a small unit. Double compression has an additional ram to compress the bale from the side. For things that reduce in volume considerably, such as aluminium cans and PET bottles, a large space filled with recyclables is required to be compressed into a small bale to avoid cycling the press several times to get a decent bale size. This is where double and triple compression units can come into

their own. One thing to watch carefully is electricity consumption, as electricity costs in many small island nations are high. Also, be careful when ordering machines that the electrical specification is one that is suitable for your country, for example a machine made for Australian or New Zealand use may not necessarily run on a United States-type power system used in the Marshall Islands and Federated States of Micronesia.

Common in the Pacific Islands, especially for small volumes, is the *Alert Engineering* RamJet range built in New Zealand, which includes a small RJ Mini Baler which can handle up to 400 kg per day of aluminium cans; also the RJ Midi Baler which can handle around a tonne of aluminium cans per day. Larger presses are also available, including scrap metal presses. Contact [www.engalert.co.nz](http://www.engalert.co.nz).

Many suppliers of recycling presses and balers can be found in the USA. *Harris Selco* produces a range of balers that can be of a suitable size for the Islands, [www.harriswaste.com](http://www.harriswaste.com). Tsissg in the USA also makes some smaller balers, including a model (the TC-710) that comes with its own 18 HP petrol engine and wheels. This may be useful for some systems where it makes sense to move the baler around. Check out [www.tsissg.com](http://www.tsissg.com). American Baler Company [www.americanbaler.com](http://www.americanbaler.com) produces a range of large baling machines for paper, plastics, scrap metals and aluminium cans. International Baler Corporation from the US makes *larger vertical balers*; vertical balers are often suitable for PET or cardboard. From India, the *Jumbo triple compression baler* is offered.

Where volumes are higher, and also to keep operators hands away from press filling, a *conveyor attachment* may be used to fill the baler.

## Scrap Metal Processing

Larger baling presses suitable for aluminium cans may be able to handle smaller scrap metal items. But be aware that using scrap metal will be likely to wear out the press quicker. For larger crushing tasks, such as cars and big pieces of scrap metal, Lollini R & M has large *mobile crushers*, shown at [www.lolliniusa.com](http://www.lolliniusa.com). Such big machines are likely to be beyond the capacity of most PICs, but smaller units are available, for example this fixed-bed *truck mounted crusher* unit operated by Gamma Corporation in New Zealand. Scrap metals can be broken up using attachments on diggers and backhoes. Examples of such attachments are available on [www.a-ward.co.nz](http://www.a-ward.co.nz). Usually these attachments are in the form of shears for cutting up cars and scrap, operated using the digging machine hydraulic system.

## Scrap Metal Cutting Hand Tools

A smaller version of such an approach is possible using a system called the *Jaws of Life*, which are often used to cut people out of car crashes. These can be seen on [www.lukasindustrial.com](http://www.lukasindustrial.com). Oxy-acetylene gases for cutting metals are usually prohibitively expensive in small island nations for cutting up scrap, especially acetylene; where possible LPG can be used with a suitable cutting torch designed for LPG. Another approach is to use cutting wheels in large grinders, though this may prove expensive in grinding wheels; or a *rotating disc saw* such as the Stihl company makes, which can cut steel and concrete ([www.stihl.com](http://www.stihl.com)). Another tool that can be useful for cutting up car bodies is a heavy-duty *reciprocating saw*, which can be used to get into the corners. Where larger pieces of steel are to be cut, and gas is very expensive, a *plasma cutter* can be used; this machine uses an electric arc to cut steel, but will require hooking up to a compressor, and some steel may need a path grinding to expose bare metal to make this machine cut efficiently. By using a combination of tools, car bodies and other scraps can be reduced in size to fit smaller baling presses where a large baling press is prohibitively costly for low volume situations. All these hand tools for cutting metal can be extremely dangerous and should only be used with the proper safety equipment and by trained operators.

## Shredders and Chippers

Shredders are generally the larger industrial machines that can eat all manner of things from car bodies to carpet and tyres, producing a consistent-sized shredded material. An article from the industry *magazine Recycling Today on shredders* gives an excellent overview of these units and how they work. For most applications in the Pacific, however, larger shredders will not be used, with such machines being more likely operated by the recycling processor who receives shipments.

A chipper for green waste is more likely to be what is required in a small Island situation. An *article from Waste Age*, obtained from the Internet, gives a good overview of what to look for in a green waste chipper. Chippers can come in small, garden sizes, such as the *Red Roo* light brush chipper with a small petrol engine, up to units such as those produced by Bandit Industries from the United States, where the unit is towed behind a light truck and has a large diesel engine to drive it. Bandit makes a wide range of different sized units, [www.banditindustries.com](http://www.banditindustries.com). Greentech from the United Kingdom has taken a different mechanical approach on how to cut the material. An *extract from*

*their promotional video* is included to show how these shredders operate, and how many such shredders might be used. These larger shredders can be used to shred plastics such as PET and HDPE bottles, which may be a useful aspect.

## Glass Crushing Machines

Unless glass is to be re-used as bottles, it will need to be crushed. See the section on Recycling Glass for advice and information on what to do with glass. Where glass is to be used in a re-use mode, such as for roading or aggregate substitution, it will need processing. A paper from the Clean Washington Center, [www.cwc.org](http://www.cwc.org) details types of glass crushing

equipment and the methods they use. Where large quantities are to be processed, a machine such as the Andela Industries unit [www.andelaproducts.com](http://www.andelaproducts.com) might be suitable; on a smaller scale is the CP GC100 unit, both are shown in the *examples of glass crushers*. A very tidy unit for places where most bottles are either PET or returnable glass is the Bottlecyclor, made in Australia, which deals with small amounts, such as a steady stream of mainly sauce and wine bottles. This unit breaks the glass into a small wheelie bin underneath, and produces fine pieces suitable for roading or concrete. This unit is very quiet, and is designed for use in bars using a lot of bottles. Another small size unit that might suit many PIC situations is the Bell range, [www.csbellco.com](http://www.csbellco.com) of *low volume glass* crushers.



# Shipping Recyclables

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## Overview

In the vast majority of cases, materials collected for recycling will require shipping to an overseas buyer. For most Pacific Island nations, these buyers will likely be in New Zealand or Australia, due to the nature of shipping links. It may be possible to sell to markets in Asia, but this may well involve using a third country buyer to facilitate this. The problem for many PICs with recyclables to sell is that quantities are small, and Asian markets are used to taking big quantities. A very important point when looking for a buyer for your materials is finding a buyer that will give you a consistent service; the best prices may not work best for small recyclers in the Pacific. A good buyer will handle all paperwork and costs associated with clearing imports and taking materials off the wharves at the importing country. Prices offered will reflect these additional costs. Be careful not to enter deals with good gate prices only to find that there are large costs (and expensive difficulties) in arranging import clearances and trucking, in an unfamiliar country. A list of companies that purchase recyclable materials is included in the [Recycling Contacts](#) section.

This list does not imply any endorsement of any of the companies concerned, and any sellers of recyclable materials must make their own enquiries and decisions regarding whom to deal with. It is important to deal with companies and people who understand the difficulties of working in the Pacific, the issues around communications, and how long some things can take. One good step is to contact other recycling companies in the region, and see who they are dealing with, and if things work well with that company. If you have a good buyer you are happy with, think hard about changing buyers just because someone offers a slightly better price; you may lose out in the long run. A long-standing business association will be better able to deal with the problems that will occur now and then over shipping schedules, payments, documentation and other issues.

However, the very first step is to determine shipping costs to possible importing countries, as the structure of countries shipping routes will be the number one factor in deciding where to look. For example shipping to New Zealand from Kiribati or the Marshall Islands involves transshipping containers half way from one ship to another (an expensive business), whilst direct links exist into Australia. Similarly, the Cook Islands, Samoa and Tonga all have regular direct links to New Zealand. Some North Pacific nations have direct links to the west coast of the USA.

Anyone thinking of exporting recyclable materials must be familiar with general shipping, transport and customs procedures, dealing with Bills of Lading and Customs Entries, port charges and procedures, and other such official processes. Without this basic knowledge the task will be much harder. If your business does not have this knowledge already, think about hiring someone who does. The [Vital Statistics for Shipping](#) gives some good basic information on this subject.

## Quality Control

Quality control is essential. Just because the materials are considered rubbish does not mean that they should be dirty and mixed with the wrong things. Recycled materials must be kept as clean as reasonably possible and free from small animals, plant life, dirt and contaminants. Dirty shipments may well result in rejection at the processing plant and extra cost to the recycling business. Different materials should not be mixed and crushed together. Care with ensuring that materials shipped are consistent in their quality will go a long way to building up a good relationship with your buyer, and encourage better prices.

## Quarantine

Shipments into Australia, New Zealand and the USA will encounter strict quarantine requirements. Check [Quarantine requirements in NZ](#) and [Australia](#), or any country you are exporting to regularly. This issue is very important and is the most common source of problems that result in rejected shipments. This means ensuring that the shipment is clear of animals, plants, insects, dirt and sand. One simple but very effective step is keeping container doors closed when not in use for filling, to prevent rats, mice and insects moving in. This measure should be very strictly enforced in any recycling yard. Dirt should be kept out of them as well, so that any bales are not unnecessarily contaminated, to avoid problems with Quarantine Officials. If soil on can blocks is obvious, this may well result in impoundment of shipments at import, especially if imported into Australia or New Zealand. Containers that have stood in a yard should be checked to ensure that plant material is not stuck in doors or to the base; this will likely result in problems. If available, it may be wise to have containers fumigated once full, prior to shipping. Contact your importer/buyer overseas on this issue. Containers impounded by quarantine rapidly become very expensive to deal with, and any profit can disappear within days as port and mitigation measure charges build up. Take Care! This applies to any recyclables shipments, not just aluminium.

## Packing Declarations

Shipments will usually require [Packing Declarations](#). This document is a declaration that the shipment is clean. In particular, wooden pallets should not be used if possible, when exporting into Australia or New Zealand, as these can be a quarantine problem; but they will be necessary for battery imports. The crucial thing is to declare them so that Quarantine officers can have them destroyed if they so require. Pallets are not usually required when shipping aluminium, unless the blocks are very heavy. Wooden pallets and any wood or straw packing will attract the attention of Quarantine Officials as these materials can easily bring in pests.

## Export and Import

There are usually no export or import permits required for shipping most recyclables, except those classed as hazardous wastes, principally lead-acid batteries (see [Basel Permits in the Lead-acid batteries](#) section). However, Export Entries will usually be required to be made, prior to shipping. These will require a Tariff

number. The international Harmonized System nomenclature, called the HS Tariff, uses common numbers across many countries. The HS Tariff numbers for common recyclables are given below. 7602 0000, the number for aluminium, should be checked to ensure that it is used, in case a non-HS number is still in use locally. Countries with computerized Customs Entries will almost certainly use this number.

International Harmonized System	
Material	HS Tariff No.
Aluminium Scrap	7602 0000
Stainless steel scrap	7204 2100
Copper scrap	7404 0000
Steel Scrap	7204 1000
Plastic Scrap	3915 9000
Waste Paper and Cardboard	4706 0000
Lead-acid Batteries	8507 1000
Glass	7001 0000

## Typical Shipping Densities of Recyclables

Below are some typical densities for shipping. Densities achieved are very much dependent on the crushing machines used and how well the containers are packed. Also, be aware that however well packed a container is, there will always be some fresh air, and so measuring one block and multiplying by the volume available will only be a guide; but this is a useful exercise to help give an idea of quantities. Ideally, containers will be weighed before shipping, but this is not possible in many places. The maximum weight of a 20-ft container varies depending on the rating, but is usually between 20 tonnes and 30 tonnes, with 22 or 24 tonnes being common. The tare of a container is the weight of the container empty, and is usually about 2.2 tonnes.

### Scrap Metals

Before shipping scrap metals be sure to contact the company who owns the shipping containers. Some companies have requirements to line containers if scrap metals are to be shipped. Often, only old containers will be used for scrap metals to avoid damaging good food-grade units. Good contact between the recycler and the shipping company should avoid problems over using the wrong containers. Typical weights of containers for non-ferrous scrap metal, depending on the metals included in the container, range between 11 to 16 tonnes. Typical weights of containers containing ferrous scrap metals are on average heavier, ranging between 21 to 24 tonnes.

For large volumes of scrap steel, the purchaser would use open hold vessels, equipped with magnetic lifting gear. Without a crane equipped with a magnet, the handling of the scrap steel, both in and out of the vessel is very laborious and consequently costly. The type of ship that specialises in this type of cargo is large and would normally pick up a load of at least 5,000 tonnes or more. Also to consider is that time alongside loading in port is very expensive; this means that scraps must be prepared and stockpiled close to the wharf, and arrangements in place to move the scrap when the vessel is alongside. With the sort of quantities required this typically takes many trucks and loaders, plus a 24-hour operation. But it can be done, as a recent export from Pohnpei in the FSM has demonstrated.

### Aluminium Cans

Aluminium cans crushed with a small press such as the Mini Baler from New Zealand will achieve a density of around 300 kg/cu.m, or about 10 mt per 20ft container. This figure is also dependant on how old the machine is, and how crushed the cans were when they went into the crushing machine. It is also very important to carefully pack the bricks of cans produced by the press to fill the container up as much as possible.

Using a larger press, densities up to 16 mt are achievable; however, to get the density higher considerably greater force is required, and the presses become much larger, more expensive to buy, and also use much more electricity to operate. This factor is very important to consider when first sizing a press for an operation. Densities greater than 16 tonnes will be rare using equipment appropriate for small Pacific Islands.

To calculate aluminium freight, refer to the section on page 9 and 10: [How Many Aluminium Cans in a Tonne?](#)

### Plastic Bottles

Plastic bottles are much lighter than cans. A very light press will only make 2 mt per container, or around 60 kg/cu.m. It is very hard to make the system economic at that density. Densities of at least 6 mt per container, or 180 kg/cu.m. are what are really needed. Eight mt per container, or 240 kg/cu.m. is getting to a good level. PET and HDPE bottles are similar in density, but the real determining factor is the production facilities that the bottles came from. Plastic bottle weights vary far more, for a similar-sized bottle, than aluminium cans do.

### How Many Plastic Bottles in a Tonne?

This is much harder to calculate. Plastic bottles come in a variety of sizes, and also thickness. Some bottles, such as Fiji Water bottles are very thick, strong and heavy, and a Fiji Water 500ml bottle typically weighs 29.5g. A typical Chinese water bottle of 500 ml was weighed at 13.6g. An Asian-made mango drink bottle of 500 ml weighed 25.3g, whilst a Nestle Pure Water 1.5 litre bottle weighed 32.6g, nearly the same as a Fiji water bottle of a third the volume. The above are all bottles made of PET.

The number of PET bottles in a tonne is very much determined by the local product market. Around 50,000 per tonne can be used as a guide. In Tarawa, a test of 100 bottles in a press weighed 3.2 kg, which would give an average weight of 32g each, or 31,250 bottles per tonne may have been, by chance, a sample with many heavy bottles. It is advisable to conduct experiments locally with a mix of bottles sold in your area.

### Paper and Cardboard

The density possible for paper-based materials is very dependent on the size of the baling press. Very high densities are achievable, giving densities similar to light woods. Large presses will require forklifts to handle the material.

### Glass

It is not usually viable to recycle glass back into bottles for PICs. Glass is a low value material for recycling. It is also bulky, and difficult to handle. Container weights of 15 to 20 mt are reported for glass that has been shipped from the Pacific Islands. Glass recyclers also usually demand a high-quality material for recycling, such as full separation of colours, and very low contamination rate. Rejection of shipments can be very expensive. Shipping a container full to a foreign country, and then having it rejected at the glass works, means the recycling business would have to pay to have the materials landfilled.

### Lead-Acid Batteries

There are limitations when packing lead-acid batteries regarding how many can be stacked on a pallet, and pallets can only be stacked two high. About one tonne of batteries will get onto a pallet, depending on the size of the batteries, and usually eight or ten pallets can be placed in a container, depending on pallet size. Thus the typical weight of a 20-ft FCL is 16 to 20 tonnes. When packing batteries, check the pallet size being used so that the container is well used, as pallets come in different sizes and some pallet sizes, when mixed together in one container, may leave a large empty space. Take care with pallet stacking to see that the space is best used.

# WASTE MANAGEMENT



ORGANIC WASTES

WASTE COLLECTIONS

TOXIC WASTES

LANDFILLS



# Organic Wastes

## Overview

Organic waste comes from animals and plants, or soil. In most Pacific Island countries, organic wastes will amount to about half the solid waste stream. In some places organics can be as much as 75% of the waste stream. Organic wastes are extremely useful materials, and their value increases where the local soil is less fertile. On volcanic islands with rich, dark soils, where plants grow so easily and quickly, organic wastes are not so valuable, as the soil is so fertile. But in places where the soil is poor (and in the Pacific the atoll islands usually have very poor soils), organic wastes are very valuable. They should be recovered from the waste stream at all costs where possible, as they can be an important source of fertilizer.

It is important to appreciate the following, especially in poor soil places: when organic material in the waste stream is placed in with man-made wastes, and thrown in a landfill, an important resource is lost. Not only that, some of the goodness of the soil has been removed and lost for a very long time. The poorer the soil, the more of the goodness available is actually contained in plant matter, in the leaves and branches of the trees and bushes. So when we throw organic wastes into landfill on an atoll, we are actually helping to denude the soil. Organic goodness is removed from the natural cycle of plants growing up, decaying into the soil, and new plants growing from it.

A crucial first step when looking at how to deal with organics in the waste stream is to see how much of a problem organics are, and what type of organics are the main components. These issues are absolutely crucial before determining the approach to take. For example, whilst in some places up to 80% of collected waste might be organic, such as Kiribati in the past, in others there may be very little organic waste, such as in Samoa. Also, how important is the food waste component? In many PICs food waste rarely makes it into the trash. But in big cities, food waste in the waste stream makes the waste dirty, attracts rats and flies

and is a massive problem contaminating other useful materials. When making this initial appraisal of the organic types in your waste stream, by all means look at waste surveys. (A set of surveys of many PICs can be found in the [Waste Surveys](#) section.) It is absolutely vital to go to the dump and check what is actually going into the stream: for example, woody palm wastes must be treated differently to food wastes. Once a clear idea of what is available is found, a strategy to deal with it can be developed.

## Diverting Organic Wastes from the Waste Stream

The primary course to take with organic waste diversion is to convince people that organics are a useful resource to them. Developing a strategy to do this effectively will depend in very large part on local conditions. The hardest areas to achieve this will be in densely populated urban areas, where people have little space for retaining organic wastes. In slightly less heavily populated areas, such as much of suburban and main island villages, most households have yards and gardens where some natural processing of organic wastes can be done through compost heaps, or such techniques as the Banana Circle. In Kiribati, a very successful campaign was run for over two years that urged people not to put organics in their garbage bags: this reduced organics in the landfill to residual levels.

## Banana Circles

The Banana Circle is derived from Permaculture principles, as a way to process organic waste onsite with the minimum of effort – something which always appeals to the public. The Banana Circle is a simple hemispherical pit lined with old cardboard boxes flattened out, and filled with any organic wastes that are available. A set of pictures is provided to show how to build a Banana Circle in the [Banana Circle Photos](#), whilst a sample of a wall poster from FSP Kiribati is provided as [Make a Banana Circle](#). This

poster was actually made as a centre page spread for use as an advert in local newspapers in Kiribati, so that households could pull out the centre pages to stick on the wall. A [set of video instructions](#) from IWP Kiribati is also included. A simple [Banana Circle Diagram](#) completes a full set of tools to help people build Banana Circles. The same technique can be used to grow pawpaws, but bananas and pawpaws should not be grown together as they compete and one will kill the other soon. Other plants may be grown around such a pit compost system; the technique is not exclusive to bananas. But where a useful, and often desired, food crop is grown using organic wastes, people are encouraged to use the technique. For example, in many atoll locations bananas are hard to grow and to get to fruit; a Banana Circle provides food to the plant to bring the fruit on.

A Banana Circle compost heap can absorb old tin cans and paper in moderation. In many Pacific Island villages, sweeping up the leaves around the house is part of the daily routine. Where a house has a Banana Circle, the sweepings can be swept straight into it rather than into a heap by the road, or into the garbage for removal. This builds on an ancient composting technique on atolls, of sweeping leaves and other rubbish on the ground into a pit near the house. Once the pit is full (and of course it is composting down all the time, and so takes a long time to fill up) a tree is planted on top. Another ancient technique is to pile leaves around the base of breadfruit trees. The Banana Circle is a refinement of these ancient traditional practices, where cardboard is used to encourage a mat of roots to grow along a damp lining to the pit, so that water is retained, and the full nutritional value of the compost is recovered by the plant.

Every PIC will have its own specialists who understand the local plants intimately, and these people are a very valuable resource in deciding what useful plants can be grown using such simple techniques as the Banana Circle. It is no use promoting bananas in a place like Kosrae for example, where they are like weeds and grow everywhere!

## Large-Scale Composting

Composting is the process of using micro-organisms to break down organic wastes. Good composting requires a fairly careful mixing of different proportions of various types of organics, to achieve a good breakdown rate. This can be done on a commercial scale at a suitable site, such as to one side of a landfill. This process will deal with Green Waste, which includes the large organic wastes such as trees, bushes, leaves, branches, usually from gardens or yard tidy-ups. The Green Waste can be mixed with other organic wastes, such as copra mill waste, fish

processing wastes and animal manure, be fed through a chipper and placed in rows. The rows are called windrows, and these will be turned over periodically, perhaps every couple of weeks, to allow good mixing of the wastes and the air. An example of this process is shown using an adapted [drawing of windrows](#) from part of the Tahitian Tamara'a Nui waste project.

Tonga has made some serious efforts to look into this area, and a study visit to New Zealand was run to look at a variety of commercial-scale composting methods. The report of the [Visit to NZ Composting Operations](#) is an excellent resource, and should be read closely by anyone looking at composting on any scale larger than a market garden. This report covers a real range of different-size operations and ways of operation, from full business models to local community volunteer-run methods.

## Home Composting

Composting can of course be done on a small scale in the home. When running a programme on home composting it is essential to involve local agriculturalists and expert gardeners, as local conditions and plant life will have a major effect on the manner in which compost is made. Taking a technique that works well in a temperate country like New Zealand for example, and following it on an atoll, may not work well. However, the basic principle is the same everywhere, and is shown simply in the [Cycle of Life](#), a diagram adapted from the NZ Soil Association Composters' Guide. The overriding principle is to provide the best conditions and food sources for the local micro-organisms to do their work of breaking down the organic waste into natural fertilizer, which then is a valuable resource. But making compost in your location will require good local knowledge and experience; look for people who have been working with plants for many years, as you will find that their knowledge of local conditions will usually far surpass any fly-in expertise.

A video adapted from a [Tonga Compost Video](#) is provided that shows the process well enough. A companion [Composting Guide](#) was also produced to support this work. Composting of woody wastes in particular will need the addition of animal wastes or similar high nitrogen materials to improve the composting process. The Kiribati Ministry of Public Works Water Engineering unit promotes an [Eco-Friendly Pig Pen](#) as a way to contain pig wastes, and so prevent water pollution. Using this approach, the pig wastes can be used in composting to improve the process. The Tonga IWP used the approach of competitions in their pilot area to encourage the uptake of composting, and their experiences are summarised in a short paper on a [community composting program](#).



# Waste Collections

## Overview

The way in which wastes are collected has a dramatic effect on the end results. How much recyclable material can be collected from the waste stream will be dependent more on the method of collecting the materials than the actual quantities involved. Waste collections in developed urban settings like modern cities can be conducted in a completely different way to collections in much simpler environments, such as a small PIC. Local governments there may be underfunded and have no revenue base. Below we look at a few examples.

## Recyclables

### Deposit and Refund Systems

These systems are known to provide very high recovery rates. The most common types are Container Deposit systems and they usually use legislation to force compliance. They used to be very common when drink manufacturers recovered glass bottles for refilling, but since the arrival of the plastic bottles, they have fallen to the wayside. Beer bottles in Fiji and Samoa are still recovered by this process, but the brewers operate these collection systems. The [Container Deposit Legislation](#) (CDL) section of this Kit gives a very detailed analysis of such systems, and the [Kaoki Mange Case Study](#) provides a detailed description of putting such a programme in place.

Deposit / Refund systems use a principle called Extended Producer Responsibility (EPR) which works on the idea of attaching the cost of waste recovery to the market price of the product. The same principle can be used to recover larger items, such as fridges, computers, lead-acid batteries, and even cars. Germany and Japan are leaders in this field, and a short [paper from Japan on EPR](#) describes the Japanese approach. For more detail also look in the [Economic Tools](#) section.

Deposit refund systems are demonstrably by far the most effective way to remove recyclables from the waste stream; for example in Kiribati aluminium can recycling went from around 25% in 2003 to 90% in 2005, and PET (see p. 15) went from zero percent in 2003 to 90% in 2005!

### Kerbside collections

A common method of recovering recyclables is to have a recyclable collection alongside the normal waste collections, by the side of the street, called a kerbside collection. This usually only operates in urban areas, but there are places in New Zealand such as the Coromandel area where kerbside recycling is provided to all local government ratepayers. Kerbside recycling usually works with a single receptacle provided for recyclables, and the public are provided with information as to what can be put in that bin or bag. The collector, either at the point of pickup, or at a collection facility, then does the sorting. A collection truck with bins along the bottom and the main part collecting general wastes, can fulfil this task quite well in a smaller volume situation. Trying to get the householders to sort their wastes into recyclable types in the home has been found to be a cumbersome system. It is generally better to pick up all the recyclables together, and have the collector sort it out. As people often do not do the sorting well themselves, this approach saves having to check the pre-sorted materials. Large-scale kerbside collections often use large machines, combined with human operators to sort large volumes of recyclables. This type of arrangement usually requires a large facility and a big investment. However, in many places in the Pacific labour is cheap and plentiful, and an elevated conveyor with people pulling materials off into bins under their feet is quite feasible without massive investment.

## Landfill Wastes

If any landfill is to be useful, waste must be collected to place in it. General waste that goes to landfill can be collected in bags, dustbins or wheelie bins. In some places, wastes are uncontained and piled up in the streets. This method is very poor for several reasons:

- Wastes are mixed up;
- Large wastes are often put out for collection;
- Waste in this form is difficult to pick up;
- It is very unsanitary;
- It is unsafe for waste collection workers.

Anywhere uncontained waste collections are still operating, effort must be directed at containing that waste for collection. The cheapest way to achieve this is to have the waste put into bags. Someone has to buy the bags, and whether these are provided free, sold by the council, or sold in stores, and whether or not only certain official bags can be used, are all things that impact on the design of the waste collection system.

### Waste Collection Fees

In places with a regular household rating or local government tax system in place, waste collection charges can be collected using existing revenue collection systems. Elsewhere, paying for the garbage collection system is usually a major issue. How any waste collection fee is to be paid for, is a major determinant as to what sort of collection system can be run. Other factors to consider are the logistics of the actual collection, quantity of materials to be collected, cost of running machines and equipment, and any local customary or cultural elements. It is no use setting up a payment collection system that requires a large part of the money collected just to pay the administration. Below are a few ideas that may overcome this problem.

So some preliminary work must be done in order to decide on what might be the most appropriate type of collection system in your location. In Tonga this sort of work has been done, in particular we can see in the *Waste Trials and Audit* that efforts were made to evaluate how a collection system might operate, and what sort of collection capacity is required. This information was fed into a larger strategy, detailed in the *Tonga Institutional Framework report*, which involved setting up a Waste Management Authority for Tongatapu island, and passing a *law to set up the Waste Management Authority*.

### Collecting Fees

As a result of these studies to assess the situation, Tonga is experimenting with a system where Women's Community Groups that already exist in local communities will collect the waste collection fees in

each village. This is a very interesting development, as it allows each community to devise their own particular solutions. A flat fee is charged per household by the Waste Management Authority: in a village of say 300 households, with the flat fee at \$10/month, the women's group has to provide \$3,000/month. They get a 10% commission, paid back by the Authority. However, the group can consult with the community to develop any mechanisms to provide for any differences in household waste generation rates and income. A *briefing paper describing the system* is included here for further information. This is a very innovative approach, and it will be interesting to see how the system operates. At the time of writing, the collection system was about to start.

Other interesting work has been done in Chile that has found that waste generation rates correlate with electricity consumption patterns. This is shown in an extract from a *JICA/WHO/SPREP presentation* from Okinawa University. The whole presentation is more relevant to the SWM Tools section, and is included there. The interesting point here is that electricity systems will already have a payment system set up. So that in places where a waste payment system is being put in place, this method of attaching waste collection payments to electricity bills can have great merit. Households and businesses that use a lot of electricity usually are bigger consumers, and so will produce more waste. They may have larger numbers of people living or working in that house or business place, or they may be wealthier and so consume more. Again, the crucial issue is to find a fair and practical way to collect money that allows for different rates of waste generation.

## Sample Collection Systems

There are a variety of ways to actually collect the waste from households; at its simplest, houses put out rubbish in bags or bins (dustbins or wheelie bins) and the collector picks up the waste from the side of the road. This can work well enough, but it is worth making sure that there are laws or local government bylaws in place that prevent people from uncontained dumping. This behaviour is very detrimental to good waste management, and should be treated harshly. Everyone can find at least a rice sack, shopping bags or a cardboard box to pack rubbish into, and if the household is at a level that these things are unusual, it is probably producing a minimal amount of inorganic waste anyway. People who persist in dumping their wastes in a pile by the street must be seen as the anti-social polluters that they are, and not be allowed to get away with complaining that it is the collection workers problem. That said, let us look at a few of the options.

### Pre-paid garbage bags

Increasingly common in New Zealand and Australia is the pre-paid garbage bag system. This is where householders must use the official garbage bag, and the price of each bag includes a premium that pays for its collection. Typically these systems use a contractor who arranges the printing and distribution of the bags through local stores in the relevant local government area. The contractor also picks up the bags, and only picks up the correct bags, as they are getting the money from these bags. This way, the contractor makes sure that the bags are widely available, as it is in their interest that more bags are sold. This system is very fair, as those who make more waste pay more, and are penalised for their behaviour, whilst those who try and minimise their waste are rewarded. This system completely avoids any administrative costs of collecting fees, and it is easy to build the cost of garbage bag distribution into the system, as it uses conventional wholesale distribution systems, where costs at each stage are attached to the price of the bag. A public awareness campaign that runs alongside its introduction is important to show people what a fair system this is.

It is very important with these kinds of systems to build the right incentives into the system to make each participant act in the best way for the outcome of the system, and thus the wider society. For example in Coromandel in New Zealand, where such a system operates using a *pre-paid blue bag*, the contractor not only distributes the bags to stores (using conventional wholesale networks) and collects the bags, but also collects the recyclables through a kerbside recycling system that operates alongside the garbage pick-up. The contractor is given a target of recyclables to meet: if he meets a certain rate of waste diverted to recycling, he receives the income from the recyclable materials; whereas if the target for recyclables is not met, the local council keeps all the income from recyclables. If the initial target is set high enough, and the contractor achieves a good level of recycling, then the recycling system will be sufficiently developed that there is incentive on the contractors part to try and lift the recycled component even higher, as income will increase. For the council, diverting waste to recycling that might otherwise be landfilled is a major saving now that landfill cost per cubic metre is increasing rapidly.

Kiribati has been experimenting with a pre-paid garbage bag system, called the *Green Bag*. This is a biodegradable bag made in New Zealand. In the beginning, Green Bags were distributed free, as at that time, in 2003, no one used any sort of bag or bin at all, with garbage being piled into the street. Tractor and trailer picked up garbage, with the collectors using shovels. This was a very unsatisfactory situation.

Eighty percent of the waste was actually coconut palm, trees and leaves, and waste collection was very slow and infrequent. By getting people used to using bags, large items such as palm leaves, were pushed out of the waste stream. The garbage workers had much better conditions to work in, and could pick up waste using a *new truck* provided by the landfill project, and far more garbage could be picked up in a much shorter time. Next trick was to get people to pay, and at the time of writing bags were 20c each, with the aim to move to 50c each. The landed cost of bags was around 14c, with the cost at point of sale about 25c. Thus around 25c could be sent to the local council as the cost of picking up the garbage. This is all explained in far greater detail in the *Impact of the Green Bag* on South Tarawa report.

### Wheelie Bins

Wheelie bins are common in modern cities. Some places in the Pacific have them in use too. Wheelie bins are a very good system if they can be made to work well. One problem is that on setting up the system many bins may find a use elsewhere, as they are very useful things. It cannot be expected that all householders will buy a wheelie bin with their own money as the cost may be typically between \$100 and \$150. So this leads to another problem, in that to handout a wheelie bin to each household can involve a large capital expenditure, and some of that capital can disappear quickly where wheelie bins disappear to alternate uses. Wheelie bins can be picked up using a special truck with a side lifter, and a lot of waste can be cleared quickly with them. Nauru has a wheelie bin collection operated by the Nauru Rehabilitation Corporation. The people who run that have done very well under difficult conditions to make it work, so wheelie bins can work well. Wheelie bins can be a great solution, but need to be entered into only after careful consideration.

### Private Sector Collections

Many places will have a private business operating in urban areas to pick up waste from larger producers. These usually use large garbage bins that are picked up with a truck. The IWP in Fiji has experimented with a village having one of these bins for village garbage, with the cost partially offset by any recyclables that the village collects. Again, incentives can exist for the village to recover recyclables from their wastes stream as this decreases the cost of waste management. Pohnpei uses a private contractor for some waste collections, who also operates the landfill, using a *large truck that empties bins* mechanically. Customers pay a monthly fee for the service. However, if only the private sector is available to pick up waste in a Pacific Island context, it is likely that many people (those least able to deal with the problem) will be left out of the collection system.



# Toxic Wastes

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## Overview

The Toxic Wastes that we find in the Pacific Islands will usually be chemicals of some sort, often manufactured overseas. Some common day-to-day items are actually classed as toxic wastes once they enter the waste stream: primarily old batteries, computer monitors and TVs, and much electronic equipment. This is a large field, and here we can only provide an overview. However, the Waigani Handbook published by SPREP in 2003 is an excellent one-stop resource for dealing with toxic wastes.

## Waigani Convention Handbook

The Waigani Convention is a Treaty between Pacific Island nations, including larger regional countries such as Australia and New Zealand, which deals with hazardous substances and movement of hazardous wastes. It is similar to the Basel Convention, which is a global treaty concerning the movement and trade in wastes, in particular hazardous wastes. These treaties arose when it was found in the 1980s that wealthy countries were exporting hazardous wastes to other countries with usually less environmental control. Often the recipients of the wastes had no idea what they were accepting. At its worst, a company would lease a piece of land in a developing country, store drums of hazardous waste on it, and disappear, leaving the waste behind. When questions were asked regarding who owned the drums (usually the next time the rent was due) the company had ceased to exist.

The Waigani handbook was produced for SPREP to assist PICs in navigating their way around this complex issue. The Handbook is included here entirely, although it was originally distributed on a separate CD. It has a wealth of information primarily relating to toxic wastes, and how to deal with them. From the opening page of the *Waigani Handbook*, the user can click with the mouse on various tabs at the right of the page. Once a

subject has been chosen with a click, another row of tabs will appear alongside the original set; these can lead, with a click, to further information within that chosen category.

Note that the Waigani Convention is very similar to the [Basel Convention](#), and much of what applies in one will be true for another. The Waigani Convention effectively grew out of the Basel process, with a specific aim of protecting the Pacific Islands from the *International Waste Trade* and its unpleasant effects. The Waigani Convention parties agree not to import hazardous wastes into their countries. To check if your country is a Party to either Convention, check the website addresses: [www.basel.int](http://www.basel.int) for the Basel Convention, and [www.sprep.org](http://www.sprep.org) for the Waigani Convention; SPREP is the Secretariat for the Waigani Convention.

### Waigani Reference Library

Of particular interest is the Reference Library section, which has a variety of documents in it. Some of these documents are also reproduced elsewhere in this Kit. Click on A on the Reference Library page, and then just scroll down through the Library alphabet categories to get an overview of the material held there. This might be useful later when a question on toxic wastes comes up needing an answer. Anyone who is dealing with toxic wastes of any type should spend some time looking through the Waigani Handbook as it contains a huge amount of useful information.

### Tutorial for Adobe Reader

Also of great use is the *Tutorial* section, which gives great tips on using Adobe Reader to extract useful pieces of text and images. This Tutorial will also help the user with the Waste Resource Kit, if they are not familiar with the computer tools available in Adobe Reader for extracting information from documents. Please remember to acknowledge any material you might use from these reports supplied.

## Persistent Organic Pollutants

Persistent Organic Pollutants or POPs are all around us, unfortunately. These are chemicals (usually man-made) that are very poisonous in tiny amounts, and take a great deal of time to break down. Classic examples of POPs are the pesticide DDT, PCB oils used in some electrical equipment, and Dioxins produced by waste incinerators, and present in the pesticide 2-4-5-T (commonly known as *Agent Orange*, used in the Vietnam War to strip the leaves off trees). Many of these chemicals were not well understood when first produced, and millions of litres and kilos were spread around the Earth for many years. Now, some of the highest concentrations of these chemicals are found in places where they were never used, such as the Arctic, as the natural processes of the Earth have spread them around. This is a very large subject, and outside the scope of this Kit. However, some information is included in the Waigani Handbook, and also a set of three radio programs that were made by the Pacific Concerns Resource Centre (PCRC) in Fiji, as part of a public education programme. To listen to the programs click on POPs [program 1](#), [program 2](#), or [program 3](#). A great set of posters went along with the radio programs. Contact the PCRC for more information.

The Waigani, Basel and Stockholm Conventions are all attempting to deal with this problem of POPs. The [Stockholm Convention](#) defines POPs, and Parties agree to work to eliminate these chemicals from their industrial and manufacturing processes.

### Legislation

National legislation on toxics is in the development stage for many small island nations, but Tonga has produced a [paper on Hazardous Waste Legislation](#) and the position for Tonga with regard to the international treaties mentioned above, and what is required to implement a national law that would meet the country's obligations under those treaties. The situation for many nations in the Pacific would be quite similar, and this paper will provide a great starting point to looking at your national situation.

## Household Toxic Wastes

On a household level, the [Collection of Household HazWaste](#) gives a useful set of guidelines for any programme proposing to do this. Fluorescent light tubes are actually classed as a hazardous waste, and should not be sent to ordinary landfill, but to a hazardous waste facility. The US EPA has a paper detailing [Rules for Dealing with Fluorescent Lights](#).

The Pacific Island POPS programme run by SPREP is the best place to get good information locally on household toxics in your country. The officer in charge should be available through your local environment ministry, or contact SPREP via [www.sprep.org](http://www.sprep.org) or at [sprep@sprep.org](mailto:sprep@sprep.org).

## Ozone Depleting Substances (ODS)

This is a large and very specialised area dealing with chemicals that damage the ozone layer. These are usually Chlorofluorocarbon chemicals used in refrigeration and air conditioners (often the ones termed R11 and R12), and also pesticide/fumigants. These chemicals are being phased out, but may still be present in the waste stream from older equipment. If you think you have any such chemicals to deal with, the first course should be to contact your national ODS Officer at the Ministry of Environment or equivalent Ministry. Included here is the UNEP Guide for National Ozone Officers as it may be useful. This document is targeted at the ODS Officers in national environment ministries, but the annexes in particular contain useful information about these types of chemicals.

## Exporting Hazardous Wastes from Pacific Island Countries

Anyone who is trying to export batteries, old electronic scraps or other any kind of waste that is classed as hazardous, will need to look carefully at the Waigani Handbook to assist them with the export. Battery recycling and export is dealt with in detail in the [Battery Recycling](#) section. Look at the [Example Scenario of Implementation](#) of exporting old batteries from a PIC to Australia, in the Handbook. Also, look at the [Basel Permits Guide](#) produced by Environment Australia (the Australian Government Agency that handles applications for permits to export and import hazardous wastes into Australia). The section detailing what kinds of materials are wastes covered by the Convention is detailed in [Annex I](#) of the Basel Convention section, and look in the section called [Wastes covered by the Waigani Convention](#).

## Computer and Electronic Wastes

These materials, also referred to as E-waste, fall under the definition of hazardous wastes because they contain heavy metals in the circuitry. These materials leak into the environment quite easily when placed in a landfill, or if thrown in the sea, for example. These materials are hard to recycle, in that it is expensive to do so; what usually happens is that they are shipped to Asian countries where very low-wage labour in very

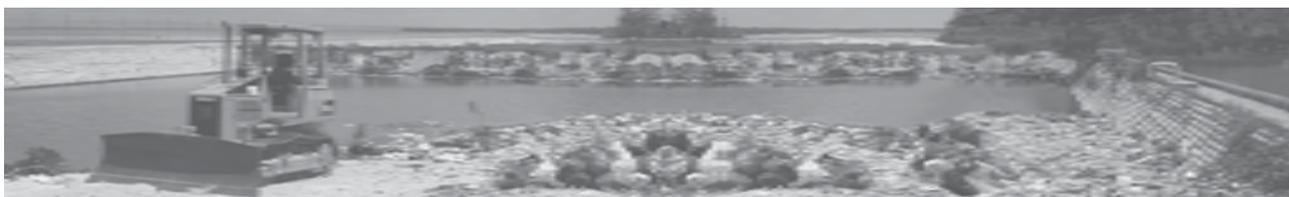
unsafe conditions is used to break them up. The report *Exporting Harm* details this process in great detail, with graphic pictures from a Chinese area that recycles much E-waste.

Waste computers are a big problem all over the world. Computer monitors and TV screens, especially of the Cathode Ray Tube (CRT) type (the bulky TV style monitor) can contain a kilo or more of lead. When these screens are thrown in a landfill, they usually break, and the lead seeps into the leachate and into the water system. Lead is very poisonous, especially for children. A good recycling system can collect these items, and in a first-stage approach, allow repairers to access the old equipment for useful parts.

A technical document from the OECD, *Scrap Computer Disposal*, details some aspects of handling waste computers. For most places in the Pacific, a programme to get the E-waste off island and back to where it came from is the best that can be done. Direct recycling of equipment should be avoided, as it is likely to create much pollution in the process, as *Exporting Harm* shows. Ideally, a scrap buyer who will recycle the material with a company that conducts an environmentally sound recycling process should be sought, and the materials exported.

It is to be expected that removing E-waste from Pacific Islands will cost money, not only for shipping, but the recycler may require payment to take the material. This case would be a very good example of Extended Producer Responsibility (EPR) being the best tool: Items would pay a deposit on import, just as with cans and bottles in a CDL system, and some of that money would be returned when the item came into the Materials Recovery Facility. Not all the original deposit is returned; the remainder would be used as a Handling Fee to pay for the export of the item. This covers not only the cost of export and recycling. As it sets a minimum value on an item, let us say \$20 on a Computer CPU, it means that these items are not dumped on beaches, or lying around Ministries and offices filling up storerooms, but are actively returned. Twenty dollars is good money when a machine is dead, but as a part of the initial cost of say \$1000 for a computer, it is very small; there is frequently a difference in price between one store and another for the same item.

The report *EPR in Asia* details several examples of this approach, in particular the Japanese Specified Household Appliances Recycling Law (SHAR). A similar approach is being taken in Germany, and this is dealing with recycling cars in a similar manner.



# Landfills

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## Overview

Landfills, their operation, and how to construct them, is a very large subject in itself, and one that requires the skills of suitably qualified people. This Waste Kit is primarily designed to advise on recovering resources from the waste stream; in a Zero Waste world, there would be no landfills, as everything would be re-used. That said, here we look at a few useful resources that can help the Pacific Island Waste Manager. There is a whole area on containing and processing leachate, landfill design, and siting of landfills. These issues comprise very large subjects in themselves, and are only touched on in this Kit.

## Cost of Landfills

The primary object of Landfill Management, from a waste recovery point of view, is to keep them as small as possible, and have them fill as slowly as possible. The great aim is to extract useful wastes before they go into the landfill. This approach of resource recovery usually requires some information to be presented to Government, businesses and the wider community regarding the cost of throwing things in landfill. *Throw it in the dump* is always the apparently easy option. However, there are costs to this approach, some easy to measure, some not. An economic effects study, such as that done for the IWP and the Pacific Islands Forum Secretariat, on the cost of *poor waste management in Tonga* is always very useful and illuminating, and is essential for understanding the wide impacts of SWM in a country. Sometimes politicians and decision makers may be more quickly convinced by direct measurable costs, such as the actual cost of landfill space.

The modern approach is to conduct full cost-accounting of landfills, and the New Zealand Ministry for the Environment has produced a complex form that can be used to work out the full cost of a particular landfill. This *Full Cost Accounting Guide* is used in conjunction with a Microsoft Excel file that can be used to *calculate the value for a particular landfill*. The Guide is a comprehensive document requiring careful study, and can produce very interesting results for working out local landfill costs.

An example of putting this approach into practice is the *Florida State Regulation* which requires all local governments to full-cost their SWM. This document has a good set of definitions in the first two pages that can be useful for those starting on this road. This may be useful for governments seeking to encourage local governments to full-cost their landfills.

A simpler treatment of landfill costs is provided as part of a report looking at an aspect of SWM, the *impact of garbage bags on South Tarawa*, Kiribati. This report simply works out the volumes and quantities of the landfill site and the waste to go in. It includes some indication in *Section 5* of the quantities of landfill space saved through diverting recyclable materials away from the waste stream. An interesting aspect that this report shows is the dramatic effect in slowing the filling rate, that increasing waste density in the landfill has - *Section 5.4*. The treatment of the issue in this report is not difficult, and could be conducted by any competent local professional. A full economic analysis will require specialist consultants who may or may not be available locally. Information derived from calculations of landfill space costs and *avoided costs* would then be very useful to economists doing a wider review, that would determine the real costs of SWM.

## Avoided Costs

Above is a mention of *avoided costs*. The cost of *not* having to do something, in economic analysis, is termed the Avoided Cost. Avoided Costs can be very significant, and usually arise through taking certain actions that save money in the future. Maintenance of a vehicle may result in avoided costs of vehicle replacement, for example; energy efficiency can result in avoided costs, shown as savings in electricity purchases. Looking at Avoided Costs helps policy makers to attach real dollar values to actions that will save money in the future. The savings in pushing organics, recyclable cans and bottles, out of the landfill waste stream in South Tarawa, is a classic case of avoided cost savings.

In order to calculate the avoided costs, it is simply necessary to calculate what the cost is, with and without the mitigating action; or, in the Tarawa case, the cost of landfilling all waste as opposed to waste collected after measures to push recyclables and organics out of the waste stream. In the Tarawa case, it was found that the savings of landfilling just the non-recyclable, non-organic waste (as opposed to landfilling all waste, *if all waste was collected* which it is not in Tarawa), could amount to savings of around A\$100,000 per annum in landfill space saved. This is a Best Case avoided cost, but it does serve as an indicator of how significant can be the efforts to reduce landfill waste, on Landfill costs.

## Fukuoka Method Semi-Aerobic Landfills

The Fukuoka Method is a way of constructing landfills that has been developed and pioneered by the Japanese city of Fukuoka, and has become commonplace in Japan. This landfill design is simple to construct, and has a leachate recovery and processing system that circulates the leachate and gases through the landfill, getting bacteria to do the hard work of cleaning the leachate. The collection pipes can be made from bamboo, old tyres, or similar useful waste materials. Such a landfill has been built in Samoa, and an information paper for the [Tafaigata Landfill](#) is very useful in describing how this type of landfill works. Also, the [Case Studies](#) section, has a quick appraisal of that landfill. It has an excellent set of simple diagrams showing the principles behind the Fukuoka Method, and also shows how local materials

in the wastes stream already, such as oil drums and old tyres, can be used in the landfill construction.

A WHO report, that includes a draft plan for [SWM using the Fukuoka Method](#), written for Chuuk and Kosrae States in the FSM, contains detailed information about setting up such a landfill in a small PIC environment, including the sort of budget required. This report would be very useful to any place looking into the feasibility of building a Fukuoka Landfill. A [video](#) has been made of the Fukuoka Method. A copy of the CD [Road to Sanitary Landfill](#) video is included here; this CD was produced by JICA (the Japanese International Cooperation Agency) and includes lectures, video clips and documents detailing the Fukuoka method.

## Landfill Charges

Good landfill management will require controlled access to landfill, and landfill charges may be instituted to control dumping. For example, to prevent large dumping of Green Waste organics, such as trees (which could best be used elsewhere saving valuable landfill space), charges can be placed on vehicles bringing in wastes. This is common practice in New Zealand for example, where typical tipping charges are in the region of \$20/cu.m, \$20 - \$100 / tonne; or (assumed at \$33/tonne) \$6 - \$10 per car load; \$12 - \$20 per trailer. These charge rates must be carefully pitched to avoid severe illegal dumping, and it may be advisable to start with very low charges to establish the principle, and allow the public to understand why charges are in place. Then, as public education has reached out, charges can be adjusted to more suit the true cost. For example, many rural landfills in NZ would accept recyclable materials free if separated out, and may allow a discount on landfill wastes if separated recyclables are brought in with the same load. Gate charges also mean that each load must be checked to determine charges payable. This can ensure that recyclable materials, or reusable items, are recovered before tipping, and Green Waste is tipped in an appropriate Green Waste pile, ideally for chipping. Large metal items can go on a scrap pile. The person tipping can be told that this simple sorting (usually quite easy unless the waste is composed of a mass of small mixed items) will save them money; the tipper then does some of the sorting work for the landfill operator. As seen above, reduced quantities to landfill result in major savings in landfill costs.

## Compaction of Wastes

It is essential for wastes deposited to landfill to be correctly processed with heavy machinery to achieve good compaction rates, and a stable piece of land after landfill closure. The WHO report cited above gives details of *how wastes should be handled by bulldozers* in different landfill locations. The report on the *impact of garbage bags on South Tarawa* clearly demonstrates that in the long term, high rates of compaction, and thus landfill densities, can lead to much lower landfill costs, as less landfill space is required. As waste is cumulative over time in a landfill, the effect after ten or fifteen years of good day-to-day landfill management is dramatic. Wastes that have not been compacted, and not had sufficient soil cover during filling, will likely produce a piece of land that is unstable and possibly dangerous, once the landfill is full. This can mean that use of landfills as sports grounds or the like is not possible. Large items such as car bodies thrown into landfills may result in large pockets of loose material where explosive and poisonous gases can build up, or subsidence takes place. Good landfill construction and management will deal with these kinds of problems before they arise, as well as save money in the long term.

## Waste Density in the Landfill

The *density* of waste can be very difficult to measure. Crude measurements can be made by using a *wire cage hanging off a large scale*, and the known volume of the cage divided by the weight will give some idea. Household waste from roadside collection in bags or bins is usually in the 100 to 130 kg /cu.m range. As the waste is processed into landfill, and crushed by machinery or just the weight of the material on top, the density will change. Density is of interest as while weight of waste is easy to measure, it is volume that governs how much fits into a truck, shipping container, or landfill space. An extract from a report for the *IWP in Kiribati* has looked at this in some detail, and also includes some references to other useful reports in this area. Density in landfill is a difficult thing to measure, and there will always be a degree of estimation involved, as waste is not uniform. Densities in landfills may reach 1000 kg/cu.m which is great, but densities of around 500 kg/cu.m should not be hard to achieve where a heavy machine is used to compact the waste, and the use of cover materials to keep the waste well covered. Densities of 300kg/cu.m are easily possible through simple compaction.

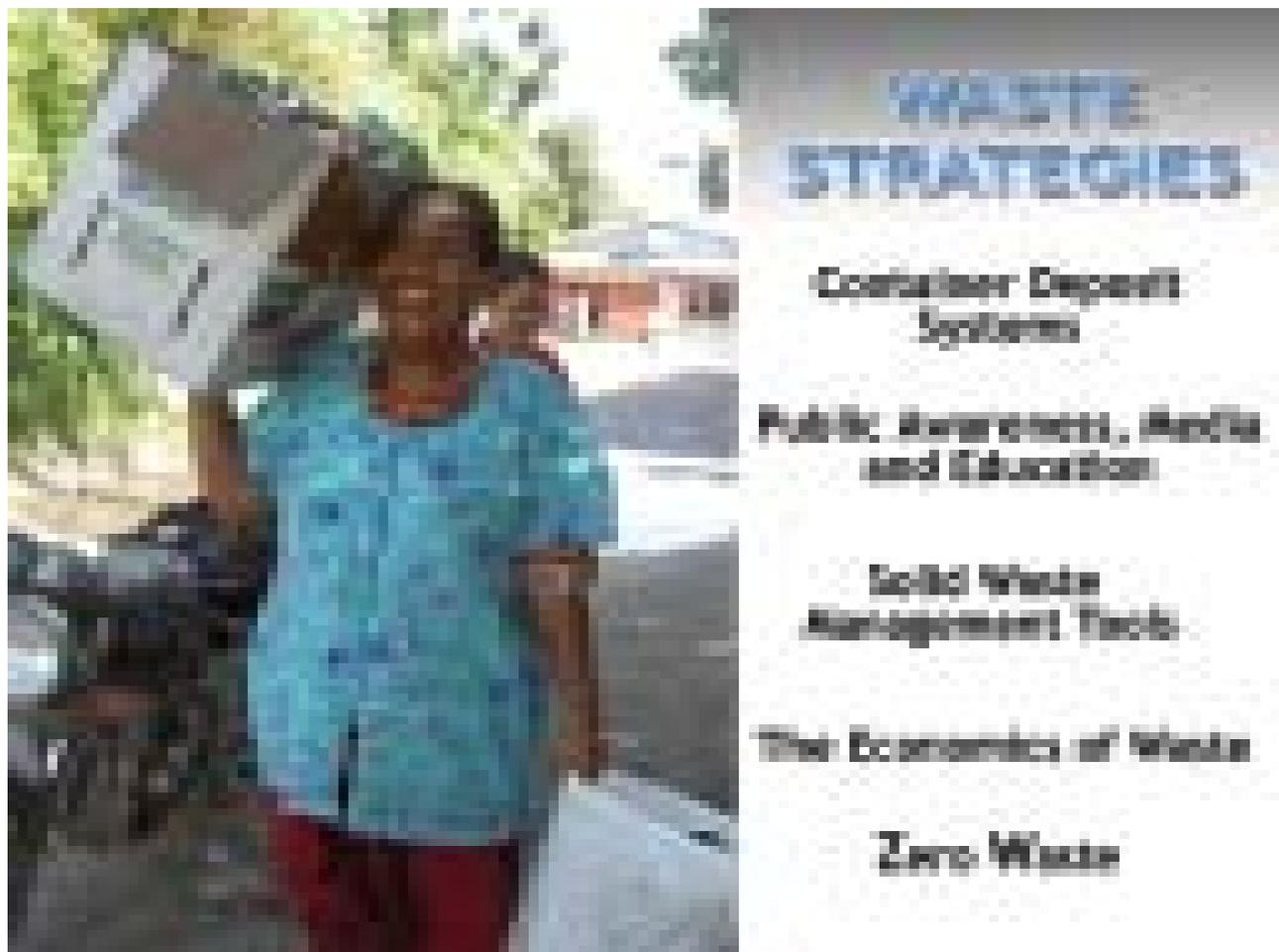
## Burning Wastes

**Landfills should NOT be set on fire under any circumstance.** It is common that landfills are burnt: sometimes this is caused by people lighting fires; sometimes by landfill management trying to decrease the volume of waste in the landfill; sometimes a landfill might catch fire on its own through spontaneous combustion, especially in hot places. Burning the landfill to decrease the volume of material in it is an extremely short-sighted process, as it will in many cases turn waste that is reasonably inert into noxious gases and a material (ash) that is extremely mobile in both wind and water. Trade Winds, cyclones and, frequently, landfills sited close to water tables, are all common in the Pacific Islands. Hence burning the landfill is similar in effect to taking the waste in a landfill, turning it into a toxic material, and spreading it around the local countryside and water sources. Any people or animals living in the vicinity of a landfill that is burning, or even passing on a road nearby, will be subjected to noxious gases likely to damage their health.

The New Zealand Government produced a guide titled the *Hazards of Landfill Burning* to assist landfill management prevent landfill burning. It is a comprehensive look at all aspects of landfill burning. *Section 2, Types of landfill fires*, describes the different types of landfill fires and their causes; *Section 3, Health effects and hazards of landfill fires*, describes the potential health effects and physical hazards of landfill fires; means to prevent various types of landfill fires are described in *Section 4, Prevention of landfill fires*; whilst Section 5, *Control of landfill fires*, describes how landfill fires can be controlled if they do occur.

Section 6, *Alternatives to burning*, describes alternative means of managing refuse to reduce volumes in landfills and extend landfill life. This section has useful information about managing wastes to achieve higher landfill density and thus, reduced volume (often the reason fires are lit by landfill operators). It also has a brief summary of measures to decrease Green Waste quantities going to landfill, as this is usually the largest single type of waste in landfills (unless, like Kiribati, a very effective programme has diverted organics from the landfill). The *Appendix A* contains a provision for use in any Landfill Management Operational Plans, regarding fire fighting.

See also the Section on *Zero Waste* for information about alternatives to landfilling.





# Container Deposit Legislation and Systems

## Overview

Container Deposit Legislation (CDL) is where a Government passes a law that requires beverage containers, for example drink bottles, cans and perhaps drinks boxes, to carry a small deposit. This is then refunded once the empty container is returned. These systems are a form of Extended Producer Responsibility (EPR), or Product Stewardship.

These systems originally came into being as a way of controlling litter, which was in large part caused by empty drink cans and bottles being cast aside. This is a common problem in the Pacific Islands. The idea is that the deposit encourages people to return the drink container for a refund. In a Pacific Island context, using CDL is an extremely effective way to remove drink bottles and can litter from the environment, making recycling systems viable with a steady flow of materials, creating employment and also saving large amounts of money and space in landfill sites.

The introduction of CDL is by far the easiest and most effective way to tackle pollution and boost recycling at the same time. A side effect is that people begin to become more aware of the materials in their waste stream. The impact of Container Deposits in Kiribati is detailed in the *Kaoki Mange! Case Study*, in the Case Studies section of this Waste Kit. Also from Kiribati *a video clip that shows the system* in daily operation is provided. There are different types of CDL, and such systems are common throughout the world. The following is a brief review of documents in this Container Deposit Legislation Directory.

## Container Deposit Analysis

### New Zealand

The report from Envision New Zealand: *Getting Serious About Packaging Waste* provides an excellent overview of strategies to reduce packaging waste, with a particular emphasis on Container Deposit type systems. This report also contains lots of useful figures, much near the beginning, that show the sort of job numbers and economic advantages that Container Deposit systems will create. Also included is a good set of references. The authors of this report can be contacted through [www.envision-nz.com](http://www.envision-nz.com).

### Australia

The Independent Review of Container Deposit Legislation, from the Institute of Sustainable Futures, University of Technology, Sydney, Australia, is a very detailed analysis of Container Deposit systems worldwide. This report was written for the NSW Government in 2002 to assist in the proposed introduction of a CDL system in NSW. The report is in three sections:

- **Volume I: *Extended Producer Responsibility: Principles, Policy and Practice in NSW***

This is a detailed briefing on the principles of EPR, and looks at current international *Best Practice*. In particular it looks at how these aspects might affect NSW policy. This volume is probably most useful to those seeking information and researching setting up CDL systems in a PIC. It has detailed information on system details, deposit rates, and rates of recovery in countries where CDL is used (*Section 4* pages 38 to 44). This section also looks at items other than just beverage containers. *Section 5* has product case studies covering items such as tyres and refrigerators. *Section 6* looks at Implementation issues, which is a crucial part of getting a CDL system off the ground and up and running. At the end of Volume I is a very useful reference section.

- **Volume II:** Is a cost-benefit analysis of CDL for NSW.

This has some modelling and determines estimates of costs and benefits.

*Section 1* has a good description of Container Deposit systems, with a flow diagram on page 6 that may be useful.

*Section 2* has more information on system design from international systems, with 2.2 looking specifically at the South Australian model. Section 2.5 specifically deals with litter reduction and CDL, and has some good points. Section 2.6 looks at factors affecting recycling behaviours. 2.9 looks at material flows, which is crucial in looking at potentials for recycling.

*Section 3* looks at developing the cost-benefit analysis, and this will be of help to those developing information for Government and interested parties in order to promote the introduction of recycling and CDL systems. This section contains useful information about the costs of waste management that are usually borne by the wider community through local and national governments. Whilst these cost analyses may well not be transferable directly to a PIC context, they do give indications of the scale and sort of cost involved in waste management. Section 3.6.6 looks at low-income groups who scavenge for refundable containers. This is a significant income generator in PICs, especially where few government welfare payments exist; and can contribute to increased recovery rates and employment

*Section 4* looks at implementation of CDL, and whilst much of this is based on an Australian context, essential points are covered here. Section 4.6 looks at handling fees, which will be essential in a PIC environment with the transportation costs to the recycling plant. Handling Fees can be very small, but make the difference between a sustainable system and one that requires constant support. Section 4.7 looks at Deposit / Refund levels; 4.9 looks at collection points where refunds are obtained; 4.10 looks at public awareness campaigning that must go with the introduction of CDL.

*Section 5* Looks at alternatives to CDL systems for waste reduction and recovery; 5.2 reviews other possible economic instruments for waste recovery; 5.4 Covers regulatory approaches. *Section 6* has the conclusions and recommendations of Volume II.

*Appendix A* contains very detailed information from several international CDL systems, complementing the materials from Volume I. Appendices *B* and *C* look at refillable plastic containers. Appendices *D* and *E* look at quantities of recyclables in NSW.

- *Volume III* covers consultation and social research in relation to CDL in NSW.

This section is very Australian orientated but may be useful as a guide to those seeking to do some research on acceptance of CDL in their country.

### United States

The Bottle Bill Tool Kit is produced by the Container Recycling Institute in Washington D.C., USA. This is available from [www.container-recycling.org](http://www.container-recycling.org). This tool kit contains extensive information from all the United States that have CDL, or Bottle Bills as they are usually called in the USA. The kit is in three parts, and two are included here: *Get The Facts* which has a wealth of information regarding how bottle bills operate and perform in the USA and *Know The Opposition* which has detailed information to meet the arguments of people who do not like CDL: usually the Drinks Industry (they think it costs them money). This is extremely useful.

### The Impacts of Container Deposit Legislation

In Kiribati, recycling rates for PET went from 0% in 2003 to 90% in 2005, with aluminium cans going from around 25% in 2003 to 90% in 2005. Lead-acid battery recycling similarly went from 0% to about 300% of annual imports in 2005 as residual waste batteries were collected. These massive improvements were all caused by the introduction of Container Deposit Legislation.

From South Australia, *The Economic and Environmental Impacts of CDL* are looked at in a report for the South Australian EPA. This study attempts to quantify the direct costs and benefits of CDL in South Australia. Note that the study has difficulty putting a value on the cost savings of landfilled beverage containers. Some information regarding how much space typical beverage containers might take up in landfill is available in the Landfill section of this Kit. With no attempt to either estimate the cost per cubic metre of Landfill in South Australia, and no attempt to estimate the volume of typical beverage containers in a landfill, a major, and measurable, benefit has been ignored.

In this context, it would seem that the landfill savings in Tarawa alone, from the aluminium cans and PET bottles collected by the CDL system, amount to an estimated 250cu.m. per year of landfill space, which is \$6,250 worth of space, without factoring the cost to council of taking it to landfill. South Australia consumes 30 times more cans and 77 times more PET bottles than Kiribati per year.

*Collection Industry Arrangements Under CDL* is a consultants report for the South Australian Government on measures that might improve the current system there. It is particularly interesting as it describes the S.A. system in great detail, including how the processing side of the industry works, and is very useful for anyone designing a CDL system. It highlights some potential design problems that can result in lack of incentives to act for some participants.

*Container Deposit Legislation: Financial Impacts* is a policy background paper prepared for the Victorian State Government for the possible introduction of CDL. The proposal to introduce CDL in NSW, and with such a system in S.A., puts pressure on other eastern Australian State Governments to look at introduction in their states.

## Examples of Legislation

### Kiribati

The Kiribati Container Deposit law: *Special Fund (Waste Materials Recovery) Act 2004* is a simple piece of legislation that provides for the creation of a Container Deposit system in a small island nation environment. The associated *Regulations* are where the real detail of what materials are covered are, and what are the rates of deposit and refund. After the actual regulations can be found the accompanying *Explanatory Statements*.

### South Australia

South Australia takes a different approach to CDL from Kiribati. Here, the law requires the sellers of cans and bottles, or specified collection points, to pay a refund of 5c or 10c, depending on the beverage container. The law requires that all beverage containers have to be marked as refundable in S.A. and that there is a system of collection points where beverage containers can be refunded. The manufacturers are obliged to reimburse the retailers and collection points for the materials collected. Included here is the full

*Environmental Protection Act 1993* for reference; the specific provisions relating to deposits and refunds have been extracted as the *SA CDL provisions* of the Act.

## CDL Fact Sheets

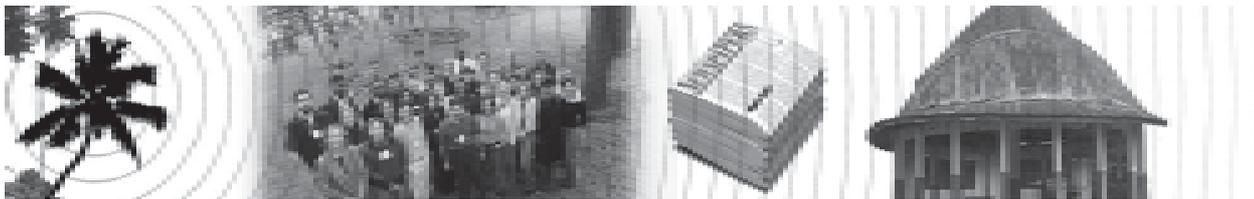
The Zero Waste South Australia organisation has a good fact sheet that describes the *South Australian CDL* system. This system does not involve the government directly, except to set the legislation, and pass beverage container types for sale to the public.

Examples of fact sheets that can be useful in preparing a CDL campaign are included: one is a *Frequently Asked Questions* paper, and *What is Container Deposit Legislation?* is another. Envision NZ has also produced a CDL Summary fact sheet, which has some useful statistics, included. Also produced here is an example of a fact sheet that provides information to importers of drinks into Kiribati: *Importers Information Sheet*. Accompanying this is, a sheet called *Tariff Numbers of Items affected by CDL*, detailing affected products commonly on sale in Kiribati, and the HS tariff numbers of relevant products, to assist importers with the changes.

Extracted from the Bottle Bill Toolkit are two pages of *Arguments Against CDL and Replies* which are useful for those entering debates with industry opponents of CDL. The references for the replies are in the Bottle Bill Toolkit section *Know the Opposition*, and can be found at the end of that document.

## International Examples of Container Deposits

A short paper on *International Examples* gives some idea of other countries' activities in the area of CDL, and this information might complement material found in *Section 4, Volume I* of the Independent Review, cited above.



# Public Awareness, Media and Education

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## Overview

Any project promoting changes in the way people deal with their waste requires a publicity programme to run alongside it, to educate the public to the changes in waste management. A new recycling system, for example, can also be used to encourage a new approach to the way people create and manage waste. If conducted carefully, a public awareness programme can capitalise greatly on the new mood, and reinforce the feeling that real, positive change is happening.

A primary element, and the one that can have a very great effect on all other aspects of a public awareness programme, is to choose a local name for the new system. A name that is readily accepted by the population and a name that has a bit of humour in it is always a good start. Once this name is in place, the rest of the campaign planning may come much easier. These notes included here are provided to help plan and execute a public awareness campaign to run alongside changes to waste management that are put in place in your country.

### Communication Tools used in Public Awareness Work

A public awareness programme should work primarily through the use of posters, leaflets and fact sheets. Use media such as newspaper advertisements, radio spots, and simple TV adverts for local TV use where that is an option. There may also be opportunities to produce magazine articles, and at certain moments put out press releases which local news can pick up. These press releases become a way of keeping the public up to date on what is happening as the programme develops. The other main area of public awareness is through education. This generally takes place using the school system, but can also use existing community groups. First we shall look at using the traditional mass media, then educational tools.

## Developing a Waste Awareness Campaign

### Communications Strategy

The overall aim of communications is to condense the activities and purpose of the recycling system to a name, and one or two slogans. For example *Do not Drink and Drive* is well understood in many countries as to mean: do not drink excessive amounts of alcohol and drive vehicles as that is how people get killed, and your life will get in a big mess one way or another if you are involved in such accidents. It does not mean, don't drink anything and drive anything, which is literally what it says. Similarly, the aim here is to get people to participate in the recycling system because they see it to their personal and their communities overall advantage. Ideally, it shows that *not* to do so is being anti-social in some way as it is contributing to the degradation of life in the Islands. To do this takes a degree of skill.

In Kiribati the slogan *Kiribati Te Boboto* was developed to cover several SWM projects that were running at the same time. *Kiribati Te Boboto* loosely translates as *Kiribati is Beautiful*, but is understood as *Make Kiribati Beautiful*. This slogan was used across garbage bag collection, anti-littering, and recycling programs, and tied the various programmes together in the public mind. Much of the details of the different systems became easily captured in people's minds through the *Kiribati Te Boboto* slogan, just as the *Don't Drink and Drive* slogan contains a lot of other details under the simple slogan. This is the art of communication. Put some time and effort into this, as it is crucial. It is also a lot of fun thinking up new (and humorous) ways to get your message across. Drawing up a communications strategy near the beginning of your public awareness programme can help map out the steps needed to promote your

system to the public. Provided below are examples of some simple steps that can help you build a Communications Strategy.

First, it is essential to know your overall goal:

**Overall Objective:**

*Make the recycling system an integral part of daily life in the XXXX Islands.*

You need to know what your overall objective is, what you are trying to do. All other parts are aimed at achieving this objective.

**Aim of the public work:**

To provide a small set of visual and audio signs that become universally recognisable in the XXXX Islands identifying the recycling and minimisation of waste materials.

Next, create the pieces to achieve these aims and objectives. Some examples are provided, but do not necessarily need to be done in this order. But naming the programme is an essential early step.

**Choosing a Programme Name**

This is the number one important aspect that will likely define the real success of a public awareness programme.

**Give the Project a Local Name**

This must be short, lyrical, and ideally humorous. For example, in Kiribati, the name developed was *Kaoki Mange!*: it rolls off the tongue, and it means *Send Back the Rubbish!* which provided a simple and humorous answer to the famous Kiribati beer can litter problem. It also described the system of exporting waste for industrial recycling far more effectively than earlier attempts to develop a local language word for recycling. The name embodies both the solution to the problem, and the process of dealing with the waste. This slogan was developed through informal short workshops with local NGO educators, people who work with public education on a daily basis.

Consistency of message is essential for any good public awareness campaign. It is very important to develop a central message, ideally the campaign name, that is always used with any promotional materials so that all the different pieces clearly come from one source in the public mind. Also, a good name becomes a simple way of representing all the aspects of the things promoted: recycling, organic waste use, reduction of waste, prevention of litter and water pollution, etc.

It cannot be overstressed that a consistent message can make the difference between success or failure, no matter how well other parts of the total Solid Waste Management programme are designed.

**Step 1:**

Convene a small working group of media and public awareness professionals and agree on a name for the project in the local language. Name not more than three words. Should be snappy.

**Step 2:**

Test this name on a few local groups: school kids, teachers; media people; educators; then the general public through a small survey, say over a week. This need not be a long process, as a poor slogan will soon show up a negative, and a good one gets a good response.

**Create Posters**

Posters are a very useful way to communicate. It is advisable to experiment a little with simple posters that can be printed on a sheet of A4 paper from an office printer, before putting a large effort into a fancy A1 large full colour poster design, which will be expensive. The IWP Kiribati programme had a very effective team of people who developed their posters through a set of stages, until they later produced a nice big colour poster. Their poster evolution is represented with a *set of their posters*; as they gained experience, the posters became more detailed. Notice on the *How to Use the Greenbag* poster that the poster is very instructional; it also has a set of the donor agencies logos at the bottom so that the donors are happy and it is clear where the poster came from. Also included is an example of a poster from Tonga, where a *Clean Water poster* graphically illustrates the point to hand, even if it had no words.

It is easy to spend lots of time, and money, early in your campaign on a poster, only to find that you might have done it different later. Simple posters can be produced in A4 and usually A3 sizes from small printers in offices. The use of laminations on the posters also makes them last much longer, and can allow some outside locations to be used.

Another advantage of local poster production is that posters can be quickly produced for different times and events, such as Christmas or National Holidays. Learning to produce your own local posters will help a huge amount when, and if, you feel the need for a high-quality professionally designed and printed poster. Other examples of posters can be found in the *Photo Library Posters section* of this Kit.

Placing posters in stores, schools, cafes and community buildings is very effective when working on waste, as everyone makes wastes. Posters can also be informative, and can add to the simple messages put out by radio spots.

## Plays and Sketches

A play is a very effective way to reach a lot of people who are not so used to absorbing information through written media. The play will also provide songs for the Radio Spots that may be developed. Choose a local group with experience in this kind of public awareness work.

It is very fruitful to develop a suitable play of 20 minutes or so duration that can be shown at schools and any appropriate public event where many people gather. An example is provided of a play developed by Te Toamatoa Theatre Company in Kiribati. A simple [video of the play](#) is provided here. This is perhaps useful to show any theatre group at the stage of early development.

It is very important to make sure that the theatre group understands the central messages that need promoting. It is also important for any project to stay closely involved in the play development and production so that these messages are clear, whilst still providing entertainment. Note also in the video provided how the presenter uses the time before and after the performance to bring home the messages of the play performance. This is a crucial part of the programme, to encourage the audience to absorb the central messages, especially with schools. These plays are very effective for schools and public events. Once the play is rehearsed, play it at a school to test it, and modify if needed. A song that is part of the play, but with a good *jingle* aspect, can also be used in producing any radio and TV spots. As the theatre group become comfortable playing the song, take them to a recording studio and record the play song.

## Radio Spots

A crucial factor of play development is the writing of at least one song that contains within it the signature jingle that can then be used for the radio and TV spots. This is an essential component of the whole process to develop a local name, along with at least one motivational slogan to tag the recycling system. This must be developed early, at the beginning of the whole programme. This way an integrated programme is developed that allows a consistency of message. Radio spots are a very effective and cheap way to achieve high visibility for the project. Also, as they are not obtrusive, they provide a way to daily reinforce the message. Radio can also reach a large number of people, especially in the islands where there are few radio stations. Again, from Kiribati is provided a [song from the play](#) referred to above; this song was recorded in the local radio station, and then used to make radio spots. Tonga also developed a [Rubbish Song](#) to back up their public education efforts.

### Step 1

- Take the play song recording, and cut out suitable bits to bracket a message that pushes the name, and contains a message on waste. Aim at 30-second spots, to keep the message snappy. An early [radio spot](#) from Kiribati is included as an example.

### Step 2:

- Make more spots, and always include the local name and the jingle, along with different messages, but using essentially the same music. A spot from Kiribati that is a development of the original format, using parts of the song, but a different arrangement of the spot is included; this [radio spot of a can thrown from a bus](#) was used to tackle littering behaviour.

### Step 3:

- Try out new slogans and see what sticks. Keep changing the detail, but **always keep the jingle and the key slogans.**

Where project funds are limited, you may find that radio spots can be produced cheaply using the local talent of someone who works to mix music on a computer, and such people usually have the software and skill to do the task. The mixing and cutting and recording itself can usually be done on any good modern computer.

## Newspaper Adverts

Develop Newspaper adverts that follow a standard, easily recognisable format in which the name and slogan are dominant, but allow insertion of different messages. Develop through time a visual Logo device that can be used subsequently on project signboards and Collection Points to identify recycling activities on the street. The [Logo](#) devised for Kiribati by a local artist is provided. By having the adverts in a regular format, it is easy to add new information into the existing format, and so update the adverts without having to start from scratch with building a whole new advertisement each time. A Kiribati newspaper advert is included as an example; this was a simple quarter page item run for several weeks at a time, and then the message changed, whilst the overall format was retained.

## Press Releases and Making News

Press releases are ways to get local media such as newspapers and radio reporting on what is happening with your publicity campaign. Efforts to gain public attention can be boosted by getting essentially free publicity through contributing a news item. The way

that the news media attention is captured is through using a press release or media release.

A media release should be no more than a single page; it should be dated, with a place name at the top, and with a *further information from*: set of contact details at the end. It should include: **what** happened, **where** it happened, **why** it happened, **who** was involved, ideally a quote of someone involved, and perhaps a paragraph of background information. Keep it all short and precise. An example of a simple *press release* from the Kaoki Mange! in Kiribati is provided. It is a good idea to involve someone experienced with press releases to write them. Good press releases will be interesting in the first paragraph, and catch the attention of the newspaper editor.

A good press release will provide free advertising for your campaign, as well as give the public an update on what is happening. A paragraph may be included that sets out the project achievements at this point. After a press release has been sent to newspapers, radio and TV stations, follow up with a phone call to a suitable journalist or editor (find out people's names and keep regular contact with them) and see if they need more information, or would like to do an interview. Do not wait for them to contact you unless your press release is rather dramatic and you can expect a response.

### TV spots

TV ads in many small places are primarily in the form of static public announcements. The TV ad can be drawn from materials used to make the Newspaper ads. Simple Community Service TV ads will use the local name and slogan predominantly. TV work will involve developing visual signs, as will newspaper adverts. Where larger audiences are involved, and TV is well developed (such as Fiji) TV adverts may be too expensive. Again, consistency of message and visual and audio signs is essential.

That said, the Tonga Solid Waste Management Project has produced some great TV spots that include humour to get their message across: one spot on *dumping diapers* and another on *littering* in general; this will make you smile, and would not have been expensive to make. Another more serious spot on the overall *pollution of the islands*, from IWP Tonga, puts the big picture across to the audience in a nice, rounded, short way.

## Leaflets and Factsheets

Leaflets and factsheets are great ways to keep people informed at a very low cost of production. Keep them simple, and make them in house, and it becomes very easy to update them and print more as required. Ideally, keep them to a single sheet of paper, that is two sides. This means not only that production costs are very low, but that one needs to distil the messages into short pieces, which are much easier for the public to absorb; they may well not read long, involved factsheets. Tonga has produced some good examples: one fact sheet is a wide-ranging, general *Waste Fact Sheet*, that is a good example of a big picture approach, whilst *Oceans of Rubbish* puts the whole issue of marine pollution into a simple nutshell.

Leaflets can also be made by taking a sheet of A4 paper, printing both sides, and putting a couple of folds in it. This provides a small item to handle, and breaks up the information into tidy packets. An example is the *Nappies Leaflet* produced again by the Tonga Solid Waste Management Project. These folded leaflets are easier to handle for house drops or for distribution on shop counters and the like, as they take up little space. A printing business will have a machine suitable to do the folding, and can assist with layout and printing, but it can also be done by hand if numbers are not too large.

## Consistency of Message

By starting with the naming process, then a play, and then the Radio spots and Newspaper ads, a consistent stream of experience builds up. It is very important to be consistent with messaging across all media, whilst using that particular media strengths in creative ways. Once you have a good slogan, use that to mark ALL media materials, along with the particular message. The overall slogan then comes to contain all those other messages in the public mind. Again, see how Do not Drink and Drive means so much to the public in many countries: it contains messages about road safety, about social responsibility, about being law abiding, and about personal behaviour, all within one simple slogan.

## Budgeting

Media advertising can be very expensive, but can also be done much cheaper with care. Do not believe that you need an expensive advertising agency and design studio to make your ads. If you have money for it, great, get some professional help. If funds are limited, it is surprising what can be made using the skills of people around you. But you must have some idea of budgeting and the costs involved in your plan as you start. Otherwise you may put in much work and planning only to discover that you have no funds to pay for the advertising. A good grasp of costs and budgets will help determine where to put your efforts in developing media materials: for example it might be easy to plan for lots of TV ads and then find, after spending money to develop them, that you could not afford to run many. Much better to aim at cheaper saturation coverage of radio spots in that case.

An example of a typical budget requirement is provided, based on a nine-month saturation coverage campaign in the Marshall Is. of one newspaper advert per week in the Marshall Islands Journal, four radio spots per day on V7AB AM (free spots for community announcements) and the top FM radio Station in Majuro and Ebeye, Emon FM, and a daily slot on the Public Announcements on Marshalls Broadcasting Company (MBC) for 40 weeks. This is provided as an indication only, to help campaigners begin to plan budgets. Costs will vary greatly between different locations. Where it is expected to run large numbers of spots and ads over several weeks and months, negotiate with the media for bulk rates. Also, lower rates can be had for public service announcements. See if the radio station can sponsor you, for example. Radio is, after all, a medium that creates very little rubbish whilst informing and entertaining.

Example Media Campaign budget

Media	Unit	Cost/unit	Frequency	Day or weeks	Total cost
Radio spots Emon FM	30 sec	\$2.25	4/day	270 days	\$2,430
Radio spots V7AB	30 sec	Free	4/day	270 days	\$0
Marshall Is Journal	¼ page	\$200	1/week	36 weeks	\$7,200
MBC TV	24 hr	\$10	7/week	30	\$2,100
Total				9 months	\$11,730

## Educational Tools

This material is primarily targeted at groups of people in an institution of some sort, whether school or formal group. Often this type of material is best presented through a teacher, or at least people with school or community education experience.

Simple, easily produced items are one or two pages, and suit a shorter, targeted approach, such as the *Origins of Waste* information sheet. Or the materials promoting the Four Rs: Refuse, Reduce, Reuse, Recycle; here we have both a *4Rs poster* and a *4Rs Fact Sheet*. These materials are great for classroom walls and for promoting the overall ideas of waste reduction and recycling. Another useful poster item is the *Decomposition Timeline*, showing how long different materials take to degrade.

From Canada, a *video made by a nine-year-old boy* is included, detailing the State of Nova Scotia's efforts to become a Zero Waste Community. This gives a great, simple perspective of the overall problem of waste.

For deeper, classroom activities tools, we have some great materials from Tonga for teachers: a school *Waste Resource and Activities Guide*, and from SPREP materials detailing possible activities as a *World Environment Day Kit*. Teachers can use these great resources as part of an ongoing waste education programme spread over weeks, as they are full of materials. These items can of course be printed off from this Kit if you need to. They can also provide great ideas to produce your own materials that suit your own place and teaching styles.

To complement the above materials, people always love snappy facts that illustrate the big picture. The Central Queensland Regional Organisation of Councils has put down some great stuff on the internet. This material has been slightly adapted from presentation here as a set of fact sheets called *The Impact of Waste*. Along the same lines, the Tonga Solid Waste Management Project, which produced the teachers resource mentioned above, has provided a *Resource Kit set of attachments* that go with their school materials, that give a great graphic representation of the big picture.



# Solid Waste Management Tools

## Overview

Solid Waste Management (SWM) is a big issue, and involves most of the ground that this Waste Kit covers. Good SWM requires a degree of planning and research before improved action to tackle the problem is decided upon. To help formulate plans of action, and decide on the resources that may be required, several useful tools are available to help the SWM professional.

## Waste Surveys

One of the first steps is to have a clear idea of the nature of the waste that we are tackling. This usually involves some kind of survey of the waste stream. For smaller Pacific Islands the majority of waste is household waste, and a household waste survey is a good place to start. Some places have had waste surveys conducted in the last few years, and this information will be very useful. If the survey is 10 years old or so, it may be too far out of date to be of much current value, except to measure against a new survey as a comparison. Several Countries had waste surveys conducted by SPREP under the 2000 WASTE Project, and it is worth checking to see if any data collected at that time can be useful. The SPREP *Draft Waste Master Plan* of 2003 has, in Section 2.2, an amalgamation of data from waste surveys under the WASTE Project. A set of the original Waste Characterisation Studies from that project is provided: *Papua New Guinea; Samoa; Fiji; Kiribati; Solomon Is; Tonga; Tuvalu and Vanuatu*. A *Waste Awareness Baseline Study* was also conducted under this project to discover the general level of knowledge and awareness on waste issues in Suva, Tarawa and Apia.

Be wary of using data from other places and assuming that it is similar to the local situation. Data that may exist for similar physical and economic environments may be useful, but it can also be misleading.

For example, whilst Majuro and Tarawa are very similar geographically, the types of waste generated can be quite significantly different. Majuro generates a large quantity of disposable cups and plates, and has significant quantities of food waste in its rubbish, whilst Tarawa has virtually no food waste or disposable cups and plates. Per capita waste generation rates are significantly less in Tarawa; organic content is much higher than in Majuro, where a greater proportion of waste is man-made. Waste surveys from [Tarawa](#) and [Majuro](#) are included for comparison.

### How to Conduct a Survey

A description of how to conduct a survey can be found in the waste survey examples. A useful strategy to employ is to collect the waste from the first day and discard it, as it may contain materials from outside the survey period. Waste can be collected daily from households, and this makes the sorting much easier. This is especially important where there is food in the waste stream. Where generation rates are low, and food is rare, several days can be allowed between collections. Usually waste is collected over a week from a number of households to get a good picture of what is in the waste stream. A waste survey from [Nauru](#) is included that used this methodology, whilst [another from Tonga](#) is included which details the technique.

A [Template Data Sheet](#) is provided as an example, to record information. For really detailed surveys, the New Zealand Government has produced a [Solid Waste Analysis Protocol](#) to create some correspondence across surveys. It is very important that waste surveys are consistent between one another or else the comparison becomes much harder. For those working in larger, urban areas, an example of a [survey form used in New York](#) is provided; something similar to this form could be distributed to recyclers, landfills and large waste generators in your area.

## Good Analysis is Very Important

It is essential that easily recyclable materials in the waste stream are clearly separated and measured when conducting wastes surveys: Aluminium cans, tin cans, PET and HDPE bottles, cardboard boxes, lead-acid batteries, glass bottles and jars. These items must be clearly delineated and not lumped together as *Metals* or *Plastics* or *Paper Products*, or potentially very valuable information can be lost. If there are found to be 1500 tons of *Metals* in a town waste stream, with tin cans worth say \$100/mt and aluminium cans worth say \$1,000/mt, it makes a huge difference to any plan for recycling if there are 10 tonnes of aluminium cans included in that total, or 500 tonnes. This has been a common failing of some surveys. Also, *Organics* that is palm fronds, pandanus and small branches is quite a different issue to *Organics* that is leftover food including meat and fish remains.

## Survey Requirements

A waste survey will need a small truck to pick up bags, plenty of garbage bags to give out, a big scale such as a *hanging spring scale*, a small scale, some containers to put materials in after sorting, rubber gloves and soap to wash up, and a good flat space to tip out the bags for sorting. Several *Garbologists* (and Garbologists are not necessarily grimy) to assist with sorting, weighing and recording are useful. Photos of different garbage surveys are included in the *Photo Library* section.

Tonga SWM Project produced a nice single page summarising what they found with the *Waste Audit Results* clearly displayed.

## Waste Densities

Measuring the *density of waste* can be very difficult, as explained in the section “Waste Density in the Landfill” on page 42. Please refer back to that section for further details.

## Integrated Waste Planning

The *SPREP Draft Master Plan for Solid Waste Management* in PICs is a big-picture document that will help define the areas to look at closely, in order to produce a plan for any particular island location – be it a national or local government. Use this Master Plan, in conjunction with some preliminary research, to make a Terms of Reference for drawing up any planning documents that a particular location requires. For example a review of the materials in the waste stream can give a clear idea of which materials to target initially for recycling. A brief look at recycled materials buyers and shipping routes can dictate where your export markets might lie. For example, if there is little PET in the waste stream, and the shipping to Australia or

Asia is very expensive involving transshipments of containers, it may not be worth targeting PET. Only secondary recycling of PET is undertaken in New Zealand.

SPREP has produced *Guidelines for MSWM in Small Island States in the Pacific*, which is a great place to start when looking at drawing up SWM plans. Another *set the scene* document is *PowerPoint presentation from Okinawa University*: this takes a big-picture view, with some great graphics showing the hierarchy of dealing with waste. A different Big Picture is provided by the *UNDP Conceptual Framework for SWM in Low Income Countries*, a large and in depth document. The *UNEP Directory of Environmentally Sound Technologies for Pacific SIDS* is another wide-ranging view that covers much of the practical systems available for waste management, and so can help with working out which technologies and approaches may work best for your particular location and nation.

Waste Plans can be very long and involved, but disconnected from reality, or try and do too much at once. All these things will make it harder to tackle the waste problem. Waste for most of the Pacific is like trying to eat a cattle beast: you look at the size of it and say, *I can never eat all that!* But start eating the easy bits first, and after a while you realise you have actually made a bit of a hole in the thing! Crucial with waste plans is to start with the easiest bits, whilst having a clear long-term view of where you are going.

The Zero Waste movement is a classic example of this: a Zero Waste plan may not have all the answers to dealing with all the waste problems right now, but as bits are dealt with, and the residual problem parts get smaller, so it becomes easier to focus on those hard-basket parts. Perhaps the worst situation to find is that after spending most of the funds for SWM on a big plan, the problem looks bigger than ever, resources are less, and it is very unclear where to start. The SPREP waste unit has produced a *National Waste Strategy Guide*, which provides helpful tips and an example template for drawing up a National Waste Strategy.

A good plan is exactly that: it tells you where to start; it has targets that are matched to times. It has a long-term vision of where things are going, and it is implemented in a way that allows it to grow naturally. For example, lead-acid batteries might seem easy to collect and recycle as they can be got in numbers from workshops and stores that sell batteries. But to collect and recycle batteries on their own can be very inefficient; there are usually not enough of them around for a business to exist solely on batteries. But attach a battery recycling operation to a drink can and scrap metal operation, and you may find that there is enough together to keep things ticking over.

## Different Examples of Waste Plans

Some integrated management plans are included here by way of example. From Hawaii, the *Honolulu SWIP* is a comprehensive and detailed consultant's report on SWM in a mature modern city. From South Australia, the *Adelaide Integrated Waste Strategy* is a more general document that shows the overall direction desired by the City of Adelaide in dealing with its waste over the next 20 years. This area is a detailed area, and usually will require assistance from specialists to draw up good plans. But those commissioning plans should have done some preliminary research so that they have a clear idea of the detailed assistance that is required. A plan that is too generalised may not make any serious impact on SWM as it is unclear exactly what to do next.

From the Pacific is provided the *Cook Islands Waste Management Strategy*, which is perhaps more relevant to a small Island nation. From a larger Pacific nation, a Draft version of the *Fiji Waste Action Plan* is offered. At the other end of the scale, *Tuvalu's SWM Plan* is provided.

From the Canadian province of Nova Scotia the *2001 Annual Report* of the Waste Recovery Board demonstrates a local government that has set clear targets and specific programmes to deal with different parts of the waste stream. The clear effect here has been (as with eating the cattle beast), that as they have chipped away at the problem they have gained confidence and skills to deal with some of the harder problems, and thus they become leaders. In Kiribati a similar situation exists with a seemingly intractable problem being turned around through a clear, targeted set of measures and activities (see the *Kaoki Mange Case Study*).

## Using Controls on Particular Materials

### Plastic Shopping Bags

One very useful SWM tool is to target particular problem materials. The classic one is plastic shopping bags. Twenty years ago such items might be rare in Pacific Islands, but today they are a major litter problem all over the world, PICs included. Some national, local and city governments are now banning them outright. Vanuatu passed a law banning plastic bags to encourage people to use local bags. An enquiry by *Palau on legislation banning plastic bags* contains details.

Papua New Guinea introduced a 12-month trial ban on plastic bags, and a copy of the *Interim Policy on Plastic Bags* is included here. Some local governments in Australia have also banned plastic bags. In Europe, the Republic of Ireland (Eire) introduced a charge of 15 Euros (approx. US\$15) on all plastic shopping bags, which was reported to cut use by around 90% in three months. Making stores charge a set fee for shopping bags is a good strategy, and encourages shoppers to get in the habit of taking their own bag along when shopping.

### Pesticides and Other Toxic Chemicals

It is not unusual to find that some chemicals banned in developed countries are still sold in developing countries. In particular, chemicals described in the POPs section in the fact sheets, should not be available for sale in any form. A very useful task for any Government Waste and Environment Officers is to check the prohibited chemicals imports of their nations, and compare these with the lists available for Australia, New Zealand, France and the USA, for example. It may well be found that some countries continue to make toxic chemicals that are banned from sale in their own countries. This is an appalling practice, relying on legislative loopholes in less developed nations to continue to sell chemicals that are known to be extremely dangerous. Contact some of the organisations listed in the POPs section of the *Contacts* section for assistance.

### Other Examples

Other materials known to be controlled in PICs are beer in glass bottles. No beer bottle refilling takes place, and beer bottles get thrown around the environment. Where bottles are refilled, the bottles have a value, and so are collected. Where there is no refilling, and particularly in very small, crowded islands, beer bottles can be a major health hazard. Kwajalein Atoll Local Government in the Marshall Islands has an outright ban on drinks in glass bottles; Kiribati takes a softer, but also very effective, approach, by tripling the import tariff rate on beer in glass bottles. Using economics is a very useful tool; it gets over the problem of complaints that Government is preventing free choice. However, when some peoples consumption creates problems for the whole local community, one persons free choice can turn into someone elses problem.

Something that could benefit from this approach is the explosion in disposable nappies, or diapers, in PICs over the last 10 years or so. Increasing tariffs on non-biodegradable nappies, or any disposable nappies as opposed to washable one, would discourage their use.

## Controls on Packaging

For most PICs it is hard to have any impact on the packaging of products in their stores, as most packaged products are imported. New Zealand and several Australian states have Packaging Accords with the industry: these are voluntary agreements between industry and Government. The central problem is that business produces packaging, often with little interest in the results and the wider community bears the costs of dealing with the rubbish created. Packaging is a classic instance of where EPR is a useful tool. The producer has to have some responsibility for the product. The German Government is perhaps the most advanced in this area, with regulations and laws requiring industry to take back large quantities of materials. Voluntary Packaging Accords look good on the surface, but their record is often poor, as governments are reluctant to fight with big businesses who resist change. A *submission on the renewal of the New Zealand Packaging Accord* lays out just how ineffective they can be. A Packaging Accord can take up a lot of government officials time in negotiation, but unless there are clear penalties for non-compliance, then usually little changes. After all, laws on littering, for example, do not say that *we would prefer it if you didn't throw your trash in the river, and if you do we might think about trying to stop you*. If you litter and get caught, you get fined.

Refillable bottles were very common in the past, but have become less so in the age of disposable PET bottles. Often, it is said that refilling bottles is not cost effective. Studies can be found to show either way, particularly when financed by those who seek to go the disposable route. Like most things in life, it is a matter of how it is done. A report from the *Institute for Self Reliance* in the USA shows how refillables can be quite cost effective; this report also has a useful set of references. This raises the whole issue too, about whether lowest cost should be the benchmark by which everything is measured. The Economists would have us believe that the only thing that matters is lowest

cost. If that were the case, the world would drink Chinese beer and drive around on Chinese motorcycles eating two-minute noodles at mealtimes. If a business cannot survive by providing an environmentally responsible product, then it should move over and let some in who can.

Another very beneficial effect of placing controls on food packaging in a PIC is to encourage local markets. Here, food is generally of a higher nutritional content. There is increasing incidence of poor health caused by over consumption of imported foods, for example the diabetes epidemic.

In larger Pacific centres, with local producers, some controls can be put on local production. An easy example would be measures relating to water and softdrink bottles. These are typically made from imported pellets of PET plastic, which are then shaped into bottles in-country with a machine. This a clear case for Container Deposit Legislation, which could encourage the return of most of the bottles through a refund, paid on return. In Kiribati, a clear case of local packaging causing much litter is the ice block tube of plastic, sealed at both ends. Some people (children mostly) buy the ice block, bite a hole, suck out the cold liquid, and toss the plastic in the street. It was found by a local resident, who was very concerned about this litter, that a biodegradable plastic could be used to make the tubes. He then informed the importer of all the tube wrappers, who agreed to switch supplier to the biodegradable plastic.

Whilst the real answer is public education to stop littering, this is a good example of how there may be local measures that can be taken with a bit of research. As with glass beer bottles, there may be instances of items that should be closely controlled. Remember that everyone pays the cost of dealing with these problems whether through taxes, less money for other services, or poor health and environment.



# The Economics of Waste

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## Overview

The cost to nations of the way waste is dealt with, or the *Economics of Waste*, is a fairly new area, as economists work out the details and derive dollar values for poor waste management. The IWP has been a big force to push for this work to be done in the Pacific, and some of the information that has started to come out is presented below. There are large economic advantages to be had by dealing with waste from the point of view of waste being a mine of hidden resources. This point of view turns a problem into an opportunity. What is needed is information and results of studies that show where those opportunities lie. Planning can then start us off on the road to working out how to capture those resources; then the practicalities of dealing with the waste will finally deliver those hard dollars. A PowerPoint presentation from the University of Okinawa on *Management of Solid Waste in the Future* gives a good overview. It introduces some of the economic tools and ideas dealt with below or in other parts of this Kit. The economics of waste, using conventional economic approaches, is primarily about three things:

- Costs of poor waste management practices to the whole country;
- Potentials for employment and income generation from waste;
- Attaching the cost of dealing with waste to the products and people who make it.

## The Economic Costs of Poor Waste Management

This is a big issue and can only be very briefly touched upon here. The most comprehensive piece of work done by the IWP, in conjunction with the Forum Secretariat, in the Pacific is an *Economic Impacts Study for Tonga*. This looks very carefully at the real costs of poor waste management in Tonga, in terms of fishing, health, tourism, costs to Government, environmental costs, potential for income and employment through recovering resources from the waste stream. This study found that the cost to Tonga was of the order of \$6.5 million. In a country the size of Tonga this is a very significant sum.

Another IWP report looks at the *cost of watershed pollution in Rarotonga* in the Cooks, and concludes that a cost of around 3% of GPD is the price of water pollution. Water pollution costs accumulate downstream in more ways than one. A similar report (only a draft is available here, but it is included with that caveat) is an *economic evaluation from Palau*. Again from the IWP, it gives a possible average cost of around \$200 per household per year. These hidden costs to Pacific Island nations are a very important factor, and these reports are very valuable contributions to getting to grips with the real, and cumulative costs to PICs from poor waste management. Turn those losses into gains through good waste management and waste recovery!

Looking at more direct costs is an *analysis of savings in landfill space* in Tarawa, Kiribati through a comprehensive programme of waste reduction. Using actually measured figures rather than projections or estimates, it showed that the savings to Government could amount to A\$100,000 per year (assuming all waste was collected). Cost saving over a year (with much of the waste uncollected) showed a saving of around A\$14,000, which is over 12% of waste collection costs. The savings accumulate, as landfills take much longer to fill up, so a landfill that might be full in 5 years under a *business as usual* scenario, can last as long as 15 years with fairly simple waste reduction measures. Look in the *Landfills* section for greater treatment of this subject.

## Employment from Recycling and Resource Recovery

Studies from around the world show that recycling and resource recovery activities create more jobs, per tonne of material, than landfilling or incineration. In fact it can quite legitimately be said that when waste materials are buried or burnt, jobs are destroyed. Worse, these are local jobs because they are based by necessity where waste accumulates: in communities at the end of the supply chain.

### United Kingdom

The authors of *Re-Inventing Waste – Towards a London Waste Strategy* (Ecologica 1998) say that *Recycling is an engine of urban job creation*. They calculated in their report that for every 10,000 tonnes of material diverted from disposal by recycling, there would be a net job gain of 21-39 jobs, without including any remanufacturing and related employment. They also predicted (in 1998) that London could create 7,000 recycling-related jobs by 2002, and 14,000 jobs by 2007; 7,000 jobs would inject an estimated 100 million pounds into the London economy. A multiplier of 1.5 (to take into account remanufacturing and related employment) would raise the job totals to 10,500 and 21,000 respectively, or to 14,000 and 28,000 with a multiplier of 2.

One of the authors of the London report, economist Robin Murray, later wrote *Creating Wealth from Waste* (Demos 1999) in which he noted that in Germany the waste and recycling sector is bigger than either steel or telecommunications. He estimates that an intensive programme of recycling in the UK could create between 40,000 and 50,000 new jobs, taking into account those that would be lost in the process.

### United States

The recycling/resource recovery industry is a value-adding industry. It creates more jobs and more wealth from the small percentage of the waste stream the sector is able to access, than the waste industry which has control of the lion's share. A report produced for the USA National Recycling Coalition, *USA Recycling Economic Information Study* (R. W Beck 2002) showed that in 2002 as many as 56,061 recycling businesses were operating in the USA, employing over 1.1 million people and generating an annual payroll of \$US37 billion and gross annual revenues of \$US236 billion. By comparison, the total annual revenue of the USA waste industry was less than \$US50 billion. The recycling/re-use sector supported, directly and indirectly, 3.1 percent of paid jobs in the USA and 2.7 percent of the USA GDP.

### New Zealand

These results are supported, on a smaller scale, by two reports looking at the Auckland situation produced by Envision New Zealand. In the *Auckland Recycling Industry Study*, Envision found that in Auckland (population 1.2 million) in 2004 nearly 2,000 people were employed in 103 recycling businesses, with a combined annual turnover of \$147 million. In another report titled *Reclaiming Auckland's Resources*, the estimated turnover of the waste industry was calculated to be around \$162 million per annum. It is interesting that the recycling industry which has far less control over and access to waste resources, manages to almost match the waste industry in annual turnover.

This shows that the recycling industry has managed to create more value from less material; and there are significant other economic impacts such as employment and new business opportunities when compared to the waste industry. In that report Envision also estimates the number of jobs that could be created, if the region were to invest in a network of seven purpose-designed Resource Recovery Parks (a further development of the Materials Recovery Facility model). Based on statistics gathered from existing facilities around New Zealand and around the world, the report conservatively estimates that between 86 and 184 full-time positions could be created in these facilities, the number climbing to around 300 when associated resource recovery activities are factored in. Taking a more liberal approach and using the community-run models in operation elsewhere in New Zealand, the number of jobs could be vastly greater: between 450 and 2,553. This number is significantly higher because organisations running community recycling facilities usually have job creation as a key objective.

Although the Resource Recovery Centres/Park concept is still relatively new and still evolving, there are good examples around the world that show they can become significant employment centres in communities of any size. *Resourceful Communities: A Guide to Resource Recovery Centres in New Zealand* provides case studies of successful facilities in communities ranging from 5,000 to 300,000 people.

Purpose-designed facilities are only one part of the equation however. Without policies that support and encourage waste minimisation, facilities will never reach their full potential in terms of either waste diversion or employment generation. Policies such as user pays, landfill levies, landfill bans and producer responsibility are all necessary to optimise the effectiveness of Resource Recovery Centres and Parks.

### **Container Deposit Legislation as an Employment Generator**

Container Deposit Legislation (CDL) is a waste reduction policy that has been proven to have a significant positive effect on employment. CDL is where a deposit is placed on beverage containers at the point of sale and refunded when they are returned to the retailer or approved collection depots. There are various forms of CDL operating around the world with successful examples in the Pacific region in South Australia and Kiribati. The CDL approach is described in *Getting Serious About Packaging Waste* and *Employment Opportunities from Packaging Waste*.

#### **Kiribati**

In Kiribati ten full-time jobs have been created on South Tarawa as a direct result of Container Deposit Legislation, with an estimated 30 people deriving their main source of income from can and bottle collection through their own efforts. With only around 3,000 people having cash employment in Kiribati outside of the Government, that represents something like 1% of non-government employment. Also, the value of recycled materials exported from Kiribati per year is around \$100,000 per year, in a country with an export income of about A\$13 million (2002). That equates to about three quarters of one per cent of annual exports (0.77%) through exporting what was before just

rubbish! The system could easily be replicated throughout the Pacific by providing high-quality recycled material for remanufacture as well as stable local jobs.

#### **South Australia**

Around 1,700 jobs have also been created in South Australia as a direct result of CDL, most based in the community collection depots scattered throughout communities. The full economic impacts of the SA CDL system are detailed in a report from the South Australian Environmental Protection Authority, detailing the Environmental and Economic Impacts.

## **Extended Producer Responsibility and User Pays Waste Management**

This approach tries to attach the cost of waste management to the products and people who make the waste. This aims for two things, to ensure fairness in that those who make waste pay for their consumption, and that the cost of dealing with the waste is already provided. For waste collections, the ideas of pre-paid bags (like the [Kiribati Greenbag](#)), or tying household waste charges to electricity consumption (as detailed above in the [Okinawa presentation](#)), are both attempts at fairness in who pays for waste management. Much of this approach comes under the general heading of Extended Producer Responsibility (EPR), and CDL is a very good example of that. A great overview of the sort of economic tools that might be available to a Pacific Island nation in dealing with their waste has been provided by a Japanese JICA volunteer working in Fiji. This paper on [Economic Instruments](#) used in Japan is an excellent place to look. The Japanese have worked hard in this area, and another paper on [EPR in Asia](#), and how it is used, particularly in the areas of white goods and computers, is also provided. This area of using economic tools to bring about change is crucial if the PICs are to adequately deal with their wastes in a fair way. Used creatively, the cost of waste management can be shifted to those who are making money from importing the materials in the first place.



# Zero Waste

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## Overview

Understanding the overall effect of material and energy use is the *Big Picture* view that we must begin to consider if we are to create truly ecologically sustainable communities. It is often at the point of waste generation that we start to comprehend this Big Picture. For example, in a world where energy is increasingly expensive, and energy from fossil fuels is having severe adverse impact on the Pacific through Climate Change, the act of recycling an aluminium beer can is far more important than clearing up litter, or saving landfill space. This is the essence of Zero Waste. Waste of materials is also inevitably a waste of energy. This approach ties so many environmental threads together.

Zero Waste sounds difficult? Some would say impossible perhaps. Zero Waste is the condition of Pacific Island cultures prior to the use of imported man-made materials beginning in the nineteenth century. It was how the Pacific Peoples existed for millennia. It obviously worked before, as cultures existed on tiny islands for many generations. Why not again? It is the current way of living, with so much waste, that is difficult, and eventually, impossible.

## Countries Aiming for Zero Waste

### New Zealand

The New Zealand Government has a Zero Waste Strategy developed in conjunction with New Zealand local governments. This is contained in *The New Zealand Waste Strategy* document. This document has four sections: *The Waste Problem*, which discusses why waste matters, defines waste, and also introduces the ideas that one persons waste is another's resource, and also the concept of *Ecological Rucksack*, or Material Intensity Per Service (MIPS). This can also be described as the *Ecological Footprint* of materials and waste, the mark left behind on the natural world from using a material or a service. To quote from page 8 of that report:

*The concept of the ecological rucksack is used to assess the environmental impacts of various products and services. A kilogram of metal obtained from mining, for example, usually requires the processing of tonnes of ore. When you use a product made from that metal it carries its own ecological rucksack. So using the MIPS measure, a ten gram gold ring carries an ecological rucksack of three tonnes! The concept can measure all the ecological effects of producing goods.*

Whilst this report is primarily concerned with a New Zealand context, it is a clear concise look at the issue. It also contains examples from both businesses and communities that have taken steps to tackle these issues of resource waste. This first part of the report also clearly defines some specific aspects of the waste problem, and this is useful when looking at a different location, such as a Pacific Island nation, and deciding what needs to be done. This ties in with making *Integrated Waste Management Plans*.

Section 2 of the report: *A New Direction* looks at *closing the loop* so that the generation of waste is not a straight line process, where something is made, used, and dumped. Closed loop systems are where something is produced, used, and recycled back into reusable materials for production of new things. This is what recycling is, where the item is re-used for the same product, or similar, such as aluminium cans recycled back into aluminium cans, or glass bottles back into bottles. Where something like a plastic bottle is recycled into a plastic post for a street sign, that is *Downcycling*, as the plastic post cannot be used to make plastic bottles at the end of its life. The New Direction outlined in the report leads us to *Extended Producer Responsibility*, and the *Precautionary Principle*. Perhaps the simplest way of starting down this road for Pacific Island nations is *Container Deposit Legislation*.

Section 3: *Taking Action* looks at the relative harm of different wastes, and lays out some priority of actions to take. Again, whilst this written for New Zealand, it can help, in a different place, to identify which may be priority areas, and where to start. This is often the largest problem dealing with waste: *Where do we start?!* The report sets some targets for action. It is very important to have clear targets and a clear set of activities to get there. Targets that are too ambitious may never get off the ground; targets that are too easy may mean that nothing has really changed. Set targets that require effort, but can be reached. This gives confidence to tackle the next round of targets. This section also looks at some of the harder-to-deal-with wastes that are in the wastes stream, such as tyres, computers, used oil.

Note also on page 26, the Christchurch Super Shed that collects discarded items such as bicycles, furniture, and computers from the wastes stream, repairs and resells them. *Taking Action* then goes through a series of sections dealing with legislation, waste reduction, information and communication (people need to know what to do and how to do it), standards and guidelines, and who is responsible to do what. In all, this Zero Waste document is a great resource in itself.

Envision New Zealand has produced the excellent *Road to Zero Waste* which is a very accessible document with lots of practical information about getting to a Zero Waste Society. This material is developed by people with a vast amount of community experience, and contains descriptions of such places as Materials Recovery Facilities that are essential parts of building Sustainable Communities.

If you find you are promoting Zero Waste, communicating that idea to the community is a number one consideration. In New Zealand, the Zero Waste Trust [www.zerowaste.co.nz](http://www.zerowaste.co.nz) produces a *Zero Waste Update* that is a mixture of professional and public information. It serves as a good example of the kind of work that can be done. The Zero Waste New Zealand Trust has been operating for many years now and is a vast pool of experience and knowledge, and a great first stop for those seeking technical assistance in this area. Their work is encapsulated in the *Profile of a National Campaign*, which ties all the aspects of waste reduction and resource recovery in together. This has good information on other efforts internationally.

### Canada

The Canadian province of Nova Scotia has made great strides towards a Zero Waste SWM system. Hit by a collapse in its fisheries and industry in the 1990s, the province moved toward an aggressive *Waste As A Resource* strategy that has results that speak for itself,

having created over 3,000 jobs and diverting half of all waste from landfill. A *video clip, extracted from a film by Dr Paul Connett*, and distributed on the Greenpeace *Road to Zero Waste* CD, shows clearly the progress that has been made. Also, the *Annual Report* from Nova Scotia for 2001 shows how progress and planning have developed.

### United Kingdom

From Scotland the *Zero Waste Manifesto* is a shorter look at the same thing. It contains at the end 12 Steps Towards Zero Waste that is useful, and a good list of references. Greenpeace UK has done considerable work in this area over the last few years, and has produced a guide called *Getting to Zero Waste*. This contains a fairly detailed look at how local governments can move down the Zero Waste path, and so recover useful materials, decrease quantities to landfill, increase employment, and avoid the costs of large landfills (or worse, the large amounts of pollution that come from waste incineration plants).

To assist local governments in this area, Greenpeace has produced a detailed report on Mechanical-Biological Treatment (MBT) of waste, which, in conjunction with other Zero Waste activities, can process the residual waste without resorting to incineration. This report is called *Cool Waste Management* as it minimizes emissions and avoids burning; it is very detailed and involves a processing plant that would be way too large in most Pacific Island contexts. However, the detail does give some excellent insight into waste separation and getting nature to do its work.

### Australia

From South Australia comes a piece of legislation, the *Zero Waste Act*, which sets up a corporation called Zero Waste SA to promote Zero Waste in South Australia. This Act, in Section 17, also provides for a Waste To Resources fund, which is funded in part by levies from landfill operations. In this way the waste of today is used to promote reduction of waste tomorrow. This is a very effective strategy to start to *internalise* the true longer-term costs of waste production and push us off down the road of seriously dealing with waste.

Zero Waste SA is also responsible for producing waste reduction strategies; this way a dedicated office is working on the issue permanently rather than a report being written, which then hangs as there is no implementation mechanism. As well as dealing with Big Picture strategies, Zero Waste SA deals with very simple day-to-day issues, such as: if I do not collect plastic shopping bags from the store, what shall I use in my kitchen rubbish bin for a *bin liner*?

In the Australian Capital Territory, Canberra has been working since 1996 to become a Waste Free community with its *No Waste Activities*, and in 2000 produced a *Next Steps* paper to plan ahead, included here.

### **Kiribati**

In the Pacific Islands, there are also Zero Waste advocates. The IWP Kiribati Project Office has run several competitions under the Akeatemange banner (Zero Waste), and these have proved very effective in reaching out to the population to bring the ideas of Zero Waste to everyday life. A report from early 2005 on the *Akeatemange Competition* for households in South Tarawa details how the competition was conducted, and provides a wonderful set of down to earth facts, information and advice as to how to run such a programme in a small island environment. The experience built up by the IWPK office in this area is very impressive, and they have achieved tremendous results in a place with few resources and a very fragile atoll environment. If you think Zero Waste is too hard for you, look at Kiribati and think again!

### **Incineration**

Incineration is not a viable strategy for any Zero Waste program, even though it might seem attractive on the surface. Incineration would seem to reduce the amount of waste, and even recover energy from the burning process. Surely this is a good thing? Think again. Incineration produces some very nasty chemicals in the process, which cannot be completely removed however good the scrubbers are. And keeping those state-of-the-art systems operating in places like small Pacific Islands is exceedingly difficult. But around a third of the waste remains as ash; the ash is a very difficult material to contain, and easily spreads to the wider environment. Incinerators themselves are very expensive pieces of equipment, and require close expert supervision and operation. But perhaps the

overriding issue is that we will never learn to produce less waste in the first place, or extract the resources in our waste stream, if we take the road of high technology 'solutions' that are no solution at all. The materials and jobs that flow from a Zero Waste resource recovery approach are lost with incinerators. The report *A Dying Technology* details the grave problems inherent in incineration (especially if you happen to live near an incinerator: note that they are not built in the rich suburbs), whilst the *PowerPoint presentation from Dr. Connett to a Waste to Energy Conference* covers the main issues of incineration in a simple manner. Greenpeace has also produced a report: *The Case Against Incineration* that was produced for a proposed incinerator in Australia, and there is also an *Incineration Fact Sheet* that covers the main points.

### **Further Reading**

For those who wish to look at this subject in real depth, Robin Murray, one of the great thinkers on Waste, has written a *book about Zero Waste*, which is provided here in an electronic format. Coming to grips with Zero Waste will bring the solutions to all our waste problems, as Zero Waste is the place to bring them together. This tie up of modern society with waste is also neatly demonstrated in Dr. Paul Connett's *Zero Waste PowerPoint* that graphically illustrates where the world is heading, and where we need to be heading. Dr. Connett has produced several films on Zero Waste, and also, in conjunction with Greenpeace Australia Pacific, a CD that includes a wealth of information on Zero Waste (some included here). Contact Greenpeace Australia Pacific on [www.greenpeace.org.au](http://www.greenpeace.org.au).

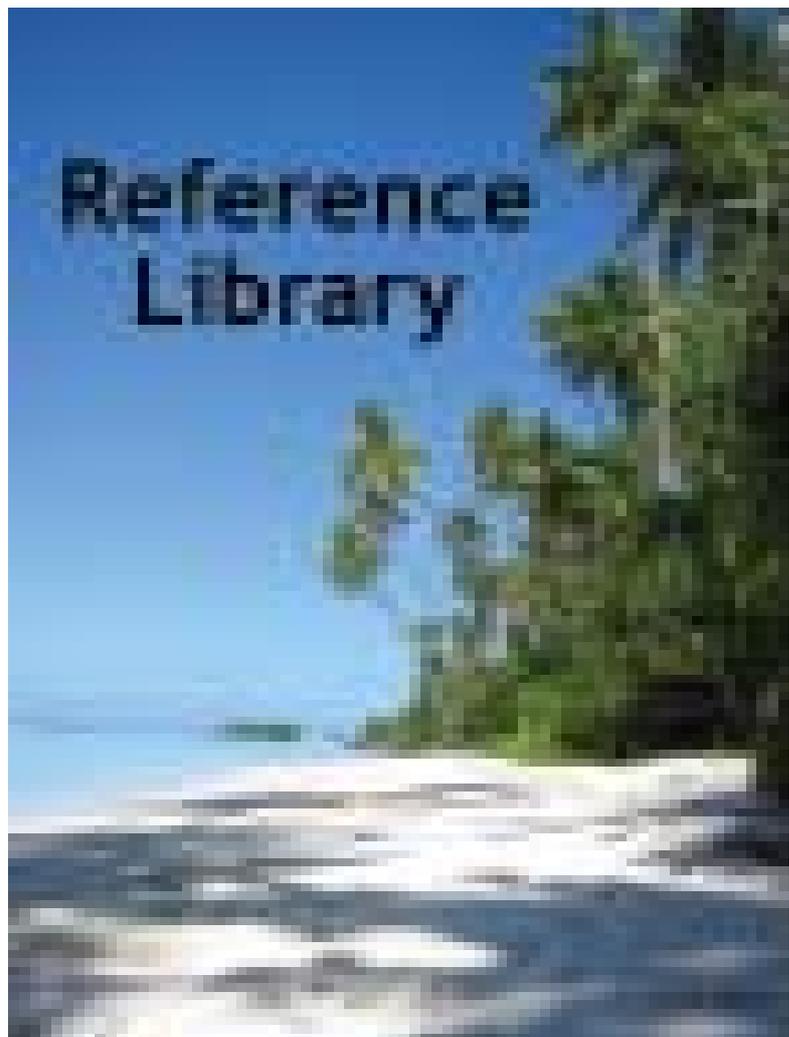
Given that the Zero Waste movement is fortunately a worldwide one, much literature is also available in languages other than English. Covering that is, however, outside the scope of this work.

## Acronyms used and their meaning

ARA	Auckland Regional Council
CD	Compact Disk
CDL	Container Deposit Legislation
CD-ROM	Compact Disk-Read Only Memory
CPU	Central Processing Unit (of computer)
CRT	Cathode Ray Tube (TV or computer screen)
DDT	Dichloro-diphenyl-trichloroethane
DLAB	Drained Lead Acid Batteries
DVD	Digital Video Disc, Digital Versatile Disc
EOL	End-of-Life
EPR	Extended Producer Responsibility
GEF	Global Environment Facility
HS	Harmonised System (tariff)
HDPE	High-density Polyethylene (a plastic)
IWP	International Waters Project
JICA	Japan International Cooperation Agency
LPB	Liquid Paper Board
LPG	Liquified Petroleum Gas
NGO	Non-Governmental Organisation
ODS	Ozone Depleting Substance
OECD	Organisation for Economic Cooperation and Development
PCB	Polychlorinated biphenyl
PCRC	Pacific Concerns Resource Centre
PE-HD	High-density Polyethylene (a plastic)
PE-LD	Low-density Polyethylene (a plastic)
PET	Polyethylene Terephthalate (a plastic)
PIC	Pacific island Country
POP	Persistent Organic Pollutant
PP	Polypropylene
PPE	Personal Protective Equipment
PS	Polystyrene
PS-E	Expanded Polystyrene
PVC	Polyvinylchloride
PVC-P	Plasticised Polyvinylchloride
PVC-U	Unplasticised Polyvinylchloride
SA	South Australia
SAE	Society of Automotive Engineers
SHAR	Specified Household Appliances Recycling
SPREP	Secretariat of the Pacific Regional Environment Programme
SWM	Solid Waste Management
ULAB	Undrained Lead Acid Batteries
UNEP	United Nations Environment Programme
WHO	World Health Organization

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(in French)

The contents of this Handbook plus the entire Reference Library shown above, are contained on the DVD of the Waste Resource Kit. Contact Mark Ricketts (Solid Waste Officer: [markr@sprep.org](mailto:markr@sprep.org)), Jaap Jasperse (Editor and Publications Officer: [jaapj@sprep.org](mailto:jaapj@sprep.org)) or the SPREP Information Resource Centre ([irc@sprep.org](mailto:irc@sprep.org)) for your copy.