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ISLANDS Pacific Ocean

Scoping Study for Bulky Waste Recycling Report



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Our vision: A resilient Pacific environment sustaining our livelihoods and natural heritage in harmony with our cultures.

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Executive Summary

Background

Systems for the recycling of End-of-life Vehicles (ELVs), and other metals streams in Pacific Island Countries (PICs) are limited. Larger PICs have recyclers that recover a portion of the materials of value for export. Some smaller PICs collect and store items which are now stockpiled awaiting export, in other smaller PICs no formal material recovery operations exist.

The lack of comprehensive recycling systems means that ELVs and other bulky waste items are landfilled or stockpiled across the Pacific. Bulky waste includes items such as ELVs, white goods (including refrigerators, washing machines), other electronic equipment (including for example televisions, computers) and heavy machinery. These bulky items continue to be abandoned along roadsides and open spaces or stockpiled in obscure locations and backyards.

The uncontrolled degradation of these materials in the environment is giving rise to environmental issues such as the uncontrolled discharge of hazardous substances (for example some components of bulky waste items include persistent organic pollutants (POPs). POPs are organic chemical substances that are recognized as a serious, global threat to human health and to ecosystems. The environmentally sound disposal of POPs through bulky waste management is a key consideration for this project. Disposal of these materials at waste disposal or dump sites can lead to the creation of breeding grounds for mosquitos.

This report is an assessment of the options for a regional recycling initiative for the management of ELVs, white goods and associated plastics. The PICs considered in the analysis are the *Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Palau, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu*. Swire Shipping has been identified as a strong partner for the Pacific due to potential to use backload capacity to move bulky waste to recycling markets. Swire Shipping has a current role in the Moana Taka Partnership (an initiative formed to 2018 to remove waste from the region through backloading arrangement). Swire Shipping currently operates a shipping network servicing nine out of 14 of the PICs included in this project.

Objectives

The project has four objectives, namely:

- To understand the financial viability of a regional bulky waste recycling program;
- To validate what volumes of material are available for such a venture (legacy and future); and
- To take a regional approach to the assessment and understand what value Swire Shipping's network and opportunity to backhaul cargo can contribute to a regional solution.
- To support future regional processing initiatives within the Pacific including the role of existing shipping networks within the Pacific.

Relevant regional and country initiatives

There is significant work occurring at a country and regional level that should be considered as part of this project. A key regional initiative is a PRIF funded scoping study for a regional recycling network. This is considering regional logistics and centralised processing for the 14 countries and territories also covered by this project. Sixteen different materials, that overlap with this project, are being considered including white goods, ELVs and plastics (for the PRIF study PET and plastic bags). The Recycling Network is expected to include local processing centre(s), trans-shipment, and recycling facilities. For this reason, this study has not included PET or plastic bags in the scope of materials. However, could easily be included in the waste recycling supply chain.

Country level initiatives relevant to this project include feasibility work currently being undertaken to develop or extend Advanced Recovery Fee and Deposit (ARFD) schemes that include bulky waste items. These have been completed or are underway in Cook Islands, Kiribati, Nauru, Niue, Papua New Guinea, Republic of the Marshal Islands, Samoa, Solomon Islands and Vanuatu. Additional detail on the progress of these ARFD schemes is detailed in the relevant sections of the main report. There is an existing scheme covering bulky waste in Tuvalu.

An ARFD scheme has been identified as a key opportunity to address potential funding gaps in sold material revenue and recycling processing, intra Pacific shipping and export logistics. Implementing a legacy clearance programme provides an opportunity to finalise the development of an ARFD scheme for each Country including establishing in country processing and logistics arrangements.

Other key country level initiatives include the Kiribati Scrap Metal Project (legacy clearance program) National Recycling Plan (Nauru), Recycling Centre Development (Niue), National Used Oil Management Plan development (Samoa, Solomon Islands, Tonga and Vanuatu).

Key considerations of bulky waste recycling in the Pacific

There are several key considerations for improving recycling of bulky waste from across the Pacific. These are:

- **Material value –** Scrap metal and other high value items recovered from dismantling bulky waste are traded as commodities so material value is highly variable. Price also reflects quantity (larger volumes can negotiate a higher price, end market location and quality).
- **Material markets –** Current markets fall into two categories. New Zealand and Australia (interim markets where materials are typically sold on to final markets in Asia) and final markets located in Asia where a higher price can often be negotiated. Case studies in the region identified that due to the complexity of commodity export negotiations sometimes securing a reliable market where a close relationship has been built up over time is preferable to seeking higher value for each shipment.
- **Biosecurity -** Scrap metal presents a potential biosecurity risk because it is often stored pre-shipment in conditions that would allow it to become contaminated with soil or infested by insects, snails or other pests. Addressing biosecurity requirements for transboundary scrap metal shipments can increase cost including accessing certified fumigation personnel and equipment, ensuring staff located in country are trained in the inspection of packing of containers with consideration of biosecurity requirements (cleanliness and removal of contamination, certificates and documentation, container sealing).
- **Multilateral Environmental Agreements (MEAs) -** There is wide scale adoption of all conventions (Basel, Stockholm, Waigani, Rotterdam, Minamata, Montreal) that apply across the Pacific region meaning any exports of material will need to adhere to the requirements of convention protocols. Bulky waste items contain a number of hazardous components and materials containing Persistent Organic Pollutants (POPs) which need to be disposed of in an environmentally sound manner. There is a lack of safe disposal options for POPs in the Pacific, meaning items containing POPs are likely to need to be exported for disposal in an approved facility overseas. These transboundary shipments will need to be conducted in accordance with the MEAs listed (Basel, Waigani and Stockholm being key). As a GEF-funded project, a key project performance indicator will be safe disposal of POPs safely.

Current state of in country processes

PICs currently collecting and exporting scrap metal through private recycling or government run programs include the Cook Islands, Fiji, Palau, Papua New Guinea, Samoa, Tonga, Federated States of Micronesia (Yap and Kosrae Provinces) and Vanuatu. Activities are mainly concentrated on the main islands with access to recycling services on outer islands ad hoc or non-existent.

No PIC has a system at this stage where bulky waste items from across the Country (covering outer islands) are collected and processed. Bulky waste is still present in stockpiles or abandoned on public land in across the PICs.

Accessing up to date and correct information on bulky waste management systems is challenging as services availability can change rapidly. Where services are available, they face significant challenges in maintaining consistency of service with disproportionate numbers of equipment breakdowns and funding challenges. Activities in many PICs (Federated States of Micronesia (Chuuk and Pohnpei)), Kiribati, Nauru, Niue, RMI, Solomon Islands, and Tuvalu) are limited to ad hoc government and private collections (often only when funding is available) and storage of a proportion of items at government facilities. Where items are stored the level of depollution is variable. The dumping and uncontrolled stockpiling of items in the environment is a significant issue for all PICs, including those where some recovery is occurring. This is due to a number of factors, one of the largest being the costs associated with the appropriate management of items within the PICs and subsequent onward transport of materials to markets.

Estimate of costs

To evaluate potential approaches to bulky waste management a simple model of costs has been developed. Key cost assumptions and drivers include material value, in country processing cost and shipping cost (incorporating handling and port costs). For this study option costs have been evaluated based on of the following assumptions:

- ***Material value:*** To account for market impacts and other uncertainties associated with bulky waste value, material/item values (at an overseas facility, for example Australia, New Zealand, or Asia), based on low end estimates of material value at current market rates, have been adopted. Lower and upper values have also been presented to illustrate variability in market rates and allow simple sensitivity analysis. It is important to acknowledge that for some items or materials there may be a processing cost (rather than revenue from sale) at the destination market. However, this should not exclude them from consideration for export as it may be a better option than disposing in landfills in the Pacific that may have limited capacity, typically are not well engineered, and in some cases lead to further environmental degradation.
- ***Shipping cost:*** In general shipping costs per tonne were estimated at in the range USD150 to USD180 with a mix of shipping to Asia and Australia/New Zealand. The two exceptions to this range (for modelling purposes) were the Cook Islands (higher costs, in the order of USD300 per tonne to New Zealand) and Papua New Guinea (shipping costs in the order of USD75 per tonne to Asia).
  The shipping rates are all based on 'guideline' rates, effectively the starting point for negotiation.
- ***In country processing cost:*** Between USD44 and USD425 per item (dependant on the complexity of stripping prior to export and nature of item). White goods were at the lower end of the range reflecting relatively simple processing at a small scale. Light vehicles were in the middle of the range, while full stripping of heavy vehicles was at the upper end.

Combining material value, shipping costs and processing costs provides an indication of the net cost of managing bulky wastes for each Country. While the specific costs vary, the modelling suggested that additional funding will be required to support the processing and export of bulky waste for recycling. This assessment holds even for reduced (discounted) shipping costs and increased material values.

Individual country processing options

The viability of processing has been assessed for each individual country. The assessment considered materials value, implementation cost, infrastructure needs, environmental impact, socio-economic impact, and available land area.

The options considered include:

- Option 1: Bulky items depolluted prior to crushing and export.
- Options 2: Bulky items depolluted, and high value items removed through dismantling prior to crushing and export.
- Options 3: Bulky items depolluted, and high value items and all non-metal items removed.
- Option 4: Bulky items stripped and shredded (only considered for larger countries).

The options assessment concluded that:

- Bulky waste processing and export has not been identified as a commercial opportunity at present for any of the PICs assessed. In all cases the cost of collecting, processing, and exporting materials for recycling or appropriate disposal was modelled as exceeding the likely revenue from sale of recyclable materials (predominantly metals). This funding gap needs to be addressed to enable processing and export to become commercially viable.
- There is often a trade-off between the opportunity to further process in country (increasing positive socio-economic impacts and the creation of higher value materials), the potential environmental impact of disposing of processing by products in the PICs and the potential presence and value of the markets being targeted.
- A key limitation to the ability to complete processing in-country, is the safe disposal of materials likely to contain POPs. Without proper engineered landfills no PICs (with the exception of Fiji) have adequate waste infrastructure to dispose of POPs in an environmentally sound manner.
- Where there is capacity and suitable equipment, recovery of high value items is worthwhile. This requires space, suitably trained personnel and appropriate equipment.

The table below (**Table 1**) summarises the preferred option for each country.

Table 1: Preferred option for each country

Country	Option 1 – bulky items depolluted prior to crushing and export	Option 2 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export	Option 3 – bulky items depolluted and high value items and all non metal items removed and exported
Cook Islands			✓
Federated States of Micronesia	✓		
Fiji			✓
Kiribati	✓		
Nauru		✓	
Niue		✓	
Palau			✓
Papua New Guinea			✓
Republic of Marshall Islands	✓		
Samoa			✓

Country	Option 1 – bulky items depolluted prior to crushing and export	Option 2 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export	Option 3 – bulky items depolluted and high value items and all non metal items removed and exported
Solomon Islands	✓		
Tonga			✓
Tuvalu	✓		
Vanuatu			✓

A fourth option was also considered – bulky items stripped and shredded, however the scoping study has not identified this as a preferred option.

Regional opportunities

Several regional opportunities have been identified that may potentially improve the viability or effectiveness of individual country activities. However, none of these will address the current funding gap. This means that while these regional opportunities will improve the viability of recycling for individual countries the analysis completed for this report suggests that funding will be required for clearance of legacy items and sustainable financing schemes required for long-term recovery programmes.

Regional opportunities identified for further consideration include:

- ***Country level ARFD scheme development***

  As noted previously, this is underway in a number of Countries. This is being supported by PacWaste Plus and J-PRISM II in several countries, employing a broadly similar approach. There are however several countries with no existing or planned system in place for bulky waste (Micronesia, Tonga, Fiji).

- ***Improve data***

  The data compiled for this report has limitations - each PIC have different approaches on the recording of material type and quantity data of bulky waste items and in some cases this data is not collected at all and thus not available. Therefore, assumptions were required to enable the projections of legacy and future generation of bulky waste items. For example, customs data, (where available) and in varying levels of detail was used to develop the estimates for this project. In developing detailed proposals and financial models for Country and Regional activity, work should continue quantifying materials availability, shipping arrangements (routes and pricing) and markets for key target materials.

- ***Regional Centre of Excellence***

  Establishing coordinated training and capability development for bulky waste management across the Pacific is an important component of regional support for country level initiatives. While the establishment and ongoing operational costs of this activity will be low compared to processing and shipping materials ongoing technical support including assistance with import/export arrangements and paperwork will be of significant benefit for many PICs.

  This is not an initiative to manage materials in a central location, rather, the Centre of Excellence will support in-country collection and processing (including meeting export requirements).

The outcome will be improved management of the depollution process (for example, removal of lubricating oils, hydraulic fluid) and effective recovery of high value items to improve revenue.

- ***Market coordination***

  While actual marketing of materials will not start until collection, processing, and shipping commences, early work will be required to establish links to key outlets for materials. Work will also be required to link all participating PICs to appropriate shipping routes and develop an appropriate commercial model covering handling costs, shipping and import/export requirements.

  The shipping component of the market coordination is vital to the success of the project. Existing shipping companies with a strong presence in the Pacific are ideal partners for this aspect, for example Swire shipping with extensive operations in the Intra-Pacific region and their experience in the Moana Taka partnership (shipping at cost). The coordinated marketing of materials could be undertaken by a shipping company such as Swire Shipping, leveraging their ability to coordinate the delivery of similar materials from multiple originating ports in order to achieve economies of scale at end markets.

- ***Legacy clearance programme***

  The analysis highlighted the value in a coordinated legacy clearance programme preceding the establishment of ongoing management of bulky waste across the Pacific. A legacy programme provides an opportunity to develop markets for key materials and remove materials that could overload an ongoing recovery programme if not removed. A legacy programme also provides an opportunity to develop and establish processing and in-country logistics arrangements.

  Developing a detailed legacy clearance programme design is an important early activity. This will provide the basis for discussions with potential funders (which may include SPREP, JPRISM, UNEP and other potential funders) and also link with Country level design activity. The implementation of an ongoing recovery scheme needs to consider legacy materials and will require allowance for clearance of legacy items as part of scheme establishment. Coordination of this legacy clearance process across the Pacific will manage cost at an individual country level and avoid duplication of effort in market development, shipping arrangements and capability development for in-country processing and logistics.

  Swire Shipping have indicated willingness to assist with in-region and international shipping logistics for a legacy clearance programme. Subject to detailed logistics planning, this provides access to backload options, along with coordinated delivery to markets that will both reduce cost and maximise the value of recovered materials.

Next steps

Recognising the interdependencies, the recommended next steps for regional activity focussed on bulky waste management are outlined below with a summary provided in the table below (**Table 2**).

Table 2: Preliminary next steps

Activity	Start now	Next steps	Implementation
Country level scheme development			
Scheme design	*Underway in some PICs*		
Legislative process			
Implementation			*Must be in place once legacy clearance is complete*

Activity	Start now	Next steps	Implementation
Improve data			
Material quantity (legacy and ongoing)			
Shipping costs and aggregation logistics		*For specific markets*	
Material markets (access and value)			
Regional Centre of Excellence			*Ongoing*
Mobile Crushing/mobile equipment			*Ongoing*
Market Coordination			*Ongoing*
Legacy Clearance Programme			
Programme Design			
Confirm funding			
Implementation			

Glossary

Term	Definition
ARFD	Advanced Recovery Fee and Deposit
CDL	Container Deposit Legislation
CDS	Container Deposit Scheme
CIGT	Cook Islands General Transport
DDT	Dichlorodiphenyltrichloroethane
ELVs	End-of-life vehicles
GEF	Global Environment Fund
HDPE	High-density polyethylene
JICA	Japan International Cooperation Agency
J-PRISM II	Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries Phase 2
PCBs	Polychlorinated biphenyls
PICs	Pacific Island Countries
PICTs	Pacific Island Countries and Territories
POP	Persistent organic pollutant
SPREP	Secretariat of the Pacific Regional Environment Programme
UNEP	United Nations Environment Programme
UNCTAD LSCI	United Nations Conference on Trade and Development's Linear Shipping Connectivity Index
USD	United States Dollar

1 Introduction

The Secretariat of the Pacific Regional Environment Programme (SPREP) has engaged Tonkin & Taylor International Limited (T+TI) to undertake an assessment of the most favourable option for a regional recycling initiative for End-of-Life Vehicles (ELVs), white goods and plastics.

This project is being undertaken as part of the Implementing Sustainable Low and Non-Chemical Development in Small Island Developing States (ISLANDS) Pacific Child Project. Funded by Global Environment Facility (GEF), the ISLANDS project aims to support Pacific Island countries (PICs) to enter into a development pathway safe from the harmful impacts of chemicals and hazardous wastes.

This analysis covers the 14 PICs participating in the ISLANDS Project: Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Palau, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu.

1.1 Project objectives

SPREP's primary project objective is as follows:

To complete ***"a feasibility study looking at the process, procedures, viability and environmental issues related to collecting and transporting ELVs, white goods, and plastics, dismantling in the region, and then crushing of the steel parts and exporting to recycling markets, and disposing of the POPs[1] component in an environmentally sound manner. This study will include an assessment of opportunities for women in the recycling of ELVs."***

Following project award, an inception meeting was held with representatives from all project stakeholders to confirm all project objectives. The primary objective was broken into four key project objectives, namely:

- To understand the financial viability of a regional bulky waste recycling program;
- To validate what volumes of material are available for such a venture (legacy and future);
- To take a regional approach to the assessment and understand what value Swire Shipping's network and opportunity to backhaul cargo can contribute to a regional solution; and
- To support future regional processing initiatives within the Pacific including the role of existing shipping networks within the Pacific.

1.2 Background / scene setting

1.2.1 Current situation

Systems for the recycling of ELVs and white goods in PICs are limited. Some PICs (generally the larger) have recyclers that recover a portion of the materials of value for export (Cook Islands General Transport (CIGT) in the Cook Islands, Gio Recycling in Tonga, RecycleCorp in Vanuatu amongst others). A significant portion of material in these countries still remains unrecovered. Smaller PICs do sometimes collect items but in an ad hoc manner with large stockpiles forming that await export or processing, in other PICs no formal material recovery operations exist.

The lack of comprehensive recycling systems means that ELVs and bulky waste items continue to be abandoned along roadsides and open spaces or stockpiled in obscure locations and backyards. The uncontrolled degradation of these materials in the environment is giving rise to environmental issues such as the uncontrolled discharge of hazardous substances and creation of breeding ground for mosquitos. These items often contain chemical hazards targeted by the broader ISLANDS Pacific Child

[1] Persistent organic pollutants

Project, including persistent organic pollutants (POPs), such as DDT and PCBs[2], mercury, e-waste, used oil, and plastics in their components.

The degree to which current and future pipeline of activities aim to address the bulky waste recycling issue varies between PICs. Several countries are also considering creating or, where they are already established, extending Advance Recovery Fee and Deposit (ARFD) schemes to cover bulky waste such as ELVs and white goods.

1.2.2 Reverse logistics

Swire Shipping operates a shipping network servicing nine out of 14 of the PICs included in this project. Swire Shipping has identified the imbalance between net imports and exports from these countries as an opportunity to backload empty cargo containers with bulky waste and deliver them to markets for recovery. With a shared interest in managing bulky waste in the Pacific, Swire Shipping, the United Nations Environment Programme (UNEP) and SPREP have come together to explore the possible establishment of a joint venture partnership to develop bulky wastes recycling as a commercial, or at least cost neutral exercise. This builds on the existing Moana Taka Partnership[3].

1.3 Project scope

1.3.1 Countries

The project focuses on the 14 PICs working with SPREP and the UNEP to undertake the GEF-funded ISLANDS Pacific Child Project, with the aim of preventing the future build-up of hazardous chemicals and managing and disposing of existing harmful chemicals across the Pacific. These 14 PICs are: Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Palau, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu **(**Figure 1.1).

[2] Dichlorodiphenyltrichloroethane (DDT), Polychlorinated biphenyls (PCBs)

[3] The Moana Taka Partnership is between Swire Shipping Pte Ltd ("SSL": the ship owning and operating company) and SPREP. Swire Shipping offers their shipping service and shipping container hire free of charge to transport non-commercial waste to end markets which are capable of treating them.

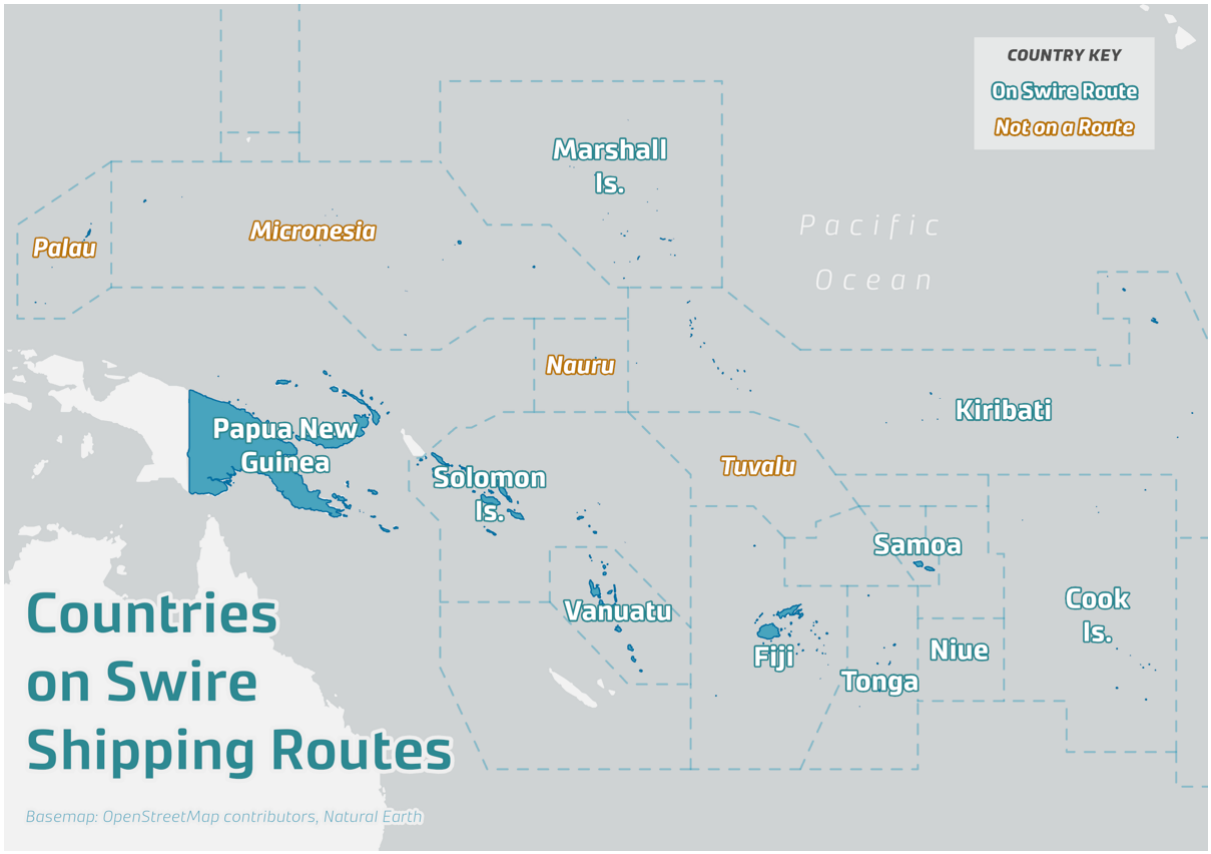


Figure 1.1: Location of PICs included in this project

Information on the demographic characteristics of each of the countries in this project is included in **Table 1.1** and **Figure 1.2.**

Table 1.1: Description of participating countries

Country	Population[4]	Islands (inhabited)	Description
Cook Islands	15,281	15 (12)	The Cook Islands has a total land area of 240 km^2, spread across 15 islands and 2,000,000 km^2 of ocean. Three quarters of the population lives on the main island of Rarotonga, with a further 15 % on Aitutaki. The remainder of the population is spread across 10 islands each with less than 500 people inhabiting them.
Federated States of Micronesia	105,503	607 (65)	Federated States of Micronesia is made up of four different states covering 702 km^2 of land area, spread across more than 600 islands and occupying more than 2,600,000 km^2 of ocean. The state of Pohnpei is largest, covering 345.5 km^2 of land over six major island groups, followed by Chuuk, with seven major island groups totalling 127.4 km^2 of land. Yap has 118.1 km^2 total land area and Kosrae 109.6 km^2.The most populous state is Chuuk (48,564) followed by Pohnpei (36,196), Yap (11,377) and Kosrae (6,661)[5].
Fiji	894,961	300 (100)	Fiji is an island nation with 18,274 km^2 of total land area. Nearly 90 % of this is split across the two main islands Viti Levu and

[4] SPC Statistics for Development Division (2020)
[5] FSM Division of Statistics, Federated States of Micronesia 2000 population and housing census report (2002)

Country	Population[4]	Islands (inhabited)	Description
			Vanua Levu. Approximately 75 % of the population lives on Viti Levu and 18 % on Vanua Levu. The rest of the population is split across the remaining inhabited islands, with populations ranging from just one or two people through to 25,000 people.
Kiribati	118,744	33 (23)	Kiribati has 811 km² of land area. Over half of the population is located on the Tarawa Atoll.
Nauru	11,690	1 (1)	Nauru is a single island nation of 21 km² in size, divided into 14 small districts with populations numbering from about 200 people through to 1,400 people each.[6]
Niue	1,562	1 (1)	Niue is a single island nation with a land area of 262 km². One third of the population resides in Alofi.
Palau	17,930	340 (9)	Palau covers an area of 458 km². Its major populated islands are Koror (11,500) and Babelthuap (Babeldaob) (5,000). Koror and Babeldaob Islands are joined by bridge.
Papua New Guinea	8,934,475	600	The total land area of Papua New Guinea is 462,840 km². This makes it significantly larger than other PICs in this project. The nation has 22 provinces, but the main region is the eastern side of the Island of New Guinea. The national district, where the capital, Port Moresby is located, has a population of 361,222.
Republic of Marshall Islands	54,590	34 (25)	The nation consists of 29 atolls and five coral islands, spanning 181 km² of land. Two chains divide the nation: Ralik, and Ratak. The capital is in the Ratak chain, on the Majuro Atoll, where half the population reside. The atoll with the highest population in the Ralik chain is Kwajalein with just over 20 % of the total population[7].
Samoa	192,126	9 (4)	The island nation has a land area of 2,831 km². Savaii Island and Upolu Island are the two main inhabited islands, with populations of approximately 44,000 and 147,000 respectively.
Solomon Islands	712,071	Approx. 1000 (300)	The nation has a land area of 28,399 km², consisting of six main islands and close to 1,000 small volcanic islands and atolls. Malaita, with 173,000 people, is the most populated province, followed by the island of Guadalcanal at 154,000. The capital, Honiara, is located on Guadalcanal, and is home to 130,000 of its total population.
Tonga	99,780	170 (36)	The Island nation has a land area of 749 km². The main island is Tongatapu, which is home to three quarters of the population. A further seventh of the population resides on the island of Vava'u, with the remainder split across the other inhabited islands.
Tuvalu	10,580	9 (9)	The island nation covers 26 km². Close to 7,000 of the residents inhabit Funafuti Island, which is where the capital, Vaiaka, is situated. Vaitupu is the second most populated island with one tenth of the population.
Vanuatu	294,688	83 (66)	The nation consists of six provinces spread across a land area of 12,199 km². The most populous province is Shefa (98,000), which includes Efate Island with the highest population at 82,000. This is followed by Santo in the Sanma province, with 46,000, and Tanna in the Tafea province with 32,000.

The population distribution in these countries and across the wider Pacific is included in **Figure 1.2**.

[6] Republic of Nauru (2012)

[7] Economic Policy, Planning and Statistics Office, Republic of the Marshall Islands, and the SPC Statistics for Development Programme (2012)

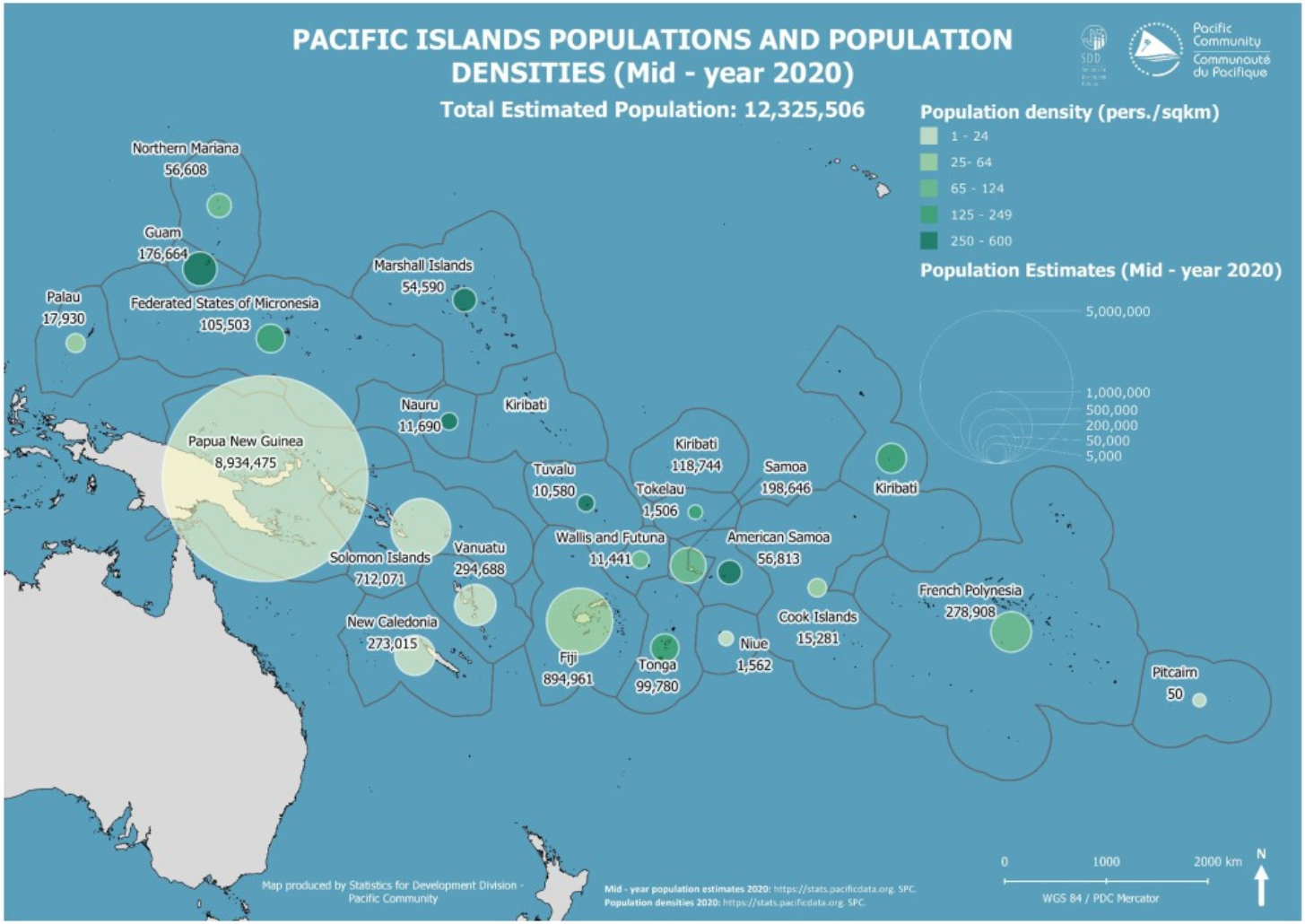


Figure 1.2: Population distribution across the Pacific (SPC Statistics for Development Division, 2020)

The most populous PICs included in this project are Papua New Guinea, Fiji, and the Solomon Islands. These three PICs alone account for over 90 % of the population represented in this project. There are five PICs in this project with populations of less than 20,000 people (Nauru, Niue, Palau, Tuvalu and the Cook Islands). The smallest of these is Niue, with a population of just over 1,500.

Many PICs consist of a number of main islands with urban centres and multiple smaller islands with limited population and economic activity. The research focuses on the main islands where the population (and therefore waste) is concentrated, and smaller communities where waste data is known. For countries with multiple island communities, it is likely that material will need to be transported within country to one or more consolidation points prior to export. While the focus of the research is on materials available per country, country logistics are also addressed where sufficient data is available. Where relevant, multiple ports may require consideration, for example Lae and Port Moresby in Papua New Guinea and Tawara and Christmas Island in Kiribati.

1.3.2 Materials

The materials addressed in this research include ELVs, white goods and plastics. The scope of what is included under each of these three categories is provided in **Table 1.2**.

Table 1.2: Materials included in the scope of this project

Material category	Definition
End-of-life vehicles	A specified vehicle which is discarded or is to be discarded by its registered owner as waste. ELVs in this project include cars, trucks, heavy machinery, boats and motorbikes.
White goods (end-of-life)	Large domestic and commercial appliances such as refrigerators, freezers, dishwashers, washing machines, stoves, microwaves ovens and air conditioners.
Plastics	Low value, often mixed plastics associated with the dismantling and recycling of bulky waste items. Source segregated stockpiles of HDPE and PET awaiting export. Note: PRIF have commissioned a Regional Recycling Network Study which covers plastics (PET and plastic bags).

There is potential for cross over with a Regional Recycling Centre: Scoping Study being completed for the Pacific Regional Infrastructure Facility (PRIF). The PRIF study is also considering regional logistics and centralised processing for the 14 countries covered by this project. The Recycling Network is expected to include local processing centre/s, trans-shipment, and recycling facilities. The Regional Recycling Network Study is considering options for 16 different materials that overlap with this project, i.e. white goods, ELVs and plastics (PET and plastic bags).

1.4 Report Structure

The report is structured as follows:

- Study methodology (**Section 2**) – provides a summary of the research plan.
- Regional overview (**Section 3.1**) – provides a summary of the current regional state of play relating to material export in the Pacific.
- Country overview (**Section 3.2**) – provides a summary of the current legislation, bulky waste management systems, material availability and relevant country inanities in each country.
- Key issues and opportunities (**Section 4**) – a summary of the key issues and opportunities raised through consultation with in-country representatives.

- Option development and evaluation (**Section 5.1 and 5.2**) – a summary of all bulky waste processing options available to PICs.
- Options evaluation - Country Snapshots (**Section 5.3**) – evaluation of bulky waste processing options in the context of individual PICs.
- Regional opportunities evaluation (**Section 5.4**) – evaluation of key regional approaches.
- Implementation and delivery considerations (**Section 6**).
- Conclusion and next steps (**Section 7**).

2 Methodology

2.1 Summary of research plan

Prior to beginning the data collection and analysis for the project, a research plan was developed summarising the proposed project and explaining the overall strategy, methodology, and analyses to be used to successfully achieve the project objectives. The research plan has been attached for reference in **Appendix A**.

The project methodology is broken into the following sections (**Figure 2.1**):

1 Research

2 Evaluate components in place for bulky waste recovery by country and their outer islands (Documented in **Section 3**)

3 Issues and opportunities assessment (Documented in Sections 4 and 5)

- a Country and Regional options
- b Multi criteria analysis

4 Reporting

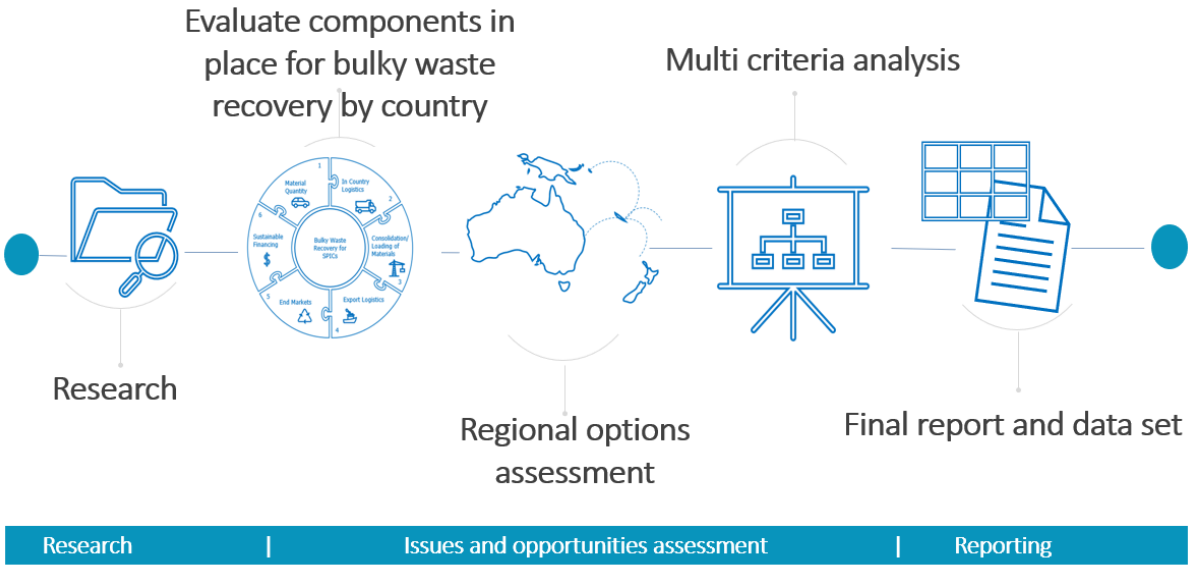


Figure 2.1: Summary of our research approach

2.1.1 Key information sources

Key information sources for this project include:

Previous reports provided by SPREP (note a full reference list is provided at the end of this report):

- Waste audits completed by the EU (managed under the PacWaste Plus programme by SPREP), World Bank, JICA and the International Union for the Conservation of Nature (IUCN)[8].
- Moana Taka Partnership Plus Study Raaynakers (2022).
- Recycling Market Research Report (MRA Consulting Group, 2021).

Liaison and information sharing with consultants undertaking complimentary projects:

[8] Sagapolutele et al. (2019), SPREP (2021f), APWC (2020), T+T (2020), T+T (2021a), T+T (2021b), T+T (2021c), (T+T, APWC, 2020)

- Regional Recycling Centre: Scoping Study – Final Inception Report (ADB, 2022).

Liaison and communication with in-country representatives for up-to-date information on:

- ELV, white goods and plastics waste management and available infrastructure. Conducting of in country interviews and requesting information with recycling companies, waste sector public servants and customs departments.
- Validation of stockpile information collected during the waste audits and/or where necessary additional stockpile assessments undertaken by in country sub-contractors.

2.1.2 Key information limitations

Key information limitations and how they were addressed during this project are listed in the **Table 2.1**.

Table 2.1: Project approach for key information limitations

Item/questions	Research data gaps and limitations	Approach
Material Quantity	• Data quality varies, especially for areas outside of urban centres and remote islands • High level of uncertainty around legacy waste. Stockpile volumes have been estimated but legacy waste at private residences is unknown • Import data for all countries is not available or not at a level of granularity to provide any useful insights	• Focus on areas where data is available (main islands). State clearly where assumptions have been made or data is not available. • Consider impact of a scenario with a large upper bound of legacy waste volumes to explore what risk this would impose on any legacy waste clearance initiative. • Use data for countries where stockpiles on public and private residences are known to help develop assumptions for countries where waste audit reports may not be available for this project. • Undertake additional surveys (where required and appropriate given the project timelines) to develop material quantity estimates. • Make use of data from comparable locations (countries of similar economy/population or TradeMap.org) and state assumptions clearly.
Potential POPs contained in targeted bulky waste	• There is no data on potential POPs contained in targeted bulky waste	• Review literature on POPs content of bulky waste items and components.
Country logistics	• Cost/risk of removal of legacy waste will be variable and difficult to predict where it is not stockpiled • Current services that could be displaced, potential collaborators are not well documented, especially for the informal sector	• As above, consider impact of a scenario with a large upper bound of legacy waste volumes to explore what risk this would impose on any legacy waste clearance initiative. • Draw on knowledge from in country contacts. State clearly where assumptions have been made or data is not available.
Consolidation/ loading of materials	• Current services that could be displaced, potential collaborators	• Draw on knowledge from in country contacts. State clearly where assumptions have been made or data is not available.

Item/questions	Research data gaps and limitations	Approach
	are not well documented, especially for the informal sector	
Export logistics	• Limited publicly available information on shipping costs and processes	• Draw on information from Swire Shipping to fill this research data gap.
End markets	• End markets are characteristically volatile and future trends/prices are difficult to predict • Some key data is commercially sensitive • Large scope of options for markets given the extent of Swire Shipping network across Asia Pacific and beyond	• End market analysis will be kept to a high level – highlighting what materials are likely to have market value now and into the future. • Will draw on work completed to date by PacWastePlus such as the Recycling Market Research Report (MRA, 2021) • Any cost modelling will be built with the ability to change input variables so that impacts due to changes of variables can be understood. • Use conservative (low) default assumptions for material value, note and consider the impact of upper and lower bounds for market value. • Cross check assumptions on end markets with other projects occurring co-currently namely the Regional Recycling Centre: Scoping Study being undertaken by PRIF.
Sustainable financing	• The uncertainty around the quantities of legacy waste has the potential to drain the schemes seed money causing failure • Sustainable financing schemes that are currently planned may not be implemented	• Documenting areas of significant uncertainty for further investigation to provide a satisfactory understanding of legacy waste and ongoing bulky waste generation.

3 Current Situation

3.1 Regional overview

3.1.1 Regional shipping infrastructure

A draft guidance document has been developed on behalf of UNEP and SPREP for the Moana Taka Partnership Plus (Raaynakers, 2022) that includes:

- Key shipping companies and shipping routes servicing the Pacific region.
- Maps of key shipping routes.
- Lists of destination ports of key shipping routes.

The Moana Taka Partnership Plus study documents an established network of shipping routes and ports in the Pacific region servicing all PICs referenced in this project. There are at least 14 international shipping companies operating in the region, covering all 22 Pacific Island Countries and Territories (PICTs) (across wider Micronesia, Melanesia and Polynesia). There are 10 Pacific Rim countries and 25 associated ports that receive shipping from PICs.

As one of the key shipping service providers for the region, Swire Shipping has provided information on their shipping routes relating to this project. These routes are summarized in **Table 3.1**. Swire Shipping currently maintains shipping routes to nine of the 14 PICs included in this study to varying degrees. The PNA Service in particular services many of the PICs from this project. All Swire Shipping routes are mapped on **Figure 3.1**.

Table 3.1: Swire Shipping Routes

Service reference	Countries included (PICs from this project in bold)
CHA Service	South Bound: Singapore, Malaysia, Papua New Guinea North Bound: **Solomon Islands, Papua New Guinea,** New Caledonia, Taiwan, Indonesia, Singapore
ESEA Service	South Bound: Thailand, Singapore North Bound: **Papua New Guinea**, New Caledonia, **Fiji**, New Zealand, Australia, **Papua New Guinea**, Thailand, Singapore
NAT Service	South Bound: Taiwan, China, Japan, Korea, China, **Papua New Guinea**, **Solomon Islands**, New Caledonia North Bound: New Zealand, New Caledonia, Philippines, Taiwan, China, Japan
NAX Service	South Bound: Taiwan, Korea, China, Hong Jong, China, Taiwan, **PNG** North Bound: Australia, New Caledonia, China, Taiwan, China
NGS Service	South Bound: Singapore, Malaysia, Indonesia, **Papua New Guinea** North Bound: **Solomon Islands**, **Papua New Guinea**, Indonesia, Malaysia, Singapore
NZPI Service	North Bound: New Zealand, **Tonga**, **Fiji**, American Samoa, **Samoa** South Bound: **Cook Islands**, **Niue**, **Tonga**, New Zealand
PIS Service	South Bound: Australia, Sydney, Brisbane North Bound: New Caledonia, **Vanuatu**, **Fiji**, American Samoa, **Samoa**, **Tonga**, Australia
PLY Service	South bound: USA North bound: French Polynesia, **Samoa**, American Samoa, **Samoa**, **Fiji**, USA

Service reference	Countries included (PICs from this project in bold)
PNA Service	South bound: Taiwan, China, Korea, Japan, **Republic of Marshall Islands**, **Kiribati**, **Solomon Islands**, **Vanuatu**, New Caledonia, **Fiji**, **Tonga**, **Samoa**, French Polynesia North Bound: **Kiribati**, New Caledonia, **Vanuatu**, New Caledonia, **Vanuatu**, Taiwan, China, Korea, Japan
Papua New Guinea Service	South bound: New Caledonia, Australia, **Papua New Guinea**, **Solomon Islands**, New Caledonia, Australia, **Vanuatu**, **Fiji**, Australia

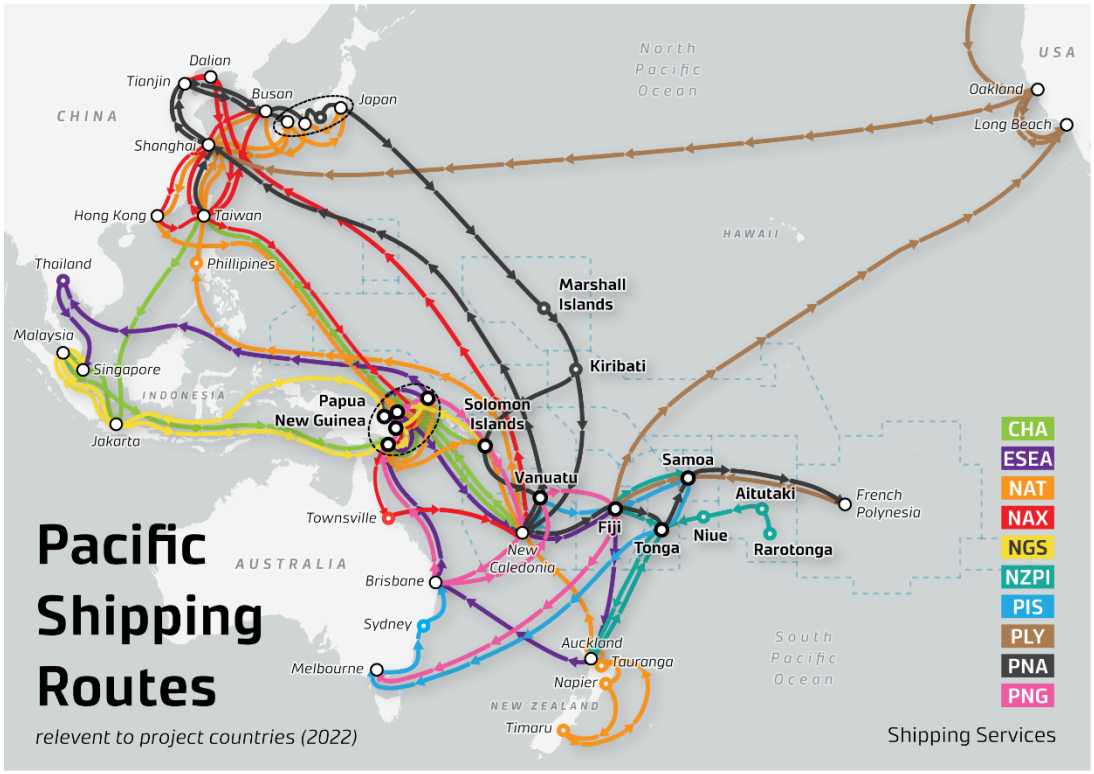


Figure 3.1: Shipping Routes provided by Swire Shipping (as of February 2022 and subject to change)

There are varying degrees of shipping route connectivity in the Pacific region. Smaller PICs are serviced by a smaller number of shipping companies. Ships originating at these ports often consolidate material at a larger port (such as Suva, Fiji) before leaving the region. By comparison, Suva has established itself as a key "hub" port in the region due to its large population, proximity, existing shipping networks and port facilities. Other ports of significance include Port Moresby and Lae among others in Papua New Guinea and Honiara in the Solomon Islands, reflected by the number of Shipping Routes to these destinations maintained by Swire Shipping.

Previous studies[9] have discussed the opportunity to consider hub and spoke shipping models in the context of regional recycling networks to service PICs. A hub and spoke model would allow for the consolidation of material from smaller, remote island nations (such as Palau, Federated States of Micronesia, Tuvalu and Nauru, located at the end of "spokes", feeding into various hubs at locations within the network that have the capacity and shipping network connections to consolidate and transport material to recycler located in Pacific Rim countries (for example, Fiji or Samoa might act as "hubs").

[9] UN Environment (2019). SIDS Waste Management Outlook

Opportunities for a processing/recycling/transhipment hub are also a key focus of the Regional Recycling Centre: Scoping Study being undertaken by PRIF.

Papua New Guinea, Fiji and the Solomon Islands are included in the largest number of Swire Shipping routes. **Table 3.2** summarises information from the Moana Taka Partnership Plus report and information provided by Swire Shipping to demonstrate the connectivity of each of the PICs in this project to Swire Shipping Routes and broader regional shipping providers. Countries in the table are ordered from highest to lowest UNCTAD LSCI (United Nations Conference on Trade and Development's Linear Shipping Connectivity Index) which is an indicator of position in maritime shipping networks.

Table 3.2: Summary of regional shipping infrastructure and Swire Shipping routes to PICs

Country	How many shipping companies[10]	Destination ports[11]	Number of Swire Shipping Routes[12]	Comment on connectivity[13]
Papua New Guinea	6	• Australia • Malaysia • Korea • Japan • Thailand	6	Access to developed countries in both the Pacific and Asia Considered a freight hub due to: - Sophistication of port facilities - Number of shipping companies and destination ports - Central pacific region location - Size of economy Linear Shipping connectivity index (2022): **2.5**
Fiji	11	• New Zealand • Canada • USA • China • Korea • Japan • Taiwan	6	Considered a freight hub due to: • Sophistication of port facilities • Number of shipping companies and destination ports • Central Pacific region location • Linear Shipping connectivity index (2022): **10.4**
Solomon Islands	6	• Australia • China • Korea • Japan • Vietnam	5	• Access to developed countries in both the Pacific and Asia • Located on a number of shipping routes Linear Shipping connectivity index (2022): **8.1**
Samoa	8	• USA • New Zealand • Fiji • Korea • Taiwan • Australia	3	• Access to developed countries in both the Pacific and Asia • Located on a number of shipping routes • Linear Shipping connectivity index (2022): **8.6**

[10] Raaynakers (2022)
[11] Raaynakers (2022)
[12] Information provided by Swire Shipping. Routes as of 10 February 2022.
[13] UNCTAD (2022)

Country	How many shipping companies[10]	Destination ports[11]	Number of Swire Shipping Routes[12]	Comment on connectivity[13]
		• Japan		
Vanuatu	5	• New Zealand • Japan • Korea • Taiwan • Australia	3	• Access to developed countries in both the Pacific and Asia • One a number of shipping routes • Linear Shipping connectivity index (2022): **7.4**
Tonga	7	• New Zealand • USA • Korea • Japan • Taiwan • Australia	3	• Access to developed countries in both the Pacific and Asia • Located on a number of shipping routes Linear Shipping connectivity index (2022): **7.8**
Republic of Marshall Islands	4	• Korea • Japan • Guam • New Zealand • Fiji	1	• Located on a number of shipping routes • Close proximity to Asia • Linear Shipping connectivity index (2022): **7.2**
Kiribati	4	• New Zealand • Fiji • Korea • Japan	1	• Located on a number of shipping routes • Linear Shipping connectivity index (2022): **6.2**
Federated States of Micronesia	3	• Korea • Japan • China • Guam	0	• Not serviced by Swire Shipping currently • Closer proximity to Asian markets • Linear Shipping connectivity index (2022): **4.4**
Palau	3	• Korea • Japan • Hong Kong	0	• Not serviced currently by Swire Shipping • Linear Shipping connectivity index (2022): **2.5**
Cook Islands	3	• New Zealand	1	• Limited connectivity: • Geographically isolated – located further east • Limited current destination ports • Linear Shipping connectivity index (2022): **2.52**
Niue	2	• New Zealand	1	• Geographically isolated • Small economy requires infrequent shipping • Linear Shipping connectivity index (2022): **2.0**
Nauru	1	• Fiji • Solomon Islands	0	• Not serviced currently by Swire Shipping • Geographically isolated

Country	How many shipping companies[10]	Destination ports[11]	Number of Swire Shipping Routes[12]	Comment on connectivity[13]
				• Linear Shipping connectivity index (2022): **1.8**
Tuvalu	1	• Fiji	No	• Not serviced currently by Swire Shipping • Geographically isolated • Small economy requires infrequent shipping • Linear Shipping connectivity index (2022): **1.5**

3.1.2 Relevant regional initiatives

There is considerable investment in improving management of waste and pollution across the Pacific through the Pacific Regional Waste and Pollution Management Strategy 2016–2025 (Cleaner Pacific 2025). This strategy captures the waste and pollution management priorities of the region. It is split into a large number of regional initiatives, implemented with the assistance of donor funding.

Given there is so much activity happening under the Cleaner Pacific Strategy it is important that this project recognizes opportunities for synergies with other key regional initiatives being undertaken. Key initiatives within these strategies relevant to this project is listed in **Table 3.3**.

A timeline and list of regional initiatives is shown in **Figure 3.2** including several initiatives that have already been completed. Relevant country level initiatives are covered separately in **Section 3.2.4**.

Table 3.3: Relevant regional initiatives

Initiative name	Date	Relevance
Pacific waste audits	Past 2019-2021	Between 2019 and 2021, PRIF, SPREP with support of DFAT, UNEP and the World Bank used the PRIF standard Waste Audit Methodology to conduct waste audits in 14 Pacific countries and Timor Leste. These audits were an important investment in establishing waste data at country and regional scales and have been used to substantiate some of the key conclusions of this project.
Cleaner Pacific 2025: Pacific Regional Waste and Pollution Management Strategy	Current 2016-2025	Aims to prevent and minimise generation of wastes and pollution, and associated impacts, recover resources from wastes and pollution and improve monitoring of the receiving environment.
Regional Pacific Nationally Determined Contributions (NDC) Hub	Current 2017+	Initiative emerging from Pacific Island Leaders at the Climate Action Pacific Partnership in 2017 and Fiji's Presidency of COP23. The Hub aims to provide a regional coordinated mechanism to support countries to meet their climate related commitments under the Paris Agreement as part of their NDCs, with provision of tailored assistance to members to produce relevant national policies and measures that action those commitments. The focus is on building in-country capacity to sustain long-term climate action.
PacWaste Plus	Current 2018-2023	The European Union-funded PacWaste Plus programme works with 15 Pacific countries and territories to improve and enhance waste management activities and the capacity of governments, industry and communities to manage waste to reduce the impact on human health and the environment.

Initiative name	Date	Relevance
		The project's work includes (but is not limited to): • Development of a publication on the Moana Taka Partnership which aims to sustainably and cost effectively improve regional management of waste and pollution, including free shipping of low value recyclables. Options analysis/implementation plan development projects for ARFD schemes in multiple countries (Cook Islands, Kiribati, Nauru, Niue, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, and Vanuatu). • Research into recycling market for multiple materials, including all plastic types 1-7 in its various forms), hazardous chemicals, e-waste, metals, and any other product found to have an accessible market. Research on in-country utilisation options for End-Of-Life Tyres in PICs. • Draft - Development of Policy Guidance, and legislative drafting guidance to assist PacWaste Plus countries to undertake the necessary legislative reform processes to effectively license and manage waste management activities, and to include and enforce environmental and waste monitoring requirements on businesses and waste service providers.
Pacific Regional Marine Litter Action Plan	Current 2018-2025	The plan sets out the policy context and key actions to minimise marine litter across the Pacific Island Countries and Territories. Developed to build on Cleaner Pacific 2025, in consultation with all island members.
Options for a Pacific regional recycling network	Current 2021-2022	PRIF scoping study for a regional recycling centre, considering regional logistics and centralised processing for the 14 countries and territories also covered by this project. Options for 16 different materials that overlap with this project are being considered, i.e. white goods, ELVs and plastics (PET and plastic bags). The Recycling Network is expected to include local processing centre/s, trans-shipment, and recycling facilities.
ISLANDS – Pacific Child Project	Current 2020-2026	This project focuses on increasing the capacities of sub-national, national and regional institutions and strengthening the enabling policy and regulatory frameworks to support better management of chemicals and hazardous waste. The countries and territories involved are the Cook Islands, Fiji, Federated States of Micronesia, Marshall Islands, Kiribati, Palau, Papua New Guinea, Nauru, Niue, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu.
Sustainable Waste Actions in the Pacific (SWAP)	Current 2020-2023	The first part of the SWAP project includes development of a regional training program focused on the areas of used oil, disaster waste, marine debris, and sustainable finance mechanisms. The aims of the project include strengthening technical, financial and governance capacities in the Pacific, while supporting populations and local authorities in implementing good practices and helping preserve the natural environment. The countries and territories involved are Fiji, French Polynesia, New Caledonia, Samoa, Solomon Islands, Tonga, Vanuatu, and Wallis and Futuna. Relevant to this project is the **National Used Oil Management Plan** (2021/2022) which is a Feasibility study for used oil management, and development of a National Used Oil Management Plan for Samoa, Solomon Islands, Tonga and Vanuatu. Safe management options for used oil is an important consideration of best practice bulky waste management.
Nature 2030 – IUCN Programme 2021-2024	Current 2021-2024	Working with governments and regional organisations to support implementation of multilateral environmental agreements, national biodiversity strategies and action plans, and build regional coordination/cooperation.

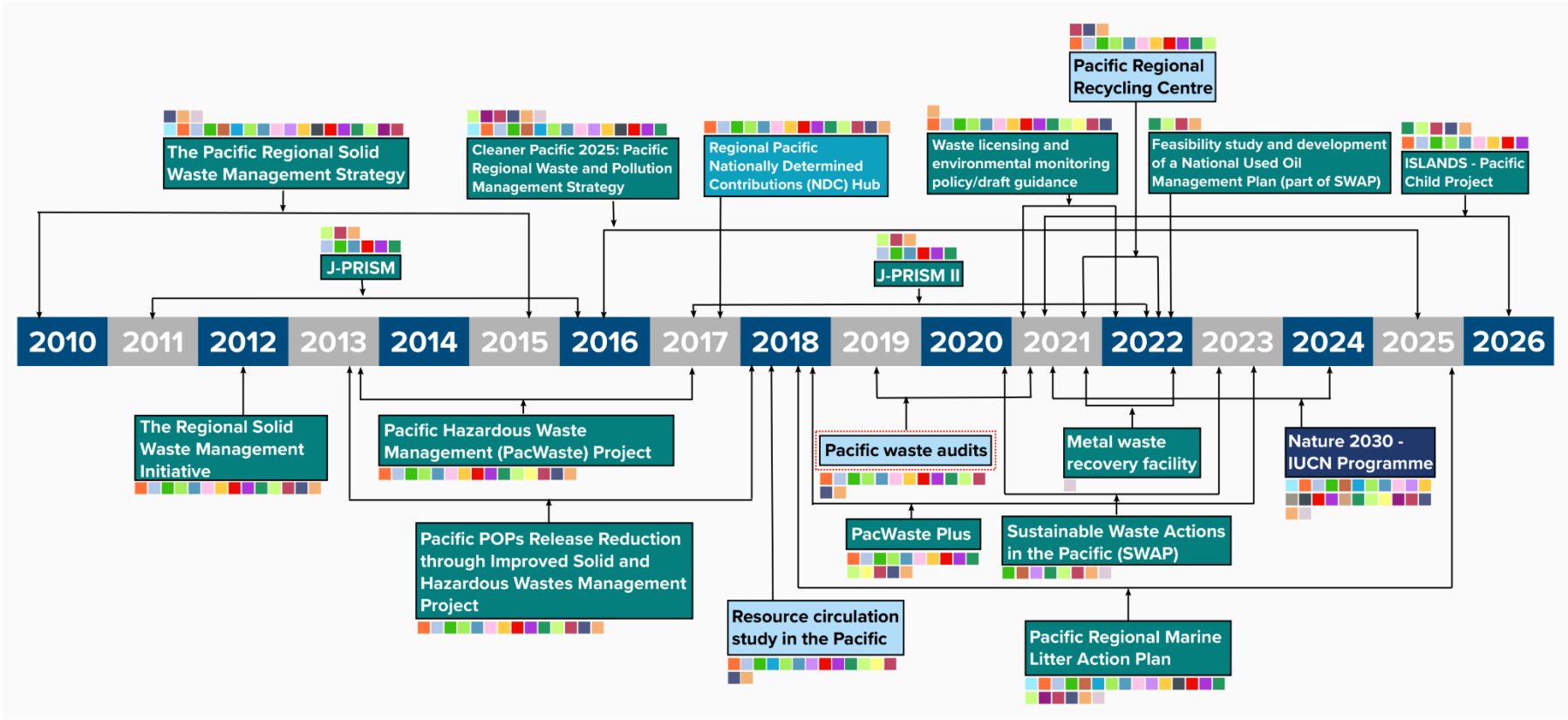


Figure 3.2: Timeline of regional initiatives (2010 to 2025)

3.1.3 Material markets

Recent work commissioned by SPREP that focuses on understanding what export markets are available to PICs includes:

- SPREP - Recycling Market Research Report, (MRA, 2021)
- PRIF - Regional Recycling Centre: Scoping Study, Final Inception Report (ADB, 2022)

There are limited domestic or regional markets for recyclable materials in PICs. For the value of material to be recovered, it needs to be transported and sold to international markets where demand is present.

The Recycling Market Research Report included a review of legislation to understand regulatory barriers to accessing recycling markets, and to determine the most viable export destinations. Potential market destinations were categorized as easy, medium, or difficult reflecting the level of administrative requirement and cost burden to reach these markets. Some of the countries listed are net exporters of scrap so would be a temporary destination (potentially for further processing) prior to export. A summary of the potential markets and their characteristics from this report is included in **Table 3.4** and **Table 3.5**. Fiji has been added to the market destinations and did not form part of the markets identified in the Recycling Market Research Report.

Table 3.4: Identified markets for ferrous metals (including depolluted white goods and ELVs)

Market destination	Market destination category[14]	Interim or destination market
Fiji	Moderate	Interim
Australia	Easy	Interim[15]
Hong Kong	Easy	Final
Korea	Easy	Final
New Zealand	Moderate	Interim[18]
Philippines	Moderate	Final
Malaysia	Moderate	Final
Indonesia	Moderate	Final
Japan	Moderate	Final

Note: Easy, Moderate refers to regulatory requirements and transport links.

Table 3.5: Identified markets for mixed unsorted plastics

Market destination	Market destination category[14]	Interim or final destination market	Comment
Australia	Difficult	Interim	High quality standard
Philippines	Moderate	Final	
Malaysia	Moderate	Final	
Indonesia	Difficult	Final	High quality standard

[14] MRA (2021)

[15] Domestic recycling markets are available however anecdotal evidence suggests consolidation of imports from the Pacific for export offshore is a common place activity.

It will need to be confirmed that the identified markets to receive and process recyclables (as per **Table 3.4** and **Table 3.5**) will accept the specific materials proposed at time of shipment. Some countries have bans on items, and market rules are often changing.

The case study below illustrates the benefit of long-term relationship with a materials buyer in some situations.

Case Study – CIGT (based in Rarotonga, Cook Islands) and Global Metal Solutions NZ

Cook Islands General Transport (CIGT) has a long-standing relationship (over 20 years) with Global Metal Solutions (GMS) in Hamilton. GMS have taken all of CIGT's product since the start of their operations. CIGT is provided with a MPI checklist by GMS to ensure that the items ready for export meets the quarantine requirements prior to shipment. The checklist is then attached to the Bill of loading and commodities list which provides the description and weight of the items.

Once the items are packaged and ready, a local fumigation company sprays the items and issues a fumigation certificate. All the handling and clearance is the responsibility of GMS once the shipment arrives in New Zealand. GMS re-processes the bales for on sells to Asian markets.

Consultation with CIGT revealed the value (long standing working relationship and mutual understanding of how the markets can change. For example CIGT will hold onto materials when the value of the market is low and then ship when prices increase) they placed on the consistency and reliability of the market they deliver to.

Engine oil is captured recycled or repurposed, batteries are removed for recycling, tyres and wheel rims are on sold, become scrap metal or are made available to the public to use for gardening or farming. Any remaining by-products from the recovery process that have no value for export is disposed of at the Rarotonga Waste Facility.

CIGT requires ongoing support from Government and development partners through the provision of funds to source and purchase equipment, provide specialised training, as well as operating subsidies to sustain the operations and service proposed.

Bulky waste from the Pa Enua (outer islands) could be transferred to Rarotonga, for the materials to be processed which would include baling, shredding and compacting for onward transport to New Zealand to be repurposed, recycled or resold to markets abroad.

3.1.4 Material value

Traded as commodities, the value of recycled items and their material constituents (primarily non-ferrous metals) fluctuate considerably due to market factors. For instance, the price of scrap metal is strongly tied to the price of virgin material.

When the price of virgin material increases people look to substitute costly virgin material with scrap metal. Currently scrap metal prices are high as shown in the trend graph in **Figure 3.3**. the prices shown are not necessarily indicative of what price could be fetched for scrap metal as factors such as location, quality and volume effect price (as discussed below). What this information does show is the large fluctuations in price.



Figure 3.3: London Metal Exchange (LME) historical closing prices, [16]

Material value is also dependent on:

- Volume (typically larger quantities fetch higher prices) Some PICs lack the volumes or infrastructure to process bulky waste items into significant quantities
- Condition (the cleaner and less contaminated the scrap the higher price)
- Location

While New Zealand and Australia have some of the closest and most well-connected recycling markets in proximity, these locations will have a lower offer price for scrap metal since materials are on sold to the Asian market for profit. Shipping and logistical costs to various ports differ greatly and would require reassessment at the time when materials were ready to be sent to market.

Table 3.6 shows some spot market prices for scrap metal in the last 24 months with an example of a recent low and high prices for 2022 in New Zealand and Taiwan.

Table 3.6: Indicative market prices comparing New Zealand and Taiwan prices (high and low) over last 24 months

	NZ price low in last 24 months	Taiwan Price low last 24 months	NZ price high last 24 months	Taiwan Price High last 24 months
Light scrap steel US ($/t) unless otherwise stated	NZ $175 US $122[17]	$224	NZ $340 US $237[17]	$570

[16] https://www.lme.com/Market-data/Reports-and-data/Historical-data-for-cash-settled-futures
[17] Conversion used $0.7 US to NZ $1

To account for market impacts and other uncertainties associated with bulky waste value, for modelling purposes this project has adopted material/item values (at an overseas facility, for example Australia, New Zealand or Asia) based on low end estimates of material value at current market rates. Lower and upper values have also been presented to illustrate variability in market rates and allow simple sensitivity analysis. The lower, upper, and adopted values for target materials for this project are shown in **Table 3.7**. For some items or materials there may be a processing cost (rather than revenue from sale) at the destination market. However, this should not exclude them from consideration for export. This may be a better option than disposing in landfills in the Pacific that may have limited capacity, typically are not well engineered, and in some cases lead to further environmental degradation.

For POPs containing residual materials (plastics, textiles/seats with flame retardants) the values noted reflect the cost of transport from port to landfill and landfill gates rates in Australia and New Zealand. There is potential for these materials to be processed through appropriately configured energy from waste facilities with costs anticipated to be similar based on current developments in Australia and New Zealand.

Further detail on material values and their application to target bulky waste items is provided in Appendix E.

Table 3.7: Estimated value of export material (refer Appendix E)

	Material/item value (USD$/tonne)		
	Lower value	**Upper value**	**Adopted value**
ELV – whole	$50	$200	$50
Light steel	$50	$200	$90
Whiteware – whole	-$20	$0	$0
Residual mixed plastic waste from bulky waste recycling	-$100	$50	$0
POPs containing residual materials	-$250	-$150	-$200

The values shown in **Table 3.7** are indicative only and have been generated to enable modelling and comparison of different options for bulky waste recycling and the actual value will be subject to the market prices and material specific characteristics at the time of shipment.

3.1.5 Pacific-wide material availability

This project focuses on material availability in three forms, which includes:

- Formal stockpiles of segregated bulky waste that is ready for export
- Informal stockpiles of legacy bulky waste that is abandoned/dumped/stored on private property. This material would require a coordinated mission to survey, quantify and retrieve waste
- The generation of bulky waste into the future

There are significant challenges with estimating the likely volumes of each of the three forms of bulky waste listed. Within the scope of this project, it was not possible to map every abandoned item. The scale of the task is especially challenging when considering that some of these island nations are made up of many remote islands.

Based on a number of assumptions and a combination of customs, census and survey data, this project has produced a range of potential estimates for the magnitude of material available in each PIC in the three forms listed above.

The full methodology for this derivation for each PIC is provided in **Appendix B**. The information has been produced to inform this scoping study only, with estimates limited to magnitude and lower and upper bounds provided. These numbers should be refined through further data consolidation if this project progresses to feasibility and business case level.

Heat maps combining country data and showing the scale of material available are provided in **Figures 3.3**, **Figure 3.4** and **Figure 3.5**.

Assumptions associated with the heat maps are defined below:

- The only PIC to have an ARFD currently in place for bulky waste is Tuvalu and this is not currently working effectively for bulky items. Currently only aluminium cans are exported. Bulky items are stockpiled. The numbers presented are therefore prior to the introduction of any ARFD scheme.
- White goods include refrigerators, freezers, dishwashers, washing machines, stoves and air conditioners.
- ELVs include cars, trucks, heavy machinery, boats and motorbikes.
- For future projections:
  - Customs import data was used to estimate ongoing generation of bulky waste items.
  - Where customs data was not available vehicle ownership or census data was used.
  - For ELVs the default assumption was that 3% are imported new and 97% as used.
  - It was assumed that vehicles were scrapped at 20 years.
  - Legacy vehicles are only considered from 1995 onwards, reflecting low ownership and limited data prior to this time.
  - For white goods it was assumed 95% are imported as new and 5 % imported as used with a scrappage age range 8-12 years, thus 10 years.
  - Census data was used to estimate white goods quantity in Niue and Palau.
  - Legacy white goods are only considered from 2005 onwards.
  - A five year rolling average was used to account for variability in scrappage age and age at import.

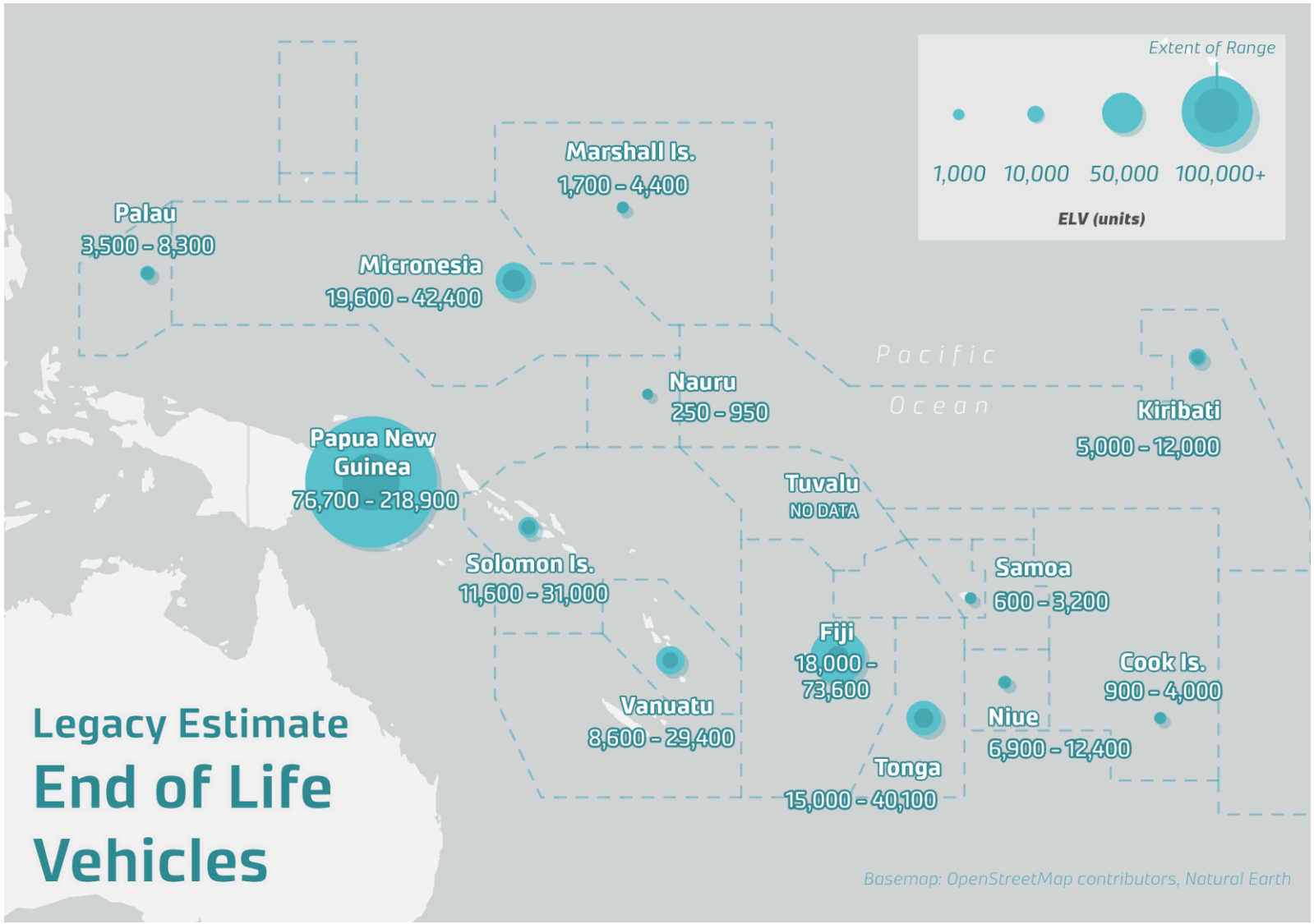


Figure 3.4: Estimated legacy material awaiting export - End-of-life Vehicles

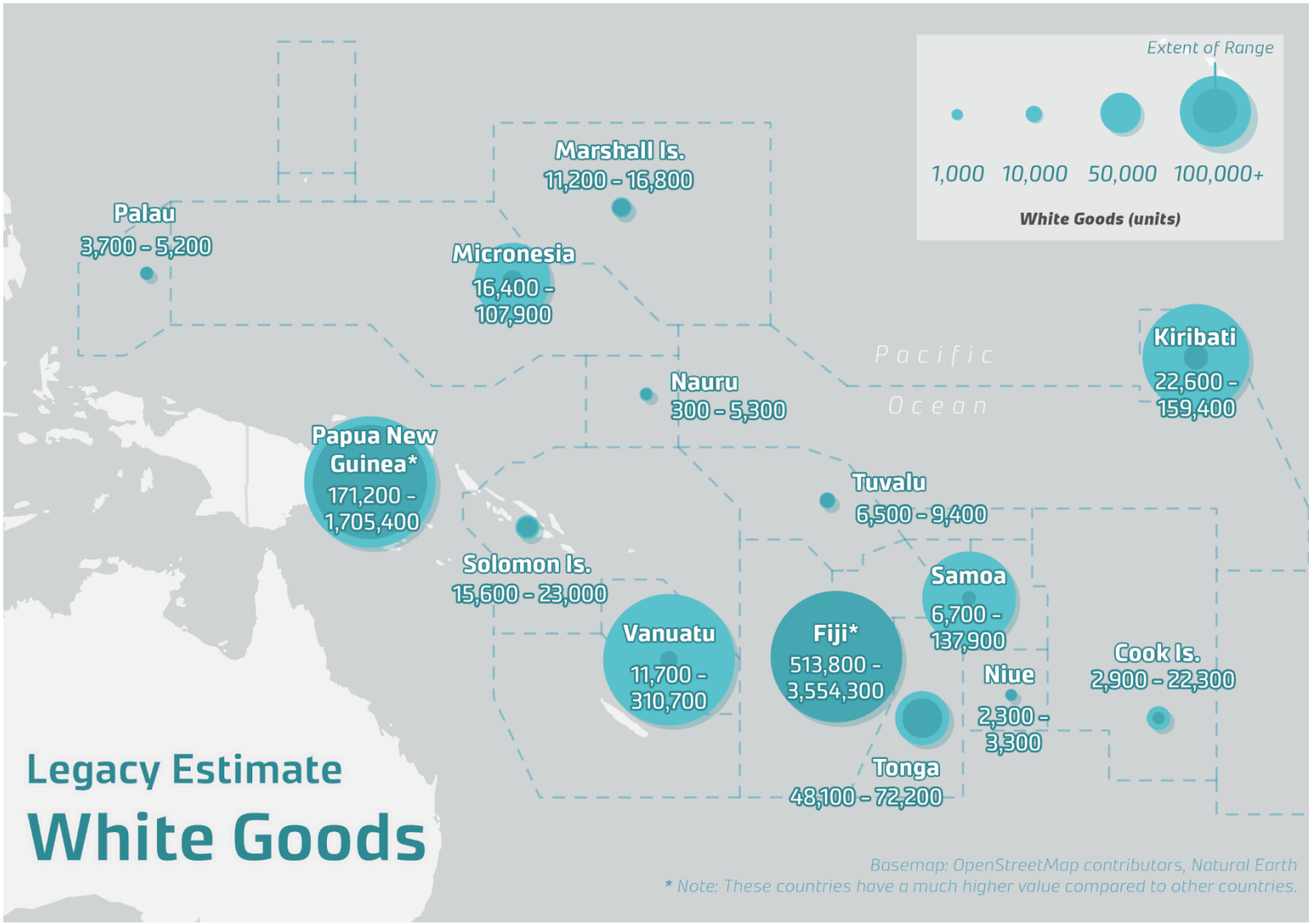


Figure 3.5: Estimated legacy material awaiting export - End-of-life white goods

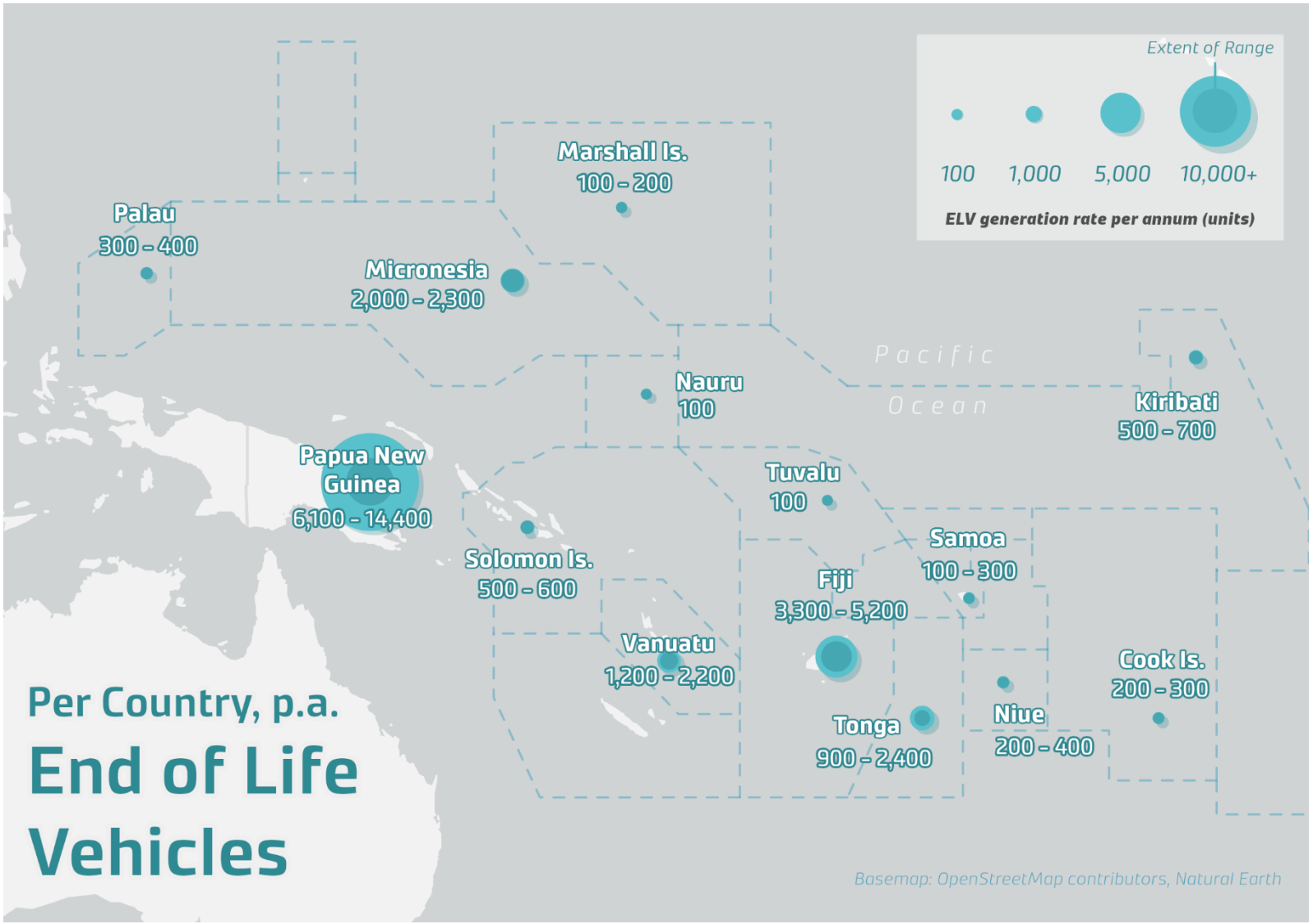


Figure 3.6: Estimated annual bulky waste generation - End-of-life Vehicles

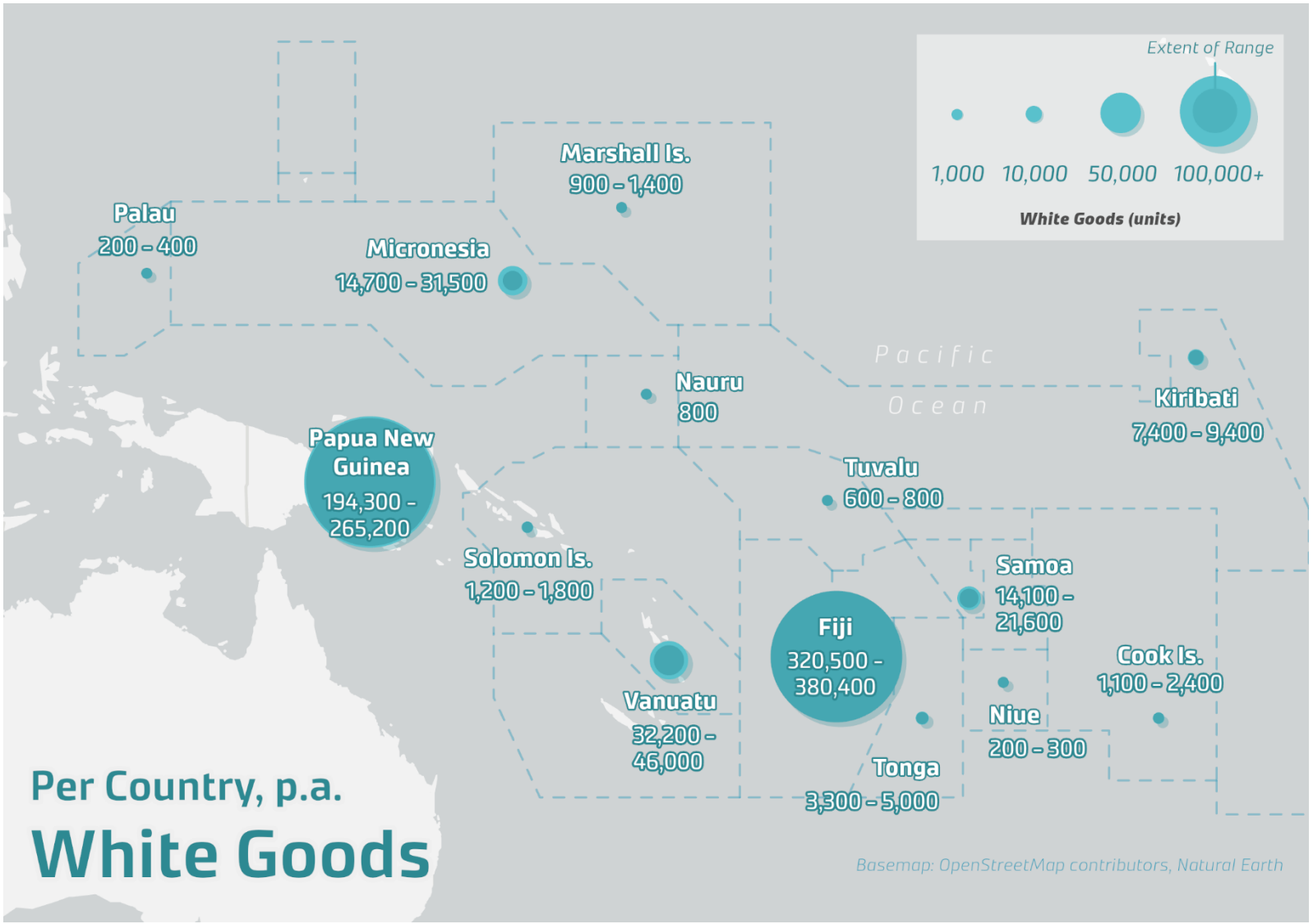


Figure 3.7: Estimated annual bulky waste generation - white goods

3.2 Country overview

3.2.1 Legislative arrangements

3.2.1.1 Multilateral Environmental Agreements

A number of Multilateral Environmental Agreements (MEAs) have been developed to assist in addressing issues associated with the transboundary movement of waste. MEAs relevant to the transportation of bulky waste in the Pacific are listed in **Table 3.8.**

Table 3.8: MEAs relevant to transportation of bulky waste in the Pacific

Convention	Materials addressed	Relevance
Basel convention on the Control of Transboundary Movements of Hazardous Wastes and their disposal	Hazardous components of ELVs (leaded fuel, used oil) Plastics Hazardous components of white goods (ozone depleting refrigerants)	Many by-products of recovery of scrap metal from ELVs and white goods are party to Basel Convention requirements. Exported items need to be free of these contaminants. Plastics a Party to Basel convention requirements as of the 2019 update.
Stockholm convention On Persistent Organic Pollutant	Persistent organic pollutants (POPs)	POPs are present in ELVs and white goods, some plastic types contain dioxins, or can act as carriers for POPs. Burning of these plastics can release these dioxins subjected to combustion conditions. Annex A-C of the Stockholm convention details those chemicals targeted including brominated fire retardants. POPs remain intact for exceptionally long periods of time, can become widely distributed through the environment, can accumulate in living organisms including humans, and are toxic to both humans and wildlife.
Waigani convention	Hazardous substances (toxic, poisonous, explosive, corrosive, flammable, ecotoxic and infectious) and radioactive wastes	Hazardous components of ELVs and white goods fall under this convention. The convention applies the strict controls of the Basel Convention to the Pacific region to ensure hazardous waste cannot travel from New Zealand or Australia to another Pacific country or to Antarctica.
Rotterdam convention	Hazardous chemicals (pesticides and industrial), including lead and mercury	Promotes sharing of information between countries on trade in hazardous chemicals to help protect against unwanted imports of hazardous chemicals. Some older car parts contain lead, mercury, and more (Rotterdam Convention, 2010).
Minamata convention	Mercury	Some older car parts contain Mercury.
Montreal Protocol and the Vienna Convention	Refrigerants	Relevant to the safe handling and extractions of Ozone Depleting Gases from white goods, and air condition units.

SPREP (through PacWastePlus) commissioned a review of waste legislation focussing on relevant global and regional legal frameworks and conventions related to waste management for the 14 Pacific region countries in March 2021[18]. In summary, all countries included in this project are member to at least one of these conventions, with the Stockholm convention being the most widely adopted. A summary of the status of MEA adoption across participating countries is provided in **Table 3.9**.

Table 3.9: Summary of MEA adoption across countries involved in this project (SPREP, 2021)

Country	Basel Convention	Stockholm	Waigani	Rotterdam	Minamata	Montreal	Pipeline activity
Cook Islands	Yes – A[19]	Yes – A	Yes - R	Yes - A	Not party	Yes	n/a
Federated States of Micronesia	Yes - A	Yes – R	Yes - R	Not party	Not party	Yes	Minamata, Initial Assessment undertaken in 2018.
Fiji	Not party	Yes – R	Yes - R	Not party	Not party	Yes	n/a
Kiribati	Yes - A	Yes – R	Yes - R	Not party	Yes - A	Yes	n/a
Nauru	Yes - A	Yes- R	Not party	Not party	Not party	Yes	n/a
Niue	Not party	Yes- R	Yes - R	Not party	Not party	Yes	Ratification of Basel, Minamata and Rotterdam Conventions.
Palau	Yes - A	Yes- R	Not party	Not party	Yes - R	Yes	n/a
Papua New Guinea	Yes - A	Yes- R	Yes - R	Not party	Not party	Yes	n/a
Republic of Marshall Islands	Yes - A	Yes- R	Not party	Yes - A	Yes - A	Yes	n/a
Samoa	Yes - A	Yes- R	Yes - R	Yes - A	Yes - R	Yes	n/a
Solomon Islands	Not party	Yes- R	Yes - R	Not party	Not party	Yes	n/a
Tonga	Yes - A	Yes – A	Yes - R	Yes - A	Yes - A	Yes	n/a
Tuvalu	Yes - A	Yes- R	Yes - A	Yes - A	Yes - A	Yes	n/a
Vanuatu	Yes - A	Yes- R	Yes - R	Yes - A	Yes -A	Yes	n/a

Key:

Green = Ratification or Accession has occurred

R = Ratification, A = Accession

[18] The University of Melbourne on behalf of SPREP (2021)

[19] Cook Islands is the only country also party to the Basel Ban amendment (as of 2019)

There is wide scale adoption of all conventions across the Pacific region meaning any exports of material will need to adhere to the requirements of convention protocols. The de-pollution of items to adhere to MEAs (examples listed in **Table 3.8**) will reduce the legislative barriers to material exports.

The ratification of these MEAs is significant when considering the management of removed materials, a number of which are hazardous and addressed by the MEAs listed above. Materials that contain elements controlled under the Basel Convention cannot be exported without the relevant Basel permits. This means scrap metal recovered from bulky waste cannot contain toxic or heavy metals or hazardous fluids. These include but are not limited to:

- Oils
- Diesel/fuel
- Batteries
- Lead containing parts (battery connectors and wheel weights)
- Cadmium
- Refrigerants (CFCs in refrigerators and freezers)
- HCFCs in air conditioners
- Brominated or halogenated flame retardants
- Upholstery (containing poly brominated flame retardants)
- Mercury containing devices (such as mercury switches)
- Chromium contaminated steel

Each MEA has a different method of ensuring compliance is met and almost all MEAs require parties to self-report on their national performance. To ensure compliance, inspections may be required pre, during and post decommissioning of materials. Where materials have inadequately been decontaminated, the exporter is responsible for the reimportation and disposal of material.

Bulky waste items contain a number of hazardous components and materials containing Persistent Organic Pollutants (POPs) which need to be disposed of in an environmentally sound manner. There is a lack of safe disposal options for POPs in the Pacific, meaning items containing POPs are likely to need to be exported so they can be disposed of in an approved facility overseas. These transboundary shipments will need to be conducted in accordance with the MEAs listed (Basel, Waigani and Stockholm being key). As a GEF funded project a key performance indicator of the project will be POPs safely disposed of.

3.2.1.2 Country legislation

To date, significant work has been completed summarizing the current situation in participating countries in relation to waste management. Recent studies include:

- Assessment of Legislative Frameworks Governing Waste Management country reports; and
- National Waste Legislation Stocktake Country Reports.

Several recent donor-funded projects support countries looking to implement or expand sustainable financing systems, such as ARFD systems, to fund waste management activities. A series of feasibility studies was undertaken to understand products that could potentially be included (which includes bulky waste items), alongside what provision for legislative support would be required for such initiatives. Through the PacWaste Plus Programme, feasibility studies considering establishment or expansion of ARFD schemes have been undertaken in the Cook Islands, Kiribati, Nauru, Niue, Papua New Guinea, Republic of the Marshall Islands, Samoa, Solomon Islands and Vanuatu.

In countries where ARFD schemes are already in place no scheme addresses bulky wastes except for Tuvalu.

A table summary of key bulky waste related legislation is included in **Appendix C**.

3.2.1.3 Biosecurity considerations

Biosecurity has been raised as a risk for ongoing consideration. The requirements will depend on the destination for materials, materials in containers being transferred between cargo vessels are unlikely to be subject to biosecurity controls at the trans-shipment port. Scrap metal presents a potential biosecurity risk because it is often stored pre-shipment in conditions that would allow it to become contaminated with soil or infested by insects, snails or other pests. Fumigation by certified personnel is the key control in the management of biosecurity risk in transboundary shipments of scrap metal. **Table 3.10** lists some of the biosecurity activities for countries listed in this study.

Table 3.10: Comment on biosecurity requirements from key countries

Country	Biosecurity activities with associated cost
Fiji	• Fumigation when items are placed inside (by approved technicians)
New Zealand	• Fumigation or heat treatment at POFA within 12 hours of arrival • 6–sided inspection at the POFA, then scrap metal inspection within 4 hours of TF unloading[20] • Low contaminant threshold levels for regulated biosecurity contaminants (i.e. plant material is prohibited).
Australia	• Cleanliness declaration for containers • Methyl Bromide treatment • Scrap metal imported from Country Action List (CAL) locations (including Federated States of Micronesia, Palau, Papua New Guinea, Samoa, Solomon Islands, Vanuatu for this study scope) are re subject to heightened biosecurity measures on arrival including mandatory inspection.

Key considerations relating to biosecurity for transboundary scrap metal shipments include:

- There may be increased processing cost with achieving cleanliness requirements of any bulky waste processed given recycling activity undertaken in PICs is generally undertaken outdoors with items sources from outdoor stockpiles and with limited space for stockpiling recovered material out of the elements.
- Ensuring that countries looking to export scrap metal have access to certified fumigation personnel and equipment.
- Staff located in country are trained in the inspection of packing of containers with consideration of biosecurity requirements (cleanliness and removal of contamination, certificates and documentation, container sealing).

3.2.2 Infrastructure

The sophistication of recycling activity varies across the participating PICs and their outer islands. In smaller island nations, material is collected and stockpiled awaiting export and no formal material recovery operations exist. In larger island nations, the scale of material available makes material recovery for export a semi viable business for private operators. For most PICs in this project, “recycling” of bulky waste is limited to stockpiling of bulky waste items at public facilities. Any further recycling activity is limited to waste pickers and the general public, removing components of end-of-life goods for re-use.

[20] Western, M. (2011)

The majority of bulky waste is abandoned on roadsides, public, and private land. Some PICs have an established government run recycling programs, as is the case for Tuvalu, where the PIC is able to export aluminium cans as part of their government run ARFD scheme, however their bulky waste is not currently exported.

The project has categorized participating countries by level of sophistication of current recycling practices.

- Level 1 – Some items disposed to landfill with no sorting
- Level 2 – Some material in segregated stockpiles at public facilities
- Level 3 – Some materials are segregated into stockpiles, and exports are being undertaken regularly (i.e. at least one set of exports in the previous year)

Table 3.12 provides a high-level overview of the activities being undertaken by each country or territory with respect to bulky waste disposal, sorting and exports. Materials are represented by the colour coding in **Table 3.11**. The table indicates whether or not the activity is currently being undertaken by a stakeholder in country that could be partnered with to grow capacity. No PIC currently has a system in place that addresses all bulky waste, even where recyclers are present, they often only are able to process a small portion of total material available. Recycling activity, where undertaken, is often only undertaken on the mainland, with ad hoc collections in outer islands or no collections at all. **Table 3.12** also notes how bulky items are typically managed on outer islands.

The existing waste management system for each specific material is further discussed in the sections below. Profile summaries of detail collected on each country are provided in **Appendix D**.

Table 3.11: Recycling system legend

Key	Representation
	White goods
	End-of-life vehicles

Table 3.12: Sophistication of recycling system in each PIC main island

Country		No. of private recycling companies process bulky waste	Landfill	Stockpiled	Exported	Outer Islands comment
Cook Islands		1				Bulky waste items are stockpiled or placed at various informal dumpsites and are collected on an adhoc basis when funding becomes available from the Cook Islands Government to transport back to the mainland.
Federated States of Micronesia	Pohnpei	0				Uncontrolled, informal dumpsites used to dispose of bulky waste.
	Chuuk	0				Burning, disposing in the ocean, or dumping on land.
	Kosrae[1]	1				Abandoned in residential back yards and along the road.
	Yap	1				Bulky waste disposed of in community designated disposal areas.
Fiji		6[21]				Bulky waste collection only occurs in Levuka Town, Ovalau. Elsewhere bulky waste is either disposed at Municipal Council operated disposal sites, in owners private land and backyards, burned and buried at village communal dumping sites, or in resort disposal sites.
Kiribati		0				There are no bulky waste collection systems, residents store bulky waste on their land, bury, burn, or dispose of waste directly into the sea.

[21] Holding a valid scrap metal dealer licence as at 6 April 2021

Country		No. of private recycling companies process bulky waste	Landfill	Stockpiled	Exported	Outer Islands comment
Nauru		0				Nauru is a single island nation.
Niue[22]		0				Niue is a single island nation.
Palau		1				Scrap metal is stored at designated areas within each state, and transported to M-Dock landfill site by the government or private contractors. Other waste is often dumped, burned or buried.
Papua New Guinea		3				East New Britai, West New Britain, and New Ireland provinces are serviced by Branis Recycling and Nuovo for scrap metals. On other islands, bulky waste is stockpiled or placed in various non-engineered dumpsites across the islands.
Republic of Marshall Islands	Ebeye	0				White goods are collected by KALGOV and stockpiled at dumpsites on the islands. Bulky wastes are not removed from the outer islands.
	Majuro	0				Unknown.
Samoa		4				Bulky waste collection points are located at wharfs on Manono and Apolima which are collected every 3 months via alia boats, and taken to recycling companies in Tafaigata. Illegal dumping also occurs.
Solomon Islands[23]		1				Bulky waste is commonly disposed of at uncontrolled landfills, dumped on public lands, or burned.
Tonga		1				Bulky waste is disposed of in public landfills and public dumpsites.

[22] Niue Recycling Facility will open mid-2022 and is the plan is to process and export bulky waste when complete.

[23] There is very little information available on the processing of bulky waste and ELVs.

Country		No. of private recycling companies process bulky waste	Landfill	Stockpiled	Exported	Outer Islands comment
Tuvalu		0				Excavators are used to collect bulky waste, which is then stockpiled at local landfills and dumpsites.
Vanuatu		1				Government assets are stockpiled at Provincial Public Works Department sites, all other bulky waste items are not removed, and do not have specified disposal locations.

3.2.2.1 Bulky waste recycling overview

Typically, the recovery of metal scrap from bulky waste consists of: Item collection

1 Item storage
2 Informal recovery of usable parts
3 Removal of hazardous fluids and materials (termed depollution)
4 Dismantling to remove high value components
5 Stripping to remove all non-steel components
6 Crushing or shredding

After depollution, the level of dismantling prior to crushing or shredding can vary. Crushing is undertaken for ease and efficiency of transport and storage. In the context of PICs, there are several routes to export bulky waste which are dependent on what recovery activities are undertaken in country and available markets, as per **Figure 3.8**.

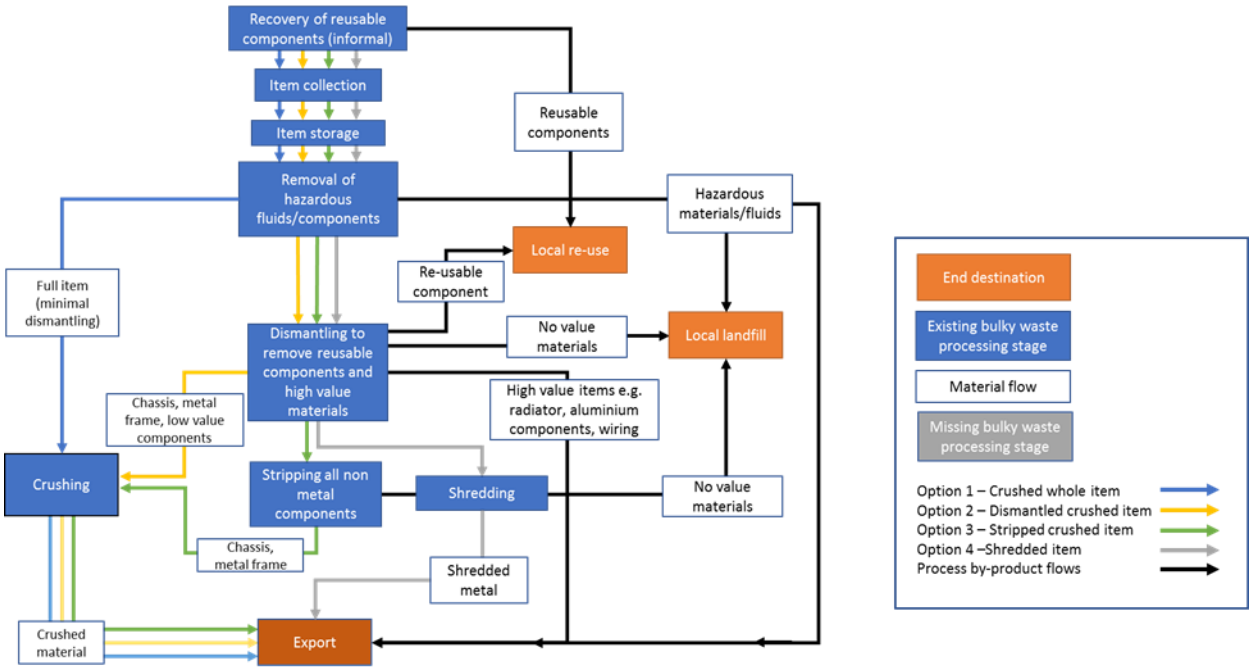


Figure 3.8: Options for bulky waste material recovery

3.2.2.1.1 Recovery of usable components

A number of bulky waste items contain reusable components of high value. Conversations within region representatives indicate that informal recovery of reusable components often occurs prior to bulky items being collected for recycling. Individuals and companies (such as auto repair dealers) store items on their land for spare parts. By the time a bulky waste item arrives at a recycler (where these organisations are present) useful undamaged components may have already been stripped. These items can include:

ELVs

- Headlights, blinkers and taillights
- Seats and upholstery
- Exhaust system parts

- Mirrors
- Alloy wheels and hubcaps
- Engines and engine parts
- Transmission systems
- Undamaged windows and windshields
- Fuel
- Batteries

White goods

- Motors
- Condenser/Evaporator coils
- Wiring

3.2.2.1.2 Item collection

In some PIC, bulky waste items are collected from collection points where residents can drop off their items. In others, bulky wastes can be collected directly from homes upon request or require residents to deliver their bulky waste directly to the recycling centres, landfills or dumpsites. Collection point infrastructure are typically skip bins, while equipment used to transport the bulky waste items from homes or collection points include the following:

- Boats
- Boom truck
- Dump truck
- Trailers
- Compactor truck

Some PICs who do not currently have collection infrastructure have plans to implement a system in the future, which includes the use of HIAB trucks for collection (Niue).

Items are currently stored on private household properties, stockpiled by businesses (such as car mechanics), abandoned items along roadsides or dumped in the environment or stockpiled at government facilities. To facilitate a collection of legacy waste a program needs to consider:

- Whether material can be consolidated at a single location prior to export (for the Kiribati ferrous scrap project ELVs are being consolidated at the port awaiting collection).
- Surveying of material owners to understand if items stockpiled are ready for collection (some owners stockpile material for spare parts).
- Access to items (items may be buried amongst other waste, trapped in vegetation, semi submerged in swampy conditions).
- Cleaning and remediation of areas after/during the waste is removal (for the Kiribati ferrous scrap project the Red Cross has been approached to help remove non-ferrous waste from areas bulky waste is removed from).
- The cleanliness and condition of the items being collected (for the Kiribati ferrous scrap project item owners are asked to clean the items prior to collection).

For the collection of ongoing items there is an opportunity to partner with organisations that collect items (such as government organisations or private operators).

3.2.2.1.3 Storage

The minimum level of best practice storage requirements of used batteries, used oil, tyres, ELV and white goods are summarised in **Table 3.13**, with reference to the *Recycling Market Research Report*, 2021. These are the requirements to prevent any pollution to the environment, exposure to toxic substances, or any unexpected incidents.

Table 3.13: Minimum best practice material storage requirements[24]

Country	Storage requirements
Used batteries (lead acid, lithium ion and nickel metal hydrate)	• Lead acid batteries must be stored inside an acid resistant container, placed on pallets or stockpiled on an impermeable surface; • Collection containers should be used where possible to avoid spillage; • Stacked in an upright orientation with all the vents and inspection caps firmly in place, with missing caps replaced or sealed with foam; • Terminals insulated with tape or cardboard to prevent short-circuiting; and • Have appropriate fire control systems and procedures.
Used oil	• Encourage responsible waste oil collection through community drop-off locations (with separate tanks for common oil types); • Regularly test oil contamination (e.g. handheld halogen detector) and prohibit oil mixing; • Maintain storage tanks in good condition, including preventative measures against rust, leaks, deterioration or structural defects; and • Install secondary containment systems or bunds around storage tanks (with volumetric capacity no less than 110% the largest tanks maximum capacity).
Tyres	• Maximum outdoor pile dimensions should be 6m by 20 m with a maximum height of 3 m; • Buffer distances of 60 m should be allowed between piles and buildings; • Fire breakers and strict ignition controls should be implemented at storage sites; and • Piles should be covered with impermeable barriers to Minimise disease vectors.
ELV	• Storage must have spillage containment including sealed drainage; • Silt traps and oil separators should be installed for treatment of stormwater runoff; and • Regular site clean-up and housekeeping practices necessary to minimise pollution.
White goods	• Storage areas should be sheltered and have an impermeable surface with sealed drained systems; • Store hazardous components in dedicated, labelled and appropriate containers; and • Minimise the risk of fires and explosions by reducing nearby sparks and heat.

In many PICs, used oil is reused on-island or exported overseas for reuse. In many PICs, oils are securely stored in government or private facilities (e.g. Republic of Marshall Islands and Nauru), in others oil is stockpiled in containers and stored on unsealed ground outdoors with minimal shelter (Pohnpei). Palau has an established hazardous waste storage for used oil.

ELV and white goods can be found stockpiled on public and private land, or stockpiled inside and outside or landfills and dumpsites landfill (e.g. Republic of Marshall Islands, Nauru, Federated States of Micronesia). In both instances the ELV and white goods are stored on unsealed surfaces, with no spillage or runoff controls. Many ELV and white goods are also not depolluted. Tyres are commonly stacked in exposed stockpiles, if they are not burned or reused.

[24] MRA Consulting Group (2021)

Car batteries can be found illegally dumped in public and private lands, sometimes stored on unsealed grounds. In some landfills, car batteries are not segregated from the mixed waste stream and are disposed in landfills. In others, batteries are segregated and stored covered (Ebeye). Some PICs collect car batteries as part of their CDL scheme (Kosrae, Kiribati).

Some PICs are seeing an increase in the imports of hybrid vehicles which contain lithium-ion and nickel metal hydrate batteries. These batteries are more difficult to recycle than a typical lead acid battery. Pacific Batteries in Lami is the only battery recycling company in the region, recycling lead acid batteries only. If batteries are intended to be stockpiled for export there is no change to storage requirements for the two types of batteries.

The Cook Islands and Fiji have established hazardous waste management systems in place, and Samoa is in the process of developing a hazardous waste management system. Containers are available for hazardous by-products if required on the Solomon Islands.

Information about management practices of private recycling companies was not able to be obtained, however previous audit reports indicate that vehicles and white goods for recycling companies and facilities are commonly stored outdoors on private land.

3.2.2.1.4 Removal of hazardous fluids and components

Bulky waste items need to be depolluted prior to recovery activity. ELVs and white goods contain hazardous materials (such as fuels, refrigerants, heavy metals) that if not properly managed can cause harm to the environmental and human health. At a minimum, depollution activity involves removal of the battery, fluids, and mercury and lead components. Depollution activity is currently being undertaken in some PICs. Staff are trained to safely remove components, and these are stored at site in preparation for export. Depollution is currently being undertaken at government and private waste facilities where bulky waste is stockpiled. Programs such as the National Used Oil Management Plans (a regional initiative as part of SWAP) are working towards addressing some of the key depollution bi-products at a regional level.

With the appropriate infrastructure and knowledge, these hazardous materials can be safely removed for safe disposal. Components required for removal during depollution are summarised in **Table 3.14**.

Table 3.14. Summary of hazardous components removal during depollution of bulky waste.

Bulky waste item	Hazardous components removed during depollution
ELVs	• Hazardous items: battery (can be sold), refrigerant, petrol or diesel fuel • Fluids: antifreeze, brake fluid, engine oil, transmission fluid, power steering fluid, differential fluid, windshield washer fluid • Hazardous materials: mercury switches, lead (battery connectors, wheel weights)
White goods	• Oils • Refrigerant • Mercury containing devices
Refrigerator/freezer	• Oils • Refrigerant • Mercury containing devices
Stove	• Chromium contaminated steel (tubular heating elements)
Air conditioner	• Refrigerant • Oils

Note: Typically, 19 litres (L) of fluids needs to be removed from an ELV during the depollution process.

3.2.2.1.5 Dismantling to recover high value material

Once depolluted there is an option to crush and export the whole item with the intention to recover value from the scrap metal content. Alternatively undertaking further dismantling can mean that other materials of high value can be recovered prior to crushing. These items are summarised in **Table 3.15**.

Table 3.15. High value items recoverable from dismantling of bulky waste.

Bulky waste item	High value items to be recovered
ELV	• Catalytic converters • Battery (lead acid (easier to recycle), lithium-ion or nickel metal hydrate (more difficult to recycle) • Aluminium radiators • Copper components (i.e. starters/alternators) • Wiring • Engine
Refrigerator/freezer	• Steel, aluminium • Copper in electrical components • Metal tubing
Dishwasher	• Copper (in solenoids, transformers, and motors) • Wire, steel • Stainless steel • Motor • Solenoid • Heating element (nickel alloy)
Stove	• Scrap copper wire
Air conditioner	• Copper • Radiator • Motor

3.2.2.1.6 Stripping all non-metal components/shredding

The remaining components of bulky waste are the steel and low value items or waste. The average large home white good items contain over 60% metals[25] while the average ELV contains about 75% metal. The remaining components after stripping high value components are listed in **Table 3.16**.

Table 3.16. Remaining bulky waste materials after high value item removal.

Bulky waste item	Remaining materials once high value items have been removed
ELV	• Hoses • Tires • Plastic components • Upholstery • Glass
Refrigerator/freezer	• Insulation • Plastics

[25] Magalini, F. et al (2017)

Bulky waste item	Remaining materials once high value items have been removed
	• Glass
Dishwasher	• Insulation • Plastic
Stove	• Insulation • Plastic
Air conditioner	• Plastic

There is the option to crush the item with these items still intact or remove these to create a steel only product that would potentially fetch a higher value on the market. Items that are crushed with the materials intact will be directed to a shredder where ferrous and non-ferrous metals are removed from the shredded material with a magnet and other post-shredder processes.

The waste material stripped from the item or shredded residue (called shredder floc) requires careful disposal management due to the potential presence of persistent organic pollutants (POPs). POPs are primarily used for their features in flame retardants and surfactants. Components of bulky waste that may contain POPs include:

- Electric transformers and capacitors (Polychlorinated biphenyls (PCBs))
- Additives in paints and plastics (PCBs)
- Additives in synthetic rubber and dyes (Hexachlorobenzene (HCB))
- Heat exchange fluids and lubricants (PCBs)
- Crude oil (Polycyclic aromatic hydrocarbons (PAHs))
- Flame retardants in polyurethane foam in vehicle upholstery (Hexabromobiphenyl (HBB))[26]
- Brominated flame retardants in vehicle upholstery and internal fittings of vehicles (Polybrominated diphenyl ether flame retardants (PBDEs))[27]

Improper treatment may lead to the release of POPs or the formation of unintentional POPs and their subsequent release into the environment. Within the framework of the Basel Convention, efforts have therefore been made to develop technical guidelines for the environmentally sound management (ESM) of POPs wastes. These guidelines include the following recommended POPs destruction and irreversible transformation methods such as cement kiln co-incineration and hazardous waste incineration. The landfills present in many PICs do not resemble environmentally sound management of POP containing waste due to a lack of environmental controls (such as leachate management) and engineered liners.

The GEF measures performance indicators with Global Environmental Benefits (GEBs), one key GEB the ISLANDS Pacific Project will be measured on is the tonnes of POPs safely reduced/eliminated. In this instance this is considered to be tonnes of contaminated bulky waste parts disposed of in a sanitary landfill. If in region processing is not evaluated as feasible, the other option for facilitating the safe disposal of POPs is to export crushed items (with POPs containing items still included) to countries with both bulky item shredding capability and appropriate disposal options. This includes engineered sanitary landfill and/or suitably controlled incineration.

[26] Stockholm Convention (2019)
[27] Australian Department of Agriculture, Water and the Environment (2021)

A summary of the level of processing undertaken in each PIC in this scope for ELVs and white goods is shown in **Table 3.17** and **Table 3.18**. This information was gathered from:

- Interviews with in-country representatives including recycling companies
- Previous recent work completed (such as the waste audit program).

This information is relevant as of December 2021 taking into account the following assumptions:

- Accessing to up to date and correct information on waste management systems is challenging as systems in the Pacific are dynamic and face significant challenges in maintaining consistency of service with disproportionate numbers of equipment breakdowns, funding challenges, identification of export markets meaning that processes occurring are likely to be subject to change.
- Where information has been taken from recent reports all reasonable attempts have been made to verify this information within country representatives however not all in country representatives have been contactable due to competing priorities on the ground (Covid 19 Pandemic and natural disasters).
- The information summarises if the activity is currently being undertaken somewhere (most often the mainland) of each PIC. In reality the sophistication of recycling systems varies across geography with outer islands often unable to access recycling services.

Table 3.17: Present status of in-country ELV processing in each PIC

Country		Item collection P = Private G = Govt.	Item storage P = Private G = Govt.	Recovery of usable parts	Removal of hazardous items	Dismantling in country	Crushing in country	Shredding in country	Whole vehicle export	Crushed metal hulk export	Scrap metal export
Cook Islands		Yes G + P	Yes G + P	Yes	Yes	Yes	Yes[28]	No	No	No	Yes
Federated States of Micronesia	Pohnpei	Yes G + P	Yes G + P	Yes	No	No	No	No	No	No	No
	Chuuk	Yes G	Yes G	Yes	No	No	Yes	No	No	No	No
	Kosrae	Yes G + P	Yes G + P	Yes	No	No	No	No	No	No	No
	Yap	Yes G + P	Yes P	Yes	Yes	Yes	No	No	No	No	Yes
Fiji		Yes P	Yes P	Yes	Yes	Yes	Yes[28]	No	No	No	Yes
Kiribati[1]		No	Yes	Yes	No	No	No	No	No	No	No
Nauru[1]		No	Yes G	Yes	No	No	No	No	No	No	No
Niue[29]		Yes P	Yes P	Yes	No	No	No	No	No	No	No
Palau[1]		Yes G + P	Yes G + P	Yes	Yes	Yes	Yes	No	No	No	Yes
Papua New Guinea		Yes P	Yes P	Yes	Yes	Yes	Yes	No	No	No	yes
Republic of Marshall Islands	Ebeye	Yes G	Yes G	Yes	No	No	No	No	No	No	No
	Majuro	Yes G	Yes G	Yes	No	No	No	No	No	No	No
Samoa		Yes G	Yes G	Yes	Yes	Yes	No[30]	No	No	No	Yes
Solomon Islands		No	No	Yes	No	No	No	No	No	No	No
Tonga		Yes G + P	Yes G + P	Yes	Yes	Yes	Yes	No	No	No	Yes
Tuvalu		No	No	No	No	No	No	No	No	No	No
Vanuatu		Yes P	Yes P	Yes	Yes	Yes	Yes[28]	No	No	No	Yes

[28] Baler for car bodies and light steel.
[29] Niue Recycling Facility will open mid-2022 and is planning to process and export bulky waste when complete.
[30] Cut to size for export.

Table 3.18: Present status of white goods processing in each country

Country		Item collection P = Private G = Govt.	Item sorting	Degassing	Breaking down parts	Exported
Cook Islands		Yes G and P	Yes	Yes	Yes	Yes
Federated States of Micronesia	**Pohnpei**	Yes P	Yes	No	No	No
	Chuuk	Yes G	No	No	No	No
	Kosrae	Yes G	Yes	No	No	No
	Yap	Yes P	Yes	Yes	Yes	Yes
Fiji		Yes G and P	Yes	Yes	Yes	Yes
Kiribati		No	No	No	No	No
Nauru		No	Yes	No	No	No
Niue[31]		Yes G	No	No	No	No
Palau		Yes F	Yes	Yes	Yes	Yes
Papua New Guinea		No	Yes	Yes	Yes	No
Republic of Marshall Islands	**Ebeye**	Yes G	No	No	No	No
	Majuro	Yes G	No	No	No	No
Samoa		Yes P	Yes	No	Yes	Yes
Solomon Islands		No	No	No	No	No
Tonga		Yes G	Yes	Yes	Yes	Yes
Tuvalu		Yes G	Yes	No	No	No
Vanuatu		Yes P	Yes	Yes	Yes	Yes

Collection systems vary from location to location. Very few routine bulky waste collections exist in the Pacific. Often when they do occur it is done sporadically once or twice a year, usually during a clean up the world day activity or village clean up. It is also common for people to arrange their own collection and disposal of bulky waste through a private contractor. However, engaging a private collection incurs a collection fee that is reportedly too high for some households to afford. The infrequency of collections can result in the continued dumping of ELVs or white goods on public property, or storage indefinitely on private property. In many PICs there are government run collection programs that collect white goods or ELVs on a quarterly or six-monthly basis. Many households and businesses may also opt to drop their bulky waste direct to recyclers or government run facilities.

[31] Niue Recycling Facility will open mid-2022 and is planning to process and export bulky waste when complete.

Once collected, bulky waste is stored either at the yards of private recycling companies or in stockpiles located at waste facilities. A number of PICs stated that space for bulky waste (ELVs, white goods and plastics) stockpiling at waste facilities was limited, constraining the number of items that could be consolidated prior to transport. This is exacerbated by the fact that certain PICs currently wait long periods between export events as (especially in the case of smaller nations) they wait for enough volume to warrant export.

The recovery of reusable parts is undertaken by waste pickers, the public, automotive companies and recycling companies. Anecdotally, it is reported that where recycling companies collect ELVs, all useful parts have generally been stripped prior to collection. Stockpiles of ELVs adjacent to or located at mechanic businesses in various countries also infer that vehicle parts are being recovered where possible. Rapidly changing vehicle model imports can limit reuse opportunities, as people struggle to find parts to repair older models of vehicles.

Currently most vehicles across the region are deteriorating in the environment without necessary depollution activities being undertaken. Where formal recycling companies are operating with the intent to export, conversations with these companies indicates that depollution is being undertaken. Not all government facilities have the resources to depollute items, so stockpiled items may still contain hazardous fluids and components. Special consideration also needs to be given as to how hazardous items/fluids removed are stored, handled, and disposed or recovered after being removed.

3.2.3 In-country logistics

Interisland logistics can pose a significant economic barrier to the collection of bulky materials from the outer islands of PICs. The ownership of local shipping companies servicing remote islands has been found to include both government and privately owned enterprises. Generally, it has been found that private domestic logistics are only found in the more populated centres and government assistance is required to provide accessibility in less populated countries. In smaller islands, access may only be possible through the use of water transport for the transportation of smaller commodities.

The additional cost of recovering materials from outer islands may result in a further funding gap between the value of recoverable materials and the cost of collection. The funding gap would have to be covered by additional donor funding or an increase in deposit as part of an ARFD scheme.

While some domestic shipping routes may utilise the same port as international shipping (it is likely collected goods will have to be unloaded and transported for processing before they can be shipped internationally. Further in country processing would likely be required to consolidate collected material in order to secure an international buyer. Information on available shipping routes is shown in **Table 3.19**.

Costs were requested from all countries

Table 3.19: Available domestic shipping routes

Country	Route	Freight (USD per 20ft container)	Comments
Cook Islands	Rarotonga to the northern Cook Islands Rarotonga to the southern Cook Islands	Not available	Costs estimated based on barge/ ship hire and fuel costs, Assuming biannual collection around $190 per T

Country	Route	Freight (USD per 20ft container)	Comments
Fiji[32]	Suva – Labasa	$947	One way travel costs
Samoa[32]	Manifanua - Saleloga	$300	One way travel cost
Tonga[32]	Nuku'alfa – Vava'u	$546	One way travel cost
Tuvalu[32]	Funafuti – Nanumea	$1,600	One way travel costs
Papua New Guinea, Federated States of Micronesia, Kiribati, Tuvalu, Republic of Marshall Islands, Solomon Islands, Palau	Information was requested from in country contacts but was not able to be provided.		
Nauru, Niue	NA – single island		

Individual ports will also have a series of charges including, but not limited to, marine service charges, cargo dues, tug hire, vessel movements, service fees, cargo charges, marshalling, equipment hire (forklift). These fees although small individually can add up quickly. The most substantial being the port charge. In Aitutaki and Rarotonga for instance port charges are $651/TEU and $247/TEU respectively.

3.2.4 Existing initiatives.

There is a range of country level initiatives to address bulky waste across the Pacific. Relevant country level initiatives are listed in **Table 3.20**.

Table 3.20: Relevant country level initiatives

Country		Initiative	Description
Cook Islands		ARFD Scheme Development	Developing an ARFD scheme that is planned to include bulky waste items.
Federated States of Micronesia	Pohnpei	None identified at this stage	Not applicable
	Chuuk	None identified at this stage	Not applicable
	Kosrae	None identified at this stage	Not applicable
	Yap	None identified at this stage	Not applicable
Fiji		None identified at this stage	Not applicable
Kiribati		Special Programme (chemical and hazardous waste)	A national information-sharing system will be developed to strengthen Kiribati's institutional capacity to undertake regular data collection and

[32] JICA (2013)

Country		Initiative	Description
			analysis, and establish a central repository for data.
		Kiribati Ferrous Scrap Waste Project	Project to remove all ferrous scrap waste from South Tarawa, to be processed and exported. Start has been delayed due to Covid.
		ARFD Scheme Expansion	Looking to expand Kaoke Maange scheme (ARFD) to cover ELV and white ware/white goods.
Nauru		National Recycling Plan	Feasibility study to design and develop an National Recycling Plan for Nauru for common recyclable products.
		ARFD Scheme Development	Developing an ARFD scheme that is planned to include bulky waste items.
Niue		Recycling Centre	Storage and potential export of ELV.
		ARFD Scheme Development	Developing an ARFD scheme that is planned to include bulky waste items.
Palau		None identified at this stage	Not applicable.
Papua New Guinea		TWM Roku Integrated Waste Management Facility Expansion	Increased recycling, re-manufacture and beneficial reuse (among others).
		ARFD Scheme Development	Developing an ARFD scheme that is planned to include bulky waste items.
Republic of Marshall Islands	Ebeye	ARFD Scheme Development	Developing an ARFD scheme that is planned to include bulky waste items.
	Majuro		
Samoa		MoU for e-waste collection and dismantling facilities	Buy-back system for e-waste including legislation, training and constructing e-waste dismantling and storage facility.
		ARFD Scheme Development	Developing an ARFD scheme that is planned to include bulky waste items.
Solomon Islands		ARFD Scheme Development	Developing an ARFD scheme that is planned to include bulky waste items.
Tonga		PacWaste (2014-17) programme	To improve e-waste management by establishing an NGO to receive and process e-waste. Furthermore, creating a pilot project to safely dismantle and export e-waste.
Tuvalu		None identified at this stage	Not applicable.
Vanuatu		ARFD Scheme Development	Developing an ARFD scheme that is planned to include bulky waste items.

3.2.5 Material availability

3.2.5.1 Material ownership

T+T conducted a series of in country surveys and interviewed stockpile owners to understand key information about the nature of stockpiles. The survey methodology was for the in country representative to cover sample areas and record notes on the stockpile size, owner and whether the material was available. The surveys completed specifically for this project are complemented by stockpile surveys recently completed for waste audits in multiple countries across the Pacific.

These include surveys completed for The Cook Islands, Nauru, Niue, Solomon Islands, Samoa, Kiribati, Papua New Guinea, Timor Leste, the Federated States of Micronesia and the Republic of Marshall Islands.

The following findings were noted:

- The majority of stockpiles were owned by a private business or homeowner, smaller quantities surveyed were abandoned on public property or government/council owned.
- Of the owners spoken to around half reported the material was available for collection, the remaining half reported that material was not available as the material was:
  - Intended for re-use of parts and would not be available soon.
  - Already had a purchaser/second user identified.
  - Could become available but only if purchased for a price.
- For Tuvalu in country representatives could not identify any large stockpiles of white goods or ELVs.

Where T+T had completed stockpile assessments as part of the waste audit program we asked our contacts to verify and provide further detail on the stockpiled items. Where audit information was not comprehensive, we asked in country contacts to complete additional in country surveys. Unfortunately, surveys were often unable to be undertaken due to staffing shortages (where we were asking government officials), timing conflicts with key country festivals, COVID-19 lockdowns, and extreme weather/natural disasters. Where stockpile surveys were not able to be completed, we still requested from all in country contacts a desktop summary of any key stockpiles targeting waste facilities, private recyclers and auto repair shops.

A summary of the stockpile information (gathered previously and through this study) is provided in Table 3.22.

Table 3.21: Stockpile information gathered as part of this study

Country	Stockpile audit information	Further information gathered through this project
Cook Islands	• The waste audit identified a number of stockpiled vehicles (Appendix D)	• T+T staff completed the audits on the ground and the information on publicly abandoned stockpiles is considered to be representative (confirming with CIGT that they have not collected and processed these items) • This information does not include stockpiles on private property.
Federated States of Micronesia Chuuk	• The waste audit identified a number of stockpiled vehicles (Appendix D)	• Derelict vehicles can be found by roadsides and in residential properties • Vehicles have historically been disposed of at the landfill • The key stockpile is located at the Marina dumpsite (estimated 150 ELVs) • Confirmation that there are no known white goods stockpiles

Country		Stockpile audit information	Further information gathered through this project
	Yap	• The waste audit identified a number of stockpiled vehicles (Appendix D) • An additional key stockpile not included in the waste audit is the estimated 150 ELVs stored at Colonia.	• Illegal dumping of ELV's is common. Some vehicles are found by the roadside, abandoned at vacant lots, or disposed of at the owner's property. • The designated area by the government to store ELV's is still in use, while smaller stockpiles are located at vehicle repair shops and public landfill sites. About 150 ELV's have been collected and stored at this allocated site, however the estimated number of ELV's that exist in the state is more than 500.
	Pohnpei	• The waste audit identified a number of stockpiled vehicles (Appendix D) • Stockpiles are located at car repair shops, scrap metal companies and the government waste facility	• Illegal disposal of ELV's can be found in the forest, roadside, and residential areas. • There are estimated to be over 3,000 ELVs around the island of Pohnpei,
	Kosrae	• The waste audit identified a number of stockpiled vehicles (Appendix D) • Key stockpiles are located at the government facility and at junk yards	• There is stockpiling for ELV's in the hope for a buyer to export. ELV stockpiles are at the designated government site. • A lot of vehicles are still abandoned in residential backyards and along the road.
Fiji		• The waste audit only provided limited stockpile data because the project was interrupted by the COVID 19 Pandemic.	• Additional surveys were undertaken and results are included in Appendix D.
Kiribati		• The waste audit for Kiribati was not provided.	• The MRF at Betio is used for stockpiling ELVs and white goods • A contract has been awarded to Macaulay Metals Ltd NZ to undertake compaction and transportation of stockpiled ELVs scrap metal from South Tarawa. The ELV survey (prior to export) indicates 1497 vehicles are currently stockpiled on the island. • Stockpiles on outer islands was requested but not provided.
Nauru		• The waste audit identified a number of stockpiled vehicles and white goods (Appendix D)	• Verification of audit findings was requested but a response was not received. • We are working with Nauru on waste issues on an ongoing basis and are familiar with materials

Country		Stockpile audit information	Further information gathered through this project
			quantities and stockpiles. In this context we are comfortable that the modelling of bulky waste quantities is appropriate.
Niue		• The waste audit identified a number of stockpiled vehicles and white goods (Appendix D)	• Verification of audit findings was requested but a response was not received.
Palau		• The waste audit stated there were 110 unspecified vehicles stockpiled in Koror and Ngeaur	• Specific information is not available, however it was reported that there are approximately 600 ELVs in Koror and Babeldaob. • No information on stockpiling of white goods was available.
RMI	Majuro	• The waste audit identified a number of stockpiled vehicles (Appendix D)	• Further information on stockpiles was requested but not provided. • We are working with the Majuro Atoll Waste Company on waste systems design and improvements including handling bulky items alongside a range of other waste streams. In this context we have a good understanding of bulky waste materials present and generated in Majuro and are comfortable with the outputs of the modelling process in this regard.
	Ebeye	• The waste audit identified a number of stockpiled vehicles (Appendix D)	• Requested verification of reported stockpile data and confirmed that not all stockpiles are captured but the assistance was not available to complete more surveys. • Confirmation that the dumping of ELVs across the island is an issue • Confirmation that other bulky waste items that are collected (white goods) are stored at the dumpsite.
Papua New Guinea		• The information provided on stockpiles in the waste audit was very limited	• The request to complete additional stockpile surveys was declined.
Samoa		• Limited stockpile data in the waste audit report	• Pacific Recyclers and Waste Management Ltd were reported to stockpile 110 and 35 ELVs each respectively. • No information on white goods stockpiling was available. • Confirmation that no stockpiling is occurring at the landfill sites. • Other stockpiles are inferred to be on private property.

Country	Stockpile audit information	Further information gathered through this project
Solomon Islands	• The Solomon Islands waste audit report did not include stockpile assessments for bulky waste	• There are abandoned ELVs particularly in residential areas in Honiara • White goods are stored at Ranadi Dumpsite • Knowledge of areas outside of Honiara is limited • Not all data requested (such as on the ground surveys) and interviews with recyclers was provided due to Covid lockdowns
Tuvalu	• The waste audit stock pile assessment located 35 stockpiled vehicles and 20 stockpiled white good units • Locations of stockpiles were not provided	• Additional surveys were undertaken and results are included in Appendix D.
Tonga	• The waste audit for Tonga was not provided	• Attempts were made to connect with on the ground personnel in Tonga but due to a recent natural disaster no one was able to respond to requests for assistance.
Vanuatu	• The waste audit for Vanuatu did not provide bulky waste stockpile data	• Additional surveys were undertaken and results are included in Appendix D.

3.2.5.2 Material generation assumptions

The project generated estimates for:

- The estimated legacy waste quantity currently present on a PIC
- Future projections of the quantity of end-of-life bulky waste that will need to be recycled each year into the future

To generate these estimates the project has used customs and census data. There are considerable limitations for using customs data to estimate material quantities and where data has not been available reasonable assumptions have been made to address gaps. A list of the generation assumptions and limitations is provided in **Table 3.22**

Table 3.22: Material generation assumptions

Model input	Assumption	Limitation
Import and export data is grouped by HS codes. HS codes have been selected for this model that could be classified as vehicles or white goods.	Vehicles: HS codes 8701, 8702, 8703 and 8704. White goods: HS codes 8415, 8418, 8422, 8450, 851660, 7321. HS codes have been allocated correctly.	Some items may be imported or exported as other HS codes. Rely on the assumption that HS codes have been classified correctly.

Model input	Assumption	Limitation
Some import and export data is not provided in quantity value and is provided in CIF (Customs, Insurance and Freight) value.	To derive units from a unit cost has been assumed to calculate a corresponding unit value.	In reality unit cost will vary considerably.
Import and export data was not always available for the years requested.	Projections for any missing years were completed by pro rating existing data using population. To reflect fluctuations in import and export trends the outputs of the model were presented as a 5 year rolling average.	Imports and exports do not correlate directly with population and fluctuate from year to year.
Assumptions around the import age/ quality and scrapping rate were adopted.	Assumptions were specific to each country but on the generic basis that almost all vehicles imported will be of considerable age. And relatively service short life to reflect the harsh conditions for products used in the PICs (corrosiveness, road quality) white goods are predominately new and have a shorter life.	Scrapping age and material age will fluctuate for each item.

The full list of assumptions for each country is provided in Appendix B.

3.2.5.3 Legacy material

An estimate of legacy material has been presented in **Table 3.23.**

Assumptions are provided in Appendix B.

Table 3.23: Estimate of the legacy bulky waste

Country	ELV (units)		White goods (units)	
Range	**Lower**	**Upper**	**Lower**	**Upper**
Cook Islands	900	4,000	2,900	22,300
Federated States of Micronesia	19,600	42,400	16,400	107,900
Fiji	18,000	73,600	513,800	3,554,300
Kiribati	5,000	12,000	22,600	159,400
Nauru	250	950	300	5,300
Niue	2,100	5,900	2,300	3,300
Palau	3,500	8,300	3,700	5,200
Papua New Guinea	76,700	218,900	171,200	1,705,400
Republic of Marshall Islands	1,300	3,400	11,200	16,800
Samoa	600	3,200	6,700	137,900
Solomon Islands	6,300	16,900	15,600	23,000
Tonga	15,000	40,100	48,100	72,200
Tuvalu	-	-	6,500	9,400
Vanuatu	8,600	29,400	11,700	310,700

1 Information above does not account for materials exported

3.2.5.4 Ongoing waste generation

An estimate of legacy material has been presented in **Table 3.24.** Assumptions are provided in Appendix B.

Table 3.24: Estimate of future bulky waste generation

Country	ELV generation rate per annum (units per year)		White goods generation per annum (units per year)	
Range	**Lower**	**Upper**	**Lower**	**Upper**
Cook Islands	200	300	1,100	2,400
Federated States of Micronesia	2,000	2,300	14,700	31,500
Fiji	3,300	5,200	320,500	380,400
Kiribati	500	700	7,400	9,400
Nauru	100	100	-	800
Niue	200	400	200	300
Palau	300	400	200	400
Papua New Guinea	6,100	14,400	194,300	265,200
Republic of Marshall Islands	100	200	900	1,400
Samoa	100	300	14,100	21,600
Solomon Islands	500	600	1,200	1,800
Tonga	900	2,400	3,300	5,000
Tuvalu	100	100	600	800
Vanuatu	1,200	2,200	32,200	46,000

4 Key Issues and Opportunities

4.1 Country and region wide issues and opportunities

In considering the existing situation at a country and regional level a number of issues and opportunities have been identified. Key comment issues are noted here with brief comment on opportunities. These ideas are developed at a Country level in **Section 5** with regional opportunities identified and discussed in **Section 7**.

Table 4.1: Issues and opportunities – region wide

	Issues	Opportunities	Key partners
Legislative	• Absence of regulations/standards for the environmentally sound handling of bulky wastes and pollution control measures. • Absence of regulated sustainable financing for bulky waste recovery.	• Legislation changes – noting that a number of PICs are currently undergoing legislation changes which may improve the current situation with regards to handling of hazardous materials and financing of bulky waste recovery.	• Lead Legislation, Policy and Regulatory Government agencies, Waste Service providers, Ministry of Finance. Local government.
Environmental	• Depollution and/or dismantling undertaken in country brings about the requirement to safely manage the waste materials produced from depollution	• Regional coordination of capability development for management of hazardous materials for bulky waste recovery activity through country-to-country joint initiatives.	• Waste Service providers, country Government focal agencies, SPREP. • PacWaste. • UNEP. • UNDP.
	• Contamination of stockpiled materials which have been awaiting export for a period of time	• Local initiatives (employment) to remediate land after waste stockpiles have been cleared. Such as community and woman lead organisations.	
	• Environmental degradation of areas where stockpiling/dumping has been prolific		• Environmental societies, community groups, NGO's.
	• Current status of landfills/dumpsites – containment of materials sent to landfill		• Focal agencies, Waste Service providers
Material quantity	• There is limited coordination and consolidation of bulky waste items across the various islands limiting the market value of key recovered items.	• Regionally coordinated consolidation and marketing of materials to maximise value and market access.	• Local waste recyclers, International Shipping Agencies, regional and international bulky waste brokers/buyers.
Markets	• Access to markets for recovered materials.	• Pursue long term relationships with key markets through	• Regional waste recyclers,

	Issues	Opportunities	Key partners
		networking and establishing mentorship and training opportunities between countries in the region and between waste recyclers and brokers regionally and internationally.	international brokers/buyers.
	• Low value for some recovered materials.	• As above, consolidate materials to improve market access and value.	• Moana Taka Partnership Plus.
	• Lack of profitable market for recycled materials which has prevented the export of materials.	• Develop legislated sustainable financing schemes where bulky waste recovery is not viable.	• Ministry of Finance, Moana Taka Partnership Plus.
Processing	• Limited capability and infrastructure in many PICs.	• Regionally coordinated capability development. • Targeted investment in processing infrastructure including existing businesses where appropriate.	• Lead government agencies, Local waste recyclers, International Shipping Agencies, regional and international bulky waste brokers/buyers. • World Bank. • ADB.
Logistics	• Some shipping routes becoming uneconomical due to the changing of liner networks which are affected by competition, covid-19 and/or a lack of volume.		• Shipping companies in the Moana Taka Partnership Plus.
	• Existing port infrastructure not suitable (for example Pohnpei – no shore crane).		
Education	• Community attitudes towards bulky waste disposal/recycling.	• Regional resources for communications and education on bulky waste recycling.	• Regional and development partners, Government focal agencies. • Local schools and churches.
		• Employment opportunities for women, with examples already shown underway in the Solomon Islands.	

Commentary has provided by in country contacts for a number of PICs. This is summarised in **Table 4.2**.

Table 4.2: Issues and opportunities – country specific

Country	Issues	Opportunities	Key partners
Cook Islands	• Public will need to familiarise with the Advanced Recovery Fee as an additional cost. • Public education and awareness on the impact of solid and hazardous waste on the environment. • Limited access to regional business network opportunities for skilled training and work experience. • Little support and assistance in the application process to access government/donor funding for the procurement of recycling equipment.	Good environmental stewardship to clear bulky waste from the Cook Islands, through formalising public-private sector partnerships, where government provide support for capital investment of recycling and bailing equipment and specialised training and waste recyclers collect, process and export bulky waste material. • Establish segregation and stockpile sites at the wharf in the outer islands where former large under cover cargo sheds exist and are no longer in use. •	Ministry of Finance and Economic Management (MFEM), Waste Recyclers, Ports Authority, Shipping Agent. • Local Island Councils. Landowners.
Federated States of Micronesia	• Limited access to initial capital funding and ongoing financial support to ensure sustainability of the programs in the sector. • Remote outer islands do not have a collection service or a designated area for disposal. • Limited or no recycling in place.	• Assessment of sustainable financing mechanisms in the areas of processing and safety, transportation route and market for shipment for reuse/disposal of materials. • Identify location/land for disposal in consultation with key stakeholders i.e. community, landowners. • For Chuuk, construction of a new building for recycling and repurposing material through the collaboration with funding donor partners. • Creation of jobs in the recycling sector when the recycling system/program is in operation.	• Ministry of Works, Development partners. • Local Island councils, landowners.

Country	Issues	Opportunities	Key partners
Fiji	• Absence or limited partnerships for the collection, processing and shipment to end markets. • A lack of support of local industries that prefer to be supplied by companies from overseas. For example China or Australia. • The density of vehicles bodies should be increased. • Current shipping costs are high and can prevent export occurring. • Some steel foundries have some technical requirements on the size of steel parts and the cost of reducing the size of steel parts (mainly done using gas-operated melting technique) is high and currently not covered by the value of steel on the international markets. • The costs of some local scrap metal is too expensive to be bought locally, and are exported to external markets.	• Improvement on tracking system from collection to final destination by all waste dealers. Development and enforcement of regulations/policies/standards to support recycling of bulky wastes. • Strengthen partnerships for the collection, processing and exportation. • Recognition of informal waste pickers and utilise their local knowledge and expertise • The remoteness of Fiji is an asset for its activity: the company is usually preferred by customers when long delays in the supply chain are not acceptable.	• Waste dealers or recyclers. • Informal waste pickers. • Ministry for Environment, Regulators and Policy setters. • Town Councils, Waste Recyclers, Ports Authority, Customs office and Shipping agents. • Informal waste pickers. • Waste Recyclers, International dealers and buyers.
Kiribati	• Trucks used to transport between collection points to site regularly fails, and no storage depot for dismantling due to lack of investments. • Limited land space at Betio Landfill.	• Increased use of the Material Recovery Facility to divert waste from Betio Landfill, and to dismantle bulky waste. • Introduce ARFD for bulky waste to create income for improved collection services and dismantling.	• Local Council, One Stop Recycling, Betio Town Council. • Ports Authority, Shipping agent, Ministry of Finance and Economic Development.
			•
Nauru	• Polluter pays principle is not evenly applied. • Limited finance for waste management which affects operations and maintenance of equipment, awareness programmes,	• Implement self-financing systems for waste recycling through CDL, collection fees and tipping fees. • Improve the operations of the dumpsite, sorting bays exist but are not functioning as designed.	• Nauru Rehabilitation Corporation (NRC), Focal Government Agencies, Donor partners.

Country	Issues	Opportunities	Key partners
	and human resources development. • Absence of a plan to repurpose and recycle bulky waste • No formal initiatives for waste reduction, reuse or recycle. • Waste education is not a formal component of the school curriculum. Very limited awareness activities conducted with the schools and in the community. •	The segregation of bulky waste at the dump is a positive action however a plan needs to be in place to recycle the material including bulky waste abandoned throughout the island. • Implement appropriate frameworks that discourage excessive waste generation and encourage recycling • Consider options for stimulating and supporting private sector initiatives for bulky waste. • Establish a waste education and awareness component in the school curriculum.	• Focal Government Agencies, Private sector. • Ministry of Education.
Niue	• Export markets overseas, PPE gears, training and maintenance. OSH and training attachments for staff. • A recycling truck fit for purpose • Communication and awareness	• Expansion already underway with existing recycling infrastructure. • Regional hub that provides informed technical support for the procurement of collection and recycling equipment that is fit for purpose and accommodates the needs of the island.	• Department of Environment.
Palau	• Limited land space, resources, institutional and human capacity.	• Resource recovery program that targets specific waste streams done through coordination with focal agencies, donor partners and private recyclers. • Develop capacity in country through the investment to improve/upgrade existing operations that is supported with adequate resources.	• Bureau of Public Works, Private recyclers, Development Partners.
Republic of Marshall Islands – Ebeye	• Only shipping available for Ebeye is KYOWA. Other shipment cannot enter Ebeye due to the military base nearby.	• Interisland shipping into Majuro.	• Domestic shipping agent.
Papua New Guinea	• Limited recycling facilities and waste collection facilities/ services that accept bulky waste. • Current shipping costs are high and can prevent export occurring.	• Subsidised freight costs for export market could assist private recycling sector. • Recognition of informal waste pickers and utilise their local knowledge and expertise • Introduce ARFD (currently in feasibility stage).	• Waste dealers or recyclers. • Informal waste pickers • Town Councils, Waste Recyclers, Ports Authority, Customs office and Shipping agents.

Country	Issues	Opportunities	Key partners
			• Waste recyclers, international dealers and buyers.
Samoa	• Existing recyclers implement their own collection services to collect their waste of interest and have • appropriate infrastructure in place to conduct these collections • Unsustainable finances resulting in insufficient annual waste budgets. • High cost of exporting • recyclable materials to • overseas markets. Recycling activities are constrained by remote location and lack of economies of scale. • Challenges developing logistics and value chains to ensure waste exports. • Lack of expertise, equipment and facilities for managing bulky wastes.	• Extensive inter island shipping service and a relatively strong private sector recycling industry, good indication to further support the deposit schemes and extend producer responsibility schemes. • Introduce economic instruments, such as Container Deposit Systems, Advanced Recycling Fees and Advanced Disposal Fees. • Strategic government support of private sector recyclers including training and equipment procurement. • Provide access to land for private recyclers to operate at landfill sites.	• Private recyclers, Domestic shipping agencies. • Focal Government Agencies, Private recycling service providers. • Private recycling service providers, Shipping agents, international brokers. • Focal Government Agencies, Recycling service providers. • Landowners, Focal Government Agencies.
Solomon Islands	• Public education and awareness of the recycling companies who purchase end-of-life white goods. • Lack of infrastructure to collect bulky waste. • Remoteness of islands and shipping freights preventing outer island bulky waste collection. • Poor management or coordination by responsible authorities.	• Public awareness campaign about recycling opportunities, may include signage at common dumping sites. • Develop Bairiki Government yard into official storage facility.	• Town Councils, Waste Recyclers. • Island Council, Recycling companies.
Tonga	• Around 7,000 empty containers leave Port of Nuku'alofa per year.	• Well established shipping networks that could be utilised to create a hub on Tonga. • Utilise learnings and skills of the female run Gio Recycling Company to expand recycling opportunities.	• Shipping agents, Ministry of Infrastructure. • Gio Recycling Company, Waste Authority Ltd.
Tuvalu	• No local companies that recycle.	• Utilising Transfer Station for dismantling of bulky waste.	• Department of Solid Waste.

Country	Issues	Opportunities	Key partners
	• ELV are not ready for export.		
Vanuatu	• High transportation costs from the wharfs. • Access to funding for the encouragement of Private Investment or public private partnerships. • Additional funding would be required for the clearance of legacy materials.	A joint Council of Ministers paper between relevant Ministers should be developed to instruct the removal of bulky wastes from all six provinces of Vanuatu. • Establishment of storage facilities at the main ports of Provincial Headquarters is required. • Establishment of adequate equipment at the wharves in the outer islands to enable the loading and unloading of containers. Ability to access donor funding to fund or co fund these types of projects that without outside capital investment are not considered financially viable for private companies. • Shipping of bulky wastes from outer islands to the storage facility at the main provincial centre.	• Cabinet Ministers, Provisional representatives. • Ports Authority, Provisional representatives. • Island Council, Ports Authority, local Government and Development partners. • Island Council, Shipping agent.

4.2 Women and bulky waste recycling

One of the objectives of the Scoping Study for Bulky Waste Recycling was to understand Gender Equality and Inclusion issues in waste management in the Pacific. The study has been undertaken in accordance with the operational principles of the SPREP Gender Policy[33] and UNEP Gender Equality and the Environment Policy and Strategy[34].

As a GEF funded project this study has also considered the opportunity for gender-responsive design and implementation in accordance with Guidance to Advance Gender Equality In GEF Projects and Programs[35]

The study has considered how gender equality and social inclusion initiatives could be incorporated into the delivery of activities that sustainably and cost effectively improve regional and local management of waste and pollution.

[33] SPREP 2016
[34] UNEP 2014
[35] GEF 2018

The activities are delivered through regional and country projects.

- Regional Projects are projects across the member countries that include communication activities, data collection and dissemination, consultations, research, pilot studies and training.
- Country Projects are specific projects that target solid waste (bulky waste, recyclables, organic waste, residual waste and disaster waste), hazardous waste and related aspects of wastewater through the design and implementation of interventions that focus in the areas of data and research, policy, community engagement, infrastructure and systems, waste management systems and capacity building.

In part, the successful achievement of the projects will require attention to the different needs, interests, priorities and roles of women in the waste sector with a view to:

- Change the stereotypical and cultural perception that a 'woman's place is in the home'.
- Building opportunities for employment in any field of the waste sphere.
- Provide support and access to resources such as finance towards business and entrepreneurship opportunities.
- Encourage upskilling in a trade field.
- Provide educational programmes to improve qualifications, and
- Establish mentorship schemes that facilitate and harness the development of women in the waste sector.

Female leadership has a strong presence amongst some of the key organisations referred to in this study. Organisations such as CIGT (Cook Islands), Gio Recycling (Tonga), SWRMA (Samoa) all have strong and successful female leaders as managers or owners. CIGT is an example of a successful Pacific business, led by a woman, handling bulky waste recycling in partnership with the community, the Cook Islands Government and donor organisations. General Manager Jessie Sword is a key voice in promoting recycling of bulky waste and e-waste in the Cook Islands and has been important contributor to the analysis for this report. Any initiative aimed at enabling woman in the sector should draw on the expertise of these current leaders as mentors and contributors and be a Pacific lead initiative.

Research into women's involvement in the waste sector of developing countries points to multiple common factors that need to be addressed to successfully create opportunities for women to participate in the waste sector including:

- Social and cultural gender roles.
- Awareness and understanding of the business environment.
- Skills and knowledge gaps.
- Industry formalisation.

Option development will consider opportunities to address the above factors as barriers to women participating in the waste sector. Examples such as CIGT demonstrate that woman can successfully participate in and lead bulky waste recycling activities in the Pacific. Legacy clearance and ongoing bulky waste management initiatives can be designed to enable the participation of women including recognising the impact of society expectations and addressing skill and knowledge gaps where they exist.

Case study: Empowering Fijian women in business and waste management practices

In 2020, NZ Ministry Foreign Affairs and Trade (MFAT) through their Business Link Pacific programme highlighted the achievements of Sagufta Janif of The Fusion Hub, to discuss her journey and new working relationship.

The Fusion Hub was born out of Sagufta's desire to provide a solution to Fiji's growing waste problem, create a more sustainable Fiji, and contribute to the economic empowerment of Fijian women. The Fusion Hub specialises in reusing and upcycling waste products (e.g. tyres, pallets, plastic and glass bottles, and textiles) sourced from landfills, garage sales, donations, and beach clean-ups into quality furniture and high-end home decor pieces, some of which decorate Fiji resorts and hotels.

Sagufta believes that including women in combatting the global waste crisis will lead to the gradual change of attitudes towards consumption and the way waste is managed. In remote villages in Fiji, women and children, not men, are largely responsible for purchasing domestic goods and disposing of subsequent waste.

Sagufta currently employs 7 women, 3 of whom work onsite and the rest work from home so that they can take care of their kids. The business aims to give women a sense of responsibility and ownership over the design and manufacturing process, employing women who are truly passionate about creating social impact.

The key message from this case study is that women have an integral role to play in any part of the waste sector. In this instance through small business enterprise and entrepreneurship that opened pathways for women at grass root level to learn and engage in recycling and repurposing initiatives. There is a continuing need to remove social stigma surrounding waste work as it is particularly challenging for women.

5 Options Identification and Evaluation

5.1 Options development

5.1.1 Bulky waste recovery steps

Figure 5.1 is a flow diagram showing the different pathways to export for bulky waste items generated in PICs.

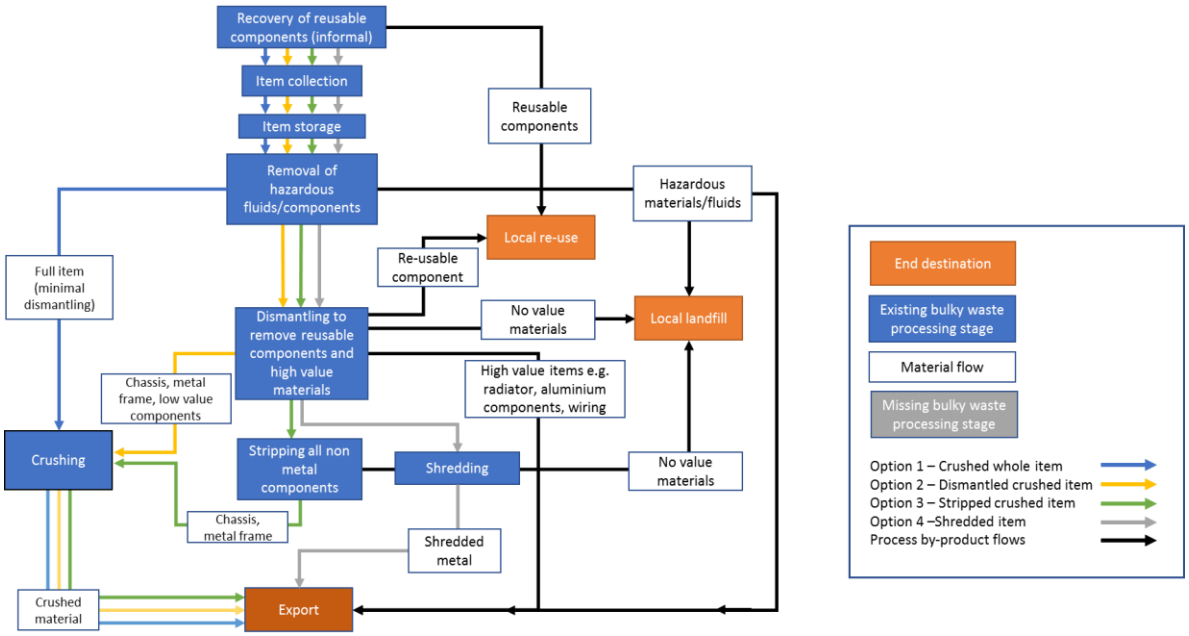


Figure 5.1: Options map for export of bulky waste in PICs

A key consideration during options development is the level of processing activity undertaken in country prior to export for each PIC. For this analysis we have considered several options. These are:

1 No dismantling, crushing of entire depolluted bulky waste item and its components.

2 Dismantling of the item to remove high value items, crushing and export.

3 Dismantling of the item to remove high value items, stripping all remaining non metal components (disposal in-country), crushing and export.

4 Dismantling of the item to remove high value items, stripping all remaining non metal components (export for disposal at engineered landfill), crushing and export.

In some cases, we have also considered shredding of whole or stripped depolluted items.

Initially items must be collected and stored prior to processing. We understand it is common practice in many PICs for waste owners or general public to recover easily and useful recoverable items to be recovered from waste prior to discarding. For instance, some private owners and mechanic businesses keep broken down vehicles on their property for extended periods as a source of usable spare vehicle parts (for example headlights, mirrors, seat belts, hub caps).

Informal recovery is less common for white goods because of the knowledge and tools required to recover useful parts.

For this analysis it is assumed that regardless of processing option, items will be depolluted prior to further processing for export. The important decision after this is the level of dismantling to be undertaken prior to export.

5.1.2 Target materials

The intention of dismantling is to recover components or materials that will fetch a higher value locally or on the export market. The primary focus is reusable components, non ferrous metals (for example aluminium engine parts, radiators and wiring) and various grades of steel. Dismantling or stripping items prior to crushing also means that the item being exported will require minimal further processing to produce metals for recycling.

Although increasing the level of processing in country will increase export value and material recovery, it will also produce material of no value that is not commercially viable for re-use or export. Many of these materials contain POPs (brominated flame retardants) and therefore pose an environmental and health risk if not appropriately managed. Without funding support if materials are removed from ELV in-country they will also be disposed of non-engineered landfills (dumpsites) in country. An alternative is to fund the export and appropriate disposal of POPs containing materials, for example plastics and textiles containing brominated flame retardants.

The level of technical expertise and capital investment in machinery to facilitate processing is also an important consideration. A metal shredder is used in large scale operations to efficiently break up bulky waste allowing the easy removal of ferrous and non-ferrous components of bulky waste with a low resulting contamination rate. Shredding is currently undertaken in Papua New Guinea and manual cutting with heavy machinery in Fiji, however it is not undertaken across the other PICs due to the high cost of the equipment required.

5.1.3 Hazardous materials/residue management and POPs

Shredder residue (plastics, metals fines, glass, textiles, rubber, oils and dirt) also requires special consideration in waste management practices due to the likely presence of oils and POPs such as brominated flame retardants in plastics and textiles. This material is typically disposed of to landfill, and a key aim of this project is to avoid the disposal of POPs containing material in uncontrolled landfills or dumpsites. Most waste disposal sites across the Pacific have limited engineering or operational controls and are therefore unsuitable for the disposal of POPs containing material.

Plastics, electronics and textiles removed during vehicle dismantling are also likely to contain POPs with similar limitations on appropriate disposal options in PICs.

White goods include a number of hazardous substances: lead and lead compounds, cadmium (used as a stabiliser in plastics) hexavalent chromium (corrosion inhibitor), chlorofluorocarbons (the refrigerant and gas in the cells of pre 1995 refrigerators and freezers), hydrochlorofluorocarbons (refrigerants used in air conditioners), now being phased out, brominated or halogenated flame retardants and oils and greases[36].

The management of POPs in the context of each country level option can be summarised as:

- **Depollute and export whole -** POPs are not removed prior to export and POPs are managed in an environmentally sound manner in receiving country in line with the Stockholm convention. Depollution activity involves removal of the battery, fluids and mercury and lead components, not POPs. Depollution activity is currently being undertaken in some PICs.
- **Partially strip and export:** POPs largely retained in vehicle structure i.e. exported to market - and POPs are managed in an environmentally sound manner in receiving country in line with the Stockholm convention.
- **Full strip and export:** POPs containing components (plastics, seats(fabric)), stripped prior to export, disposed of locally - disposal in PICs in uncontrolled landfill.

[36] New Zealand Government Ministry for the Environment (2022)

- **Full strip and export, export POPs containing materials for appropriate disposal:** POPs containing components (plastics, seats(fabric)), stripped prior to export, packaged and exported separately for appropriate management and disposal.
- **Shredding:** POPs containing components (plastics, seats (fabric) in shredder floc (POPs relatively mobile), disposal of locally - disposal in PICs in uncontrolled landfill.

5.1.4 Legacy vs ongoing bulky waste management

Different approaches are required for legacy items and managing the future generation of bulky waste. Legacy items are typically addressed through means of a campaign to remove bulky items including recover of material from items. This requires funding with costs potential very high depending on the quantity of materials requiring removal.

Once legacy items have been removed the ongoing management of future items becomes the focus. Ongoing bulky waste management is characterised by the regular removal of smaller material quantities. Ongoing bulky waste management is less attractive to external funders with funding required on an ongoing basis. Sustainable financing mechanisms (such as ARFD) are a potential sourcing funding for ongoing bulky waste management.

5.2 Options evaluation methodology

5.2.1 Evaluation approach overview

There are multiple factors to consider in identifying and evaluating options for bulky waste management. To assess options for each PIC and at a regional level, criteria were developed based on the list of proposed option considerations provided by SPREP and discussion within the project team (T+TI, SPREP and Swire Shipping).

Options identified for each country and at a regional level have been assessed against the criteria listed in **Table 5.1**. The evidence used to make an assessment is also described in **Table 5.1**. Further details on the cost model assumptions are provided in **Section 5.2.2**.

Table 5.1: Evaluation criteria adopted

Criteria	Explanation	Evidence
Export value	The value of recovered materials on the export market recovered through the option. An option that produces material with a high value is considered preferred under this criterion.	Non country specific assumptions
Implementation Cost	The capital and operational investment required for the activities associated with the option. An option that minimises both capital and operational costs is preferred under this criterion.	High level cost model – see **Section 5.2.1**
Technical assessment and infrastructure needs	The level of technical capability/training and infrastructure required for processing/consolidation/storage associated with the option. An option that matches available technical capacity and infrastructure will be preferred under this criterion.	Mapping of existing infrastructure to identify current gaps that would require investment
Environmental impact	Environmental impact of the option (carbon dioxide emissions, local pollution risk). Tonnes of POP waste safely disposed to sanitary landfill.	Evaluation of the disposal options in country for environmentally sound disposal opportunities

Criteria	Explanation	Evidence
	An option that minimises environmental impacts will be preferred under this criterion.	
Socio-economic impact	The generation of jobs and contribution to the local economy associated with the option. Overcoming barriers to social and gender inequality. An option that maximises local social and economic benefits will be preferred under this criterion.	Non country specific assumptions
Available land area	The level of land area constraints associated with space required for processing, consolidation, and stockpiling. This is particularly important in the Pacific where land ownership and access can be complex. An option that makes use of existing facilities or can be accommodated within existing facilities/land will be preferred under this criterion.	Outcome of consultation with in country representatives to summarize current land availability constraints

5.2.2 High level cost modelling approach

The cost modelling uses several components to build up an estimate of the net cost or revenue from the capture, processing, shipping and recycling of bulky waste items.

The approach uses a number of parameters to develop an estimate of net cost (listed in **Table 5.2**). The full list of parameters and data sources used to develop estimates are noted in **Appendix E.**

Table 5.2: Model assumptions summary

Model input	Data source(s)
Quantity of legacy items	Developed for this study drawing on waste audit reports and additional research - addressed in **Section 3.2.5** and **Appendix D.**
Quantity of target items	Developed for this study drawing on waste audit reports and additional research - addressed in **Section 3.2.5** and **Appendix D**.
Typical weights for target items	Standard weights adopted, refer **Appendix E.**
In-country shipping costs	Not relevant for all study countries. Developed based on research completed for this study and advice from Country focal points. Refer **Appendix E.**
Processing cost for each item	Estimate developed based on key tasks to depollute, process/dismantle item, refer **Appendix E.**
Shipping cost (to market)	Broad estimates developed based on typical shipping rates provided by Swire Shipping, refer **Appendix E**.
Material value	Estimates of value per item based on full item, partially stripped (component values) and fully stripped scenarios. Low end estimates based on 'retail' value for target components and materials, refer **Appendix E**.

5.3 Country options evaluation

The following sections provide an overview of each country, with evaluation of each option against specified criteria, mapping of the current infrastructure against requirements and key considerations for individual country situations. Jump straight to the country of interest by clicking on the country in **Figure 5.2**.

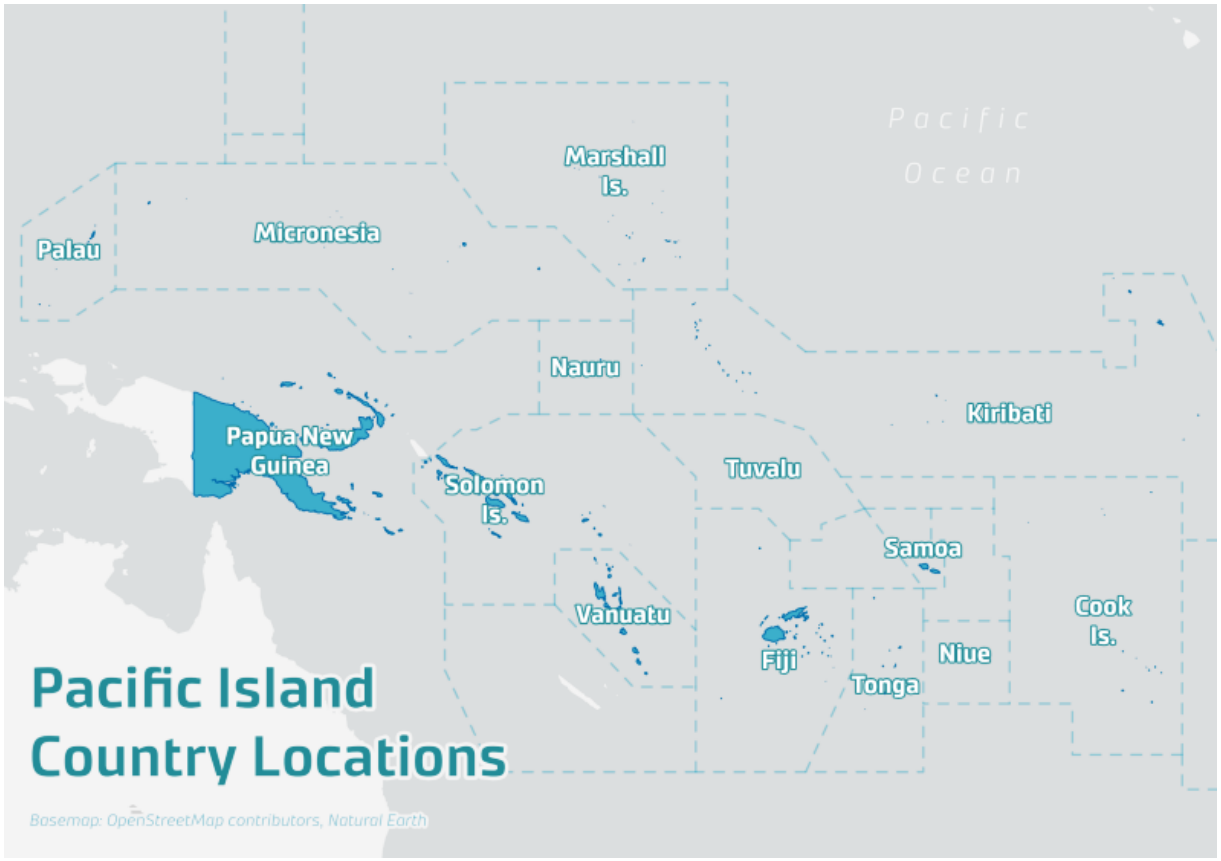


Figure 5.2: Pacific Island Country Locations

5.3.1 Cook Islands

On Rarotonga bulky waste items are collected and processed by CIGT prior to export to New Zealand. Residual materials are landfilled at the Rarotonga Waste Facility (an engineered landfill). There is also an engineered landfill on Aitutaki.

Key legislation relating to bulky waste for the Cook Islands include the Litter Prohibition Act (1983) and National Solid Waste Management Strategy 2017 – 2026. The Cook Islands currently have no ARFD scheme implemented, however the Draft Solid and Hazardous Waste legislation currently under development includes provision for ARFD which would include bulky waste. Further information on relevant legislation is provided in Appendix C. Key considerations in relation to the options for the management of bulky waste in the Cook Islands include:

- There is one private recycling company operates in the Cook Islands, CIGT, who service the main islands and outer islands. CIGT also ship materials within the Cook Islands.
- The main landfill at the Rarotonga Waste Facility is an engineered landfill, however it has almost reached capacity and there are no confirmed disposal options once the site is no longer available.
- Materials from the Pa Enua will require transport to Rarotonga for consolidation and/or processing prior to export.

The current state of bulky waste consolidation and processing has been mapped on **Figure 5.3**.

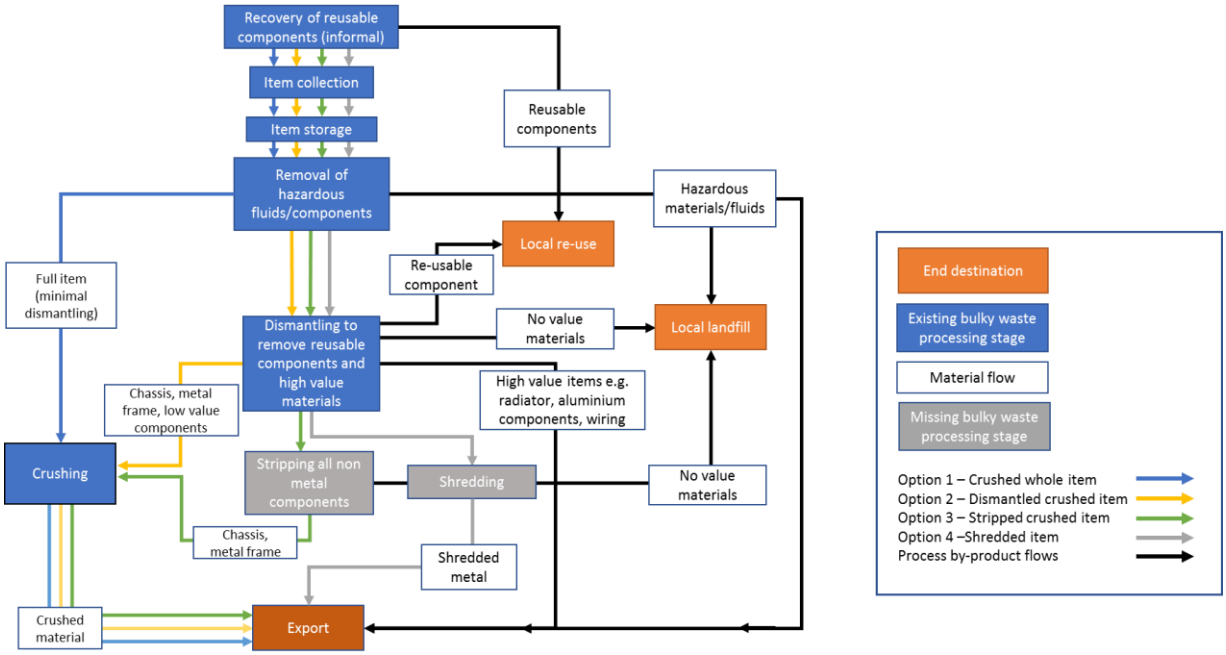


Figure 5.3: Map of recovery options for bulky waste in the Cook Islands

Three quarters of the Cook Islands population live on the main island of Rarotonga, with a further 15% on Aitutaki. The remainder of the population is spread across 10 islands each with less than 500 people inhabiting them.

Disposal of bulky waste items is also an issue for the Pa Enua (outer islands) as vehicles continue to be the main mode of transport and households tend to own a number of bulky waste items, including white goods. On the Pa Enua, bulky items are stockpiled or placed at various informal dump sites, buried, or disposed in the ocean. Bulky wastes produced on the Pa Enua can be collected on an ad hoc basis when funding becomes available from the Cook Islands Government and transported back to Rarotonga via CIGT or Taio Shipping. It should be noted that few bulky waste items have been removed from the outer islands to date, and most of the items shipped to the islands still remain there.

Cook Islands General Transport

Through CIGT much of the infrastructure and processes required to support each option are already currently in place. The more complex processing of wastes prior to shipment offshore results in higher potential export value and job creation. The trade-off is the potential environmental impact from the disposal of by-products. Although the landfill at the Rarotonga Waste Facility is engineered there are concerns around future capacity as the current cell at the landfill has already exceeded its design capacity.

Consultation revealed that there is insufficient space at the current CIGT yard to accept a larger throughput of items for storage and dismantling. CIGT is currently operating a bulky waste recycling system that exports recovered material from waste for profit. Vehicles and white goods are depolluted and then dismantled removing out the likes of engine oils, seats, batteries, some of the lining material, rims wheels and tyres. The metal frames of bulky items are then crushed (along with remaining low value components such as glass and plastic). High value items recovered (such as batteries) are stockpiled on site awaiting export. CIGT has a long-standing relationship exporting scrap metal to a company based in New Zealand for the last 20 years.

The company is currently seeking funding for a shredder. Currently only small volumes of by-products are landfilled as the main aim of dismantling is removing items that have reuse or export opportunities. As noted in **Table 5.3** shredding involves high capital investment and consideration of the environmental impacts of disposing of by-products such as floc.

CIGT also collects and processes wastes on the outer islands but is only able to do so with a financial subsidy from the Cook Islands Government.

The options for bulky waste management are as follows:

Option 1 – bulky items depolluted prior to crushing and export. Items from the Pa Enua transported to Rarotonga for processing prior to export.

Option 2 - bulky items depolluted and high value items removed through dismantling prior to crushing and export.

Option 3 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export, stripping of remaining non-metal components (disposed of locally), crushing and export of ELV body. Partial stripping is the current Status Quo for Rarotonga although not all non-metals are removed.

Option 4 – bulky items depolluted, and high value items removed through dismantling, stripping of remaining non-metal components, crushing and export. Packaging of POPs containing items (plastics, seats/textiles) for export and appropriate management.

Option 5 - bulky items stripped and shredded. This option is currently under consideration by CIGT.

Option costs

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items

2 Management of ongoing generation of items

A high-level cost for each option was developed using the cost model and relevant assumptions and the results are shown in

Table 5.3**.** The full derivation of all costs and assumptions is provided in Appendix E.

Table 5.3: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)			Total cost (USD)	
Depollute	$501	$1,392	$82	$845,490	$345,427
Partial Strip	$515	$1,406	$81	$856,432	$346,817
Full dismantle	$392	$1,200	$70	$695,220	$292,962
Full dismantle, export POPs	$448	$1,360	$82	$793,080	$331,308
Shipping Cost	$476	$1,360	$51	$644,300	$221,170

Market options

For the Cook Islands materials are exported using established shipping routes to New Zealand. This reflects long standing relationship with a New Zealand based recycler, but the following considerations should be noted.

- Shipping costs to New Zealand are generally cheaper than shipping to Asia.
- The material will likely fetch a higher price in Asia with less certainty regarding market access and pricing.

Options evaluation

Table 5.4 presents a summary of the option evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.4: Options evaluation for the Cook Islands

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Low – significant existing infrastructure, existing CIGT facility.	Low – significant existing technical capacity, existing capability within CIGT.	Minimal job creation opportunity, minimal activity within the Cook Islands.	The Cook Islands has established hazardous waste management systems.	Existing facility (CIGT).
Option 2 – Dismantling prior to export	Modelled as $60, this reflects zero value for car body and good value for components	Low – significant existing infrastructure.	Low – significant existing technical capacity.	Opportunity for job creation from dismantling activity.	Small volume of by-products requiring disposal. POPs containing items exported with chassis.	Land constraints for dismantling and stockpiling activity already noticeable at current site.
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD, this reflects some value for the stripped car bod and good value for components.	Low – significant existing infrastructure.	Low – significant existing technical capacity.	Opportunity for job creation from stripping activity.	Although the main landfill is engineered there are concerns about its remaining capacity.	Land constraints for dismantling and stockpiling activity already noticeable at current site.
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Mod – significant existing infrastructure, high disposal cost for POPs containing items.	Low – significant existing technical capacity.	Opportunity for job creation from stripping activity.	Removes POPs containing items from the Cook Islands	Land constraints for dismantling and stockpiling activity already noticeable at current site.
Option 5 - Shredding prior to export	Modelled as $100 USD, this reflects some value for the stripped car body and good value for components.	High – Shredding and associated equipment is expensive.	Medium – new equipment, significant existing technical capability.	Opportunity for job creation from shredding activity.	By-product of shredding is Floc which would require environmentally sound disposal.	Land constraints for dismantling and stockpiling activity already noticeable at current site.

The analysis presented in **Table 5.4** suggests that on balance Option 3 (dismantling and stripping prior to export) or Option 4 (dismantling and stripping prior to export, export of POPs containing items) are the preferred options for the Cook Islands. This reflects the presence of CIGT as an established recycler of bulky waste items and the cost and potential environmental impacts of managing shredder floc on Rarotonga.

Legacy waste options and considerations

The removal of legacy waste would most likely be funded as a project, for example through grant funding. Costs not considered in **Table 5.3** include detailed mapping of the location and quantity of legacy waste. There are also issues associated with waste availability, some private owners are reluctant to part with their end-of-life items if they are still being used for spare parts. Other similar legacy waste missions have required considerable investment in waste surveying prior to collection. If stockpiling of waste prior to shipment is undertaken this will require considerable space with associated land access challenges.

The New Zealand Ministry of Foreign Affairs and Trade (MFAT) is working with CIGT and New Hope Church to remove 20 cars from Rarotonga. The program includes development of a consent form for vehicle owners granting permission to remove vehicles. This is a pilot project for larger future ELV removal projects. Prior to any legacy waste mission being undertaken consultation with key stakeholders in-country should be undertaken to make sure the project does not clash with other country initiatives that are planned.

For the Cook Islands with existing processing of bulky waste for export, further investigation into the proportion of bulky waste not currently captured is recommended.

The modelling suggests a legacy bulky waste recovery programme would cost in the order of USD$800,000 including establishment, materials processing and administration costs.

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. Our modelling suggests annual costs will be in the order of USD$300,000 - 400,000 including administration costs. This is based on processing costs only, i.e. no refund component of a financing scheme has been included.

For processing in country funding needs to cover maintenance and renewal/replacement of processing equipment (i.e. crushers and shredders). Poor maintenance and a lack of availability of spare parts can mean that repairs are costly and prolonged. This means there is a risk that equipment can sit broken and idle for months to years.

For the Cook Islands there may be benefit in collaboration with others in the Pacific Region. Areas with potential for collaboration include:

- Crushing – one or more mobile crushers moving around the Pacific for areas processing small quantities of materials. If this equipment is available, it could be employed for collections from the Pa Enua depending on costs for transporting uncompacted bulky waste.
- Regional programs to train, upskill and support staff (i.e., a Centre of Excellence providing in-country support).
- Regional coordination for the consolidation and management of hazardous waste.
- Regional coordination of marketing of materials – providing scale that can translate into higher prices for traded commodities.

Key information sources

Key information sources have included the T+TI Cook Islands Waste Audit Report, Solid Waste Management in the Pacific Cook Islands Country Snapshot[37], Pacific Region Solid Waste Management and Recycling[38], Assessment of Legislative Frameworks Governing Waste Management in the Cook Islands[39], and 2016 Cook Islands Census Report[40]. Conversations were held with in-country contacts which included employees of CIGT, Taio Shipping, Bank of the Cook Islands - Vehicle Registrations, National Environment Service, and Ministry of Finance and Economic Management - Statistics Office.

5.3.2 Federated States of Micronesia

Key legislation relating to bulky waste for the Federated States of Micronesia include the national Solid Waste Management Strategy 2010 – 2015 and Plastic Products Ban 2020. ARFD schemes are in place for Kosrae, Pohnpei and Yap. There are no plans for ARFD in Chuuk. Further information on relevant legislation is provided in Appendix C.

Key considerations in relation to the processing of bulky waste in the Federated States of Micronesia include the following:

- The level of bulky waste recycling varies across the states:
  - Pohnpei: No private recycling companies are currently in operation and some bulky waste is collected and stockpiled but not exported.
  - Chuuk: No private recycling companies are currently in operation and some ELVs are collected and stockpiled by the Department of Public Works, but not exported. White goods are not collected or stockpiled.
  - Yap: Island Paradise Metal Company collects ELVs upon request for a fee (directly/ privately) and processes bulky waste and exports materials regularly. The State Government collects bulky waste during clean-ups. Outer islands of Yap do not have access to the State CDL scheme and often burn, bury or leave waste at community non engineered landfills.
  - Kosrae: No private recycling companies are currently in operation and some bulky waste is collected and stockpiled but not exported.
- All States have access to an engineered landfill with leachate management with the exception of Chuuk State which is currently utilizing a controlled interim site while an alternative landfill disposal option is finalised.

The current state of bulky waste consolidation and processing has been mapped on **Figure 5.4**.

[37] Woodruff, A. (2014)

[38] Pacific Regional Infrastructure Facility (PRIF) (2018)

[39] University of Melbourne (2020)

[40] Cook Islands Statistics Office (CISO) (2018)

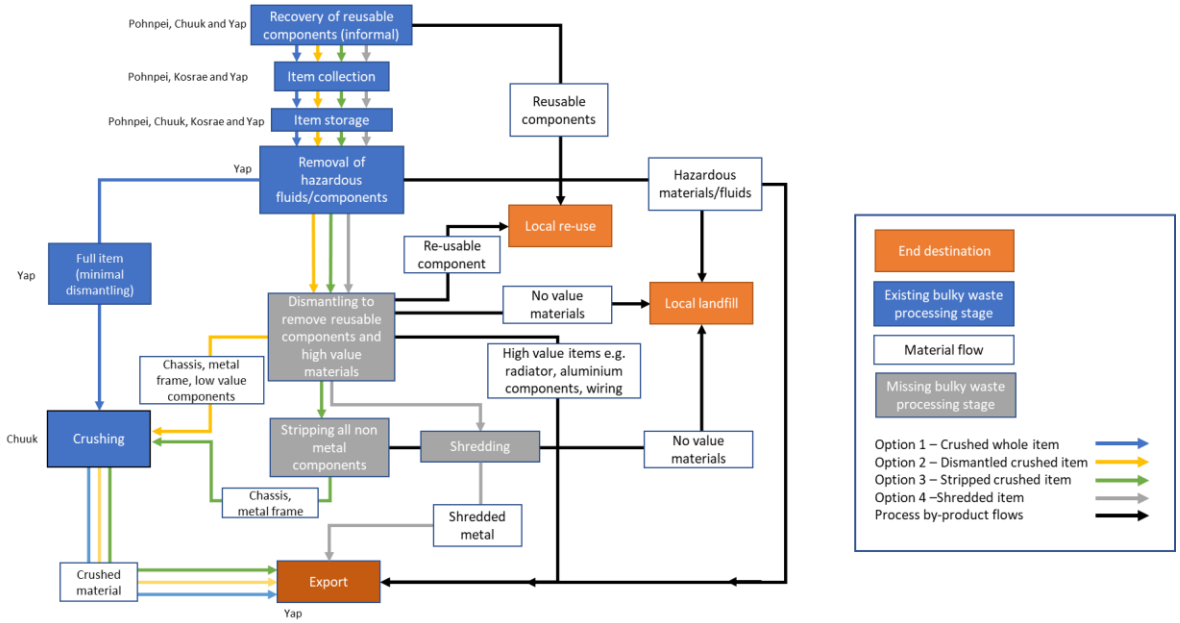


Figure 5.4: Current state of bulky waste processing in Federated States of Micronesia

The Federated States of Micronesia is made up of four different states, the most populous state is Chuuk (48,564) followed by Pohnpei (36,196), Yap (11,377) and Kosrae (6,661)[41]. It should be noted that these states can be a significant distance from each other, with Yap and Kosrae approximately 2,700 km apart. The total number of inhabited islands across all four States is 65. Population information is only reported by state, therefore no comments can be made on the prevalence of bulky waste per island.

The most recent census data from 2000 reports that electricity in housing units across the Federated States of Micronesia was on average of 53.6%. This ranges from 100% in Kosrae, to 32.6% in Chuuk. Due to the population density differences, significant amounts of white goods are still expected across all states. Key transport modes are cars, trucks, vans and buses, boats between islands, with larger numbers of vehicles reported in Pohnpei.

Disposal options of bulky waste in outer islands include burning, disposing in the ocean or dumping on land in Chuuk, with disposal in designated areas in Yap. In Pohnpei, there are no collections of bulky waste items, they are disposed of in informal dumpsites. No information was able to be obtained regarding bulky waste disposal in Kosrae's outer islands.

Much of the infrastructure and processes required to support each option are not currently in place in most States (except for Yap State). As a minimum, there would be up front investment required to improve a collection mechanism, storage arrangements and to facilitate the safe removal of hazardous components. The more complex processing of wastes prior to shipment offshore results in higher potential export value and job creation. The trade-off is the potential environmental impact from the disposal of by-products. Consultation revealed that there is insufficient space at the current stockpiling areas to accept items for storage and dismantling.

Vehicles and white goods are not currently processed in any form in Chuuk or Pohnpei States, although a crusher is available at the Chuuk Marina Dumpsite (non-engineered landfill) for crushing ELVs.

[41] Division of Statistics Department of Economic Affairs FSM National Government (2002)

Island Paradise Metal Company

Island Paradise Metal Company (IPMC) are the only private bulky waste recycler in Yap State and also operate the State CDL Scheme. IPMC undertake a periodic ELV collection for a fee using a Boom Truck. Items are depolluted with the hazardous components collected and stored by Yap EPA. No other processing is undertaken. The company exports two 20-foot containers of scrap metal on average annually to Taiwan.

The options for bulky waste management are as follows:

Option 1 – bulky items depolluted prior to crushing and export. Items from Kiritimati and other islands transported to South Tarawa for processing prior to export.

Option 2 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export.

Option 3 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export, stripping of remaining non-metal components, crushing and export.

Option 4 – bulky items depolluted, and high value items removed through dismantling, stripping of remaining non-metal components, crushing and export. Packaging of POPs containing items (plastics, seats/textiles) for export and appropriate management.

Option 5 - bulky items stripped and shredded.

Option costs

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items

2 Management of ongoing generation of items

A high-level cost for each option was developed using the cost model and relevant assumptions and the results are shown in **Table 5.5**. The full derivation of all costs and assumptions is provided in Appendix E.

Table 5.5: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)			Total cost (USD)	
Depollute	$252	$680	$55	$6,358,400	$1,964,612
Partial Strip	$266	$689	$54	$6,625,625	$1,970,339
Full dismantle	$196	$640	$54	$5,207,600	$1,821,214
Shredding	$252	$800	$66	$6,610,400	$2,241,718
Shipping Cost	$210	$600	$23	$4,650,000	$984,300

Market options

- IPMC has secured a market for their scrap metal in Taiwan

Table 5.6 presents a summary of the option evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.6: Options evaluation for Federated States of Micronesia

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Investment required in: • Collection • Storage capacity • Depollution activity • Crushing	Low, however needs to consider the disposal or export of hazardous substances.	Minimal job creation opportunity, minimal activity undertaken in FSM.	Needs to consider the safe disposal or export of hazardous substances only.	Low land availability constraints.
Option 2 – Dismantling prior to export	Modelled as $60 USD, this reflects zero value for car body and good value for components	Investment required in: • Collection • Storage capacity • Depollution activity • Dismantling (equipment)	Training of staff in dismantling. Multiple material streams to manage. Added export/transport complexity.	Opportunity for job creation from dismantling activity	Less waste requiring disposal. Engineered landfills available in country (with the exception of Chuuk State).	Moderate land availability constraints.
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD, this reflects some value for the stripped car bod and good value for components.	Investment required in: • Collection • Storage capacity • Depollution activity • Dismantling • Stripping	Training of staff in dismantling and stripping. Multiple material streams to manage including low value wastes with niche markets. Added export/ transport complexity.	Opportunity for job creation from stripping activity.	Some waste requiring disposal. Engineered landfills available in country (with the exception of Chuuk State).	High land availability constraints.
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Investment required in: • Collection • Storage capacity • Depollution activity • Dismantling/Stripping High disposal cost for POPs containing items.	Training of staff in dismantling and stripping. Added export/ transport complexity.	Opportunity for job creation from stripping activity.	Removes POPs containing items from the FSM	High land availability constraints

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 5 – Shredding prior to export	Modelled as $120 USD, this reflects some value for the stripped car bod and good value for components.	Investment required in: • Collection • Storage capacity • Depollution activity • Dismantling • Stripping • Shredding	Training of staff in dismantling and stripping. Multiple material streams to manage including low value wastes with niche markets. Added export/ transport complexity. Machinery to maintain/ repair.	Opportunity for job creation from stripping and shredding activity.	Engineered landfills available in country (with the exception of Chuuk State). Potential high environmental impact from any waste requiring disposal i.e. floc.	High land availability constraints.

The analysis presented in **Table 5.6** suggests that Option 1 (depolluted whole item export) or Option 2 (partial dismantling) are the preferred options for the Federated States of Micronesia. This reflects the lack of private bulky waste recycling companies in Pohnpei, Kosrae and Chuuk and lack of infrastructure or physical space for storage and dismantling of bulky items. Targeted removal of high value items will provide employment opportunities and capture some value from easily removable components of the bulky items.

Legacy waste issues and considerations

The removal of legacy waste would most likely be funded as a project, for example through grant funding. Costs not considered in **Table 5.5** include detailed mapping of the location and quantity of legacy waste. For instance, it is understood from consultation that the ELVs stored at the Chuuk Marina Dumpsite are partially crushed but have not been depolluted. There are also issues associated with waste availability, some private owners are reluctant to part with their end-of-life items if they are still being used for spare parts.

Other similar legacy waste missions have required considerable investment in waste surveying prior to collection. If stockpiling of waste prior to shipment is undertaken this will require considerable space with associated land access challenges. Prior to any legacy waste mission being undertaken, consultation with key stakeholders in-country should be undertaken to make sure the project does not clash with other country initiatives that are planned.

The modelling suggests a legacy bulky waste recovery programme would cost in the order of USD$6.5M including establishment, materials processing and administration costs. This is based on broad estimates of legacy material, these will require significant refining in early planning stages.

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. Our modelling suggests annual costs will be in the order of USD$2M including administration costs. For any processing waste in country, funding needs to cover maintenance and renewal/replacement of processing equipment (i.e. crushers and shredders). Poor maintenance and a lack of availability of spare parts can mean that repairs are costly and prolonged. This means there is a risk that equipment can sit broken and idle for months to years.

For Federated States of Micronesia there may be benefit in collaboration with others in the Pacific Region. Areas with potential for collaboration include:

- Crushing – one or more mobile crushers moving around the Pacific for areas producing small quantities of materials.
- Regional programs to train, upskill and support staff (i.e. a Centre of Excellence).
- Regional coordination for the consolidation and management of hazardous waste.
- Regional coordination of marketing of materials – providing scale that can translate into higher prices for traded commodities.

Key information sources

Key information sources have included the T+TI Federated States of Micronesia Waste Audit Report, Solid Waste Management in the Pacific: Federated States of Micronesia Country Snapshot[42], Pacific Region Solid Waste Management and Recycling[43], Assessment of Legislative Frameworks Governing Waste Management in the Federated States of Micronesia[44], and 2000 Federated States of Micronesia Census Report[45]. Conversations were held with in-country contacts which included employees from Federated States of Micronesia Customs and Tax Administration, Department of Environment, Climate Change and Emergency Management, Chuuk Environmental Protection Agency, Yap Environmental Protection Agency and Pohnpei Environmental Protection Agency.

[42] Woodruff, A. (2014)
[43] Pacific Regional Infrastructure Facility (PRIF) (2018)
[44] University of Melbourne (2020)
[45] Division of Statistics Department of Economic Affairs FSM National Government (2002)

5.3.3 Fiji

In Fiji bulky waste items are collected on a quarterly basis by government run collection systems in some areas and some items are processed by private recyclers and exported. Residual materials are landfill at the Naboro Landfill which is an engineered landfill on Viti Levu near Suva.

Key legislation relating to bulky waste for Fiji include the Litter Act 2008 and Environmental Management (Container Deposit) Regulations 2011. There are no ARFD schemes implemented or planned for Fiji. Further information on relevant legislation is provided in Appendix C.

Key considerations in relation to the options for the management of bulky waste in Fiji include:

- There are a number of bulky waste recyclers including Waste Recyclers (Fiji) Pte Ltd (WRF) and Pacific Scrap Buyers (PSB).
- Naboro Landfill is an engineered landfill located on Viti Levu and although the landfill was designed with significant capacity, there has been an unprecedented increase in waste generation per capita. This means that Naboro Landfill is filling up faster than expected and alternative disposal options are being discussed.
- The remainder of Fiji is serviced by controlled or uncontrolled dumpsites with proposals to developed engineered landfills in some locations.
- Materials from the outer islands will require transport to Viti Levu for consolidation and/or processing prior to export.

The current state of bulky waste consolidation and processing has been mapped on **Figure 5.5**.

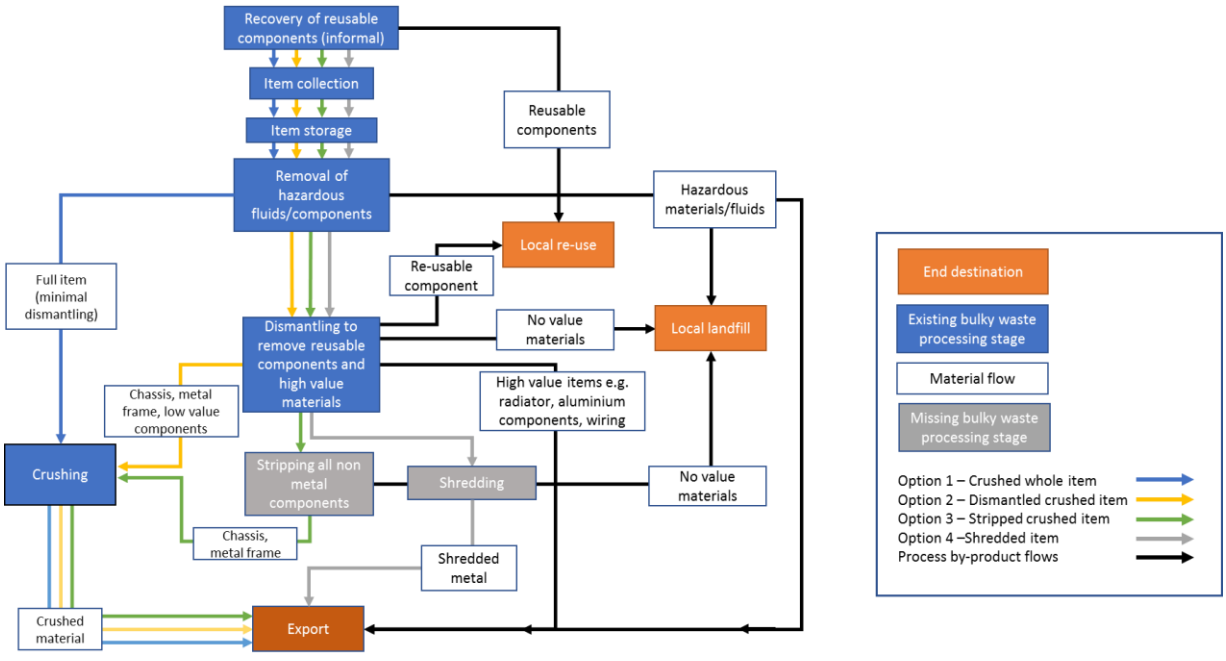


Figure 5.5. Map of recovery options for bulky waste in the Fiji

There are approximately 108 permanently inhabited islands in Fiji, the main islands are Viti Levu and Vanua Levu which contain 93% of the total population. Viti Levu has 75% of the population and made of The Western and Central divisions with populations of 337,041 and 378,284 respectively[46]. Vanua Levu has 18% of the population, with approximately 120,000 people.

[46] Fiji Bureau of Statistics (2018)

The largest remote islands include Kadavu (10,000 residents), Ovalau (9,100 residents), Taveuni (9,000 residents), Rabi Island (5,000 residents), Koro Island (4,500 residents) and Gau Island (4,000 residents). The remaining islands range in population from 1 – 2 to 3,500. The only outer island serviced by bulky waste collection services is Ovalau, in Levuka Town.

The most common bulky waste disposal practices in the outer islands are disposal at a Municipal Council operated disposal site (Ovalau and Taveuni), in owners private land or backyards, burn and bury at village communal dumping sites (Kadavu), and resort disposal sites. ELV are disposed of on owner's land for most remote islands, with useful parts taken by local mechanics. Islands within the Kadavu Group and Yasawa Islands have limited road access and limited electricity supply, and as such produce fewer bulky waste items compared to other island groups in Fiji. However, ELV (cars and boats) are commonly found in Kadavu Island. Levuka Town in Ovalau would be best positioned for bulky waste collection as the items are stored at the Municipal Council's disposal site, while other islands keep their ELV on private lands. Shipping between Suva and Labasa costs around USD$1,000 per 20ft container, each way.

Waste Recyclers (Fiji) Pte Ltd (WRF) and Pacific Scrap Buyers (PSB)

Through WRF and PSB much of the infrastructure and processes required to support each option is currently in place. The more complex processing of wastes prior to shipment offshore results in higher potential export value and job creation. The trade off is the potential environmental impact from the disposal of by-products that remain in Fiji. Although Naboro Landfill is an engineered landfill there are concerns around the future capacity as the current cell at the landfill has already exceeded its design capacity.

Currently WRF undertake manual cutting using heavy machinery and cut using saws for removing recyclable scrap metals. The company owns a bailing machine that can compress low gauge steel only.

Pacific Batteries in Lami recycle lead acid batteries only.

The options for bulky waste management in Fiji are as follows:

Option 1 – bulky items depolluted prior to crushing and export.

Option 2 - bulky items depolluted and high value items removed through dismantling prior to crushing and export.

Option 3 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export, stripping of remaining non-metal components, crushing and export. Partial stripping is the current Status Quo for recyclers in Fiji.

Option 4 – bulky items depolluted, and high value items removed through dismantling, stripping of remaining non-metal components, crushing and export. Packaging of POPs containing items (plastics, seats/textiles) for export and appropriate management.

Option 5 - bulky items stripped and shredded.

Option costs

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items

2 Management of ongoing generation of items

A high-level cost for each option was developed using the cost model and relevant assumptions and the results are shown in **Table 5.7**. The full derivation of all costs and assumptions is provided in Appendix E.

Table 5.7: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)			Total cost (USD)	
Depollute	$196	$520	$49	$38,643,800	$19,247,150
Partial Strip	$210	$534	$48	$38,799,200	$18,906,562
Full dismantle	$140	$480	$48	$35,713,250	$18,738,215
Shredding	$196	$640	$60	$45,810,050	$23,499,335
Shipping Cost	$210	$600	$23	$24,810,000	$9,129,000

Market options

Currently in Fiji, recyclable materials are exported to Australia, Thailand, China, and India. Materials are primarily exported in containers to Australia before being combined with Australian recyclables before being shipped to end market companies.

Options evaluation

Table 5.8 presents a summary of the option evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.8: Options evaluation for Fiji

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Low – significant existing infrastructure	Low – significant existing technical capacity	Minimal job creation opportunity, minimal activity within Fiji.	Fiji has established hazardous waste management systems.	Existing facility
Option 2 – Dismantling prior to export	Modelled as between $0 and $600 USD Potential for small revenue from sale of other recovered items.	Low – significant existing infrastructure	Low – significant existing technical capacity	Opportunity for job creation from dismantling activity.	Small volume of by-products requiring disposal.	Existing facility
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD Potential for small revenue from sale of other recovered items.	Low – significant existing infrastructure	Low – significant existing technical capacity	Opportunity for job creation from stripping activity.	Although the main landfill is engineered there are concerns about its remaining capacity.	Existing facility

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Significant existing infrastructure, High disposal cost for POPs containing items.	Low – significant existing technical capacity.	Opportunity for job creation from stripping activity.	Removes POPs containing items from Fiji	Existing faclities
Option 5- Shredding prior to export	Modelled as $120 USD Potential for small revenue from sale of other recovered items.	High – Shredding and associated equipment is expensive	Medium – new equipment, significant existing technical capability	Opportunity for job creation from shredding activity.	Although the main landfill is engineered there are concerns about its remaining capacity.	Land constraints not identified

The analysis presented in **Table 5.8** suggests that on balance Option 3 (dismantling and stripping prior to export) or Option 4 are the preferred options for Fiji. This reflects the presence of WRF and PSB as established recyclers of bulky waste items. Option 4 is reliant on funding support available to manage the appropriate disposal of POPs.

Legacy waste options and considerations

The removal of legacy waste would most likely be funded as a project, for example through grant funding. Costs not considered in **Table 5.7** include detailed mapping of the location and quantity of legacy waste. There are also issues associated with waste availability, some private owners are reluctant to part with their end-of-life items if they are still being used for spare parts. Other similar legacy waste missions have required considerable investment in waste surveying prior to collection. If stockpiling of waste prior to shipment is undertaken this will require considerable space with associated land access challenges.

The modelling suggests a legacy bulky waste recovery programme would cost in the order of USD$40M including establishment, materials processing and administration costs. This is based on broad estimates of legacy material, these will require significant refining in early planning stages.

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. Our modelling suggests annual costs will be in the order of USD$20M including administration costs. This is based on processing costs only, i.e. no refund component of a financing scheme has been included.

For processing waste in country funding needs to cover maintenance and renewal/replacement of processing equipment (i.e. crushing and shredders). Poor maintenance and a lack of availability of spare parts can mean that repairs are costly and prolonged. This means there is a risk that equipment can sit broken and idle for months to years.

For Fiji there may be benefit in collaboration with others in the Pacific Region. Areas with potential for collaboration include:

- Crushing – one or more mobile crushers moving around the Pacific for areas producing small quantities of materials. If this equipment is available, it could be employed for collections from smaller Islands in Fiji depending on costs for transporting uncompacted bulky waste.
- Regional programs to train, upskill and support staff (i.e., a Centre of Excellence).
- Regional coordination for the consolidation and management of hazardous waste.
- Regional coordination of marketing of materials – providing scale that can translate into higher prices for traded commodities.

Key information sources

Key information sources have included the T+TI Fiji Waste Audit Report, the Solid Waste Management in the Pacific: Fiji Country Snapshot[47], Pacific Region Solid Waste Management and Recycling[48], and the 2017 Fiji Population and Housing Census Report[49]. Conversations were held with in-country contacts which included employees from Waste Recyclers Fiji, Fiji Bureau of Statistics, and ENasome Environmental Consultant Services.

[47] Woodruff, A. (2014)
[48] PRIF (2018)
[49] Fiji Bureau of Statistics (2017)

5.3.4 Kiribati

In Kiribati bulky waste items are not collected through an established system. On the main island bulky wastes can be dropped off at the Material Recycling Facility at Betio, abandoned on public land or stored on private property. There are three landfills on South Tarawa, Nanikai, Bikenibeu, and Betio which are not managed with best environmental practice. Other smaller illegal non engineered landfill sites also exist.

Key legislation relating to bulky waste for Kiribati include the Special Fund (Waste Materials Recovery) Act 2004 and the Kiribati Development Plan 2016 – 2019. An ARFD scheme has been implemented in Kiribati, however bulky waste is not included. Further information on relevant legislation is provided in Appendix C.

Key considerations in relation to the processing of bulky waste in Kiribati includes:

- No private recycling companies are currently operating that recycle bulky waste.
- Landfills have limited capacity and are not managed in accordance with best environmental practice.
- Exports of bulky waste are infrequent and managed as missions with the assistance of donor funding. This leads to stockpiling of waste at public facilities.

The current state of bulky waste consolidation and processing has been mapped on **Figure 5.6**. Different options for the management of bulky wastes are illustrated by flows with colour code lines/arrows.

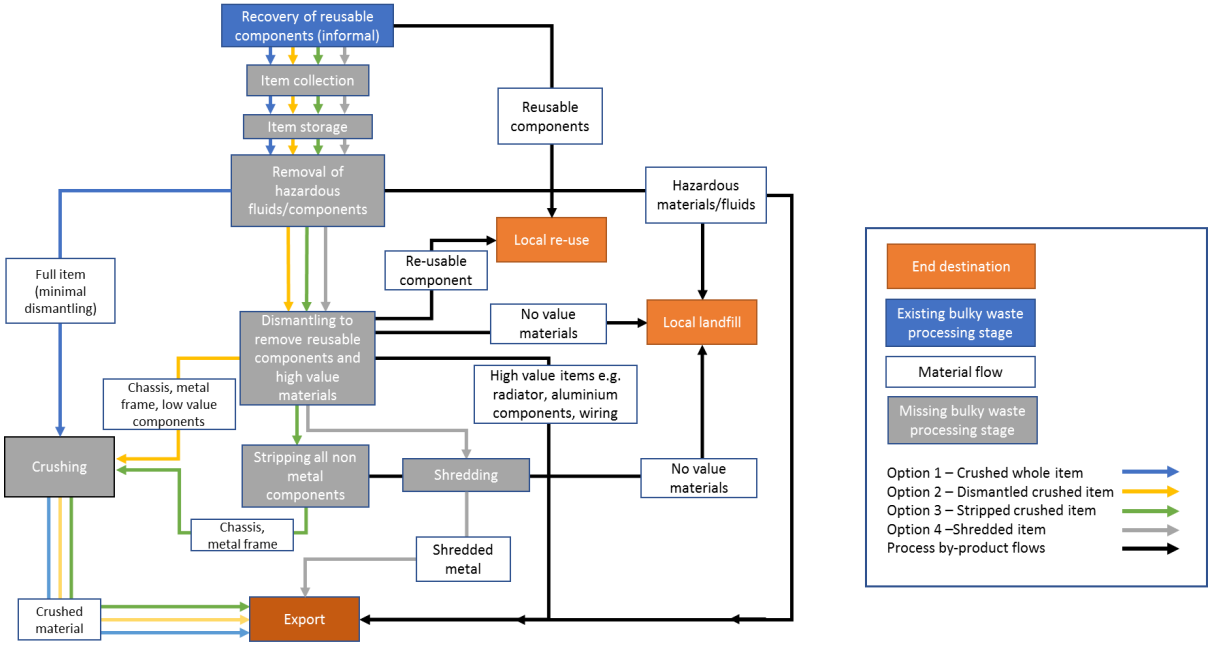


Figure 5.6: Current state of bulky waste processing in Kiribati

Kiribati is made up of 20 inhabited islands. The most populated island of is the Tarawa Atoll with approximately 58% of the population, with approximately 63,100 people in South Tarawa, and 7,000 people in North Tarawa[50]. Following the Tara Atoll is Kiritimati with a population of 7,400, and Abaiang with a population of 5,815.

[50] Kiribati National Statistics Office Ministry of Finance (2016)

The remaining population is spread across 17 islands with populations ranging from around 40 people in Kanton to 4,181 people in North Tabiteuea. It should be noted that Kiribati extends approximately 3,900 km from east to west, and as such outer islands are not easily accessible from the main island. Many of Kiribati's outer islands are small (less than 20 km^2) and typically have a single town and one main road travelling around the island, therefore there are not expected to be large quantities of ELV on the outer islands. Kiribati's outer islands have no waste collection systems so residents either store, bury, burn, or dispose of waste directly into the sea.

In many cases the infrastructure and processes required to support each option are not currently in place. As a minimum, there would be up front investment required to improve collection, storage arrangements and to facilitate the safe removal of hazardous components. Further investment to enable more complex processing of items prior to shipment offshore results in higher potential export value and job creation. The trade-off is the potential environmental impact from the disposal of by-products retained in Kiribati.

Consultation revealed that there is insufficient space at the current Materials Recovery Facility to accept large quantities of bulky items for storage and dismantling.

Vehicles and white goods are not currently processed in any form. Depollution and processing of stockpiled waste is planning to be incorporated as part of the next mission to recover and export items funded by MFAT (further information provided below).

The options for bulky waste management in Kiribati are as follows:

Option 1 – bulky items depolluted prior to crushing and export from South Tarawa or Kiritimati. Items from Kiritimati and other islands could also need to be transported to South Tarawa for processing prior to export prior to export, this would require further investigation.

Option 2 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export.

Option 3 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export (ELV bodies are proposed to be crushed into bales, fluids including engine oil, shock oil, brake fluid to be exported for refining), stripping of remaining non-metal components, crushing and export. This is the model adopted by the MFaT scrap metal project currently in implementation.

Option 4 – bulky items depolluted, and high value items removed through dismantling, stripping of remaining non-metal components, crushing and export. Packaging of POPs containing items (plastics, seats/textiles) for export and appropriate management.

Option 5 - bulky items stripped and shredded.

<u>Option costs</u>

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items through the use of a mobile crusher.

2 Management of ongoing generation of items through the use of a mobile crusher which will be moved around the PICs for use.

A high-level cost for each option was developed using the cost model and relevant assumptions and the results are shown in **Table 5.9**. The full derivation of all costs and assumptions is provided in Appendix E.

Table 5.9: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)			Total cost (USD)	
Depollute	$266	$720	$57	$3,383,015	$1,055,543
Partial Strip	$280	$733	$56	$3,430,601	$1,045,421
Full dismantle	$202	$656	$54	$2,983,837	$980,222
Shredding	$258	$816	$66	$3,698,677	$1,194,590
Shipping Cost	$252	$720	$27	$2,442,600	$567,720

Market options

For Kiribati there is the option to either ship to Australia or secure outlets in Asia (such as established routes to Taiwan) noting that:

- The material will likely fetch a higher price in Asia, but with less certainty regarding market access and pricing.
- [Shipping cost comparison to be made]

Table 5.10 presents a summary of the option evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.10: Options evaluation for Kiribati

Option	Potential export value	Implementation cost	Technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Investment required in: • Collection • Storage capacity • Depollution	Low however needs to consider the disposal or export of hazardous substances.	Minimal job creation opportunity, minimal activity undertaken in Kiribati.	Needs to consider the safe disposal or export of hazardous substances only.	High land availability constraints for all options.
Option 2 – Dismantling prior to export	Modelled as $60, this reflects zero value for car body and good value for components.	Investment required: • Collection • Storage capacity • Depollution • Dismantling	Training of staff in dismantling (occurring through MFaT project). Multiple material streams to manage. Added export/ transport complexity.	Opportunity for job creation from dismantling activity.	Small volume of by-products requiring disposal.	High land availability constraints for all options.
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD, this reflects some value for the stripped car bod and good value for components.	Investment required: • Collection • Storage capacity • Depollution • Stripping	Training of staff in dismantling (occurring through MFaT project). Multiple material streams to manage. Added export/ transport complexity.	Opportunity for job creation from stripping activity.	No engineered landfills available in country. Potential high environmental impact from any waste disposal.	High land availability constraints for all options.
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Investment required Significant existing infrastructure, high disposal cost for POPs containing items.	Training of staff in dismantling (occurring through MFaT project). Multiple material streams to manage. Added export/ transport complexity	Opportunity for job creation from stripping activity.	Removes POPs containing items from Kiribati	High land availability constraints for all options.

Option	Potential export value	Implementation cost	Technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 5 – Shredding prior to export	Modelled as $120 USD, this reflects some value for the stripped car body and good value for components.	Investment required in: • Collection • Storage capacity • Depollution • Dismantling • Stripping • Shredding	Training of staff in dismantling and stripping. Multiple material streams to manage including low value wastes with niche markets. Added export/transport complexity. Machinery to maintain/repair.	Opportunity for job creation from stripping and shredding activity.	No engineered landfills available in country. Potential high environmental impact from any waste requiring disposal i.e. floc.	High land availability constraints for all options.

The analysis presented in **Table 5.10** suggests that on balance Option 4 is the preferred options for Kiribati. Option 3 is the approach being taken for the scrap metal project funded by MFaT and delivered by McCauley Metals. Each option has different benefits:

- Option 1 exports a low value item but will have minimal local environmental impacts or ongoing infrastructure requirements.
- Option 2 captures some valuable items but minimises infrastructure requirements and complexity.
- Option 3 delivers higher value exports but requires dismantling equipment and expertise and the disposal of no value material in Kiribati.
- Option 4 delivers higher value exports but requires dismantling equipment and expertise and funding for the disposal of POPs containing material out of Kiribati.

Legacy waste issues and considerations

The removal of legacy waste is most likely to be funded as a project with the MFaT scrap metal project an example of this approach. Costs not considered include detailed mapping of the location and quantity of legacy waste. There are also issues associated with waste availability, some private owners are reluctant to part with their end-of-life items if they are still being used for spare parts. Other similar legacy waste missions have required considerable investment in waste surveying prior to collection. If stockpiling of waste prior to shipment is undertaken this will require considerable space with associated land access challenges.

The New Zealand Ministry of Foreign Affairs and Trade (MFAT) is sponsoring a project working with the Ministry of Environment, Land and Agricultural Development (MELAD) to remove all ferrous scrap waste from the urban and natural environment of South Tarawa. Macauley Metals has been engaged to undertake work to remove approximately 1200 ELVs from the island. It is not clear when this legacy waste removal program will be implemented, but the scoping work has been completed. Kiribati has 23 inhabited islands in total, with over 50% of the population residing outside of the main island. There is likely to be unaccounted stockpiles of bulky waste on the outer islands that would be logistically difficult to consolidate. Prior to any legacy waste mission being undertaken, consultation with key stakeholders in-country should be undertaken to make sure the project does not clash with other country initiatives that are planned.

The modelling suggests a legacy bulky waste recovery programme would cost over USD$3M including establishment, materials processing and administration costs. This is consistent with the current scrap metal clearance project for South Tarawa and Christmas Islands (NZD1-5M).

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. Our modelling suggests annual costs will be in the order of US$1M including administration costs. This is based on processing costs only, i.e. no refund component of a financing scheme has been included. Interisland shipping will be a component of the ongoing cost with periodic missions to each of the outer islands likely to be the most efficient approach.

For processing waste in country funding needs to cover maintenance and renewal/replacement of processing equipment (i.e. crushing and shredders). Poor maintenance and a lack of availability of spare parts can mean that repairs are costly and prolonged. This means there is a risk that equipment can sit broken and idle for months to years.

For Kiribati there may be benefit in collaboration with others in the Pacific Region. Areas with potential for collaboration include:

- Crushing – one or more mobile crushers moving around the Pacific for areas producing small quantities of materials. If this equipment is available, it could be employed for collections from smaller islands depending on costs for transporting uncompacted bulky waste.
- Regional programs to train, upskill and support staff (i.e. a Centre of Excellence).
- Regional coordination for the consolidation and management of hazardous waste.
- Regional coordination of marketing of materials – providing scale that can translate into higher prices for traded commodities.

Key information sources

Key information sources have included the Solid Waste Management in the Pacific: Kiribati Country Snapshot[51], the South Tarawa Vehicle Recycling Study (2014)[52], the Assessment of Legislative Frameworks Governing Waste Management in Kiribati[53], Pacific Region Solid Waste Management and Recycling[54], and the 2015 Kiribati Population Census Report[55]. Conversations were held with in-country contacts which included employees of Kiribati Customs Administration and Enforcement.

[51] Woodruff, A. (2014)
[52] Environment and Conservation Division-MELAD (2021)
[53] University of Melbourne (2020)
[54] PRIF (2018)
[55] Kiribati National Statistics Office Ministry of Finance (2016)

5.3.5 Nauru

In Nauru bulky waste items are not collected through an established system. Bulky waste items are dropped at (or just outside) the waste facility for stockpiling. The dumpsite located at the waste facility is unlined with no leachate collection or separation of stormwater. Nauru is a single island nation.

Key legislation relating to bulky waste for Nauru includes the Customs Proclamation (Prohibition of Export of Scrap Metal) 2007, National Solid Waste Management Strategy 2017 – 2026 and Environmental Management and Climate Change (Ban on Single Use Plastic Shopping Bags) Regulations 2021. A feasibility study on ARFD schemes in Nauru has been completed, but no scheme has been implemented yet. Further information on relevant legislation is provided in Appendix C.

Key considerations in relation to the processing of bulky waste in Nauru includes:

- No private recycling companies are currently operating that recycle bulky waste
- The only dumpsite on the island is not engineered and has limited remaining capacity

Exports of bulky waste are infrequent leading to stockpiling of waste at the dumpsite and Government Warehouse (predominantly ELVs with some export of white goods). The current state of bulky waste consolidation and processing has been mapped on **Figure 5.7**.

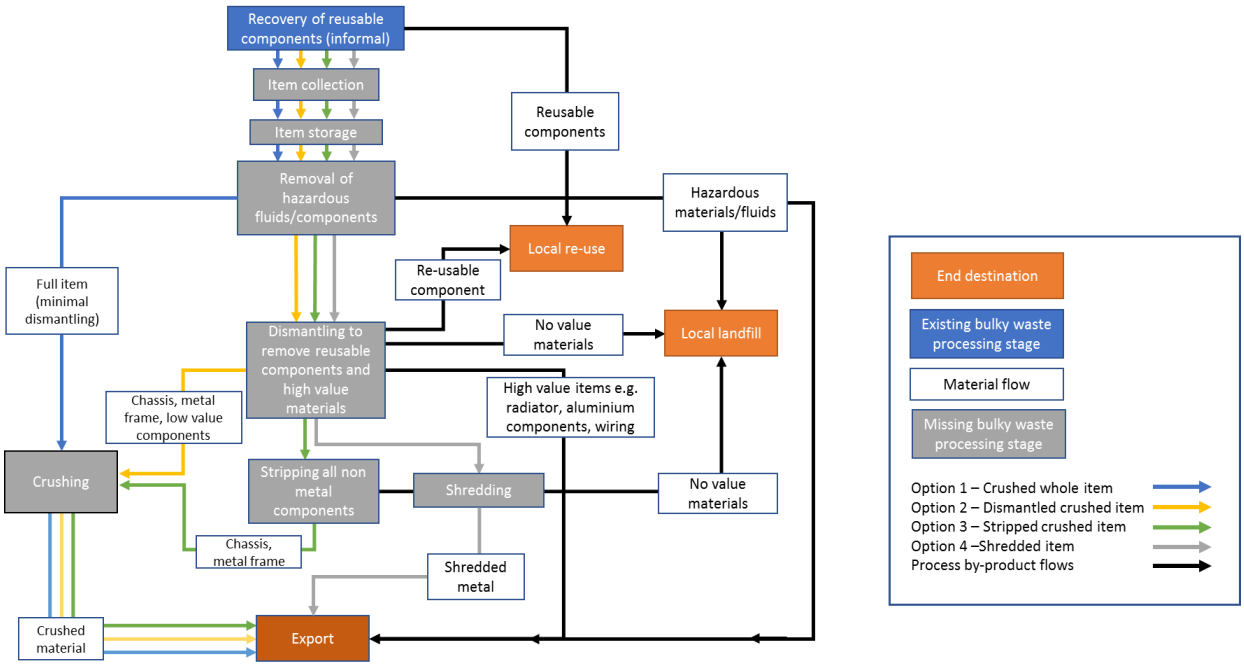


Figure 5.7: Map of recovery options for bulky waste in Nauru

Much of the infrastructure and processes required to support each option are not currently in place. As a minimum, there would be up front investment required to improve a collection mechanism, storage arrangements and to facilitate the safe removal of hazardous components. The more complex processing of wastes prior to shipment offshore results in higher potential export value and job creation. The trade-off is the potential environmental impact from the disposal of by-products.

Stockpiled vehicles and white goods are not currently processed in any form.

The options for bulky waste management are as follows:

Option 1 – bulky items are collected from around the island and depolluted prior to crushing and export.

Option 2 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export.

Option 3 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export, stripping of remaining non-metal components, crushing and export.

Option 4 – bulky items depolluted, and high value items removed through dismantling, stripping of remaining non-metal components, crushing and export. Packaging of POPs containing items (plastics, seats/textiles) for export and appropriate management.

Option 5 – bulky items stripped and shredded, unlikely to be viable due to energy requirements, available space and scale.

Option costs

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items

2 Management of ongoing generation of items

A high-level cost for each option was developed using the cost model and relevant assumptions and the results are shown in **Table 5.11**. The full derivation of all costs and assumptions is provided in Appendix E.

Table 5.11: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)			Total cost (USD)	
Depollute	$224	$600	$52	$344,200	$74,140
Partial Strip	$238	$618	$51	$350,836	$75,051
Full dismantle	$160	$536	$49	$293,443	$65,904
Shredding	$216	$696	$61	$370,723	$77,832
Shipping Cost	$252	$720	$27	$255,600	$40,320

Market options

For Nauru there is the option to either ship to a market in Australia or access Asian markets noting that the material will likely fetch a higher price in Asia with less certainty regarding market access and pricing.

Options evaluation

Table 5.12 presents a summary of the options evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.12: Options evaluation for Nauru

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Investment required in: • Collection • Storage capacity • Depollution activity	Low however needs to consider the disposal or export of hazardous substances.	Minimal job creation opportunity	Needs to consider the safe disposal or export of hazardous substances only.	Limited land for bulky waste processing, some space at the waste facility.
Option 2 – Dismantling prior to export	Modelled as $60, this reflects zero value for car body and good value for components.	Investment required in: • Storage capacity • Depollution activity • Stripping	Training of staff in dismantling. Multiple material streams to manage. Added export/transport complexity.	Opportunity for job creation from dismantling activity	Less waste requiring disposal. No engineered landfills only dumpsites available onshore. Potential high environmental impact from any waste requiring disposal.	Limited land for bulky waste processing, some space at the waste facility.
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD, this reflects some value for the stripped car bod and good value for components.	Investment required in: • Collection • Storage capacity • Depollution activity • Dismantling • Stripping	Training of staff in dismantling and stripping. Multiple material streams to manage including low value wastes. Added export/ transport complexity.	Opportunity for job creation from stripping activity	No engineered landfills only dumpsites available onshore. Potential high environmental impact from any waste requiring disposal.	Limited land for bulky waste processing. Limited power at Waste Facility.
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Investment required High disposal cost for POPs containing items.	Training of staff in dismantling and stripping. Multiple material streams to manage including low value wastes. Added export/ transport complexity.	Opportunity for job creation from stripping activity.	Removes POPs containing items from Nauru	Land constraints for dismantling and stockpiling activity already noticeable at current site.

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 4- Shredding prior to export	Modelled as $120 USD, this reflects some value for the stripped car body and good value for components.	High – Shredding and associated equipment is expensive	Training of staff in dismantling and stripping. Multiple material streams to manage including low value wastes. Added export/ transport complexity.	Opportunity for job creation from shredding activity	By-product of shredding is Floc which would require environmentally sound disposal.	Limited land for bulky waste processing.

The analysis presented in **Table 5.12** suggests that on balance Option 2 or Option 4 are the preferred options for Nauru. This reflects the lack of bulky waste collection and recycling services, limited space, infrastructure or environmentally sound disposal options.

Legacy waste options and considerations

The removal of legacy waste would most likely be funded as a project, for example through grant funding. Costs not considered in **Table 5.11** include detailed mapping of the location and quantity of legacy waste. Other similar legacy waste missions have required considerable investment in waste surveying prior to collection. If stockpiling of waste prior to shipment is undertaken this will require considerable space.

Prior to any legacy waste mission being undertaken, consultation with key stakeholders in-country should be undertaken to make sure the project does not clash with other country initiatives that are planned.

The modelling suggests a legacy bulky waste recovery programme would cost in the order of USD$3 - 400,000 including establishment, materials processing and administration costs. This is base d on stockpiles at the waste facility and nearby. Prior to commencement a comprehensive check of bulky items on private property should be completed to ensure that there is sufficient funding and infrastructure to handle actual volumes requiring processing and shipping.

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. Our modelling suggests annual costs will be in the order of USD$70,000 including administration costs. This is based on processing costs only, i.e. no refund component of a financing scheme has been included.

For processing waste in country funding needs to cover maintenance and renewal/replacement of processing equipment (i.e. crushing and shredders). Poor maintenance and a lack of availability of spare parts can mean that repairs are costly and prolonged. This means there is a risk that equipment can sit broken and idle for months to years.

For Nauru there may be benefit in collaboration with others in the Pacific Region. Areas with potential for collaboration include:

- Crushing – one or more mobile crushers moving around the Pacific for areas producing small quantities of materials. If this equipment is available, it could be employed for periodic processing of bulky waste on Nauru as part of a Pacific wide ‘circuit’.
- Regional programs to train, upskill and support staff (i.e. a Centre of Excellence).
- Regional coordination for the consolidation and management of hazardous waste.
- Regional coordination of marketing of materials – providing scale that can translate into higher prices for traded commodities.

Key information sources

Key information sources have included the T+TI Nauru Waste Audit Report, T+TI ARFD Issues and Options Nauru Report, Solid Waste Management in the Pacific: Nauru Snapshot[56], Pacific Region Solid Waste Management and Recycling[57], Assessment of Legislative Frameworks Governing Waste Management in Nauru[58], and the 2011 Nauru Census Report[59]. Conversations were held with in-country contacts which included employees of Nauru Department of Commerce, Industry and Environment, and Nauru Bureau of Statistics.

[56] t Woodruff, A. (2014)
[57] PRIF, (2018)
[58] University of Melbourne (2020)
[59] Republic of Nauru (2012)

5.3.6 Niue

In Niue bulky wastes are collected and stored by the Department of Environment. Collections were stockpiled at Huihui and Amanau, however these collections and stockpiles have been paused until the new Recycling Facility in the southeast opens. All landfills in Niue are non-engineered, with no leachate collection or lining in place. Burning of waste also occurs at Vaiea Landfill, and Makato Landfill has been proposed for closure, however it still accepts waste. Niue is a single island nation.

Key legislation relating to bulky waste for Niue includes the Environment Act 2015 and Customs Import Prohibition (Plastic Shopping Bags) Order 2020. A feasibility study on ARFD schemes in Niue has been completed, but no scheme has been implemented yet. Further information on relevant legislation is provided in Appendix C.

Key considerations in relation to the processing of bulky waste in Niue includes:

- No private recycling companies are currently operating that recycle bulky waste, however a Recycling Centre run by the Department of Environment is set to open mid-2022.
- The landfills on the island are not engineered and have limited remaining capacity.
- Exports of bulky waste are infrequent leading to stockpiling of waste at public facilities.

The current state of bulky waste consolidation and processing has been mapped on **Figure 5.8**.

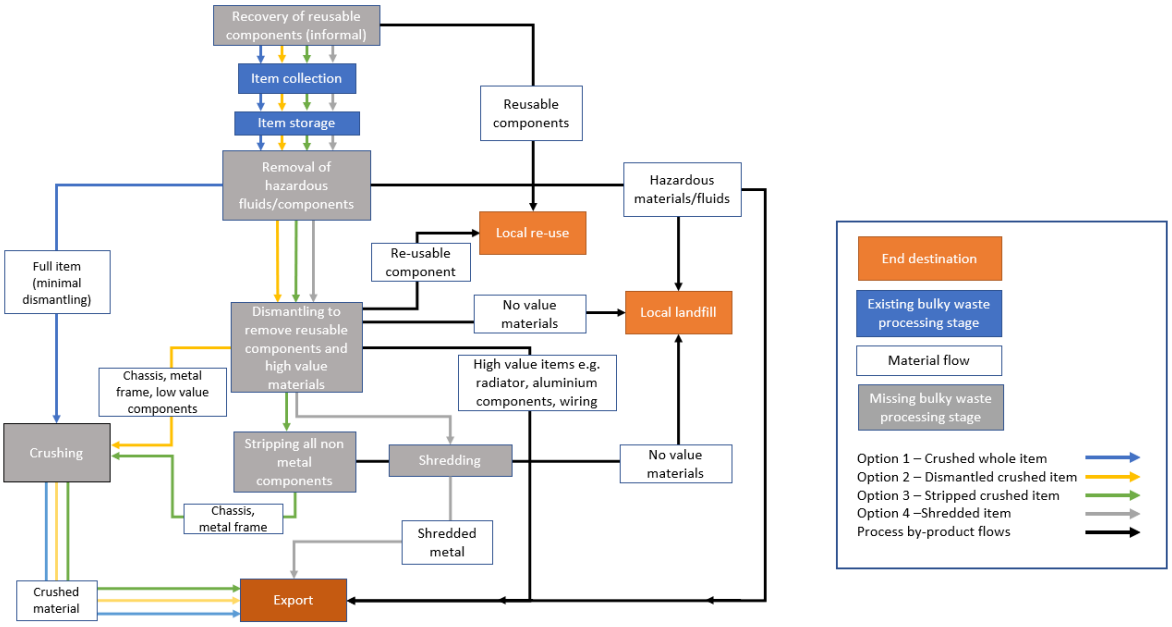


Figure 5.8: Map of recovery options for bulky waste in Niue

Much of the infrastructure and processes required to support each option are not currently in place. As a minimum, there would be up front investment required to improve a collection mechanism, storage arrangements and to facilitate the safe removal of hazardous components. The more complex processing of wastes prior to shipment offshore results in higher potential export value and job creation. The trade-off is the potential environmental impact from the disposal of by-products.

Stockpiled vehicles and white goods are not currently processed in any form.

The options for bulky waste management are as follows:

Option 1 – bulky items are collected from around the island and depolluted prior to crushing and export.

Option 2 - bulky items depolluted and high value items removed through dismantling prior to crushing and export.

Option 3 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export, stripping of remaining non-metal components, crushing and export.

Option 4 – bulky items depolluted, and high value items removed through dismantling, stripping of remaining non-metal components, crushing and export. Packaging of POPs containing items (plastics, seats/textiles) for export and appropriate management.

Option 4 - bulky items stripped and shredded, unlikely to be viable due to energy requirements, available space and scale.

Option costs

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items

2 Management of ongoing generation of items

A high-level cost for each option was developed using the cost model and relevant assumptions and the results are shown in **Table 5.13.** The full derivation of all costs and assumptions is provided in Appendix E.

Table 5.13: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)			Total cost (USD)	
Depollute	$224	$600	$52	$668,560	$107,482
Partial Strip	$238	$618	$51	$696,700	$110,210
Full dismantle	$160	$536	$49	$528,049	$86,812
Shredding	$216	$696	$61	$692,689	$111,298
Shipping Cost	$252	$720	$27	$651,600	$98,190

Market options

For Niue there is the option to either ship to market in New Zealand/Australia or try and access a market in Asia noting that the material will likely fetch a higher price in Asia with less certainty regarding market access and pricing.

Options evaluation

Table 5.14 presents a summary of the options evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.14: Options evaluation for Niue

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Investment required in: • Storage capacity • Depollution activity	Low however needs to consider the disposal or export of hazardous substances.	Minimal job creation opportunity	Needs to consider the safe disposal or export of hazardous substances only.	Recycling Centre, potential constrained for stockpiling space.
Option 2 – Dismantling prior to export	Modelled as $60, this reflects zero value for car body and good value for components.	Investment required in: • Storage capacity • Depollution activity • Stripping	Training of staff in dismantling (planned for recycle centre). Multiple material streams to manage. Added export/ transport complexity.	Opportunity for job creation from dismantling activity	Less waste requiring disposal. No engineered landfills only dumpsites available onshore. Potential high environmental impact from any waste requiring disposal.	Recycling Centre, potential constrained for stockpiling space.
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD, this reflects some value for the stripped car bod and good value for components.	Investment required in: • Storage capacity • Depollution activity • Dismantling • Stripping	Training of staff in dismantling (planned for recycle centre), step up in specialist skills required. Multiple material streams to manage. Added export/ transport complexity.	Opportunity for job creation from stripping activity	No engineered landfills, only dumpsites available onshore. Potential high environmental impact from any waste requiring disposal.	Recycling Centre, potential constrained for stockpiling space.
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Investment required High disposal cost for POPs containing items.	Training of staff in dismantling (planned for recycle centre), step up in specialist skills required. Multiple material streams to manage. Added export/ transport complexity.	Opportunity for job creation from stripping activity.	Removes POPs containing items from Niue	Recycling Centre, potential constrained for stockpiling space.

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 4- Shredding prior to export	Modelled as $120 USD, this reflects some value for the stripped car body and good value for components.	High – Shredding and associated equipment is expensive	Medium – new equipment, significant existing technical capability.	Opportunity for job creation from shredding activity	By-product of shredding is Floc which would require environmentally sound disposal.	Recycling Centre, potential constrained for stockpiling space.

The analysis presented in **Table 5.14** suggests that on balance Option 2 (targeting easily removed items or materials, depolluted whole item export) is the preferred option for Niue with Option 4 also attractive subject to funding for POPs containing item disposal. This reflects the small scale, available facility and training (for the recycle centre) and specialist equipment required for more comprehensive dismantling.

Legacy waste options and considerations

The removal of legacy waste would most likely be funded as a project, for example through grant funding. Costs not considered in **Table 5.14** include detailed mapping of the location and quantity of legacy waste. There are also issues associated with waste availability, some private owners are reluctant to part with their end-of-life items if they are still being used for spare parts. Other similar legacy waste missions have required considerable investment in waste surveying prior to collection. If stockpiling of waste prior to shipment is undertaken this will require considerable space.

Prior to any legacy waste mission being undertaken, consultation with key stakeholders in-country should be undertaken to make sure the project does not clash with other country initiatives that are planned. As noted above there are periodic shipments of bulky items accumulated at the various waste facilities. There are also likely to be individual bulky items at private properties that could be targeted in a legacy waste project.

The modelling suggests a legacy bulky waste recovery programme would cost in the order of USD$700,000 including establishment, materials processing and administration costs.

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. Our modelling suggests annual costs will be in the order of USD$100,000 including administration costs. This is based on processing costs only, i.e., no refund component of a financing scheme has been included. For processing waste in country funding needs to cover maintenance and renewal/replacement of processing equipment (i.e., crushing and shredders). Poor maintenance and a lack of availability of spare parts can mean that repairs are costly and prolonged. This means there is a risk that equipment can sit broken and idle for months to years.

For Niue there may be benefit in collaboration with others in the Pacific Region. Areas with potential for collaboration include:

- Crushing – one or more mobile crushers moving around the Pacific for areas producing small quantities of materials. If this equipment is available, it could be employed for periodic processing of bulky items on Niue to minimise the transporting of uncompacted bulky waste.
- Regional programs to train, upskill and support staff (i.e., a Centre of Excellence).
- Regional coordination for the consolidation and management of hazardous waste.
- Regional coordination of marketing of materials – providing scale that can translate into higher prices for traded commodities.

Key information sources

Key information sources have included the T+TI Niue Waste Audit Report, T+TI ARFD Issues and Options Niue Report, the Assessment of Legislative Frameworks Governing Waste Management in Niue[60], the Pacific Region Solid Waste Management and Recycling[61], and the 2017 Niue Population and Household Census[62]. Conversations were held with in-country contacts which included employees of the Niue Department of Environment.

[60] University of Melbourne (2020)
[61] Woodruff, A. (2014)
[62] Statistics and Immigration office Finance and Planning Government of Niue (2018)

5.3.7 Palau

In Palau bulky waste items are collected, processed and exported by Palau Waste Company (PWC) who are based in Koror. Palau has recently opened a new engineered landfill in Aimeliik State.

Key legislation relating to bulky waste for Palau includes the Palau Beverage Container Recycling Regulations (2009) and the Solid Waste Management Regulations 2013. An ARFD scheme has been implemented in Palau, however bulky waste is not included. Further information on relevant legislation is provided in Appendix C.

Key considerations in relation to the options for the management of bulky waste in Palau include:

- Private recycling companies are currently operating that recycle bulky waste and export the recovered scrap metals.
- The country has just opened a new national landfill that operates in accordance with good environmental practice, and the Palau Environmental Quality Protection Board is responsible for regulating hazardous materials.

The current state of bulky waste consolidation and processing has been mapped on **Figure 5.9**.

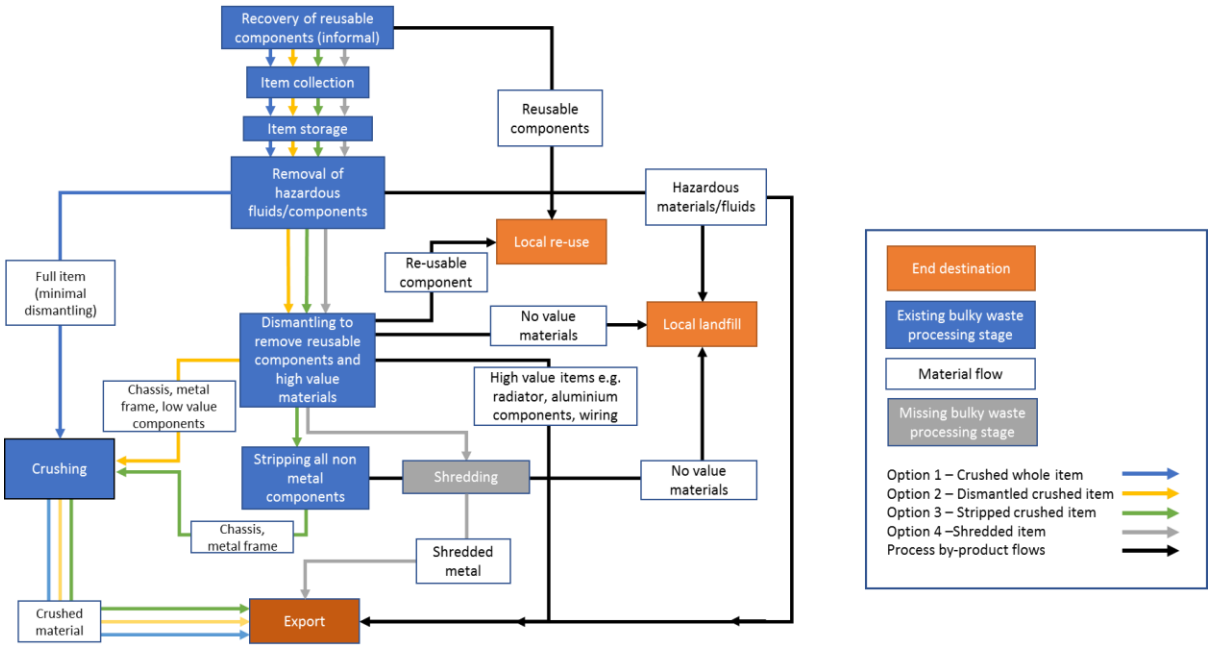


Figure 5.9: Map of recovery options for bulky waste in Palau

Palau has nine inhabited islands and 16 states, with a total population of approximately 17,660. Approximately 65% of the population resides in Koror state, which includes Oreor (population of 9,800), Ngerekebesang Island (population of 1,778) and Malakal Island (population of 85). Babelthuap (Babeldaob) has a population of approximately 5,125. The remainder of the population is spread across five islands, with less than 500 people inhabiting each. Babeldaob and Koror are connected via the Japan-Palau Friendship Bridge. In states other than Koror, scrap metal is stored at designated areas within each state, and then transported to M-Dock landfill site either by the government or private contractors. In the remote islands, waste is often dumped, burned or buried[63].

[63] APWC (2020)

Palau Waste Company

Palau Waste Company (PWC) is a Palauan owned recycling company that accepts bulky waste items including fridges, freezers, washing machines, and scrap metal derived from ELVs. They process and export scrap metals, including removing freon gas during the recycling process. PWC removes metals from bulky waste items, and anything remaining is disposed of in sanitary landfill. PWC is part of the Recycling Program for the beverage container deposit scheme, along with Koror State Government (KSG), Belau Garbage and Scrap Company (BGSC). KSG and BGSC are the redemption centres for the beverage containers, while PWC acts as the exporter of the containers to Taiwan.

Palau Metal Company (JC Auto Shop)

The Palau Metal Company (PMC) accept scrap metals and heavy equipment. Their equipment includes boom trucks for the collection of ELVs, compactor and cutting and shredding equipment. Scrap metals extracted from ELVs and heavy equipment are exported to Taiwan. There may be opportunities to utilise PMC workers skills with cutting and shredding to train new recyclers.

The options for bulky waste management are as follows:

Option 1 – bulky items depolluted prior to crushing and export. Items from other inhabited islands transported to Upolu for processing prior to export.

Option 2 - bulky items depolluted and high value items removed through dismantling prior to crushing and export.

Option 3 – bulky items depolluted and high value items removed through dismantling prior to crushing and export, stripping of remaining non metal components, crushing and export (current status quo for Palau).

Option 4 – bulky items depolluted and high value items removed through dismantling, stripping of remaining non metal components, crushing and export. Packaging of POPs containing items (plastics, seats/textiles) for export and appropriate management.

Option 5 - bulky items stripped and shredded.

Option costs

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items

2 Management of ongoing generation of items

A high-level cost for each option was developed using the cost model and relevant assumptions and the results are shown in **Table 5.15.** The full derivation of all costs and assumptions is provided in Appendix E.

Table 5.15: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)			Total cost (USD)	
Depollute	$196	$520	$49	$976,646	$138,011
Partial Strip	$210	$536	$48	$1,023,913	$142,818
Full dismantle	$140	$480	$48	$767,654	$117,153
Full dismantle, POPs exported	$196	$640	$60	$1,024,022	$141,681
Shipping Cost	$210	$600	$23	$825,600	$80,850

Market options

For Palau, there are existing exports of beverage containers and scrap metals to Taiwan. It may be possible to expand on the current exportations.

Options evaluation

Table 5.16 presents a summary of the option evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.16: Options evaluation for Palau

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Low – significant existing infrastructure, PWC and PMC	Low- significant existing technical capacity with PWC and PMC	Minimal job creation opportunity	Palau has established hazardous waste storage for used oils.	The old landfill has been converted into a waste facility.
Option 2 – Dismantling prior to export	Modelled as between $60 USD Potential for small revenue from sale of other recovered items	Low – significant existing infrastructure	Low – significant existing technical capacity	Minimal job creation opportunity	Palau has recently established an engineered landfill site.	The old landfill has been converted into a waste facility.
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD Potential for small revenue from sale of other recovered items	Investment required in storage capacity	Low – existing technical capacity	Low – existing technical capacity	Palau has recently established an engineered landfill site.	The old landfill has been converted into a waste facility.
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Existing infrastructure High disposal cost for POPs containing items.	Low –existing technical capacity.	Opportunity for job creation from stripping activity.	Removes POPs containing items from Palau	The old landfill has been converted into a waste facility.

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 4 - Shredding prior to export	Modelled as $120 USD Potential for small revenue from sale of other recovered items	High – Shredding and associated equipment is expensive	Medium – new equipment, significant existing technical capability	Opportunity for job creation from shredding activity	Palau has recently established an engineered landfill site.	Land constraints not identified.

The analysis presented in **Table 5.16** suggests that on balance Option 3 and Option 4 are the preferred option for Palau. This reflects the presence of established recyclers of bulky waste items and the cost of shredding.

Legacy waste options and considerations

The removal of legacy waste would most likely be funded as a project, for example through grant funding. Costs not considered in **Table 5.15** include detailed mapping of the location and quantity of legacy waste. There are also issues associated with waste availability, some private owners are reluctant to part with their end-of-life items if they are still being used for spare parts. Other similar legacy waste missions have required considerable investment in waste surveying prior to collection. If stockpiling of waste prior to shipment is undertaken this will require considerable space with associated land access challenges.

Prior to any legacy waste mission being undertaken, consultation with key stakeholders in-country should be undertaken to make sure the project does not clash with other country initiatives that are planned.

The modelling suggests a legacy bulky waste recovery programme would cost in the order of USD$1M including establishment, materials processing and administration costs.

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. Our modelling suggests annual costs will be in the order of US$140,000 including administration costs. This is based on processing costs only, i.e. no refund component of a financing scheme has been included.

For processing waste in country funding needs to cover maintenance and renewal/replacement of processing equipment (i.e., crushing and shredders). Poor maintenance and a lack of availability of spare parts can mean that repairs are costly and prolonged. This means there is a risk that equipment can sit broken and idle for months to years.

For the Palau there may be benefit in collaboration with others in the Pacific Region. Areas with potential for collaboration include:

- Crushing – one or more mobile crushers moving around the Pacific for areas producing small quantities of materials. If this equipment is available, it could be employed for collections from across Palau depending on costs for transporting uncompacted bulky waste.
- Regional programs to train, upskill and support staff (i.e., a Centre of Excellence).
- Regional coordination for the consolidation and management of hazardous waste.
- Regional coordination of marketing of materials – providing scale that can translate into higher prices for traded commodities.

Key information sources

Key information sources have included the APWC Palau Waste Audit Report, Solid Waste Management in the Pacific: Palau Snapshot[64], Assessment of Legislative Frameworks Governing Waste Management in Palau[65], and 2015 Palau Census of Population, Housing and Agriculture[66]. Conversations were held with in-country contacts which included employees of Palau Public Utilities Corporation, Koror State, Bureau of Customs and Border Protection, and Bureau of Public Works - Solid Waste Management.

[64] Woodruff, A. (2014)
[65] University of Melbourne (2020)
[66] of Planning and Statistics Bureau of Budget and Planning Republic of Palau (2016)

5.3.8 Republic of Marshall Islands

In Majuro, bulky waste items are collected by Majuro Atoll Waste Company (MAWC) for free, and in Ebeye bulky waste can be collected by Kwajalein Atoll Local Government (KALGOV) for a fee. In both cases, bulky waste is stockpiled at the islands respective landfills (both of which are non-engineered) and no exports of bulky waste occurs.

Key legislation relating to bulky waste for the Republic of Marshall Islands includes the Littering Act 1982 and the Solid Waste Regulations 1989. There are no ARFD schemes implemented or planned for the Republic of Marshall Islands. Further information on relevant legislation is provided in Appendix C.

Key considerations in relation to the processing of bulky waste in Republic of Marshall Islands include:

- Bulky waste is collected by public services for free in Majuro, or for a fee in Ebeye.
- Majuro Landfill is a non-engineered landfill and has exceeded the design capacity for the site.
- The Ebeye Waste Disposal Site is non-engineered, with no lining or leachate treatment system. The disposal site has 25 years of capacity remaining.
- There are currently no exports of bulky waste. Majuro Landfill separates scrap metals, white goods and PET bottles, however this material is stockpiled at the landfill due to lack of a viable market.
- Similarly, ELV are stockpiled at the Ebeye Waste Disposal Site.

The current state of bulky waste consolidation and processing has been mapped on **Figure 5.10**.

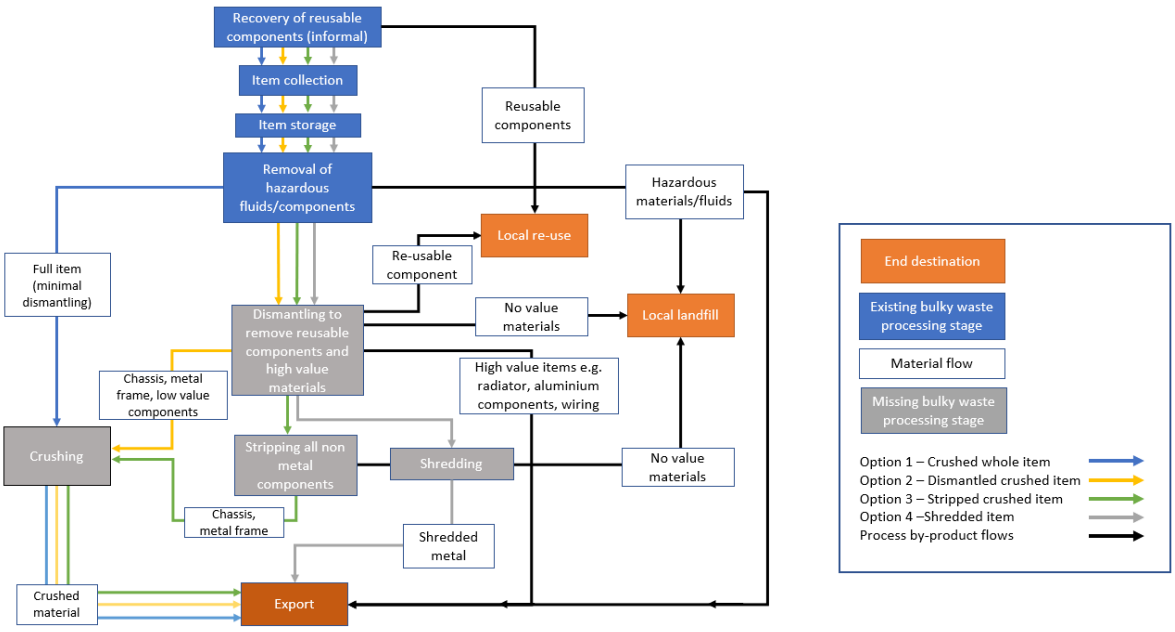


Figure 5.10: Map of recovery options for bulky waste in Republic of Marshall Islands

Republic of Marshall Islands has 25 inhabited islands and total population of approximately 53,000 (as of 2011[67]). The most populated is the Majuro Atoll followed by Kwajalein, with approximately 52% and 21% of the country's total population respectively. Aillinglaplap, Arno, and Jaluit islands have approximately 1,700 inhabitants each. The remaining islands have fewer than 900 inhabitants each, with some populations as low as 9 (Bikini). Bulky wastes are not removed from outer islands and are instead stockpiled at dumpsites.

[67] Economic Policy, Planning and Statistics Office, Republic of the Marshall Islands, and the SPC Statistics for Development Programme (2012)

White goods are collected by KALGOV on the Kwajalein Atoll and stockpiled at the dumpsites due to the inability to ship out bulky wastes. Due to the nearby military base, KYOWA is the only shipping company able to service Ebeye.

Much of the infrastructure and processes required to support each option is not currently in place. As a minimum, there would be up front investment required to improve a collection mechanism, particularly in Ebeye, storage arrangements (particularly in Majuro) and to facilitate the safe removal of hazardous components. The more complex processing of wastes prior to shipment offshore results in higher potential export value and job creation. The trade-off is the potential environmental impact from the disposal of by-products.

Stockpiled vehicles and white goods are not currently processed in any form.

The options for bulky waste management are as follows:

Option 1 – bulky items are collected from around the island and depolluted prior to crushing and export.

Option 2 - bulky items depolluted and high value items removed through dismantling prior to crushing and export.

Option 3 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export, stripping of remaining non-metal components, crushing and export.

Option 4 – bulky items depolluted, and high value items removed through dismantling, stripping of remaining non-metal components, crushing and export. Packaging of POPs containing items (plastics, seats/textiles) for export and appropriate management.

Option 5 - bulky items stripped and shredded.

Option costs

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items

2 Management of ongoing generation of items

A high-level cost for each option was developed using the cost model and relevant assumptions and the results are shown in **Table 5.17**. The full derivation of all costs and assumptions is provided in Appendix E.

Table 5.17: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)			Total cost (USD)	
Depollute	$252	$680	$55	$1,538,480	$161,815
Partial Strip	$266	$689	$54	$1,558,535	$162,627
Full dismantle	$196	$640	$54	$1,388,015	$151,753
Full dismantle, POPs exported	$252	$800	$66	$1,716,455	$176,407
Shipping Cost	$210	$600	$23	$858,000	$62,175

Market options

Waste oils are currently exported to South Korea by Marshall Energy Company (MEC) for disposal and recycling. Bulky waste material will likely fetch a higher price in Asia with less certainty regarding market access and pricing.

Options evaluation

Table 5.18 presents a summary of the option evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.18: Options evaluation for Republic of Marshall Islands

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Investment required in: • Storage capacity • Depollution activity	Low however needs to consider the disposal or export of hazardous substances.	Opportunity for job creation from dismantling activity.	Majuro Landfill and Ebeye Waste Disposal Site are not engineered. Waste oils are exported to South Korea.	No allocated land for bulky waste processing.
Option 2 – Dismantling prior to export	Modelled as $60, this reflects zero value for car body and good value for components.	Investment required in: • Storage capacity • Depollution activity • Stripping	Training of staff in dismantling.	Opportunity for job creation from dismantling activity.	Majuro Landfill and Ebeye Waste Disposal Site are not engineered. Waste oils are exported to South Korea.	No allocated land for bulky waste processing.
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD, this reflects some value for the stripped car bod and good value for components.	Investment required in: • Storage capacity • Depollution activity • Dismantling • Stripping	Training of staff in dismantling and stripping. Step up in specialist skills required.	Opportunity for job creation from stripping activity.	Majuro Landfill and Ebeye Waste Disposal Site are not engineered. Waste oils are exported to South Korea.	No allocated land for bulky waste processing.
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Investment required High disposal cost for POPs containing items.	Training of staff in dismantling and stripping. Step up in specialist skills required.	Opportunity for job creation from stripping activity.	Removes POPs containing items from the Republic of Marshall Islands	No allocated land for bulky waste processing.

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 4- Shredding prior to export	Modelled as $100 USD, this reflects some value for the stripped car body and good value for components.	High – shredding and associated equipment is expensive	High – new equipment and training of staff.	Opportunity for job creation from shredding activity.	By-product of shredding is Floc which would required environmentally sound disposal.	No allocated land for bulky waste processing.

The analysis presented in **Table 5.18** suggests that on balance Option 1 or Option 4 are the preferred options for Republic of Marshall Islands. This reflects the lack of recyclers, space constraints, limited infrastructure and the cost and potential environmental impacts of managing shredder floc.Option 4 relies on funding for appropriate management of POs and securing sufficient space for in-country processing, particularly in Majuro.

Legacy waste options and considerations

The removal of legacy waste would most likely be funded as a project, for example through grant funding. Costs not considered in **Table 5.17** include detailed mapping of the location and quantity of legacy waste. There are also issues associated with waste availability, some private owners are reluctant to part with their end-of-life items if they are still being used for spare parts. Other similar legacy waste missions have required considerable investment in waste surveying prior to collection. If stockpiling of waste prior to shipment is undertaken this will require considerable space.

The modelling suggests a legacy bulky waste recovery programme would cost in the order of USD$1.5M including establishment, materials processing and administration costs.

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. Our modelling suggests annual costs will be in the order of USD$160,000 including administration costs. This is based on processing costs only, i.e., no refund component of a financing scheme has been included.

For processing in country, funding needs to cover maintenance and renewal/replacement of processing equipment (i.e., crushing and shredders). Poor maintenance and a lack of availability of spare parts can mean that repairs are costly and prolonged. This means there is a risk that equipment can sit broken and idle for months to years.

For Republic of Marshall Islands there may be benefit in collaboration with others in the Pacific Region. Areas with potential for collaboration include:

- Crushing – one or more mobile crushers moving around the Pacific for areas producing small quantities of materials. If this equipment is available, it could be employed for periodically processing bulky items accumulated and partial dismantled on Majuro and Ebeye.
- Regional programs to train, upskill and support staff (i.e., a Centre of Excellence).
- Regional coordination for the consolidation and management of hazardous waste.
- Regional coordination of marketing of materials – providing scale that can translate into higher prices for traded commodities.

Key information sources

Key information sources have included the T+TI RMI Waste Audit Report, Solid Waste Management in the Pacific: RMI Snapshot[68], Assessment of Legislative Frameworks Governing Waste Management in RMI[69], Pacific Region Solid Waste Management and Recycling[70], and the 2011 Marshall Islands Census Report[71]. Conversations were held with in-country contacts which included employees of KALGOV.

[68] Woodruff, A. (2014)
[69] University of Melbourne (2020)
[70] PRIF, (2018)
[71] Economic Policy, Planning and Statistics Office, Republic of the Marshall Islands, and the SPC Statistics for Development Programme (2012)

5.3.9 Papua New Guinea

ELV are collected and processed by Branis Recycling, while PNG Recyclers and Nuovo International both process scrap ferrous metals. The city authority of Port Moresby undertakes annual bulky waste collection programs. Most white goods are dismantled for scrap metal before being sent to Baruni landfill (an engineered landfill). There are no formal processes for the dismantling and recycling of white goods. ELV are cut or shredded and packed prior to export using Swire Shipping, no ELV are exported as whole items.

Key legislation relating to bulky waste for Papua New Guinea includes the Customs Act 1951 (as at 2005) and the Environment (Ozone Depleting Substances) Regulations 2007. An ARFD feasibility study is planned for Papua New Guinea. Further information on relevant legislation is provided in Appendix C.

Key considerations in relation to the options for the management of bulky waste in Papua New Guinea include:

- Private recycling companies (PNG Recyclers, Branis Recycling and Nuovo International) are currently operating and recycle bulky waste, with recovered waste material provided to scrap dealers on the island or disposed at landfills.
- The main landfill in Papua New Guinea, Baruni Landfill, is engineered and has a Level 2 Environmental permit (excluding hazardous waste). Two new lined and leachate managed cells were constructed in 2015 through the J-PRISM project, and there is room for a 60% increase in space. The Baruni Landfill only services Port Moresby. The engineered Roku Integrated Waste Management Facility constructed a multi-lined hazardous waste landfill cell in 2021, with a USEPA compliant incinerator. The site is a private facility, also located near Port Moresby.
- Materials from outer provinces will require transport to Port Moresby or Lae for consolidation and/or processing prior to export.

The current state of bulky waste consolidation and processing has been mapped on **Figure 5.11**.

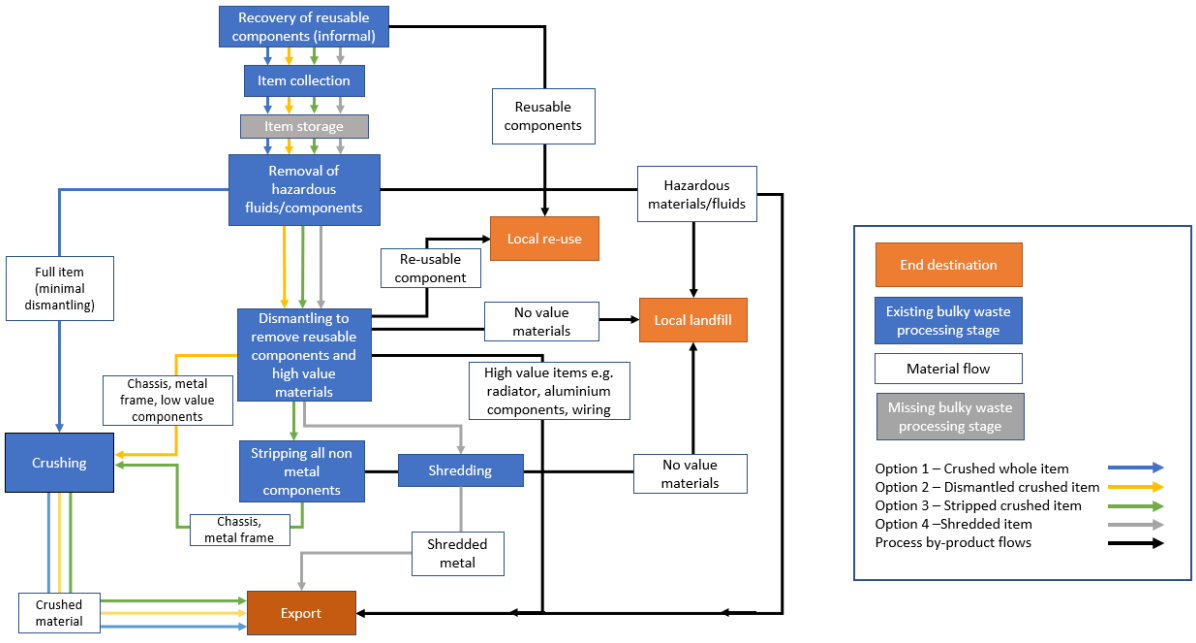


Figure 5.11: Map of recovery options for bulky waste in Papua New Guinea

Papua New Guinea is significantly larger than other PICs in this project, with 600 inhabited islands. The main region is at the eastern side of New Guinea island. The most populated provinces are Morobe (673,448) and the Eastern Highlands Province (578,242). The remaining islands range from 60,300 people (Manus) to 509,500 people (South Highlands Province). The National Capital District, where the capital Port Moresby is located, has a population of 361,200. Some outer islands are serviced by Branis Recycling and Nuovo for scrap metals, including the provinces of East New Britain (population of 327,355[72]), West New Britain (population of 263,338) and New Ireland (population of 193,488). Like the mainland, there is no formal collection service for white goods on the outer islands. Bulky waste is stockpiled or placed in various non-engineered dumpsites across the islands.

There are other population centres across the Papua New Guinea mainland (Lae, Goroka, Mt Hagen, Madang, Wewak and Alotau). Information was not able to be sourced on bulky waste management in these outer regions.

Branis Recycling

Branis Recycling is a scrap metal dealership which currently runs a collection system for ELVs in Port Moresby and other town centres. They do not keep stockpiles of ELVs on-site, and all waste streams are given to scrap dealers for dismantling and shredding.

Nuovo International Ltd

Nuovo process and trade ferrous scrap metal, as well as participating in the trade of steel products. Nuovo service the main island, as well as outer island towns such as Kimbe, Rabaul and the New Ireland province. No other information regarding Nuovo's processing of metals was provided.

PNG Recycling Ltd

PNG Recycling Ltd has branches in various provinces.

The options for bulky waste management are as follows:

Option 1 – bulky items depolluted prior to crushing and export.

Option 2 - bulky items depolluted and high value items removed through dismantling prior to crushing and export.

Option 3 – bulky items depolluted and high value items removed through dismantling prior to crushing and export, stripping of remaining non metal components, crushing and export.

Option 4 – bulky items depolluted and high value items removed through dismantling, stripping of remaining non metal components, crushing and export. Packaging of POPs containing items (plastics, seats/textiles) for export and appropriate management.

Option 5 - bulky items stripped and shredded.

Option costs

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items

2 Management of ongoing generation of items

A high level cost for each option was developed using the cost model and relevant assumptions and the results are shown in **Table 5.19**. The full derivation of all costs and assumptions is provided in Appendix E.

[72] National Statistic Office (2011)

Table 5.19: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)			Total cost (USD)	
Depollute	$91	$220	$38	$19,603,625	$10,886,210
Partial Strip	$105	$236	$37	$20,637,035	$10,586,750
Full dismantle	$56	$240	$42	$19,847,750	$11,734,610
Full dismantle, POPs exported	$112	$400	$54	$30,935,750	$15,832,970
Shipping Cost	$105	$300	$11	$17,887,500	$4,731,000

Market options

Scrap metals are currently exported using Swire Shipping.

Options evaluation

Table 5.20 presents a summary of the option evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.20: Options evaluation for Papua New Guinea

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Low – significant existing infrastructure	Low – significant existing technical capacity, existing capability within private recyclers.	Minimal job creation opportunity	Roku Integrated Waste Management Facility for hazardous waste exists, and an engineered landfill is present.	No land constraints
Option 2 – Dismantling prior to export	Modelled as $60, this reflects zero value for car body and good value for components.	Low – significant existing infrastructure	Low – significant existing technical capacity, existing capability within private recyclers.	Minimal job creation opportunity	Roku Integrated Waste Management Facility for hazardous waste exists, and an engineered landfill is present.	No land constraints
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD, this reflects some value for the stripped car bod and good value for components.	Low – significant existing infrastructure	Low – significant existing technical capacity, existing capability within private recyclers.	Opportunity for job creation from stripping activity	Roku Integrated Waste Management Facility for hazardous waste exists, and an engineered landfill is present.	No land constraints
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Significant existing infrastructure High disposal cost for POPs containing items.	Low – significant existing technical capacity, existing capability within private recyclers.	Opportunity for job creation from stripping activity.	Removes POPs containing items from Papua New Guinea	No land constraints

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 4 - Shredding prior to export	Modelled as $120 USD, this reflects some value for the stripped car body and good value for components.	Low – existing infrastructure	Low – existing technical capacity, existing capability within private recyclers.	Opportunity for job creation from shredding activity	Roku Integrated Waste Management Facility for hazardous waste exists, and engineered landfill.	No land constraints

The analysis presented in **Table 5.20** suggests that on balance Option 3, 4 or 5 (dismantling and stripping prior to export or shredding prior to export, export of POPs containing materials) is the preferred option for Papua New Guinea. This reflects the presence of established recyclers of bulky waste items.

Legacy waste options and considerations

Due to continued exports by private waste collection companies, legacy waste is not considered a substantial issue for Papua New Guinea. This has been confirmed by consultation with in-country contacts. A feasibility study for an ARFD scheme in Papua New Guinea conducted by PacWaste is expected to commence in 2022. Prior to any legacy waste mission being undertaken, consultation with key stakeholders in-country should be undertaken to make sure the project does not clash with other country initiatives that are planned.

The modelling suggests a legacy bulky waste recovery programme would cost in the order of USD$20 – 30M including establishment, materials processing, and administration costs. The higher cost includes allowance for exporting POPs containing materials.

This high cost reflects both the likely scale of the materials to collected and complexity of operating across Papua New Guinea. A programme targeting main urban centres could be designed to capture the majority of materials while reducing in-country shipping and programme management costs. The quantity of materials is uncertain with the data used in this analysis requiring significant refinement prior to progressing to detailed planning for a legacy clearance programme. It is important to note that the per item costs for Papua New Guinea are *lower* than other countries, reflecting the benefits of scale and direct (relatively low cost) access to markets in Asia.

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. Our modelling suggests a budget of almost USD$10 – $15 M per annum may be required.

Similar comments to those for a legacy clearance programme apply. Specifically, a programme targeting main urban centres could be designed to capture most materials while reducing in-country shipping and programme management costs. The quantity of materials is uncertain with the data used in this analysis requiring significant refinement prior to progressing. Further assessment to detailed planning is required for an ongoing bulky waste management programme.

For processing waste in country funding needs to cover maintenance and renewal/replacement of processing equipment (i.e., crushing and shredders). Poor maintenance and a lack of availability of spare parts can mean that repairs are costly and prolonged. This means there is a risk that equipment can sit broken and idle for months to years.

For Papua New Guinea there may be benefit in collaboration with others in the Pacific Region. Areas with potential for collaboration include:

- Crushing – one or more mobile crushers moving around the Pacific for areas producing small quantities of materials. If this equipment is available, it could be employed for collections from remote islands depending on costs for transporting uncompacted bulky waste.
- Regional programs to train, upskill and support staff (i.e. a Centre of Excellence).
- Regional coordination for the consolidation and management of hazardous waste.
- Regional coordination of marketing of materials – providing scale that can translate into higher prices for traded commodities.

Key information sources

Key information sources have included the SPREP Papua New Guinea Waste Audit Report, Solid Waste Management in the Pacific: Papua New Guinea Snapshot[73], Pacific Region Solid Waste Management and Recycling[74], Assessment of Legislative Frameworks Governing Waste Management in Papua New Guinea[75], and the Papua New Guinea 2011 Census[76]. Conversations were had with in-country contacts which included employees of the Department of Environment and Conservation, Conservation and Environment Protection Authority, and Papua New Guinea Customs Service – Compliance and Procedures Division.

[73] Woodruff, A. (2014)
[74] PRIF, (2018)
[75] University of Melbourne (2020)
[76] `National Statistic Office (2011)

5.3.10 Samoa

In Samoa, bulky waste items are collected on the main island by the Government's quarterly bulky waste collection and processed by established privately owned recycling companies prior to export. Private recyclers also visit Savaii monthly to collect high value items. Tafaigata is the main landfill on Upolu and was upgraded to a sanitary landfill in the early 2000s.

Key legislation relating to bulky waste for Samoa include their Waste Deposit Regulations, National Waste Management Strategy 2019 – 2023 and the Waste Management Act 2010 (as at 2018). There are no ARFD schemes implemented or planned for Samoa. Further information on relevant legislation is provided in Appendix C.

Key considerations in relation to the options for the management of bulky waste in Samoa include:

- Private recycling companies are currently operating that recycle bulky waste and export recovered material.
- Tafaigata landfill is the main landfill and was upgraded to a sanitary landfill in the early 2000s, however, conserving the remaining airspace is paramount and driving diversion activity.
- Materials from the other inhabited islands (Savaii, Manono and Apolima) will require transport to Upolu for recovery and processing.

The current state of bulky waste consolidation and processing has been mapped on **Figure 5.12**.

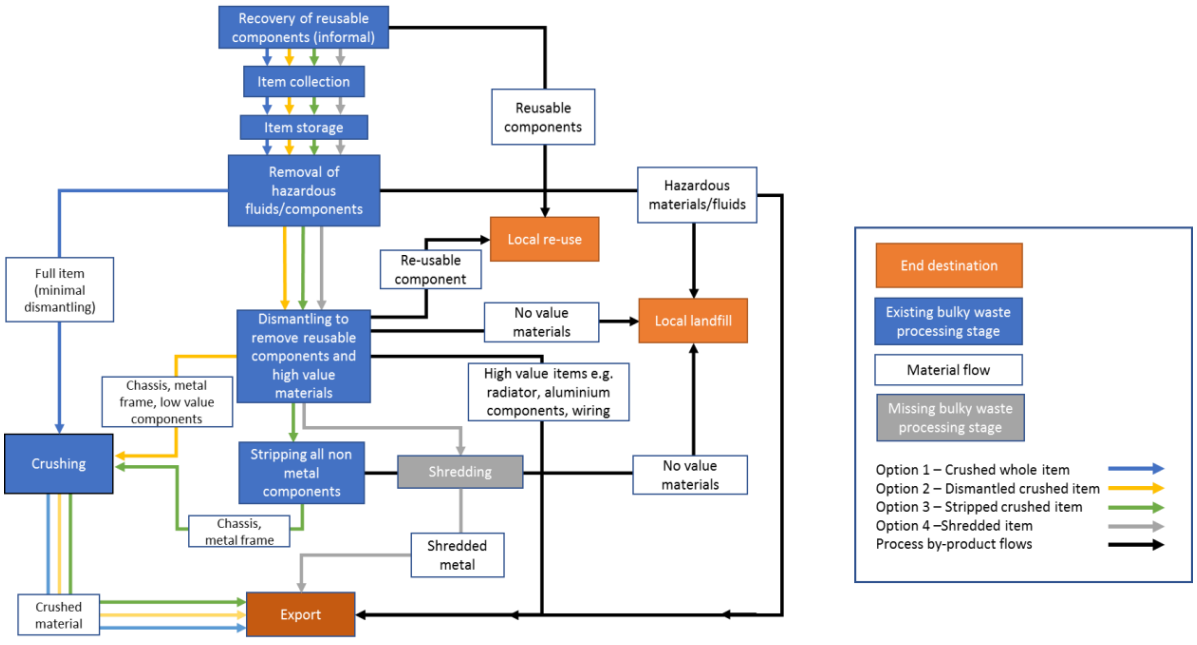


Figure 5.12: Map of recovery options for bulky waste in Samoa

Samoa has 4 inhabited islands, the main two being Upolu Island and Savaii Island with populations of approximately 147,000 and 44,000 respectfully. The remaining population is split across Manono and Apolima islands, with less than 1,000 people on each. Bulky waste is collected and shipped on alia boats from Manono and Apolima, once every 3 months by the Samoa Shipping Corporation. On Manono there are pick-up points at the islands wharfs. In Apolima there is one collection point at the single wharf on the island. The collected bulky wastes are taken to the recycling companies in Tafaigata. However, illegal dumping of bulky waste items still occurs. Shipping between Manifanua and Saleloga is around USD$300 per 20ft container, each way.

Pacific Recyclers

Through Pacific Recyclers (PR) much of the infrastructure and processes required to support each option are already currently in place. The more complex processing of wastes prior to shipment offshore results in higher potential export value and job creation. The trade-off is the potential environmental impact from the disposal of by-products. Although Tafaigata Landfill has been upgraded there are concerns around future capacity.

PR is currently operating a bulky waste recycling system that exports recovered material from waste for profit.

- Vehicles and white goods are depolluted and then dismantled.
- ELVs are stripped to remove non-ferrous metal, batteries, plastics, tyres, wiring, glass and oil.
- White goods are stripped down into metal, plastic, glass, and motor wiring.
- The metal frames of bulky items are then crushed high value items recovered (such as motors) are further stripped and high value items exported.

The options for bulky waste management are as follows:

Option 1 – bulky items depolluted prior to crushing and export. Items from other inhabited islands transported to Upolu for processing prior to export.

Option 2 - bulky items depolluted and high value items removed through dismantling prior to crushing and export.

Option 3 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export, stripping of remaining non-metal components, crushing and export (current status quo for Samoa).

Option 4 - bulky items stripped and shredded, unlikely to be viable given the lack of capacity in Tafaigata landfill which would be required for by-products unable to be exported.

Option costs

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items

2 Management of ongoing generation of items

A high-level cost for each option was developed using the cost model and relevant assumptions and the results are shown in **Table 5.21**. The full derivation of all costs and assumptions is provided in Appendix E.

Table 5.21: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)			Total cost (USD)	
Depollute	$189	$500	$48	$4,531,925	$967,280
Partial Strip	$203	$516	$47	$4,487,489	$950,480
Full dismantle	$133	$460	$48	$4,387,025	$942,973
Full dismantle, POPs exported	$189	$620	$60	$5,558,825	$1,174,393
Shipping Cost	$210	$600	$23	$2,565,000	$444,000

Options evaluation

Table 5.22 presents a summary of the options evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.22: Options evaluation for Samoa

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Low – significant existing infrastructure, existing PR facility	Low – significant existing technical capacity, existing capability within PR	Minimal job creation opportunity, minimal activity within the Samoa.	Hazardous waste management systems are still under development.	Existing facility (PR)
Option 2 – Dismantling prior to export	Modelled as $60, this reflects zero value for car body and good value for components.	Low – significant existing infrastructure	Low – significant existing technical capacity	Opportunity for job creation from dismantling activity.	Hazardous waste management systems are still under development. Small volume of by-products requiring disposal.	Land constraints for dismantling and stockpiling activity already noticeable at current site.
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD, this reflects some value for the stripped car bod and good value for components.	Low – significant existing infrastructure	Low – significant existing technical capacity	Opportunity for job creation from stripping activity.	Although the main landfill is engineered there are concerns about its remaining capacity.	Land constraints for dismantling and stockpiling activity already noticeable at current site.
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Significant existing infrastructure High disposal cost for POPs containing items.	Low – significant existing technical capacity.	Opportunity for job creation from stripping activity.	Removes POPs containing items from Samoa	Land constraints for dismantling and stockpiling activity already noticeable at current site.

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 5- Shredding prior to export	Modelled as $120 USD, this reflects some value for the stripped car body and good value for components.	High – Shredding and associated equipment is expensive	Medium – new equipment, significant existing technical capability	Opportunity for job creation from shredding activity.	By-product of shredding is Floc which would require environmentally sound disposal.	Land constraints for dismantling and stockpiling activity already noticeable at current site.

The analysis presented in **Table 5.22** suggests that on balance Option 3 and Option 4 are the preferred options for Samoa. This reflects the current operation of Pacific Recyclers as an established recycler of bulky waste items.

Legacy waste options and considerations

The removal of legacy waste would most likely be funded as a project, for example through grant funding. Costs not considered in **Table 5.21** include detailed mapping of the location and quantity of legacy waste. There are also issues associated with waste availability, some private owners are reluctant to part with their end-of-life items if they are still being used for spare parts. Other similar legacy waste missions have required considerable investment in waste surveying prior to collection. If stockpiling of waste prior to shipment is undertaken this will require considerable space with associated land access challenges.

For Samoa with existing processing of bulky waste for export, further investigation into the proportion of bulky waste not currently captured is recommended. It is likely that the estimates developed for this report (based on historical imports) overestimate what is remaining in country given the recycling activity noted above.

The modelling suggests a legacy bulky waste recovery programme could cost as much USD$5.5M including establishment, materials processing and administration costs. Further work is required to further refine the 'available' material estimates to inform he design of any legacy clearance programme.

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. Our modelling suggests annual costs will be in the order of USD$1M including administration costs. This is based on processing costs only, i.e. no refund component of a financing scheme has been included.

For Samoa there may be benefit in collaboration with others in the Pacific Region although the existing recycling activity is likely to continue regardless. Areas with potential for collaboration include:

- Crushing – one or more mobile crushers moving around the Pacific for areas producing small quantities of materials.
- Regional programs to train, upskill and support staff (i.e. a Centre of Excellence).
- Regional coordination for the consolidation and management of hazardous waste.
- Regional coordination of marketing of materials – providing scale that can translate into higher prices for traded commodities.

Key information sources

Key information sources have included the Solid Waste Management in the Pacific: Samoa Snapshot[77], Pacific Region Solid Waste Management and Recycling[78], Assessment of Legislative Frameworks Governing Waste Management in Samoa[79], and the 2016 Samoa Census Brief[80]. Conversations were held with in-country contacts which included employees of Vision Engineering Consultants, and Central Bank of Samoa.

[77] Woodruff, A. (2014)
[78] PRIF, (2018)

[79] University of Melbourne (2020)
[80] https://www.sbs.gov.ws/digi/2016_Census_Brief_No.1.pdf

5.3.11 Solomon Islands

In the Solomon Islands, bulky waste items can be collected by Honiara City Council and stockpiled at Renadi Waste Disposal Site. This service is not currently promoted due to lack of capacity to provide the service effectively. Renadi Waste Disposal Site is an engineered site; however, the Gizo Waste Disposal Site is not.

Key legislation relating to bulky waste for the Solomon Islands include the Environment Act 1998, and Honiara City Council (litter) Ordinance 2009. A feasibility study on ARFD schemes in the Solomon Islands has been completed, but no scheme has been implemented yet. Further information on relevant legislation is provided in Appendix C.

Key considerations in relation to the processing of bulky waste in the Solomon Islands includes:

- One private recycler, Alpha Metals, accepts and recycles stainless-steel metal, however they do not accept car bodies or white goods.
- Renadi Waste Disposal Site is an engineered landfill that was rehabilitated through the J-PRISM II Project in 2015, in line with semi-aerobic Fukuoka landfill technology. Gizo Waste Disposal Site was also rehabilitated through this project but is not engineered.
- Exports of bulky waste are infrequent leading to stockpiling of waste at public facilities. No import or export data was available for this report.

The current state of bulky waste consolidation and processing has been mapped on **Figure 5.13**.

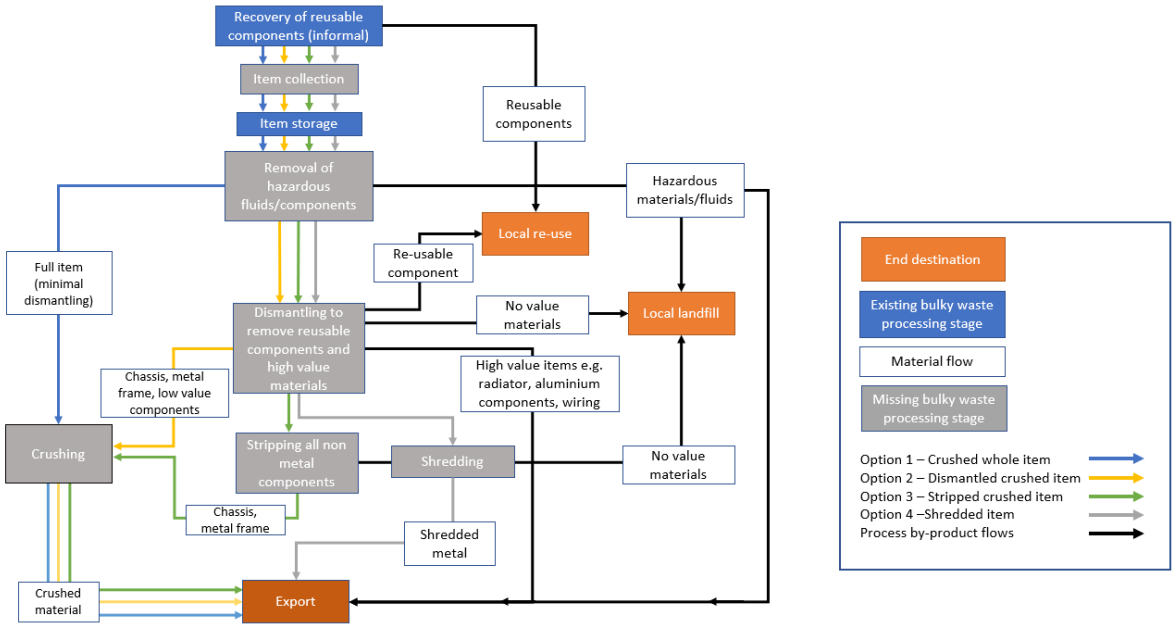


Figure 5.13: Map of recovery options for bulky waste in Solomon Islands

The Solomon Islands has a total population of 712,071. There are nine provinces and 300 inhabited islands. Malaita, with 173,000 people, is the most populated province, followed by the island of Guadalcanal at 154,000. The capital, Honiara, is located on Guadalcanal, and is home to 130,000 of its total population.

The remaining provinces have populations ranging from approximately 4,000 to 94,000. It should be noted that according to the 2015 Demographic and Health Survey, less than 1% of rural dwellings own white goods, likely because only around 68.2% of rural dwellings have access to electricity[81]. Additionally, 1.8% of rural populations own cars or trucks, and 9.6% own boats[82]. Hence the quantity of bulky waste items is expected to be significantly less in rural locations (including outer islands) compared to urban locations. Waste on outer islands is commonly disposed of at uncontrolled landfills, dumped on public lands, or burned.

Much of the infrastructure and processes required to support each option are not currently in place. As a minimum, there would be up front investment required to improve a collection mechanism, storage arrangements and to facilitate the safe removal of hazardous components. Solomon Islands does not have a collection service or centralised storage depot for dismantling white goods and e-waste. There are unaccounted stockpiles of ELVs and white goods throughout the country. Technicians are available on the island who can safely dismantle and recover valuable materials as well as suitable tools including electric saws which can be capitalised if bulky waste processing capability was developed. More complex processing of wastes prior to shipment offshore results in higher potential export value and job creation. The trade-off is the potential environmental impact from the disposal of by-products.

Stockpiled vehicles and white goods are not currently processed in any form.

The options for bulky waste management are as follows:

Option 1 – bulky items are collected from around the island and depolluted prior to crushing and export.

Option 2 - bulky items depolluted and high value items removed through dismantling prior to crushing and export.

Option 3 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export, stripping of remaining non-metal components, crushing and export.

Option 4 – bulky items depolluted, and high value items removed through dismantling, stripping of remaining non-metal components, crushing and export. Packaging of POPs containing items (plastics, seats/textiles) for export and appropriate management.

Option 5 - bulky items stripped and shredded.

Option costs

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items

2 Management of ongoing generation of items

A high-level cost for each option was developed using the cost model and relevant assumptions and the results are shown in **Table 5.23**. The full derivation of all costs and assumptions is provided in Appendix E.

[81] The World Bank, 2022. Available at: https://data.worldbank.org/indicator/EG.ELC.ACCS.RU.ZS?locations=SB

[82] Solomon Islands Demographic and Health Survey, 2015, Solomon Islands National Statistics Office, SIMoHMS, and SPC.

Table 5.23: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)				Total cost (USD)
Depollute	$210	$560	$50	$3,968,075	$267,277
Partial Strip	$224	$574	$50	$4,127,717	$273,140
Full dismantle	$154	$520	$50	$3,245,833	$232,579
Full dismantle, POPs exported	$210	$680	$62	$4,268,113	$288,523
Shipping Cost	$210	$600	$23	$3,223,500	$166,050

Market options

For the Solomon Islands there is the option to either ship to market in Australia or try and access a market in Asia noting that the material will likely fetch a higher price in Asia with less certainty regarding market access and pricing.

Options evaluation

Table 5.24 presents a summary of the option evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.24: Options evaluation for the Solomon Islands

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Investment required in: • Collection • Storage capacity • Depollution activity	Technicians are available to safely depollute bulky waste, but are not currently utilised.	Opportunity for job creation from dismantling activity.	Containers for hazardous by-products are available if needed. Renadi Waste Disposal Site is an engineered landfill.	No allocated land for bulky waste processing.
Option 2 – Dismantling prior to export	Modelled as $60, this reflects zero value for car body and good value for components.	Investment required in: • Storage capacity • Depollution activity • Stripping	Technicians are available to safely dismantle bulky waste, but are not currently utilised.	Opportunity for job creation from dismantling activity.	Renadi Waste Disposal Site is an engineered landfill.	No allocated land for bulky waste processing.
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD, this reflects some value for the stripped car bod and good value for components.	Investment required in: • Collection • Storage capacity • Depollution activity • Dismantling • Stripping	Technicians are available to safely dismantle bulky waste, but are not currently utilised.	Opportunity for job creation from stripping activity.	Renadi Waste Disposal Site is an engineered landfill.	No allocated land for bulky waste processing.
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Investment required High disposal cost for POPs containing items.	Technicians are available to safely dismantle bulky waste, but are not currently utilised.	Opportunity for job creation from stripping activity.	Removes POPs containing items from the Solomon Islands	No allocated land for bulky waste processing.
Option 5 - Shredding prior to export	Modelled as $120 USD, this reflects some value for the stripped car body and good value for components.	High – Shredding and associated equipment is expensive	High – new equipment, significant existing technical capability.	Opportunity for job creation from shredding activity.	Renadi Waste Disposal Site is an engineered landfill.	No allocated land for bulky waste processing.

The analysis presented in **Table 5.24** suggests that on balance Option 1 and Option 4 are the preferred options for the Solomon Islands. This reflects the lack of bulky waste processing by private bulky waste recycling companies, and a lack of land availability.

Legacy waste options and considerations

The removal of legacy waste would most likely be funded as a project, for example through grant funding. Costs not considered in **Table 5.23** include detailed mapping of the location and quantity of legacy waste. There are also issues associated with waste availability, some private owners are reluctant to part with their end-of-life items if they are still being used for spare parts. Other similar legacy waste missions have required considerable investment in waste surveying prior to collection. If stockpiling of waste prior to shipment is undertaken this will require considerable space with associated land access challenges.

Prior to any legacy waste mission being undertaken, consultation with key stakeholders in-country should be undertaken to make sure the project does not clash with other country initiatives that are planned.

The modelling suggests a legacy bulky waste recovery programme would cost in the order of USD$4M including establishment, materials processing, and administration costs.

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. Our modelling suggests annual costs will be in the order of USD$300,000 including administration costs. This is based on processing costs only, i.e., no refund component of a financing scheme has been included.

For processing in country, funding needs to cover maintenance and renewal/replacement of processing equipment (i.e., crushing and shredders). Poor maintenance and a lack of availability of spare parts can mean that repairs are costly and prolonged. This means there is a risk that equipment can sit broken and idle for months to years.

For the Solomon Islands there may be benefit in collaboration with others in the Pacific Region. Areas with potential for collaboration include:

- Crushing – one or more mobile crushers moving around the Pacific for areas producing small quantities of materials. If this equipment is available, it could be employed for collections from remote islands depending on costs for transporting uncompacted bulky waste.
- Regional programs to train, upskill and support staff (i.e., a Centre of Excellence)
- Regional coordination for the consolidation and management of hazardous waste.
- Regional coordination of marketing of materials – providing scale that can translate into higher prices for traded commodities.

Key information sources

Key information sources have included the Clip (APWC) Solomon Islands Waste Audit Report, Solid Waste Management in the Pacific: Solomon Islands Snapshot[83], Pacific Region Solid Waste Management and Recycling[84], Assessment of Legislative Frameworks Governing Waste Management in Solomon Islands[85], and the Solomon Islands Demographic and Health Survey 2015[86]. Conversations were held with an in-country Environmental Safeguards Specialist.

[83] https://www.adb.org/publications/solid-waste-management-pacific-solomon-islands-country-snapshot
[84] https://www.theprif.org/sites/default/files/documents/prif_waste_book_web_0.pdf
[85] https://library.sprep.org/sites/default/files/2021-03/waste-legislation-Solomon-Islands.pdf
[86] https://pacificdata.org/data/dataset/oai-www-spc-int-f5f42ae3-baef-4317-9f90-c6f7233ff7d2

5.3.12 Tuvalu

In Tuvalu, bulky waste items are collected and processed by the Department of Waste Management (DWM) through their ARFD scheme. The ARFD scheme is designed to include ELVs and white goods, with the scheme meant to collect items from collection points and stockpile items at the dumpsite. A bulky waste collection service has been reported to occur historically however on the ground representatives reported there were no bulky waste collections occurring currently. No exports of bulky waste are currently occurring. Tuvalu's landfill is a non-engineered site with a lack of equipment and land.

Key legislation relating to bulky waste for Tuvalu include the Waste Management (Levy Deposit) Regulation 2019, the Environment Protection Act (2008 revised Edition) and the Ozone Layer Protection Act (2008 Revised Edition). Tuvalu has implemented an ARFD scheme (ref legislation), which includes bulky waste. Further information on relevant legislation is provided in Appendix C.

Key considerations in relation to the options for the management of bulky waste in Tuvalu include:

- The public sector is currently running an ARFD system which is intended to consolidate bulky waste (although reportedly this is not currently occurring).
- Funafuti Dumpsite is the main landfill in Tuvalu.
- Tuvalu has a Transfer Station which opened in 2020.

The current state of bulky waste consolidation and processing has been mapped on **Figure 5.14**.

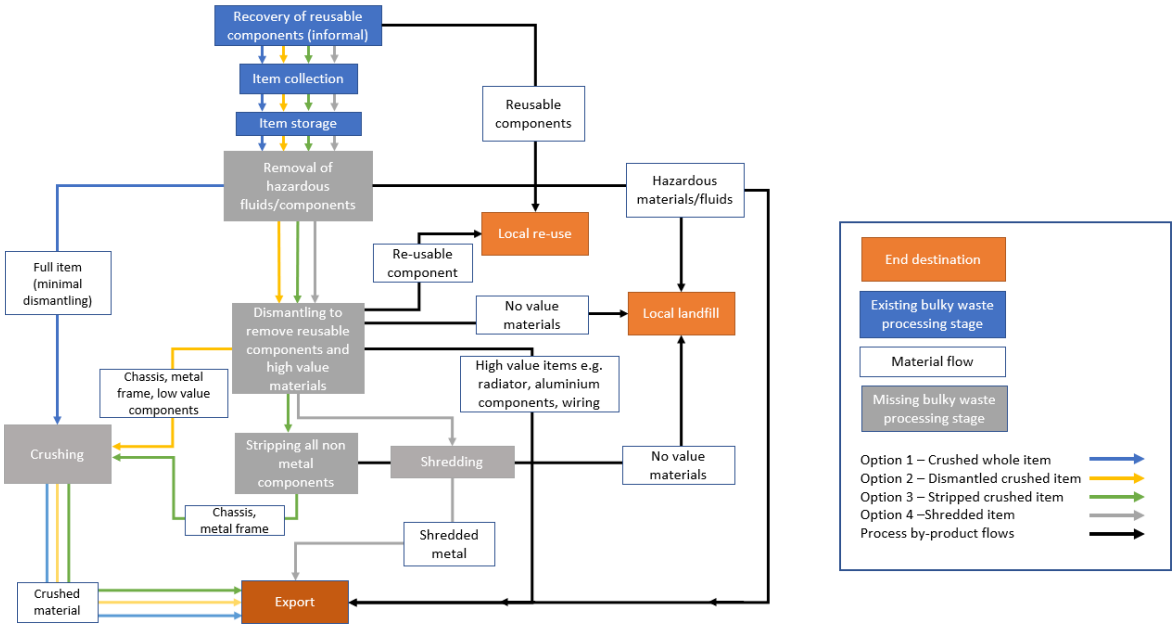


Figure 5.14: Map of recovery options for bulky waste in Tuvalu

Tuvalu has a total population of 10,580 across 9 inhabited islands and atolls. Close to 7,000 of the residents (approximately 66%) inhabit Funafuti Island, home to the capital, Vaiaka. Vaitupu is the second most populated island with 10% of the population. The remainder of the population is spread across 7 islands and atolls, with populations of less than 650 on each. On the remote islands and atolls, Waste Department excavators are used to collect bulky waste which is then stockpiled at local landfills. Shipping between Funafuti and Nanumea is around USD$1,600 per 20ft container, each way.

Tuvalu ARFD bulky waste collection and processing

The Tuvalu ARFD includes bulky waste such as vehicles, motorbikes, batteries, white goods, and small, medium and large construction equipment. The scheme is covered by the Waste Management (Levy Deposit) Regulation 2019 and is operated by the Department of Waste Management (DWM). The fees for bulky waste items are as follows (in AUD):

- White goods (Large - $100, Medium - $60, Small - $30)
- Construction Equipment (Large - $2,000, Medium - $1,000, Small - $500)
- Vehicles - $300
- Motorbikes - $200
- Batteries (motorbike - $10, vehicle - $30, solar - $60)

Collection of fees and deposits for the ARFD is conducted by Customs and paid into the Government Pool, however legislation provides for a Special Fund administered by Treasury. This money is divided as 50% for deposit, 25% for handling, and 25% for administration.

Customers can return levied items to the Transfer Station, or any designated Recycling Collection point. There is one collection point proposed for each of the islands Nanumea, Nanumage, Niutao, Nui, Vaitupu, Nukufetau, and Nukulaelae, and five collection points across Funafuti. Currently there is one central depot open on Capital Islands which is open one week per month and is operated by the DWM.

End-of-life items are delivered to or collected by the waste disposal facility. Aluminium cans are the only items from the ARFD that are exported for recycling. Currently no bulky waste items are recycled or exported from Tuvalu.

The options for bulky waste management are as follows:

Option 1 – bulky items depolluted prior to crushing and export. Items from other inhabited islands transported to Upolu for processing prior to export.

Option 2 - bulky items depolluted and high value items removed through dismantling prior to crushing and export.

Option 3 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export, stripping of remaining non-metal components, crushing and export (current status quo for Palau).

Option 4 – bulky items depolluted, and high value items removed through dismantling, stripping of remaining non-metal components, crushing and export. Packaging of POPs containing items (plastics, seats/textiles) for export and appropriate management.

Option 5 - bulky items stripped and shredded.

<u>Option costs</u>

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items

2 Management of ongoing generation of items

A high-level cost for each option was developed using the cost model and relevant assumptions and the results are shown in **Table 5.25**. The full derivation of all costs and assumptions is provided in Appendix E.

The per item costs derived through the modelling are higher than the 25% of the ARFD fee allocated to handling through the Tuvalu scheme.

- Car 25% x AUD300 = AUD75 = USD$55
- Heavy vehicle 25% x AUD1,000 = AUD250 = USD190
- White goods 25% x AUD 60 = AUD15 = USD11

Table 5.25: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)			Total cost (USD)	
Depollute	$238	$640	$54	$498,880	$77,673
Partial Strip	$252	$656	$53	$500,610	$78,292
Full dismantle	$174	$576	$51	$446,317	$68,700
Full dismantle, POPs exported	$230	$736	$63	$558,037	$84,240
Shipping Cost	$252	$720	$27	$316,800	$47,700

Market options

Tuvalu currently do not export bulky waste materials obtained through their ARFD scheme. No export data was provided to confirm this.

Options evaluation

Table 5.26 presents a summary of the option evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.26: Options evaluation for Tuvalu

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Investment required in: • Depollution activity	Training of staff in depollution. Multiple material streams to manage.	Opportunity for job creation from depolluting activity.	Tuvalu has established storage and exportation for waste oils and e-waste.	Limited land for bulky waste processing, some space at the waste facility.
Option 2 – Dismantling prior to export	Modelled as $60, this reflects zero value for car body and good value for components.	Investment required in: • Depollution activity • Stripping	Training of staff in dismantling. Multiple material streams to manage. Added export/transport complexity.	Opportunity for job creation from dismantling activity.	Tuvalu has established storage and exportation for waste oils and e-waste.	Limited land for bulky waste processing, some space at the waste facility.
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD, this reflects some value for the stripped car bod and good value for components.	Investment required in: • Depollution activity • Dismantling • Stripping	Training of staff in dismantling and stripping. Multiple material streams to manage including low value wastes. Added export/ transport complexity.	Opportunity for job creation from stripping activity.	Non-engineered landfill. Potential high environmental impact from any waste requiring disposal.	Limited land for bulky waste processing.
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Investment required High disposal cost for POPs containing items.	Training of staff in dismantling and stripping. Multiple material streams to manage including low value wastes. Added export/ transport complexity.	Opportunity for job creation from stripping activity.	Removes POPs containing items from Tuvalu	Limited land for bulky waste processing.

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 5 - Shredding prior to export	Modelled as $120 USD, this reflects some value for the stripped car body and good value for components.	High- Shredding and associated equipment is expensive	Training of staff in dismantling and stripping. Multiple material streams to manage including low value wastes. Added export/ transport complexity.	Opportunity for job creation from shredding activity.	By-product of shredding is Floc which would require environmentally sound disposal.	Limited land for bulky waste processing.

The analysis presented in **Table 5.26** suggests that on balance Option 2 (and Option 4 are the preferred options for Tuvalu subject to accessing suitable investment funds. This reflects the lack of bulky waste recycling services, limited space, infrastructure or environmentally sound disposal options.

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. Our modelling suggests annual costs will be in the order of USD$100,000 including administration costs. This is based on processing costs only, i.e. no refund component of the ARFD scheme has been included.

For processing in country, funding needs to cover maintenance and renewal/replacement of processing equipment (i.e. crushing and shredders). Poor maintenance and a lack of availability of spare parts can mean that repairs are costly and prolonged. This means there is a risk that equipment can sit broken and idle for months to years.

For Tuvalu there may be benefit in collaboration with others in the Pacific Region. Areas with potential for collaboration include:

- Crushing – one or more mobile crushers moving around the Pacific for areas producing small quantities of materials. If this equipment is available it could be employed for collections from the remote islands depending on costs for transporting uncompacted bulky waste.
- Regional programs to train, upskill and support staff (i.e. a Centre of Excellence).
- Regional coordination of the consolidation and management of hazardous waste.
- Regional coordination for marketing of materials – providing scale that can translate into higher prices for traded commodities.

Key information sources

Key information sources have included the APWC Tuvalu Waste Audit Report, Solid Waste Management in the Pacific: Tuvalu Snapshot[87], Pacific Region Solid Waste Management and Recycling[88], Assessment of Legislative Frameworks Governing Waste Management in Tuvalu[89], and the Tuvalu 2017 Population and Housing Mini-Census Report[90]. Conversations were held with in-country contacts which included employees from Calibre Project Managers.

[87] Woodruff, A. (2014) f
[88] PRIF, (2018f
[89] University of Melbourne (2020) f
[90] Central Statistics Division (CSD) of the Government of Tuvalu, 2013

5.3.13 Tonga

In Tonga, bulky waste items are collected and processed by the private company, Gio Recycling, for export to New Zealand. The main islands landfill, Tapuhia Landfill, is an engineered landfill.

Key legislation relating to bulky waste for Tonga includes the Environment Management Act (as at 2016) and the Ozone Layer Protection Act (as at 2016). There are no ARFD schemes implemented or planned for Tonga. Further information on relevant legislation is provided in Appendix C.

Key considerations in relation to the processing of bulky waste in Tonga includes:

- One main private recycling company, Gio Recycling, is currently operating that recycles and exports bulky waste.
- The main landfill, Tapuhia Landfill was expanded in 2015, and is engineered with a basal liner system and leachate collection and transfer system.
- Bulky waste is collected from 170 community cages, and recyclable materials are exported to New Zealand.

The current state of bulky waste consolidation and processing has been mapped on **Figure 5.15**.

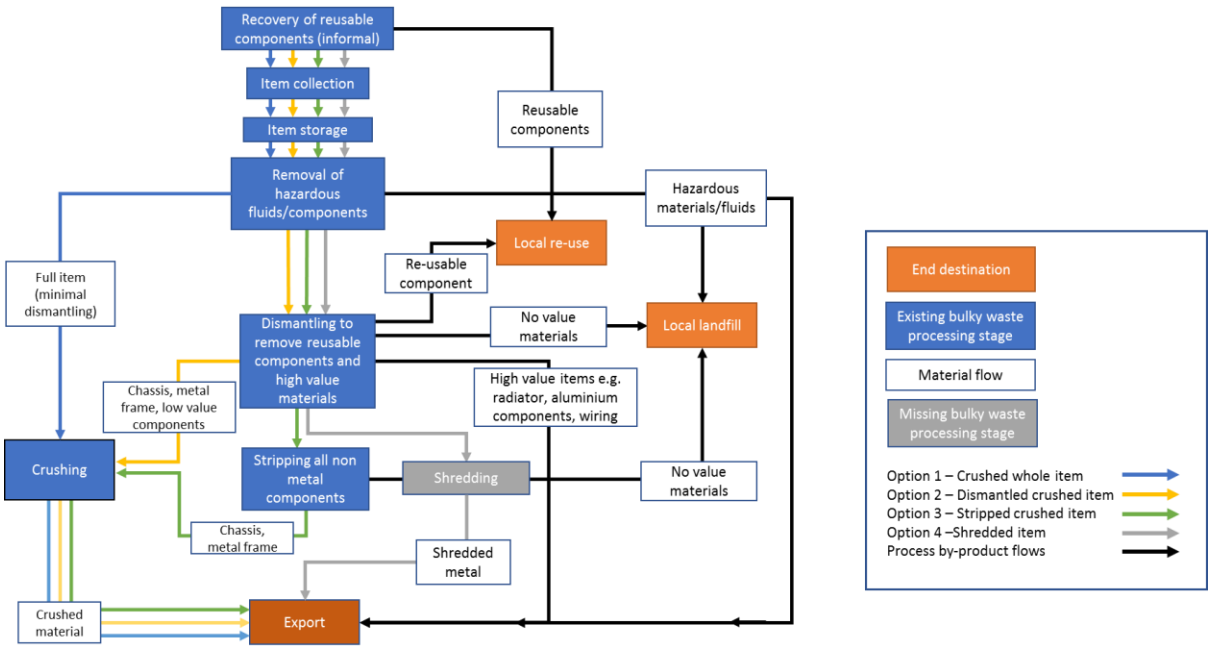


Figure 5.15: Map of recovery options for bulky waste in Tonga

Tonga is made up of 36 inhabited islands. The main island of Tongatapu is home to three quarters of the population of Tonga (74,454 people). A further seventh of the population resides in the island group Vava'u. The island 'Eau has a population of 4,903, with the remainder split across the other inhabited islands in Ha'apai division (population of 5,419) and Onga Niua division (population of 1,150). Bulky waste on outer islands is disposed of in public landfills and public dumpsites. Shipping between Nuku'alfa (Tongatapu) and Vava'u is around USD$550 per 20ft container, each way.

The more complex processing of wastes prior to shipment offshore results in higher potential export value and job creation. The trade-off is the potential environmental impact from the disposal of by-products.

The options for bulky waste management are as follows:

Option 1 – bulky items are collected from around the island and depolluted prior to crushing and export.

Option 2 - bulky items depolluted and high value items removed through dismantling prior to crushing and export.

Option 3 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export, stripping of remaining non-metal components, crushing and export.

Option 4 – bulky items depolluted, and high value items removed through dismantling, stripping of remaining non-metal components, crushing and export. Packaging of POPs containing items (plastics, seats/textiles) for export and appropriate management.

Option 5 - bulky items stripped and shredded.

Option costs

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items

2 Management of ongoing generation of items

A high-level cost for each option was developed using the cost model and relevant assumptions and the results are shown in **Table 5.27**. The full derivation of all costs and assumptions is provided in Appendix E.

Table 5.27: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)			Total cost (USD)	
Depollute	$203	$540	$50	$6,179,900	$666,665
Partial Strip	$217	$553	$49	$6,359,923	$685,607
Full dismantle	$147	$500	$49	$5,228,600	$560,195
Full dismantle, POPs exported	$203	$660	$61	$6,841,400	$723,995
Shipping Cost	$210	$600	$23	$4,680,000	$495,000

Market options

Tonga currently exports bulky waste to New Zealand.

Options evaluation

Table 5.28 presents a summary of the options evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.28: Options evaluation for Tonga

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Low – significant existing infrastructure, existing CIGT facility	Low – significant existing technical capacity, existing capability	Minimal job creation opportunity	Waste oils exported from Tonga by private company	Land constraints not identified
Option 2 – Dismantling prior to export	Modelled as $60, this reflects zero value for car body and good value for components.	Low – significant existing infrastructure	Low – significant existing technical capacity	Minimal job creation from dismantling activity	Tonga has an engineered landfill site	Land constraints not identified
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD, this reflects some value for the stripped car bod and good value for components.	Low – significant existing infrastructure	Low – significant existing technical capacity	Opportunity for job creation from stripping activity.	Tonga has an engineered landfill site	Land constraints not identified
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Significant existing infrastructure High disposal cost for POPs containing items.	Low – significant existing technical capacity.	Opportunity for job creation from stripping activity.	Removes POPs containing items from Tonga	Land constraints for dismantling and stockpiling activity already noticeable at current site.
Option 5 - Shredding prior to export	Modelled as $120 USD, this reflects some value for the stripped car body and good value for components.	High – Shredding and associated equipment is expensive	Medium – new equipment, significant existing technical capability	Opportunity for job creation from shredding activity	Renadi Waste Disposal Site is an engineered landfill	Land constraints not identified

The analysis presented in **Table 5.28** suggests that on balance Option 3 and Options 4 (subject to funding for POPs containing item disposal) are the preferred options for Tonga. This reflects the presence of Gio Recycling as an established recycler of bulky waste items and the cost and potential environmental impacts of managing shredder floc in Tonga.

Legacy waste options and considerations

The removal of legacy waste would most likely be funded as a project, for example through grant funding. Costs not considered in **Table 5.27** include detailed mapping of the location and quantity of legacy waste. There are also issues associated with waste availability, some private owners are reluctant to part with their end-of-life items if they are still being used for spare parts. Other similar legacy waste missions have required considerable investment in waste surveying prior to collection. If stockpiling of waste prior to shipment is undertaken this will require considerable space with associated land access challenges.

The modelling suggests a legacy bulky waste recovery programme would cost in the order of USD$6 - 7M including establishment, materials processing and administration costs.

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. Our modelling suggests annual costs will be in the order of USD$700,000 including administration costs. This is based on processing costs only, i.e., no refund component of a financing scheme has been included.

For processing in country, funding needs to cover maintenance and renewal/replacement of processing equipment (i.e., crushing and shredders). Poor maintenance and a lack of availability of spare parts can mean that repairs are costly and prolonged. This means there is a risk that equipment can sit broken and idle for months to years.

For Tonga there may be benefit in collaboration with others in the Pacific Region. Areas with potential for collaboration include:

- Crushing – one or more mobile crushers moving around the Pacific for areas producing small quantities of materials. If this equipment is available, it could be employed for collections from the northern islands depending on costs for transporting uncompacted bulky waste.
- Regional programs to train, upskill and support staff (i.e. a Centre of Excellence).
- Regional coordination for the consolidation and management of hazardous waste.
- Regional coordination of marketing of materials – providing scale that can translate into higher prices for traded commodities.

Key information sources

Key information sources have included the Solid Waste Management in the Pacific: Tonga Snapshot[91], Pacific Region Solid Waste Management and Recycling[92], Assessment of Legislative Frameworks Governing Waste Management in Tonga[93], and the 2016 Tonga Population and Housing Census Report[94]. No conversations were able to be held with in-country contacts due to the impacts of the volcano and subsequent tsunami.

[91] Woodruff, A. (2014)
[92] PRIF, (2018) f
[93] University of Melbourne (2020) f
[94] Tonga Statistics Department, (2019)

5.3.14 Vanuatu

In Vanuatu bulky waste items are collected and processed by RecycleCorp prior to export to markets in Asia. Residual materials are landfilled at Bouffa Landfill (a semi-aerobic, non-engineered landfill) and Luganville Dumpsite (a non-engineered controlled disposal site).

Key legislation relating to bulky waste for Vanuatu includes the Ozone Layer Protection (Amendment) Act 2014, the National Waste Management and pollution Control Strategy and Implementation Plan 2016 – 2020 and the Vanuatu National Oceans Policy 2016. A feasibility study on ARFD schemes in Vanuatu has been completed, but no scheme has been implemented yet. Further information on relevant legislation is provided in Appendix C. Key considerations in relation to the options for the management of bulky waste in Vanuatu include:

- One recycling company operates in Vanuatu, RecycleCorp, who service the main island.
- The main landfill at Port Vila, Bouffa Landfill is non-engineered, however was rehabilitated in 2016 by PacWaste to be semi-aerobic, with leachate pipes and vertical gas facilities. The sites first cell is almost at capacity, however there are plans for two additional cells.
- Materials from the outer islands will require transport and consolidation at suitable docking areas for RecycleCorp to consider collection for processing and exportation.

The current state of bulky waste consolidation and processing has been mapped on **Figure 5.16**.

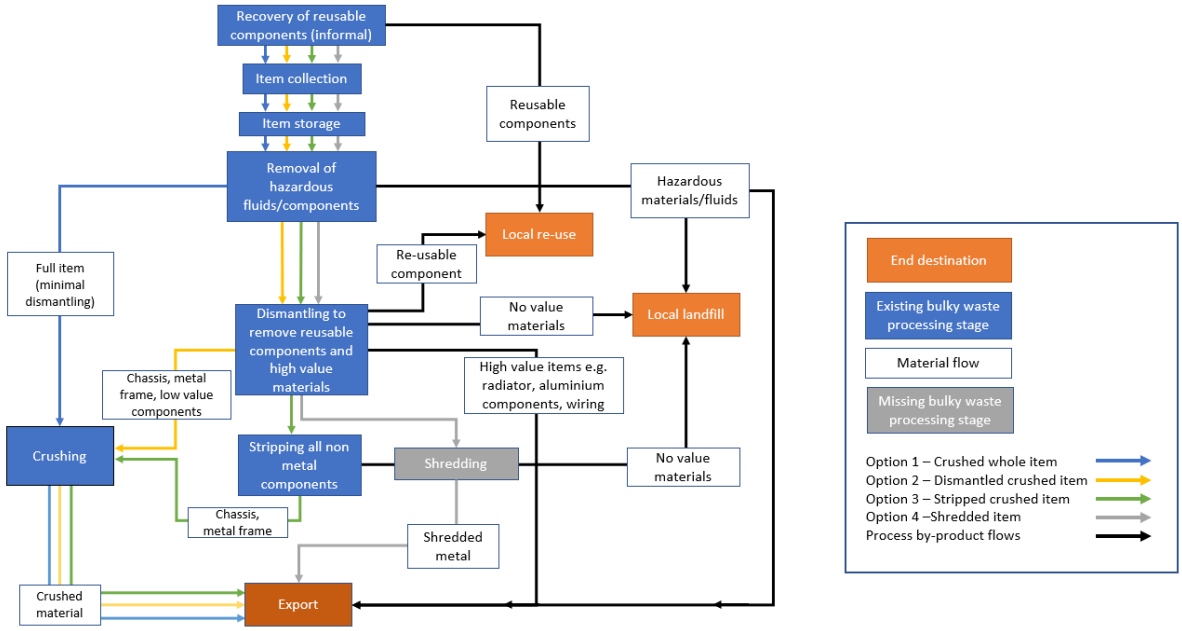


Figure 5.16: Map of recovery options for bulky waste in Vanuatu

Vanuatu is an island nation with 13 principal, and 65 total inhabited islands and a total population of approximately 270,000. The most populated island is Efate Island at 82,000 (30% of the total population). This is followed by Santo with 46,000 (17%) and Tanna with 32,000 (12%). A further 20% of the population is spread across Malekula, Pentecost and Ambae. The final 20% of the population is spread across 60 islands, 47 of which have less than 1,000 inhabitants, and 13 of which have less than 10,000 inhabitants each. The main concentration of bulky waste items in Vanuatu can be found on the islands of Efate and Santo Other small concentrations of bulky waste ownership are expected on the islands of Malekula and Tanna. Bulky waste items on Vanuatu's outer islands are not being removed, and do not have specific disposal locations, except for Government assets at Provincial Public Works Department sites.

RecycleCorp

Through RecycleCorp much of the infrastructure and processes required to support each option are already currently in place for ELVs. RecycleCorp currently do not recycle white goods however they collect them.

The more complex processing of wastes prior to shipment offshore results in higher potential export value and job creation. The trade-off is the potential environmental impact from the disposal of by-products. While Bouffa Landfill in Port Vila is semi-aerobic with a leachate collection system, the site is unlined and non-engineered thus there are concerns around the environmental safety of the site, particularly for groundwater.

Consultation revealed that RecycleCorp only store on-site what can be processed for export due to insufficient space, however they do own a mobile set-up for off-site processing. Many other ELV stockpiles exist at other mechanics and car dismantling facilities. RecycleCorp is currently operating bulky waste collection and recycling system in Port Vila and Luganville that exports recovered material from waste for profit. RecycleCorp will remove vehicles and white goods at the request of the owner of the items.

ELVs are often stripped of useful components that can be reused on the island before the owners consider disposal. Vehicles are stripped of most plastics and interior materials (seats, head linings, door cards etc) before they are cut up or baled for export. The excess products are disposed to the landfills in Port Vila and Luganville. Batteries removed by vehicles or collected by RecycleCorp are exported to Korea.

There is often no collection of oil or fuels from ELV prior to crushing, however hazardous substances are removed by a certified contractor where necessary (to be verified). This implies a sophisticated system is currently in place for the recovery, dismantling and processing of bulky waste. White goods are collected, however are not currently being recycled.

Vanuatu Recyclers and Waste Management Association is currently seeking access to funding for a plastics shredder to process waste plastics. Currently only small volumes of by-products are landfilled as the main aim of dismantling is removing items that have reuse or export opportunities. RecycleCorp would consider removal of bulky waste from outer islands if these were accessible, consolidated at inter-island ferry and barge locations. However, this would require suitable equipment to process ELV which would be costly.

The options for bulky waste management are as follows:

Option 1 – bulky items depolluted prior to crushing and export. RecycleCorp does not collect oil or fuels is currently taken from ELV prior to crushing.

Option 2 - bulky items depolluted and high value items removed through dismantling prior to crushing and export. High value items removed and reused by waste pickers prior to collection by RecycleCorp.

Option 3 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export, stripping of remaining non-metal components, crushing and export. RecycleCorp strip most plastics and interior from ELV prior to cutting up or baling prior to export.

Option 4 – bulky items depolluted, and high value items removed through dismantling, stripping of remaining non-metal components, crushing and export. Packaging of POPs containing items (plastics, seats/textiles) for export and appropriate management.

Option 5 - bulky items stripped and shredded.

Option costs

The management of bulky waste in any PIC consists of the following components:

1 Clearing legacy items

2 Management of ongoing generation of items

A high-level cost for each option was developed using the cost model and relevant assumptions and the results are shown in **Table 5.29**. The full derivation of all costs and assumptions is provided in Appendix E.

Table 5.29: Summary of option costs

	Small ELV	Large ELV	White goods	Legacy Clearance	Annual Programme
	Cost per item (USD)			Total cost (USD)	
Depollute	$210	$560	$51	$9,873,800	$2,821,475
Partial Strip	$224	$574	$50	$10,232,900	$2,776,115
Full dismantle	$154	$520	$50	$8,562,350	$2,702,615
Full dismantle, POPs exported	$210	$680	$62	$11,275,550	$3,388,475
Shipping Cost	$210	$600	$23	$9,420,000	$1,549,500

Market options

RecycleCorp currently exports scrap metals to Asia, with batteries being exported to Korea.

Options evaluation

Table 5.30 presents a summary of the options evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.30: Options evaluation for Vanuatu

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 1 – depolluted whole item export	Modelled as $0 USD	Low – significant existing infrastructure, existing RecycleCorp facility	Low – significant existing technical capacity, existing RecycleCorp facility	Minimal job creation opportunity due to existing industry in Vanuatu	Vanuatu has means for the environmentally sound hazardous waste management systems.	Processing undertaken by private contractors at their existing facilities.
Option 2 – Dismantling prior to export	Modelled as $60, this reflects zero value for car body and good value for components.	Low – significant existing infrastructure	Low – significant existing technical capacity	Opportunity for job creation from dismantling activity	Vanuatu has means for the environmentally sound storage and disposal of by-products.	Processing undertaken by private contractors at their existing facilities.
Option 3 – Dismantling and stripping prior to export	Modelled as $120 USD, this reflects some value for the stripped car bod and good value for components.	Low – significant existing infrastructure	Low – significant existing technical capacity	Opportunity for job creation from stripping activity	Vanuatu has means for the environmentally sound storage and disposal of by-products. POPs containing materials remain in Vanuatu	Processing undertaken by private contractors at their existing facilities.
Option 4 – Dismantling and stripping prior to export, export POPs containing items	Modelled as $120 USD for chassis and components. $200 disposal for POPs containing items	Significant existing infrastructure High disposal cost for POPs containing items.	Low – significant existing technical capacity.	Opportunity for job creation from stripping activity.	Removes POPs containing items from the Vanuatu	Processing undertaken by private contractors at their existing facilities.

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability
Option 5- Shredding prior to export	Modelled as $120 USD, this reflects some value for the stripped car body and good value for components.	High – Shredding and associated equipment is expensive	Training of staff in dismantling and stripping. Multiple material streams to manage including low value wastes with obscure markets. Added export/transport complexity.	Minimal job creation opportunity due to existing industry in Vanuatu	By-product of shredding is Floc which would require environmentally sound disposal than the non-engineered landfill.	Processing undertaken by private contractors at their existing facilities.

The analysis presented in **Table 5.30** suggests that on balance Option 3 and Option 4 (subject to funding for POPs containing items disposal) is the preferred option for Vanuatu. This reflects the presence of RecycleCorp as an established recycler of bulky waste items, and rehabilitated landfill.

Legacy waste options and considerations

The removal of legacy waste would most likely be funded as a project, for example through grant funding. Costs not considered in **Table 5.29** include detailed mapping of the location and quantity of legacy waste. There are also issues associated with waste availability, some private owners are reluctant to part with their end-of-life items if they are still being used for spare parts, as well as the outer islands having no current systems in place for recovery. Other similar legacy waste missions have required considerable investment in waste surveying prior to collection. If stockpiling of waste prior to shipment is undertaken this will require considerable space with associated land access challenges.

Private owners are able to request for RecycleCorp to collect their ELVs or white goods for a fee of 5,000 VT (approximately US$44), however the size and condition of the bulky waste may require extra charges. For some owners this fee is too high. A draft document for the establishment of an ARFD scheme is currently being prepared for the Government of Vanuatu and SPREP. The current intention of the document is to establish a container deposit scheme and there is no current reference to including the bulky materials investigated in this report. Prior to any legacy waste mission being undertaken, consultation with key stakeholders in-country should be undertaken to make sure the project does not clash with other country initiatives that are planned.

Ongoing waste options

For a programme to address ongoing generation of bulky waste there needs to be a sustainable financing mechanism to fund ongoing processing and export. For processing in country, funding needs to cover maintenance and renewal/replacement of processing equipment (i.e. crushing and shredders). Poor maintenance and a lack of availability of spare parts can mean that repairs are costly and prolonged. This means there is a risk that equipment can sit broken and idle for months to years.

For Vanuatu there may be benefit in collaboration with others in the Pacific Region. This will only be the case where improved access to equipment or markets translates to better commercial result for RecycleCorp.

Key information sources

Key information sources have included the T+TI ARFD Issues and Options Vanuatu Report, APWC Vanuatu Waste Audit Report, Solid Waste Management in the Pacific: Vanuatu Snapshot[95], Pacific Region Solid Waste Management and Recycling[96], Assessment of Legislative Frameworks Governing Waste Management in Vanuatu[97], and Vanuatu 2016 Census Data[98]. Conversations were held with in-country contacts which included employees of the Department of Customs and Inland Revenue, and Environmental Management Vanuatu.

[95] Woodruff, A. (2014)
[96] PRIF, (2018) f
[97] University of Melbourne (2020)
[98] Vanuatu National Statistics Office, (2010)

5.3.15 Country options evaluation summary and common issues

A summary of the preferred option for each country is shown in **Table 5.31**.

Table 5.31: Preferred option for each country

Country	Option 1 – bulky items depolluted prior to crushing and export	Option 2 – bulky items depolluted, and high value items removed through dismantling prior to crushing and export	Option 3 – bulky items depolluted and high value items and all non-metal items removed	Option 4 - bulky items stripped and shredded
Cook Islands			✓	
Federated States of Micronesia	✓			
Fiji			✓	
Kiribati	✓			
Nauru		✓		
Niue		✓		
Palau			✓	
Papua New Guinea			✓	
Republic of Marshall Islands	✓			
Samoa			✓	
Solomon Islands	✓			
Tonga			✓	
Tuvalu	✓			
Vanuatu			✓	

In summary:

- Bulky waste processing and export was not identified as a commercial opportunity in any of the PICs assessed.
- There is often a trade off between the opportunity to further process in country (increasing positive socio economic impacts and the creation of higher value materials), the potential environmental impact of disposing of processing by products in the PICs and the potential presence and value of the markets being targeted.

It is understood that in some PICs, businesses are operating that profit from the processing and export of scrap metal. We understand through consultation with these businesses that some receive funding from the Government for ongoing operations (such as the case for CIGT, based in Rarotonga).

The options evaluation process raised a number of issues that are common to multiple PICs. These include:

- Investment required in processing technology and servicing the ongoing maintenance and repair issues in a cost effective and timely manner.
- Identifying environmentally sound and safe means of handling and disposing of residual waste from processing including hazardous waste, no value material and/or floc.
- Space for stockpiling, processing and storage of recovered material.

- Working conditions and implementation of environmental best practices for working, including upgrades to infrastructure (covered areas, impervious surfaces, stormwater control).
- Current waste collection systems do not reach the outer islands of many PICs.
- Recyclable bulky items are often abandoned or stockpiled outdoors, meaning they are likely to be contaminated and will need to be cleaned to meet the biosecurity requirements of the import country.
- The cost of investing in specialised equipment for parts removal, dismantling and crushing of bulky items.

For small remote PICs many of these issues are exacerbated and in addition include:

- Accumulating enough volume that makes identification and negotiation of an export market possible.
- The costs associated with transportation of materials between outer islands associated within a PIC.
- Appropriately sized transportation for the movement of bulky items, i.e. some smaller PICs use barges to transport goods between outer islands and the scale of vessel may not be appropriate for bulky items.

Some of these common issues can be addressed, at least in part, through taking a regional approach to bulky waste management (**Section 5.4**).

5.4 Regional opportunities

5.4.1 Regional opportunities

A list of regional opportunities has been identified that may potentially improve the viability or effectiveness of individual country activities. However, none of these will entirely address the current funding gap. This means that while these regional opportunities will improve the viability of recycling for individual countries the analysis completed for this report suggests that funding will be required for both clearance of legacy items and long-term recovery programmes.

This funding could take the form of grant funding for legacy clearance programmes and or the implementation of Advance Recovery Fee and Deposit schemes (ARFD). ARFD impose a charge on items on import or at point of sale with the funds raised covering a Fee for the cost of processing, shipping and recycling and a Deposit that is refunded when items are returned for recycling.

Regional opportunities considered include:

- Co-ordinated legacy clearance process – Taking a regional approach to a programme aimed at removing legacy waste in a series of locations.
- Mobile crusher - Engagement of a mobile crusher for smaller PICs or outer islands to complete "campaigns" to crush and transport material to export markets. Crushed items reduce transport cost (by maximising container or bulk shipping payload) and in turn make responsible disposal or recycling of bulky waste items (including associated POPs), more cost effective.
- Market co-ordination – Matching available material in PICs with available markets to improve the viability of market options (presenting larger quantities at agreed quality to attract a better price). Collaborating with private sector and/ or governments to improve market access and optimise material logistics.
- Establishment of a regional centre of excellence - Regional capability development and ongoing support for bulky waste management (depollution, parts recovery, dismantling, crushing for export).
- In-region processing – Centralised processing of materials from multiple PICs.

The activities support Output 2.2 of the GEF ISLANDS Pacific Child Project (*Technical assistance and support for shipping and disposal of end-of-life vehicles (ELVs) from Pacific SIDS to Asian recycling markets (regional)*). The Regional Centre of Excellence is seen as a mechanism to support Output 2.2 as well as capability development components of other project outputs.

The options listed above consider Swire Shipping growing from a role as a stakeholder in export logistics to roles as a regional co-ordinator or recycling broker (**Figure 5.17**).

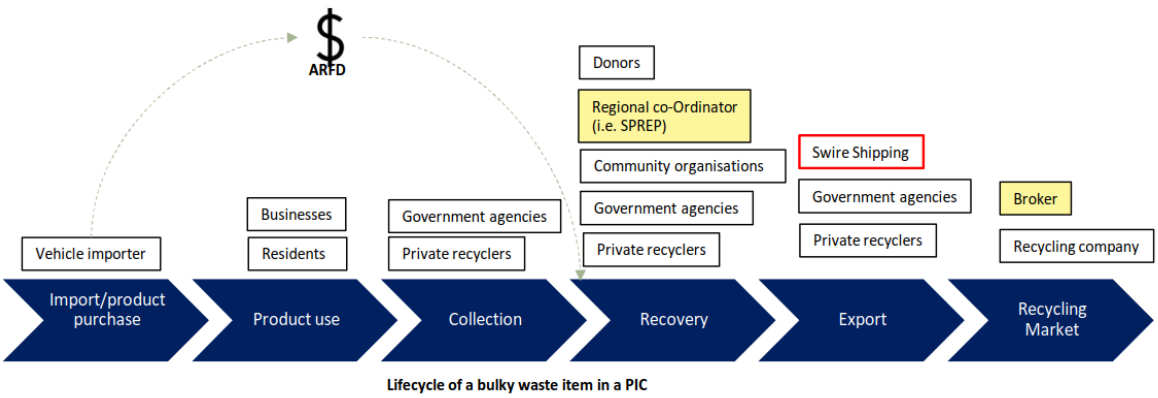


Figure 5.17: Stakeholder map – lifecycle of bulky waste item in PIC

Smaller PICs where full item stripping may not be viable as a standalone enterprise may benefit from periodic processing in country or transporting materials to a centralised processing point. Regarding less of the level of in-country processing placing materials from multiple PICs on the market together will increase scale improving both access to markets and the value of the materials. Importantly, the consolidation of materials doesn't necessarily need to happen in the Pacific - materials from multiple PICs can be shipped to a common destination to provide additional scale.

Where there is regional consolidation existing recyclers (private sector or government) could choose to 'opt in' to the regional material consolidation and trading activity. This will be driven by a combination of market access, material value.

The management of POPs in the context of each regional opportunity can be summarised as:

- **Co-ordinated legacy clearance:** Remove POPs containing bulky wastes from PICs, avoiding degradation and unplanned environmental release/discharge of POPs in individual PICs. Any programme design will include capability development and allowance for appropriate management of POPs containing materials as legacy items are collection, processed and exported.
- **Mobile crushing:** Enabling efficient export of bulky items where crushing equipment is not available locally. Crushing will occur alongside the appropriate management of POPs containing materials and items as for a legacy clearance programme.
- **Establishment of a regional centre of excellence:** Ensuring that managers of bulky waste recovery and processing operations are informed/trained to manage POPs containing materials appropriately.
- **In-region processing:** In region processing may involve removal of POPs containing materials with export for appropriate management. Centralised regional processing could present challenges with if quantity of POPs containing components and/or shredder floc requiring disposal in a single location e.g., Fiji/Naboro Landfill.

Each of these opportunities are discussed below.

5.4.2 Co-ordinated legacy clearance process

This study has indicated that there are significant volumes of legacy bulky waste on the PICs in the scope of this study. One option would be a co-ordinated clearance of legacy waste in the region. Legacy clearance processes have been undertaken in individual countries, the most recent being the MFAT sponsored project in South Tarawa (Kiribati) where Macauley Metals has been engaged to undertake work to remove approximately 1,200 ELVs from the island.

The driver for separating legacy clearance from management of items generated on an ongoing basis is that sustainable financing can be introduced for future material (such as ARFD schemes) but clearance of legacy waste is likely to require grant funding.

The advantage of taking a regional approach to legacy clearance includes:

- Sharing of equipment and expertise.
- Consolidation of larger volumes of materials enabling potential access to higher prices at market.
- Co-ordinated approach to managing hazardous material by-products (such as ELV hazardous fluids or refrigerants).
- Co-ordinated approach to the remediation of areas where bulky waste has been removed with a focus on delivering opportunities for women and partnering with local organisations to support this activity.

A legacy clearance process would take a coordinated approach to management of hazardous waste material. Given most of PICs in this study do not have established hazardous waste management processes or infrastructure it is likely that legacy clearance would need to:

- Coordinate the safe temporary storage of depollution biproducts (used oil, hydraulic fluids), arrange transport and export markets (or environmentally sound disposal).
- Consider retaining POP material in the depolluted crushed vehicle so POPs can be appropriately managed in an overseas facility or export POPs containing material for appropriate management.

A co-ordinated legacy waste approach needs to consider the large up front capital investment and inherent project complexity of addressing multiple countries at one time. A potential approach is to design a programme using a consistent approach and common equipment progressively clearing legacy items across the Pacific. It is important that any legacy clearance initiative is combined with establishing sustainably financed, ongoing management systems for bulky wastes. This is a key component of the Kiribati programme with the legacy clearance to be followed by an expansion of the Koake Mange programme to cover bulky wastes and areas outside South Tarawa and Kirimiti.

High level estimates indicate that a legacy waste clearance project could cost in the order of $120M allowing for the export of POPs containing materials for appropriate disposal. This is based on the costs for individual country legacy clearance including an allowance for administration. A regional programme is anticipated to reduce country level administration costs, have a significant regional administration cost and create some economies of scale. Regional coordination also provides an opportunity to develop capability for the careful management and export of hazardous wastes (depollution products, POPs containing materials) for appropriate treatment and disposal.

The export of POPs containing materials for appropriate disposals comprises around $30M (disposal cost) on top of processing costs. Shipping costs for POPs containing materials are assumed to be covered through the Moana Taka partnership.

5.4.3 Mobile crushing

Mobile crushing equipment can be transported to multiple locations across the Pacific in containers and/or on a barge, crushing bulky items prior to loading for transport to market. A mobile crusher can be used to reach ‘outer islands’ where scale or suitable local infrastructure is not available. This approach is relevant for legacy clearance and could also be adopted for an ongoing programme to periodically collect bulky items from remote islands.

The advantage of mobile crushing is avoiding investment in individual crushers for each PIC. If the equipment can be used to periodically ‘clear’ remote islands transport can also be optimised. Challenges facing PICs private companies or government departments looking to procure equipment include lack of adequate financing (for both capital and associated operating costs such as maintenance). There can also be challenges accessing technical capacity and access to spare parts for maintenance and repair.

Bringing a unit into the country for short periods of time means that responsibility for capital, maintenance and repair can be with an organisation focussed on bulky waste processing at a regional level. If PICs know a campaign will be undertaken in the future or regularly, they can arrange for the stockpiling of bulky waste prior. A number of campaigns have been completed in the past.

Key considerations for a successful campaign include:

- Ensuring sufficient groundwork has been undertaken prior to the barge arriving to confirm waste location, condition, and availability (some owners are reluctant to release their bulky waste to programmes). This may include removal of high value components and materials for separate baling for export – to maximise return from the programme.

- Making sure the machinery and technical expertise is available in country to support the programme for activities such as processing and loading. External assistance maybe required with education on this process.
- Ensuring there is sufficient capability for depollution activities (training of staff, management, storage and export of depollution by-products).
- Ensuring there is enough room available for stockpiling of bulky items awaiting crushing and transport (noting that in some instances this may be months to years).
- Having clearly documented procedures for moving equipment between countries (import/export requirements, biosecurity, safety regulations).
- Linking periodic clearance/processing activity to sustainable financing arrangements - grant funding followed by ARFD or similar financing schemes.

Table 5.32 illustrates estimated materials generation for one year across the target PICs. The table also translates the estimated bulky waste quantities to loaded 20 ft containers and estimates time required for crushing alongside establishment and loading for shipment to the next location. If the larger countries and those with existing export operations (Cook Islands, Samoa, Vanuatu) are excluded this translates to total crushing time of around 40 weeks. Accounting for transporting the crushing set up around the Pacific as an annual programme appears to have potential.

Table 5.32: Mobile crushing scenario in each country

Country	Steel scrap generation (t/annum)[99]	Containers/ country/annum[100]	Time spent crushing (days)[101]	Total time (weeks)[102]
Cook Islands	500	23	5	3.70
Federated States of Micronesia	5,200	237	44	8.50
Fiji	15,100	687	126	18.80
Kiribati	1,100	50	10	4.30
Nauru	100	5	1	3.20
Niue	1,100	50	9	4.20
Palau	700	32	6	3.80
Papua New Guinea	52,200	2,373	435	57.40
Republic of Marshall Islands	1,600	73	14	4.80
Samoa	1,300	60	11	4.40
Solomon Islands	600	28	6	3.80
Tonga	2,600	119	22	5.80
Tuvalu	100	5	1	3.20
Vanuatu	9,200	419	77	12.70

[99] Upper scenario – Assumes 100% of modelled annual generation delivered to crusher. Assumes outer regions and islands have delivered their bulky waste to central location.
[100] Assumed 22 tonne per container can be up to 25 tonne.
[101] 30 tonne/hour with 50% downtime.
[102] Three weeks allowance for customs, fumigation and cleaning (could likely be more). No allowance for in country travel. No allowance for Pacific shut down periods (during holidays and celebrations).

5.4.4 Establishment of a regional centre of excellence

A regional centre of excellence would be intended to develop procedures, train staff and be a point of regional capability development and ongoing support. The country options evaluations identified the training and technical expertise of staff as a key risk to the development of in country bulky waste processing. Taking a regional approach to addressing this risk means that like resources can be shared across the region. A regional centre of excellence does not currently exist for the in-country management/processing and export of bulky waste but regional approaches to developing best practice guidelines, training and support are being implemented through other Pacific initiatives. Key elements that this centre could address include:

- Shared processes and procedures for the management of hazardous materials.
- Shared processes and procedures for the shipping of materials (import/export documentation, biosecurity).
- Ongoing investigations into a regional approach for hazardous waste management resulting from bulky waste processing (such as used oil).
- Investment in training (expected to be in-country) to develop and grow the technical capability of in country personnel on skills such as:
  - Depollution procedures and controls
  - Manual dismantling and stripping.
  - Machine assist dismantling.
  - Machinery operation.
  - Loading and processing cargo for export.
  - Hazardous materials management and health and safety risk.
  - Community information and education regarding bulky waste management.

A regional centre of excellence will form a co-ordinated approach to addressing skills and knowledge gaps of women in particular who want to participate in the sector. Women may need targeted training to build skills, address knowledge gaps and ensure that they can operate safely in the waste recycling environment. Training could include:

- Proper handling of waste.
- Appropriate use of tools and machinery to assist in waste processing.
- Component materials of waste items, e.g. ELVs and white goods.
- Identification of hazardous and toxic materials.
- Processing of hazardous and toxic materials.
- Use of protective equipment.

Programs targeted at addressing skills gaps for women may need to first raise awareness about the opportunity but will likely also need to consider social and cultural gender constraints, such as provision of childcare so that women can attend training.

5.4.5 Market co-ordination

There is an opportunity for an organisation with a regional focus (such as SPREP or Swire Shipping) to procure materials from PICs and co-ordinate markets for the products. The co-ordination of larger volumes of material can assist in securing markets (that have a higher volume entry point or who pay more for larger volumes) and to provide volume scale for low volume producing PIC's. This may be post legacy phase.

With many PICs having potential to ship materials to hubs such as Suva or Port Moresby there is potential for loads from multiple PICs to be combined to secure better pricing and market access. Materials from multiple PICs could also be combined closer to market, for example in Asia, Australia, or New Zealand. This relies on consistent quality of product across PICs and coordination of timing of shipments.

Coordination of shipping should focus on opportunities to backload materials where possible. This takes advantage of outbound freight capacity from many PICs that is currently underutilised. However, from a shipping line perspective, it is important to target end user markets in or close to demand areas for container equipment.

In our high-level modelling of quantities of materials and using guideline shipping rates we have identified a significant amount of new shipping that could occur if bulky items are captured and exported from PICs for recycling. The represents a significant revenue opportunity for Swire Shipping.

The high-level analysis completed for this study suggest there is potential to move an additional 60,000 T of bulky items each year. This excludes materials from Papua New Guinea, Fiji and Vanuatu where there are already active recycling operations in the main centres. It is estimated that this represents potential freight revenue (at guideline rates) in the order of $3 - 4M. These materials exported with minimal processing are estimated be worth in the order of $1 - 1.5M based on the material values adopted for this study.

While establishing a regional programme is the long-term objective, any initiative needs to make a start on establishing logistics and material markets. Drawing on the information collected for this study it is possible to complete preliminary analysis on which countries are suitable as pilot or initial participants in a regional bulky waste network. This analysis assumes that Swire Shipping will take steps to develop the bulky waste network.

Factors that have been considered in this analysis are:

- **Scale** - how much material is generated/ could be recovered?
- **Access to Swire Shipping Network** – noting that not all PICs in this study are currently serviced by Swire. This is a consideration for early implementation but the transition to region wide activity will provide opportunities for Swire to coordinate across the region.
- **Developing an Advanced Recovery Fee and Deposit (ARFD) Scheme** – is there an established ARFD scheme for bulky waste (Tuvalu only) or clear pathway to implementing one.
- **The presence of potential private sector partners**
  - Are there established private sector parties that are open to participating/partnering will be preferred (training on separating POPs waste, selling to a regional trader at a guaranteed rate), avoiding the need to create capability from 'the ground up' while proving the concept.
  - Is there one or more private sector operators processing ELVs in PIC?
  - Is there more than 1 operator in country (i.e., an indicator of an open market)?
- **Opportunities to involve informal or under-represented groups -** for example are there existing 'waste pickers' who could be employed or supported in establishing a new enterprise operating to an export standard, improving income for these groups.
- **Current level of processing/disposal of ELV and constituent parts -** is there existing capability to dismantle/full strip materials, are ELV stockpiled or located throughout the community?
- **Anticipated level of government and business community support.**

These factors have been evaluated for each PIC in this study with a simple colour coding indicating how each factor has been evaluated. The evaluation is summarised Table 5.33.

This evaluation identifies several countries that are potential pilot or initial countries to enable Swire to prove the concept of coordinated processing, shipping, and marketing of materials. Each of the PICs identified has different advantages and disadvantages and, in some cases, the preliminary evaluation presented in Table 5.33 needs to be validated with further discussions or research on specific issues.

The import and export of recoverable and/or POPs containing materials is likely to require consideration from a biosecurity perspective, particularly where materials are entering or transiting through Australia or New Zealand or countries with similar biosecurity requirements. This is an area where coordinated shipping and handling of materials with well-established systems to achieve and document compliance will be a significant advantage.

Table 5.33: Country evaluation

Criteria		Cook Islands	Nauru	FSM	Fiji	Kiribati	Niue	Palau
Scale	Legacy	13,000	39,680	143,600	244,000	13,000	8,600	14,004
	Ongoing	640	3,310	6,420	9,000	1,140	1,310	914
Access to Swire Shipping Network	No of services	1	0	0	6	1	1	0
Developing ARFD		Drafting Leg	Drafting Reg for bulky waste	Leg in Place (CDL only)		Drafting Reg for bulky waste	Drafting Leg	Leg in place
The presence of potential private sector partners		CIGT, single operator, existing equipment in country	No private sector operator	Private sector in Yap and Kosrae	Multiple existing private sector operators	Existing, MFaT funded external operator and govt run bulky waste mgt	No private sector operator	Existing private sector operator
Opportunities to involve informal or under-represented groups		Limited	Govt run scheme	Likely Govt run scheme	Likely	Govt run scheme	Govt run scheme	Single operator, linked to Govt scheme
Current ELV Processing		Yes	No	No	Yes	Newly established	No (planned)	No
Government and business support		High	High			High	High	High
Potential initial Countries		No	No	No	Yes	Possible	No	No
Comments		Limited Swire routes Small quantity	No Swire No private sector	No Swire routes No equipment	No legislation Active private sector Existing equipment	Regulation being prepared Small quantity MFaT project	Drafting Legislation Small quantity No private sector	No Swire routes Small quantity

Criteria		PNG	RMI	Samoa	Solomon Islands	Tonga	Tuvalu	Vanuatu
Scale	Legacy	480,000	5,300	14,380	28,004	54,000	74	61,000
	Ongoing	37,000	3,010	4,280	850	35,600	190	53,820
Access to Swire Shipping Network	No of services	6	1	3	5	3	0	3
Developing ARFD		Planned	Leg in Place (CDL only)	Drafting Leg	Drafting Leg	Not planned	In Place	Drafting Leg (CDL focussed)
The presence of potential private sector partners		Multiple existing private sector operators	No private sector operator	Existing private sector operator	Existing private sector operator, open to collaborating	Existing private sector operator	No private sector operator	Existing private sector operator, hesitant to engage
Opportunities to involve informal or under-represented groups		Potential but private operators	Govt run scheme	Single operator, could be via Govt support	Potential	Single operator, could be via Govt support	Govt run scheme	Potential
Current ELV Processing		Yes	No	Yes	Yes	Yes	No	Yes
Government and business support		High	High	High	High		High	High
Potential initial Countries		Yes	No	Possible	Yes	No	No	Possible
		No legislation Active private sector Existing equipment	No legislation Small quantity	Drafting legislation Small quantity Single private operator	Draft legislation Moderate quantity, Single private operator	No legislation Moderate quantity Single private operator	Small quantity Legislation in place No private sector	Drafting Legislation Moderate quantity Single private operator

The analysis suggests that there is potential to start the processing of establishing bulky waste shipping and market access coordination in several countries. These countries are characterised by active private sector participation in bulky waste recycling, existing connections on the Swire Shipping network and Advanced Recovery Fee and Deposit arrangements in various stages of development. Each of the potential initial countries are discussed below.

Fiji is considered a potential pilot country. This reflects the presence of significant quantities of bulky waste (legacy and ongoing generation), multiple Swire Shipping routes servicing Fiji and multiple private sector operators. Container deposit and materials levies are implemented under existing legislation, but not for bulky waste.

Kiribati is considered a potential pilot country. This reflects the presence of moderate quantities of bulky waste (legacy and ongoing generation), a single Swire Shipping route and a current legacy material clearance programme funded by the New Zealand Ministry of Foreign Affairs and Trade. There is an existing ARFD Scheme focussed on containers and batteries with plans to extend this to cover bulky waste items. Swire shipping are in discussions with the MFaT project team to ship equipment to Kiribati and ship materials to market post in-country processing.

Papua New Guinea is considered a potential pilot country. This reflects the presence of significant quantities of bulky waste (legacy and ongoing generation), multiple Swire Shipping routes and multiple private sector operators. An ARFD scheme is in the early stages of development (feasibility study).

Samoa is considered a potential pilot country. This reflects the presence of moderate quantities of bulky waste (legacy and ongoing generation), several Swire Shipping routes and private sector operators. An ARFD scheme is in development (legislative drafting).

Solomon Islands is considered a potential pilot country. This reflects the presence of moderate quantities of bulky waste (legacy and ongoing generation), multiple Swire Shipping routes and a private sector operator. An ARFD scheme is in development (legislative drafting).

Vanuatu is considered a potential pilot country. This reflects the presence of significant quantities of bulky waste (legacy and ongoing generation), several Swire Shipping routes and multiple private sector operators. An industry led ARFD scheme, initially focussed on beverage containers, is in development (feasibility and early drafting).

The countries noted here all have existing bulky waste recycling activities with materials shipped to market through agreements between local private sector operators and brokers or end market buyers. There is potential for Swire to provide shipping services, including using backload capacity to reducing shipping costs. There is also potential to partner with one or more trader of materials to provide an integrated offer to private sector operators across multiple PICs.

As logistics arrangements, including addressing biosecurity requirements, and relationships with materials traders and markets are developed there is potential to quickly move to supporting other established private sector activity.

For example, the low quantity of material generated in the Cook Islands means they are considered less attractive for early participation but there is potential to collaborate on arrangements for remote and small quantity scenarios e.g., Aitutaki.

There may also be potential to provide support to private sector operators. Examples include procuring or upgrading equipment, training for bulky waste processing, and assisting with providing opportunities for the participation of underrepresented groups in bulky waste recycling activities.

To progress discussions with potential private sector partners in Fiji, Papua New Guinea and Solomon Islands (and potential other PICs) Swire Shipping will need to confirm what is being offered. This may include:

- Shipping of recoverable materials from PIC to market – shipping rate to be determined based on an acceptable return reflecting capacity and shipping routes.
- Shipping of POPs containing materials (assumed Australia or New Zealand) for appropriate management and disposal under the Moana Taka Partnership. Disposal arrangement will also require confirmation.
- Arrangements with one or more materials trader to provide an integrated shipping and materials purchase solution to private sector.
- Support for private sector partners, potentially including:
  - Access to capital for equipment and processing arrangements.
  - Access to business and technical training.

5.4.6 In region processing (Fiji)

The advantage of the establishment of centralised in region processing is that bulky waste can be dismantled in a larger PIC (such as Fiji) with any of the contaminated or low value items being disposed of at the engineered landfill. This reduces the potential environmental impact of processing options that, if undertaken in remote PICs, may lead to the disposal of by-products in uncontrolled dumpsites. Establishing a single in region processing would also ensure that any POP contaminated waste as a by-product of dismantling is disposed of in a sanitary landfill.

Investment in a single facility means that maintenance and operation costs are associated with a single facility.

Key considerations of the development of an in-region processing capacity include:

- Facility capacity.
- Intra region shipping logistics – it is likely that some crushing will be required to manage shipping costs. This will make it difficult to recover higher value components (vehicle engines, motors/compressors, radiators, wiring) if they remain in the item at export.
- Development of capacity in countries where material is being sourced including removal of higher value items prior to crushing - this approach is preferred.
- Interactions with existing processors of material who are exporting to Australia, New Zealand or Asia.
- Investment required in processing technology and completing ongoing maintenance and repair issues in a cost effective and timely manner.
- Adding value - a typical bulky waste processing operation targets the recovery of high value components and materials (vehicle engines, motors/compressors, radiators, wiring) prior to crushing. If a regional facility is receiving partially dismantled items there is limited additional value to be gained with the exception of shredding to separate ferrous, non ferrous and floc (waste). An automotive shredder generates an average of 250 kg of non metallic waste per car.

The key disadvantages of establishing in region processing include:

- The increased exposure of Swire Shipping to project risk – Swire Shipping would need to either invest in recycling infrastructure or identify a key project partner to invest in establishing operations.

- Although Naboro Landfill (near Suva) is a sanitary Landfill, airspace at the site is limited. Due to an unprecedented rate of filling in recent years alternatives to the landfill are currently being discussed.
- There is an increased cost associated with handling materials multiples times including additional port costs, import/export documentation and processing costs. This is unlikely to be off set by any increase in value from processing of crushed materials.

5.4.7 Regional opportunity evaluation

Table 5.34 presents a summary of the options evaluation. The colour coding relates to the 'performance' of the option with respect to the evaluation criteria. Green indicates that the option supports achieving the desired outcome, orange indicates that the option somewhat supports the desired outcome and red indicates the option does not support the desired outcome.

Table 5.34: Regional opportunity evaluation

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability	Scope and other considerations
Option 1 – Co-ordinated legacy clearance	• Potential increase in export value through economies of scale, a higher price for higher volume of material.	• Low – investment required in: - Understanding waste volumes/locations/accessibility. - Project administration and co-ordination. - Managing contamination and accessibility issues with legacy waste - Upskilling/training of in country project personnel. • Cost for individual PICs reduced through shared resources.	• Low – some inherent project risk and complexity introduced by addressing multiple PICs through a single project.	• Medium - there is an opportunity to upskill in region personnel to support project objectives. With a legacy programme there is potential several years of activity across the region, providing opportunities for programme management and technical delivery.	• High positive impact (removing legacy waste from the environment). • Requires the sound management of depollution by-products (i.e. engine oils) environmental impacts can be reduced by minimal in country dismantling. • Provides for the appropriate management of POPs containing materials.	• Constraints are lower: - Short term storage of legacy items prior to export (but planning for medium term, given experience from those currently operating through Covid-19). - Needs to consider an area for depollution and preparation of items prior to export (expected to be short term).	Papua New Guinea and Fiji may be too large to be included in a co-ordinated legacy clearance and would require separate initiatives. Take forward: Yes
Option 2 – Mobile crushing	• Dependent on the level of dismantling prior to crushing. • Most typically low value components are crushed with metals so export value is not increased. • Making crushing available to locations that cannot justify dedicated equipment, improving transport efficiency.	• Medium – investment required in: - Mobile crushing equipment and associated infrastructure for regular regional and inter island travel. - Understanding waste volumes/locations/accessibility. - Project administration and co-ordination. - Managing contamination and accessibility issues with legacy waste. - Upskilling/training of in country project personnel. • Cost reduced through shared resources and economies of scale.	• Medium – inherent project risk and complexity introduced by addressing multiple PICs through a single project. • The advantage of using mobile equipment is the technical risk (associated with poor equipment maintenance, breakdowns common to PICs) is reduced.	• Medium - although there is an opportunity to upskill in region personnel to support project objectives. With a movement of specialist equipment around the region there is ongoing opportunities for programme management and technical delivery experience and employment.	• Requires the sound management of depollution by-products (i.e. engine oils) environmental impacts can be reduced by minimal in country dismantling.	• Constraints are lower: Do we need Short term storage of legacy items prior to export (but planning for medium term, given experience from those currently operating through Covid-19). - Needs to consider an area for depollution and preparation of items prior to export (expected to be short term).	Take forward: Yes
Option 3 – Establishment of a regional centre of excellence	• Proper training and skill development will improve export value to an extent. Small PICs will still struggle to find markets for products without the volume required to negotiate a price which would enable export.	• Low – investment required in: - Resource development (guidelines, best practice). - Personnel upskilling. - Co-ordinated approaches to hazardous wate management. Potentially lower cost through not investing in infrastructure.	• Low – regional approaches to training, best practice environmental management are commonly facilitated through key organisations such as SPREP, who are well placed to support initiatives and have proven track record.	• High – focussed on the development of in country capability and knowledge. • Centre of excellence could take a co-ordinated approach to training women and creating environments where women can participate in the sector.	• Focussed on development and in country capability relating to sound environmental management.	• Low land availability constraints.	Take forward: Yes

Option	Potential export value	Implementation cost	Option technical complexity	Option positive socio-economic impact	Environmental impacts	Land availability	Scope and other considerations
Option 4 – Market co-ordination	• Potential increase in export value through economies of scale, a higher price for higher volume of material.	• Low – investment required in: - Large scale administration and co-ordination (relationship development, capability building). - Lower cost of infrastructure development and skill development. • Potential to work with private sector including procuring suitable equipment.	• Country evaluation highlighted that there are a number of PICs where there would need to be significant investment in infrastructure and processes to support in country facilities for depollution ready for export. • Potentially lower technical complexity as focus is on outsourcing in country item management to in country partners (existing businesses, community groups, government organisations).	• Medium - although there is an opportunity to upskill in region personnel to support project objectives (Option 3) • Medium - increased value will improve the viability of recovery creating new economic activity and jobs in PICs.	• Requires the sound management of depollution by-products (i.e. engine oils) environmental impacts can be reduced by minimal in country dismantling. • Export of POPs containing materials via Moana Taka Partnership	• Stockpiling of waste prior to export and land availability for depollution activity remains a concern for a number of PICs.	Take forward: Yes Recommend piloting market coordination approach with several PICs (with existing private operators, govt support (including pathway to ARFD) and existing connection to Swire Shipping network.
Option 5 - In region processing	• Extraction of other materials of value for export. • Stripping of scrap metal to produce a metal of higher value for export. Potential increase in export value through economies of scale, a higher price for higher volume of material.	• High - investment required in: – New processing facility - capital costs. • The double handling of materials (consolidating and processing items in a central location) incurs a high cost compared to value of material (at this point in time).	• High – country evaluation highlighted a number of PICs where significant investment is required in infrastructure and processes to support in country facilities for depollution ready for export. • There is high level complexity involved in transporting materials intra regionally for further processing (MEAs, biosecurity, establishment of in country infrastructure, further processing).	• Potential to partner with local businesses. • Potential to develop in country capacity.	• Requires the sound management of depollution by-products (i.e. engine oils) environmental impacts can be reduced by minimal in country dismantling. • Although Naboro Landfill (Viti Levu, Fiji) is engineered there are concerns about airspace.	• Constraints are potentially high: - Processing requires space for dismantling activity, long term storage of items and their components.	Take forward: No

5.4.8 Regional opportunities - summary

In summary the analysis presented in this Section suggests all options should be taken forward for further consideration with the exception of in region processing in Fiji. This reflects the benefits of regional collaboration with respect to access to markets, capability development and managing complexity. The in-region processing options is not recommended for further consideration at this stage due to the high cost of double handling material with limited increase in value and the significant volume of waste that would require disposal in Naboro Landfill.

Considering the management of POPs, regional collaboration and capability development will enable individual PICs to appropriately manage bulky waste items through to export for recycling and/or appropriate disposal. This is in contrast to in-country or in-region processing where uneanted components or shredder floc risks being disposed in dump sites or in very high quantities at Naboro Landfill in Fiji.

It is important to reiterate that the regional opportunities support activity at an individual country level. This means unless there is bulky waste recovery activity occurring in a significant proportion of individual PICs there is limited value in progressing the regional opportunities identified here.

6 Implementation and Delivery Considerations

The information presented in the report indicates that existing reprocessing capability and sophistication varies considerably across the PICs included in this study. In some PICs (generally the larger) there are private businesses who currently consolidate, process and export bulky waste.

The key opportunities identified in this report require further analysis, and in some cases policy and/or funding support, to be fully implemented. The opportunities discussion in **Section 5.4** are summarised in **Table 6.1.**

Table 6.1: Country and Regional Opportunities

Country	Further analysis of available materials	Sustainable financing scheme (ARFD or similar)_	Clarify ownershi9p of end-of-life items	Coordinated legacy clearance programme	Potential user of mobile crushing equipment	Participant in regional centre of excellence	Participant in market coordination
Cook Islands	✓	~[103]	✓	~[100]	✓	✓	✗[104]
Micronesia	✓		✓	✓	✓	✓	✓
Fiji	✓	~[105]	✓	✓	✗[106]	✓	✓
Kiribati	✓	~[107]	✓	✗[108]	✓	✓	✓
Nauru	✓	~[101]	✓	✓	✓	✓	✓
Niue	✓	~[101]	✓	✓	✓	✓	✓
Palau	✓	~[103]	✓	✓	✓	✓	✓
Marshall Islands	✓	~[101]	✓	✓	✓	✓	✓
Papua New Guinea	✓	~[101]	✓	✓	?	✓	✓[102]
Samoa	✓	~[101]	✓	✓	✗[104]	✓	✓[102]
Solomon Islands	✓	~[101]	✓	✓	✗[104]	✓	✓[102]
Tuvalu	✓	✓	✓	✓	✓	✓	✓
Tonga	✓		✓	✓	✓	✓	✓
Vanuatu	✓	~[101]	✓	✓	✗[104]	✓	✓[102]

There is a significant amount of activity occurring at a Country level focused on developing sustainable financing arrangements for the ongoing management of bulky waste items. These schemes will operate most effectively if legacy items are removed from circulation prior to scheme commencement. These schemes will also rely on access to markets for materials collected.

[103] An ARFD scheme including bulky items is under development
[104] The existing bulky item recycler has established markets
[105] There is an existing Container Deposit scheme that could be extended to bulky items.
[106] There is existing equipment in country.
[107] There are plans to extend the Kaoke Mange scheme to cover bulky items across Kiribati
[108] MFAT is working with the Kiribati Government on an ELVs clearance project.

The analysis at a country and regional level concludes that the recovery of items for export does not present a commercial opportunity without funding, for example through ARFD schemes within each country.

If this funding can be secured there is a significant amount of new shipping activity anticipated (over 60,000 tonnes per year, or over 3,600 teu). The value of the projected bulky waste generated each year is in the range USD $1 - 1.5 M based on the material values adopted for this study.

From the study, a good number of regional opportunities have been identified to likely improve the economic viability of the recovery of these waste materials, through the likes of shared resources, consolidation of larger volumes of material (improving market access and value) and other options. Ultimately, a level of funding will still be required.

This suggests that in parallel with development of long-term sustainable financing arrangements (ARFD schemes or similar) in each country, work at a regional level should focus on:

- **Confirming arrangements for collection and recycling of legacy items.** The analysis presented in this report suggests that a regional coordinated programme would benefit from economies of scale and provide opportunities for local and regional capability development. In many, but not all, PICs there is an opportunity to collaborate with private sector operators to undertake collection and processing with regionally coordinated shipping and marketing of materials.
- **Commencing initial discussions in several PICs** to establish **coordinated shipping and marketing of materials** in partnership with willing private sector partners. Recommended PICs are PNG, Fiji and the Solomon Islands with Kiribati, Samoa and Vanuatu also potential countries to prove the concept. This will provide an opportunity to establish partnerships or other relationships with material traders and markets, addressing biosecurity arrangements and refine logistics planning to maximise the use of backload / spare capacity.
- Based on the outcome of initial discussions and proof of concept work **confirm the business case** for regional coordination of shipping and marketing of materials from bulky waste recovery. This will provide an opportunity to consider actual shipping rates and logistics associated with presenting material aggregated from several PICs to end markets. Other considerations include additional sensitivity analysis on market value for recovered materials, level of processing completed in each Country, improving infrastructure (including potential mobile equipment) and the management of POPs and other hazardous materials associated with bulky waste.
- Provide support and guidance to individual PICs to accelerate the **creation of opportunities for women and other underrepresented groups** in the waste sector. Opportunities identified in this report include:
  - Providing training, leadership and other employment opportunities in bulky waste recycling enterprises.
  - Partnering with community organisations fostering the establishment of women other underrepresented groups in leadership roles to lead the rehabilitation work which is required once bulky waste has been removed from the environment.
  - Using the centre of excellence as a co-ordinated approach for delivering training and systems in which women other underrepresented groups can better participate in best practice bulky waste management. This can draw on examples of women leading resource recovery activity in the Cook Islands, Tonga and Samoa noted in this report.

In developing country level and regional proposals, the key uncertainties should be further evaluated. These are noted where relevant in this report and repeated below.

- Cost assumptions, key drivers include:
  - Shipping costs - the analysis used guideline rates for several key shipping routes from/to the Pacific as a guide, these are at the upper end of typical commercial rates for these routes prevailing in March 2022. The rates are subject to market fluctuation and negotiations specific to individual routing considerations.
  - Material value - the analysis used retail rates i.e., for small quantities of materials. These are at the lower end of material value with value improving with quantity and processing to separate specific items and materials. Material values are subject to market fluctuations over time.
  - In country transport and processing - the analysis built up transport costs based on guideline rates for shipping and processing costs based on anticipated activity. These costs will vary with scale and also with the experience and equipment available for specific operations.
- Volumes of material as data available for the Pacific varies in quality and completeness.

The following implementation and delivery approach addresses the points above.

1 Design and implement a legacy clearance program including developing processing and export arrangements that are suitable for ongoing volumes of material likely to feed into an ongoing future programme.

This activity needs to be led by a single organisation, supported by other interested parties. It is clear from the discussions undertaken in the preparation of this report that interested parties include SPREP (potentially drawing on fund from AfD, EU and UNEP), JICA (through their J-PRISM II programme), ADB (supporting several ARFD scheme developments through urban development projects) and MFAT (supporting ARFD expansion to cover bulky waste in Kiribati alongside legacy clearance of bulky waste from South Tarawa and Kirimiti). Swire Shipping are also committed to support both legacy and ongoing bulky waste management across the Pacific as part of their commitment to supporting the communities that they do business in.

Development of a clearance programme will involve:

- Piloting working with the private sector in several PICs to develop / refine logistics and materials trading approach to be adopted for legacy clearance and ongoing bulky waste recycling activity.
- Developing a detailed programme design, identifying funding required for in-country activity (processing and internal shipping), shipping and POPs containing materials management. (3 - 6 months)
- Subject to suitable funding and confirmed progress towards ARFD implementation in each PIC commence a legacy clearance programme, working progressively across participating PICs (18 months or more).

2 Design and implement sustainable financing schemes for managing the ongoing generation of items, reflecting where relevant links to a regional approach including:

- In country skill development, best practice, and environmental management (through a regional centre of excellence).
- Market co-ordination.
- For remote areas, an annual system of consolidating and exporting material.

ARFD scheme development or expansion is ongoing across the Pacific with support from the EU (PAcWastePlus), JICA (J-PRISM II), MFAT (Kiribati) and ADB (Nauru). It is likely that within the next 2-3 years most PICs will have a legislative framework for ARFD and be underway with implementing the approach for some materials. This timeframe matches well with the completion of a legacy clearance programme as noted above. It is important for the successful establishment of an ARFD programme that legacy items are addressed, either as part of the ARFD scheme establishment or before the scheme is put in place. This avoids the fees paid as items are imported being used to fund the management of legacy items, leaving limited or no funding for ongoing management of target items or materials.

3 Through establishment of the annual system, data will be available on material generation for each PIC. This information will allow stakeholders to revisit the option for in country or regional processing with further data to aid business case evaluation.

7 Conclusion and Next Steps

7.1 Conclusion

In summary, this report concludes that:

- There are significant volumes of bulky wastes stockpiled or dumped in the environment across the Pacific. These bulky waste items contain a significant number of POPs in the form of brominated flame retardants in plastics and textiles.
- Bulky wastes are projected to continue to be generated as new items are purchased and existing item reach the end of their life.
- In many PICs there are no arrangements for the recovery and export of bulky waste items, meaning they are dumped or inappropriate stored, potentially discharging hazardous materials (such as POPs and engine oil) to the environment and providing breeding grounds for mosquitoes.
- Cost modelling suggests that recovery and export of bulky items is not currently financially viable with material value too low to cover the cost of processing and export for both regional ventures and for individual countries.
- A coordinated legacy clearance programme across the Pacific is expected to provide some economies of scale and lay the groundwork for ongoing management of bulky waste and the associated hazardous materials including POPs and waste oil.
- Ongoing management of bulky waste should be supported by Country level sustainable financing arrangements (such as ARFD schemes) building on in-country processing, shipping and associated management arrangements established as part of a legacy clearance programme.

ARFD schemes are in place, being expanded to cover bulky items or in development for most of the PICs in this study. A legacy clearance programme will support the effective introduction of ARFD schemes addressing bulky waste items, avoiding funds collected for current bulky waste items being expended on addressing the management of legacy bulky wastes.

Section 7.2 sets out next steps for implementing a Legacy Clearance programme and working with countries on establishing an ongoing bulky waste management arrangement including ARFD or similar scheme to provide funding.

7.2 Next steps

The next step in the project is to progress country level and regional opportunities. This work can progress in parallel at this stage, but as physical recovery, processing and shipping activity starts it will be important to recognise that some activities require, or will benefit from, other initiatives being in place. For example:

- A legacy clearance program will require periodic repeating if it is not followed by the implementing of ongoing bulky waste management scheme including sustainable financing (such as ARFD schemes).
- An ongoing bulky waste management scheme will be more effective if legacy items are ‘cleared’ prior to commencement or as party of an initial establishment phase.
- Both legacy clearance and ongoing bulky item management schemes will be more effective if there are companion capability (training, mobile equipment, management of hazardous materials, tracking and appropriate management of POPs containing materials) and market access arrangements in place.

Recognising the interdependencies, the recommended next steps for regional activity focussed on bulky waste management are outlined in **Table 7.1**. Key early activities include:

- Country level ARFD scheme development

  As noted previously, this is underway in a number of countries. This is being supported by PacWaste Plus, ADB, MFAT and J-PRISM II in several countries adopting a similar approach. There are still several countries with no existing or planned system in place for bulky waste (Micronesia, Tonga, Fiji). Pilot work on establishing logistics and market access arrangements will assist in providing optimised shipping costs and material values to assist with setting advanced disposal fees.

- Improve data

  The data compiled for this report has limitations. In developing detailed proposals and financial models for Country and Regional activity work should continue on quantifying materials availability, shipping arrangements and market for key target materials.

- Regional Centre of Excellence – supporting in country capability development

  Establishing coordinated training and capability development for bulky waste management across the Pacific is an important component of regional support for country level initiatives. While the establishment and ongoing operational costs of this activity will be low compared to processing and shipping materials ongoing funding is still likely to be required. Training and capability development should where possible occur in country and focus on the effective management of hazardous waste including POPs containing materials and the maximising the value of bulky wastes through the target removal of high value components for reuse or recycling.

- Market Coordination

  While actual marketing of materials will not start until collection, processing and shipping commences, early work will be required to establish links to key outlets for materials. Work will also be required to link all participating PICs to appropriate shipping routes and develop an appropriate commercial model covering handling costs, shipping and import/export requirements. The shipping component is vital to get right and is likely to be able to draw heavily on work currently underway on establishing a Moana Taka Plus partnership across the region.

  There is an opportunity to prove the market coordination concept by starting with a subset of PICs. Potential PICS for early action have been identified based on existing connections to the Swire Shipping network, progress on implementing ARFD for bulky waste and the presence of potential private sector partners. It is recommended that discussions are initiated with private sector partners in Fiji, Papua New Guinea and the Solomon Islands. Other potential early participant PICS include Samoa, Vanuatu and Kiribati.

  To progress discussions with potential private sector partners in Fiji, Papua New Guinea and Solomon Islands (and potential other PICs) Swire Shipping will need to confirm what is being offered. This may include:

  - Shipping of recoverable materials from PIC to market – shipping rate to be determined based on an acceptable return reflecting capacity and shipping routes.
  - Shipping of POPs containing materials (assumed Australia or New Zealand) for appropriate management and disposal under the Moana Taka Partnership. Disposal arrangement will also require confirmation.
  - Arrangements with one or more materials trader to provide an integrated shipping and materials purchase solution to private sector.

- Support for private sector partners, potentially including:
  - Access to capital for equipment and processing arrangements.
  - Access to business and technical training.

- Legacy Clearance Programme

  The analysis presented in this report highlights the value in a coordinated legacy clearance programme preceding the establishment of ongoing management of bulky waste across the Pacific. Developing a detailed legacy clearance programme design drawing on the early market coordination is an important early activity. This will provide the basis for discussions with one potential funder and also link with Country level design activity.

  The focus of the legacy clearance programme should be on effective removal of POPs containing materials from PICs supported by maximising the value of recoverable materials in bulky waste.

Next steps are summarised in Table7.1.

Table 7.1: Preliminary next steps

Activity	Start now	Next steps	Implementation
Country level scheme development			
Scheme design	*Underway in some PICs*		
Legislative process	*Underway in some PICs* *In place in some PICs*		
Implementation			*Must be in place once legacy clearance is complete*
Improve data			
Material quantity (legacy and ongoing)			
Shipping costs and aggregation logistics	*For specific markets*		
Material markets (access and value)			
Regional Centre of Excellence			*Ongoing*
Mobile Crushing/mobile equipment			*Ongoing*
Market Coordination			*Ongoing*
Legacy Clearance Programme			
Programme Design			
Early participants			
Implementation			

8 References

- AIB Blog, 2020, *Fiji's Tax Credits for the Importation of Hybrid Cars: The Unintended Consequences of Environmental Policies*, available from: https://www.aib.edu.au/blog/aib-review/fijis-tax-credits-for-the-importation-of-hybrid-cars-the-unintended-consequences-of-environmental-policies/ accessed 01/16/2022
- Asian Development Bank (ADB), 2022, *Regional Recycling Centre: Scoping Study Final Inception Report*, COWI
- Asia Pacific Waste Consultants (APWC), 2020, *Palau – Waste Audit Report*, UN Environment Programme (UNEP), available from: https://palau-data.sprep.org/system/files/UNEP%20Palau%20Report%20FINAL%20APWC%5B1%5D%20copy.pdf
- Asia Pacific Waste Consultants (APWC), 2020, *Samoa Waste Audit Report Summary*, The World Bank, available from: http://rio-samoa.mnre.gov.ws/sites/default/files/Samoa%20Waste%20Audit%20Report%20summary.pdf
- Asia Pacific Waste Consultants (APWC), 2021, *Plastic Waste-Free Island Project: Plastic Waste National Level Quantification and Sectorial Material Flow Analysis in Fiji*
- Asia Pacific Waste Consultants (APWC), 2021, *Samoa Waste Characterization and Situation Analysis Report*, The World Bank, available from: http://rio-samoa.mnre.gov.ws/sites/default/files/World%20Bank%20Samoa%20Report%20FINAL.pdf
- Bank of the Cook Islands, 2022, *Motor Vehicle Dealers Report 2017-2022*
- Basel Convention, *Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal*, available from: http://www.basel.int/?tabid=4499
- Bradley, M., 2020, *Cleaner Pacific 2025 Pacific Regional Waste and Pollution Management Strategy*, SPREP, available from: https://www.sprep.org/sites/default/files/ExecBoardMeeting/2020/EngV2/WP%2011.3.2%20Att.1%20-%20Output%203b_Final%20Draft_CP2025_Implementation%20Plan%202021-2025_.pdf
- Central Statistics Division (CSD) of the Government of Tuvalu, 2013, *Tuvalu 2012: Population and Housing Census Volume 1 Analytical Report*, available from: https://pacificdata.org/data/dataset/oai-www-spc-int-d37445da-2ea3-44d9-8dcd-cecd2e68fae5
- Central Statistics Division (CSD) of the Government of Tuvalu, 2017, *Tuvalu Population & Housing Mini-Census 2017 Report*, available from: https://pacificdata.org/data/dataset/spc_tuv_2017_phc_v01_m
- Chai, P., 2020, *Industry in the dark on Papua New Guinea's single-use plastic ban,* Business Advantage PNG, available from: https://www.businessadvantagepng.com/industry-in-the-dark-on-papua-new-guineas-single-use-plastic-ban/
- Clark, R. 2020, *Per Public Law 21-76, One-Time-Use Disposable Styrofoam & Plastic Food Service Items Prohibited from Importation into the FSM Beginning July 1st, 2020; Such Items Already in the FSM Can Still Be Used*, The National Government of the Federated States of Micronesia, available from: https://gov.fm/index.php/component/content/article/35-pio-articles/news-and-updates/330-per-public-law-21-76-one-time-use-disposable-styrofoam-plastic-food-service-items-prohibited-from-importation-into-the-fsm-beginning-july-1st-2020-such-items-already-in-the-fsm-can-still-be-used?Itemid=177

- Constable, A., 2017, *Climate change and migration in the Pacific: options for Tuvalu and the Marshall Islands*, Reg Environ Change (2017) 17:1029-1038
- Cook Islands Government, 2021, *National Infrastructure Investment Plan, 2021-2030*, available from: https://www.theprif.org/sites/default/files/documents/Cook%20Islands%20NIIP%20Report%20Rev2_PRIF.pdf
- Cook Islands Statistics Office (CISO), 2018, *Census of Population and Dwellings 2016*, available from: http://www.mfem.gov.ck/images/documents/Statistics_Docs/5.Census-Surveys/6.Population-and-Dwelling_2016/2016_CENSUS_REPORT-FINAL.pdf
- Department of Agriculture, Water and the Environment, Australian Government, 2021, *Polybrominated diphenyl ether flame retardants (PBDEs),* available from: https://www.awe.gov.au/environment/protection/publications/factsheet-polybrominated-diphenyl-ether-flame-retardants-pbdes
- Department of Environmental Protection and Conservation Vanuatu, 2016, *National Waste Management, Pollution Control Strategy and Implementation Plan 2016-2020*, available from: https://www.nab.vu/document/national-waste-management-and-pollution-control-strategy-and-implementation-plan-2016-2020
- Department of Environmental Protection and Conservation Vanuatu, 2021, *Vanuatu National Biodiversity Strategy and Action Plan (NSAP) 2018-2030*, SPREP, available from: https://pacific-data.sprep.org/dataset/vanuatu-biodiversity-strategy-and-action-plan-nsap-2018-2030
- Department of Strategic Policy, Planning and Aid Coordination, Republic of Vanuatu, 2016, *Vanuatu 2030 The People's Plan National Sustainable Development Plan 2016 to 2030*, available from: https://www.gov.vu/index.php/resources/vanuatu-2030
- Division of Statistics Department of Economic Affairs FSM National Government, 2002, *Federated States of Micronesia 2000 Population and Housing Census Report*, available from: https://spccfpstore1.blob.core.windows.net/digitallibrary-docs/files/9d/9d8a445f29dc9e970a59e5d7059703c1.pdf?sv=2015-12-11&sr=b&sig=011g1dLOmb0ygqC%2B%2F7FPNGFLg1O%2F5xdbl2Qh3ODBaSM%3D&se=2022-09-17T04%3A09%3A12Z&sp=r&rscc=public%2C%20max-age%3D864000%2C%20max-stale%3D86400&rsct=application%2Fpdf&rscd=inline%3B%20filename%3D%22FSM_2000_National_Census_Report.pdf%22
- DJS Research, *Pacific Islands: Plastic Waste Spotlight on Vanuatu*, available from: https://vanuaturecyclingandwaste.org/wp-content/uploads/WRAP_Plastic-waste_Vanuatu-report_FINAL_Small.pdf
- Economic Policy, Planning and Statistics Office, Republic of the Marshall Islands, and the SPC Statistics for Development Programme, 2012, *Republic of the Marshall Islands 2011 Census Report*, Noumea, New Caledonia, available from: https://sdd.spc.int/digital_library/republic-marshall-islands-2011-census-report
- Engineers without borders Australia, 2020, *Vanuatu: World First Disposable Nappy Ban*, available from: https://ewb.org.au/blog/2020/12/15/vanuatu-world-first-disposable-nappy-ban/
- Environment and Conservation Division-MELAD, 2021, *Draft National Solid Waste Management Strategy*, available from: https://kiribati-data.sprep.org/dataset/draft-national-solid-waste-management-strategy
- Fiji Bureau of Statistics, 2018, *Fiji Population & Housing Census*, available from: https://www.statsfiji.gov.fj/

- Fiji Bureau of Statistics, 2021, *Key Statistics: Transport 11.2 Vehicles Newly Registered*, available from: https://prdrse4all.spc.int/system/files/11.2_vehicles_newly_registered_sep_13_0.pdf
- Fiji Bureau of Statistics, 2021, *Statistical News 2019-20 Household Income and Expenditure Survey Preliminary Release*, available from: https://www.statsfiji.gov.fj/images/documents/2007_Census_of_Pop_Housing/Population-Censuses-and-Surveys/2019-20_Household_Income_and_Expenditure_Survey_Preliminary_Release.pdf
- Fiji Revenue and Customs Service, 2017, *Preliminary Customs Tariff Schedule*
- FSM Department of Environment, Climate Change, and Emergency Management, *Good Practices on Solid Waste Management throughout the FSM Highlights of 2017-2019*\
- GEF, 2018, Guidance to Advance Gender Equality in GEF Projects and Programs, available from: https://www.thegef.org/sites/default/files/publications/GEF_GenderGuidelines_Dec2018_CRA_web.pdf
- GHD, 2021, *Waste to Energy Research Report*, SPREP, available from: https://www.sprep.org/publications/waste-to-energy-research-report
- Giardino, A., Nederhoff, K., Vousdoukas, M., 2018, *Coastal hazard risk assessment for small islands: assessing the impact of climate change and disaster reduction measures on Ebeye (Marshall Islands)*, Regional Environmental Change (2019) 18:2237-2248, available from: https://doi.org/10/1007/s10113-018-1353-3
- Gouvernement de la Republique du Vanuatu, 2018, *Vanuatu National Water Strategy 2018-2030*, available from: https://mol.gov.vu/index.php/en/policy-legislation-water
- Infrastructure Cook Islands, 2021, *Cook Islands Advanced Recovery and Disposal Fee Policy 2021 (draft)*
- Infrastructure Cook Islands, 2019, *Cook Islands Single-Use Plastic Ban Policy 2018-2023,* available from: *https://www.theprif.org/sites/default/files/documents/Cook%20Islands%20Single%20Use%20Ban%20-%20Policy%202018-2023%20FINAL.pdf*
- Infrastructure Cook Islands, 2016, *Cook Islands Solid Waste Management Policy 2016 – 2026*, available from: https://policycookislands.files.wordpress.com/2017/05/2016_ci-solid-waste-management-policy-2016-2026_final.pdf
- International Environmental Technology Centre (IETC) v1.1. *Gender and waste*, available from: https://www.ctc-n.org/files/resources/gender_and_waste_management.pdf
- Irvin, A., 2021, *No "Third-Hand" Vehicle Market For Car Exports*, Fiji Sun, available from: https://fijisun.com.fj/2021/01/13/no-third-hand-vehicle-market-for-car-exports/ accessed 16/01/2022
- Island Times, 2019, *Palau's plastic bag ban begins today*, accessible from: https://islandtimes.org/palaus-plastic-bag-ban-begins-today/
- Japan International Cooperation Agency (JICA), 2013, *Data Collection Survey on Reverse Logistics in the Pacific Islands*, available from: https://openjicareport.jica.go.jp/pdf/12112264_01.pdf
- JPRISM, 2019, *The Detailed Action Plan of Priority Activities of WG in 2019 (Public version)*, available from: https://environment.gov.vu/images/Waste.Management/Public_Version_NWMPCS_Action_Plan_in_2019.pdf

- Kiribati National Statistics Office Ministry of Finance, 2016, *2015 Population and Housing Census Volume 1: Management Report and Basic Tables*, available from: https://pacificdata.org/data/dataset/oai-www-spc-int-fab0f2ea-9c32-4a23-b364-ba35057ca246
- Leney, A., 2004, *Vehicle Recycling on South Tarawa An Initial Feasibility Study*, Foundation for the Peoples of the South Pacific Kiribati, available from: https://library.sprep.org/content/vehicle-recycling-south-tarawa-initial-feasibility-study
- Magalini, F., Kuehr, R., Huisman, J., Deubzer, O, Sinha Khetriwal, D., 2017, *Material Flows of the Home Appliance Industry*, available from: http://www.materialflows.eu/assets/Material_Flows_of_the_HA_Industry_LR.pdf
- Membrere, M., 2021, *Conservationists endorse new recycling initiative*, Samoa Observer, available from: https://www.samoaobserver.ws/category/samoa/89471
- Ministry for the Environment, New Zealand Government, 2022, *3 Environmental Issues Related to Whiteware*, available from: https://environment.govt.nz/publications/product-stewardship-study-whiteware-sector/3-environmental-issues-related-to-whiteware/
- Ministry of Commerce, Trade, Tourism and Transport, 2021*, Database for Valid Scrap Metal Dealers*
- Ministry of Finance & Economic Development, Government of Kiribati, 2016, *Kiribati Development Plan 2016 to 2019*, available from: https://www.mfed.gov.ki/publications/kiribati-development-plan-2016-2019
- Ministry of Natural Resources and Environment Samoa, 2019, *National Waste Management Strategy 2019-2023*, available from: https://www.sprep.org/attachments/VirLib/Samoa/national-waste-management-strategy-2019-2023.pdf
- Ministry of Waterways and Environment Republic of Fiji, 2020, *Strategic Plan 2020-2024*, available from: https://www.mowe.gov.fj/wp-content/uploads/2020/03/2020_2024_Strategic-Plan_MoWE.pdf
- MRA Consulting Group (MRA), 2021, *Recycling Market Research Report*, SPREP, available from: https://library.sprep.org/content/recycling-market-research-report
- Nauru Department of Commerce, Industry and Environment, 2021, *Republic of Nauru National Solid Waste Management Strategy 2017-2026*, available from: https://nauru-data.sprep.org/resource/nswms-2017-2026
- National Advisory Board on Climate Change & Disaster Risk Reduction Government of Vanuatu, 2016, *Vanuatu's National Ocean Policy*, available from: https://www.nab.vu/vanuatu-ocean-policy
- National Environment Protection Council (NEPC) Palau, 2021, *National Solid Waste Management Strategy" The Roadmap towards a Clean and Safe Palau 2017 to 2026*, available from: https://palau-data.sprep.org/dataset/national-solid-waste-strategy-2017-2026
- National Statistic Office (2011). *Population, available from: https://www.nso.gov.pg/statistics/population/*
- Office of the Auditor General, Republic of Fiji, 2020, *Performance Audit on Management of Traffic Congestion*, available from: http://www.parliament.gov.fj/wp-content/uploads/2020/02/4-Office-of-the-Auditor-General-Report-on-Performance-Audit-on-Management-of-Traffic-Congestion.pdf
- Office of Planning and Statistics Bureau of Budget and Planning Republic of Palau, 2016, *2015 Census of Population Housing and Agriculture for the Republic of Palau Volume 1 Basic Tables*,

available from: https://www.palaugov.pw/wp-content/uploads/2017/02/2015-Census-of-Population-Housing-Agriculture-.pdf

- O'Reilly, M., 2013, *Luganville Waste Characterisation Report 2013*, available from: https://library.sprep.org/content/luganville-waste-charactersation-report
- SPC Statistics for Development Division, 2020. *Population estimates and projections.* Available from: Population estimates and projections | Statistics for Development Division (spc.int)
- Pacific Reef Savers Ltd (PacReef), 2014, *Summary Report to the PacWaste Technical Advisory Panel E-waste Country Assessments*, available from: https://www.sprep.org/attachments/Publications/WMPC/Summary_Rep_PacWaste_TAP_Ewaste_Country_Assess.pdf
- Pacific Regional Infrastructure Facility (PRIF), 2018, *Pacific Region Solid Waste Management and Recycling Pacific Country & Territory Profiles*, PRIF, Sydney, available from: https://www.theprif.org/sites/default/files/documents/prif_waste_book_web_0.pdf
- Pacific Regional Infrastructure Facility (PRIF), 2018, *Solomon Islands Profile in the Solid Waste and Recycling Sector*, available from: https://www.theprif.org/document/solomon-islands/solid-waste-management-and-recycling/solomon-islands-profile-solid-waste
- Pacific Regional Infrastructure Facility (PRIF), 2018, *Tonga Profile in the Solid Waste and Recycling Sector*, available from: https://www.theprif.org/document/tonga/solid-waste-management-and-recycling/tonga-profile-solid-waste-and-recycling-sector
- Pacific Regional Infrastructure Facility (PRIF), 2018, *Tuvalu Profile in the Solid Waste and Recycling Sector*, available from: https://www.theprif.org/document/tuvalu/solid-waste-management-and-recycling/tuvalu-profile-solid-waste-and-recycling
- Pacific Regional Infrastructure Facility (PRIF), 2018, *Vanuatu Profile in the Solid Waste and Recycling Sector*, available from: https://www.theprif.org/document/vanuatu/solid-waste-management-and-recycling/vanuatu-profile-solid-waste-and-recycling
- Pacific Regional Infrastructure Facility (PRIF), 2022, *Regional Recycling Centre Scoping Study Market Assessment Report (draft)*, PRIF
- PacWastePlus Programme, *Advance Recovery Fees and Deposits*, available from: https://pacwasteplus.org/regional-project/advance-recovery-fees-and-deposits/
- PacWastePlus Programme, 2021, *Gender & Social Inclusion (GESI) Guiding Document*, SPREP, available from: https://library.sprep.org/content/gender-social-inclusion-gesi-guiding-document
- POPS Project, 2011, *Vanuatu National Plan for Implementation (NIP) of the Stockholm Convention on Persistent Organic Pollutants*, Climate Change Directorate, available from: https://pacificdata.org/data/dataset/national-implementation-plan-nip-for-the-stockholm-convention-on-persistent-organic-pollutants-
- Public-Private Infrastructure Advisory Facility (PPIAF), 2008, *The informal recycling sector in developing countries*. Available from: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.552.5069&rep=rep1&type=pdf
- Raaynakers, S., 2022, *Pacific Islands Region Moana Taka Partnership Plus Guidance Manual for Partners 2022 (Draft)*, UNEP & SPREP
- Reloop Platform, 2020, *Global Deposit Book 2020*, available from: https://www.reloopplatform.org/wp-content/uploads/2020/12/2020-Global-Deposit-Book-WEB-version-1DEC2020.pdf
- Republic of Nauru, 2012, *National report on population and housing: census 2011*. Noumea, New Caledonia: Pacific Community, available from:

https://pacificdata.org/data/publications/oai-www-spc-int-43ebe7dc-90a0-422c-bf1f-fc5e4a52ed39/resource/73378eeb-9218-4ca5-aa40-e74a622cb8c1

- Rotterdam Convention, 2010, *Annex III Chemicals*, available from: http://www.pic.int/TheConvention/Chemicals/AnnexIIIChemicals/tabid/1132/language/en-US/Default.aspx
- Sagapolutele, F., Wander, A., Prince, A., 2019, *Tuvalu – Waste Audit Report*, Pacific Region Infrastructure Facility (PRIF), available from: https://www.theprif.org/document/tuvalu/solid-waste-management-and-recycling/waste-audit-tuvalu
- Samoa Bureau of Statistics, 2017, *2016 Census Brief No. 1 Revised version Populations Snapshot and Household Highlights*, available from: https://sdd.spc.int/digital_library/2016-census-brief-no-1-revised-version-population-snapshot-and-household-highlights
- Samoa Bureau of Statistics, 2017, *Statistical Abstract 2017*, available from: https://www.sbs.gov.ws/newsandevents/samoa-bureau-of-statistics-statistical-abstract-2017
- Smith, G., Juria, N., (2019), *Diagnosis of historical inundation events in the Marshall Islands to assist early warning systems*, Natural Hazards (2019) 99:189-216, available from: https://doi.org/10.1007/s11069-019-03735-9
- Solomon Islands National Statistics Office, the Secretariat of the Pacific Community, and Macro International Inc., 2009, *Solomon Islands Demographic and Health Survey 2006-2007*, available from: https://sdd.spc.int/digital_library/solomon-islands-demographic-and-health-survey-2006-2007
- Solomon Islands National Statistics Office, Solomon Islands Ministry of Health and Medical Services and the Pacific Community, 2017, *Solomon Islands Demographic and Health Survey 2015 Final Report*, available from: https://pacificdata.org/data/dataset/oai-www-spc-int-f5f42ae3-baef-4317-9f90-c6f7233ff7d2
- SPREP, 2018, *Yap State Solid Waste Management Strategy 2018-2027 (Action Plan: 2018-2022)*, available from: https://www.sprep.org/attachments/VirLib/FSM/yap-solid-waste-management-strategy-2018-2027.pdf
- SPREP, 2020a, *Fiji To Ban Polystyrene In 2021*, available from: https://www.sprep.org/news/fiji-to-ban-polystyrene-in-2021
- SPREP, 2020b, *PacWastePlus Project Snapshot Niue*, available from: https://www.sprep.org/pacwaste-plus
- SPREP, 2021a, *An Evaluation of the Waigani Convention*, available from: https://www.sprep.org/sites/default/files/30-SPREP-Meeting/Waigani%20Convention/WC_6.1_Att.1-Waigani_Convention_Review_Final_Report-July-2021.pdf
- SPREP, 2021b, *Clean Pacific Roundtable Enables Pacific Islands To Enhance Understanding Of Waste Management Sustainable Financing Systems*, SPREP, available from: https://www.sprep.org/news/clean-pacific-roundtable-enables-pacific-islands-to-enhance-understanding-of-waste-management-sustainable-financing-systems
- SPREP, 2021c, *Kiribati Continues To Show The Way In Waste Management With Kaoki Maange System*, available from: https://www.sprep.org/news/kiribati-continues-to-show-the-way-in-waste-management-with-kaoki-maange-system#:~:text=They%20have%20recently%20introduced%20a,display%20them%20for%20marketing%20purposes.
- SPREP, 2021d, *Project Snapshot Niue E-Waste & Recyclables Project*, available from: https://www.sprep.org/pacwaste-plus

- SPREP, 2021e, *SWAP – Together to Fight against Plastic Waste,* available from: https://pacwasteplus.org/news/swap-together-to-fight-against-plastic-waste/
- SPREP, 2021f, *Waste Audit Report Papua New Guinea*, available from: https://library.sprep.org/content/waste-audit-report-papua-new-guinea
- SPREP, 2016, *SPREP Gender Policy*, available from:

  https://www.sprep.org/attachments/Publications/Corporate_Documents/SPREP-GenderPolicy-14Nov16.pdf
- SPREP, Australian Maritime Safety Authority, International Maritime Organization (IMO), *A Regional Reception Facilities Plan for the Small Island Developing States in the Pacific Region*, available from: https://www.sprep.org/attachments/Publications/WMPC/reception_facilities_plan_final.pdf
- SPREP, EDO NSW, 2018, *Niue Review of Natural Resource and Environment Related Legislation*, available from: https://www.sprep.org/attachments/Publications/EMG/sprep-legislative-review-niue.pdf
- Stockholm Convention, 2019, *Hexabromobiphenyl,* available from: http://chm.pops.int/Implementation/Alternatives/AlternativestoPOPs/ChemicalslistedinAnnexA/HBB/tabid/5860/Default.aspx
- Srinivas, H., 2022, *Gender and E-Waste: Policy Considerations for Developing Countries*, available from: http://www.gdrc.org/gender/gender-ewaste/index.html
- Statistics and Immigration office Finance and Planning Government of Niue, 2018, *Niue Household and Population Census 2017*, available from: https://niue.prism.spc.int/census/population-housing/
- Tonga Statistics Department, 2019, *Tonga 2016 Census of Population and Housing Volume 2: Analytical Report*, available from: https://pacificdata.org/data/dataset/oai-www-spc-int-4218d7fc-7ff3-45bb-91c9-cff8428af869
- Tonkin & Taylor International Ltd, (T+T) 2021a. Waste Audit Report- Fiji. Available at: https://www.theprif.org/sites/default/files/documents/Waste%20Audit%20Fiji_web.pdf
- Tonkin & Taylor International Ltd, (T+T) 2021b. Waste Audit Report- Cook Islands. Available at: https://www.theprif.org/sites/default/files/documents/PRIF_WasteAudit-CookIslands_web.pdf
- Tonkin & Taylor International Ltd, (T+T) 2021c. Waste Audit Report- Cook Islands. Available at: https://library.sprep.org/sites/default/files/2022-02/rmi-waste-audit-report.pdf
- Tonkin & Taylor International (T+T), Asia Pacific Waste Consultants (APWC), 2020. Waste Audit Report- Vanuatu. Secretariat of the Pacific Regional Environment Programme. Available at: <https://library.sprep.org/sites/default/files/2021-11/waste-audit-Vanuatu.pdf>
- Tonkin & Taylor International Ltd, (T+T) 2020. Waste Audit Report- Nauru. Secretariat of the Pacific Regional Environment Programme. Available at: https://library.sprep.org/sites/default/files/2021-12/Nauru-Waste-Audit-Report-Final.pdf
- Towards Osaka Blue Ocean Vision, 2021, *Solomon Islands Actions and Progress on Marine Plastic Litter*, accessible from: https://g20mpl.org/partners/solomonislands
- UN Environment Programme (UNEP), 2019, *Gender and waste nexus: Experiences from Bhutan, Mongolia and Nepal,* available from: https://www.unep.org/resources/report/gender-and-waste-nexus-experiences-bhutan-mongolia-and-nepal?_ga=2.86681112.1607143869.1646791511-1712628237.1642987139
- UN Environment Programme (UNEP), 2014, *Basel Convention on the control of transboundary movements of hazardous wastes and their disposal, Protocol on liability and compensation for*

damage resulting from transboundary movements of hazardous wastes and their disposal texts and annexes, Secretariat of the Basel Convention

- UN Environment Programme (UNEP), 2014, Gender Equality and The Environment Policy And Strategy, available from:

  https://wedocs.unep.org/bitstream/handle/20.500.11822/7655/-Gender_equality_and_the_environment_Policy_and_strategy-2015Gender_equality_and_the_environment_policy_and_strategy.pdf.pdf?sequence=3&isAllowed=y
- UNFPA Papua New Guinea, *Gender equality and women's empowerment*, available from: https://png.unfpa.org/en/topics/gender-equality-12
- United Nations Conference on Trade and Development (UNCTAD, 2022), Liner Shipping Connectivity Index, quarterly, available from: https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=92
- University of Melbourne, 2020, *Assessment of Legislative Frameworks Governing Waste Management in Tuvalu*, SPREP, available from: https://library.sprep.org/content/assessment-legislative-frameworks-governing-waste-management-tuvalu
- University of Melbourne, 2020, *Assessment of Legislative Frameworks Governing Waste Management in the Cook Islands*, SPREP, available from: https://library.sprep.org/sites/default/files/2021-03/waste-legislation-Cook-Islands.pdf
- University of Melbourne, 2020, *Assessment of Legislative Frameworks Governing Waste Management in the FSM*, SPREP, available from: https://library.sprep.org/sites/default/files/2021-03/waste-legislation-FSM.pdf
- University of Melbourne, 2020, *Stocktake of Existing and Pipeline Waste Legislation: Kingdom of Tonga*, SPREP, available from: https://www.sprep.org/publications/stocktake-of-existing-and-pipeline-waste-legislation-kingdom-of-tonga
- University of Melbourne, 2020, *Stocktake of Existing and Pipeline Waste Legislation: Kiribati*, SPREP, available from https://www.sprep.org/publications/stocktake-of-existing-and-pipeline-waste-legislation-kiribati
- University of Melbourne, 2020, *Stocktake of Existing and Pipeline Waste Legislation: Papua New Guinea*, SPREP, available from: https://www.sprep.org/publications/stocktake-of-existing-and-pipeline-waste-legislation-papua-new-guinea
- University of Melbourne, 2020, *Stocktake of Existing and Pipeline Waste Legislation: Republic of Fiji*, SPREP, available from: https://www.sprep.org/sites/default/files/documents/publications/waste-legislation-fiji.pdf
- University of Melbourne, 2020, *Stocktake of Existing and Pipeline Waste Legislation: Republic of Palau*, SPREP, available from: https://www.sprep.org/publications/stocktake-of-existing-and-pipeline-waste-legislation-palau
- University of Melbourne, 2020, *Stocktake of Existing and Pipeline Waste Legislation: Solomon Islands*, SPREP, available from: https://www.sprep.org/publications/stocktake-of-existing-and-pipeline-waste-legislation-solomon-islands
- University of Melbourne, 2020, *Stocktake of Existing and Pipeline Waste Legislation: Samoa*, SPREP, available from: https://www.sprep.org/publications/stocktake-of-existing-and-pipeline-waste-legislation-samoa
- University of Melbourne, 2020, *Stocktake of Existing and Pipeline Waste Legislation: Vanuatu*, SPREP, available from: https://www.sprep.org/publications/stocktake-of-existing-and-pipeline-waste-legislation-vanuatu

- University of Melbourne, 2021, *PacWastePlus Waste Legislative Review: Regional Solutions Assessment*, SPREP, available from: https://library.sprep.org/sites/default/files/2021-03/waste-legislative-review-PWP.pdf
- University of the South Pacific, 2004, *Solid waste management and recycling in The Fiji Islands*, available from: https://library.sprep.org/sites/default/files/2_15.pdf
- Vanuatu National Statistics Office, 2010, *2009 National Population and Housing Census Basic Tables Report Volume 1*, available from: https://pacificdata.org/data/dataset/oai-www-spc-int-20341de1-b8c1-416c-9110-64294f5f7f05
- Vanuatu Recyclers & Waste Management Association, 2019*, Strategic Plan 2021-2024*, available from: https://vanuaturecyclingandwaste.org/about/
- Wander, A., Sagapolutele, F., Foxe, A., Prince, A., 2019, *Solomon Islands – Waste Data report*, Centre for Environment Fisheries & Aquaculture Science (CEFAS), available from: https://www.cefas.co.uk/clip/resources/reports/south-pacific-clip-reports/
- Wander, A., Sagapolutele, F., Prince, A., 2019, *Vanuatu – Waste Data report*, Centre for Environment Fisheries & Aquaculture Science (CEFAS), available from: https://www.cefas.co.uk/clip/resources/reports/south-pacific-clip-reports/
- Waste Recyclers (Fiji) PTE Ltd, *Waste Recyclers (Fiji) PTE Ltd Company Profile*
- Waste Recyclers (Fiji) PTE Ltd, 2022, *Total Containers Exported 2017 - Jan 2022*
- Weibold, 2021, *Fiji launches end-of-life tire stewardship initiative*, available from: https://weibold.com/fiji-launches-endoflife-tire-stewardship-initiative accessed 01/16/2022
- Western, M., 2011, *Import Health Standard for Importation of Inorganic Risk Materials (MAF-STD-IRM),* available from: https://www.mpi.govt.nz/dmsdocument/1876-Inorganic-Risk-Materials-Import-Health-Standard
- Wilson, D. C., Velis, C., Cheeseman, C., 2006, *Role of informal sector recycling in waste management in developing countries*. Habitat International vol. 30.
- World Bank, 2011, *Increasing the Participation of Women Entrepreneurs in the Solomon Islands Aid Economy*. Washington, DC, available from: https://openknowledge.worldbank.org/handle/10986/27893
- Woodruff, A., 2014, *Solid Waste Management in the Pacific: Cook Islands Country Snapshot*, ADB, available from: https://www.adb.org/sites/default/files/publication/42674/solid-waste-management-cook-islands.pdf
- Woodruff, A., 2014, *Solid Waste Management in the Pacific: The Federated States of Micronesia Country Snapshot*, ADB, available from: https://www.adb.org/publications/solid-waste-management-pacific-federated-states-micronesia-country-snapshot
- Woodruff, A., 2014, *Solid Waste Management in the Pacific: Tuvalu Country Snapshot*, ADB, available from: https://www.adb.org/publications/solid-waste-management-pacific-tuvalu-country-snapshot
- Woodruff, A., 2014, *Solid Waste Management in the Pacific: Tonga Country Snapshot*, ADB, available from: https://www.adb.org/publications/solid-waste-management-pacific-tonga-country-snapshot
- Woodruff, A., 2014, *Solid Waste Management in the Pacific: Solomon Islands Country Snapshot*, ADB, available from: https://www.adb.org/publications/solid-waste-management-pacific-solomon-islands-country-snapshot
- Woodruff, A., 2014, *Solid Waste Management in the Pacific: Samoa Country Snapshot*, ADB, available from: https://www.adb.org/publications/solid-waste-management-pacific-samoa-country-snapshot

- Woodruff, A., 2014, *Solid Waste Management in the Pacific: Palau Country Snapshot*, ADB, available from: https://www.adb.org/publications/solid-waste-management-pacific-palau-country-snapshot
- Woodruff, A., 2014, *Solid Waste Management in the Pacific: Nauru Country Snapshot*, ADB, available from: https://www.adb.org/publications/solid-waste-management-pacific-nauru-country-snapshot
- Woodruff, A., 2014, *Solid Waste Management in the Pacific: Kiribati Country Snapshot*, ADB, available from: https://www.adb.org/publications/solid-waste-management-pacific-kiribati-country-snapshot
- Woodruff, A., 2014, *Solid Waste Management in the Pacific: Fiji Country Snapshot*, ADB, available from: https://www.adb.org/publications/solid-waste-management-pacific-fiji-country-snapshot
- Woodruff, A., 2014, *Solid Waste Management in the Pacific: Papua New Guinea Country Snapshot*, ADB, available from: https://www.adb.org/publications/solid-waste-management-pacific-papua-new-guinea-country-snapshot
- Woodruff, A., 2014, *Solid Waste Management in the Pacific: The Marshall Islands Country Snapshot*, ADB, available from: https://www.adb.org/publications/solid-waste-management-pacific-marshall-islands-country-snapshot

Appendix A: Research Plan

Appendix B: Assumptions for deriving material availability

Decision flow charts summarizing the assumptions for legacy and ongoing bulky waste generation are shown

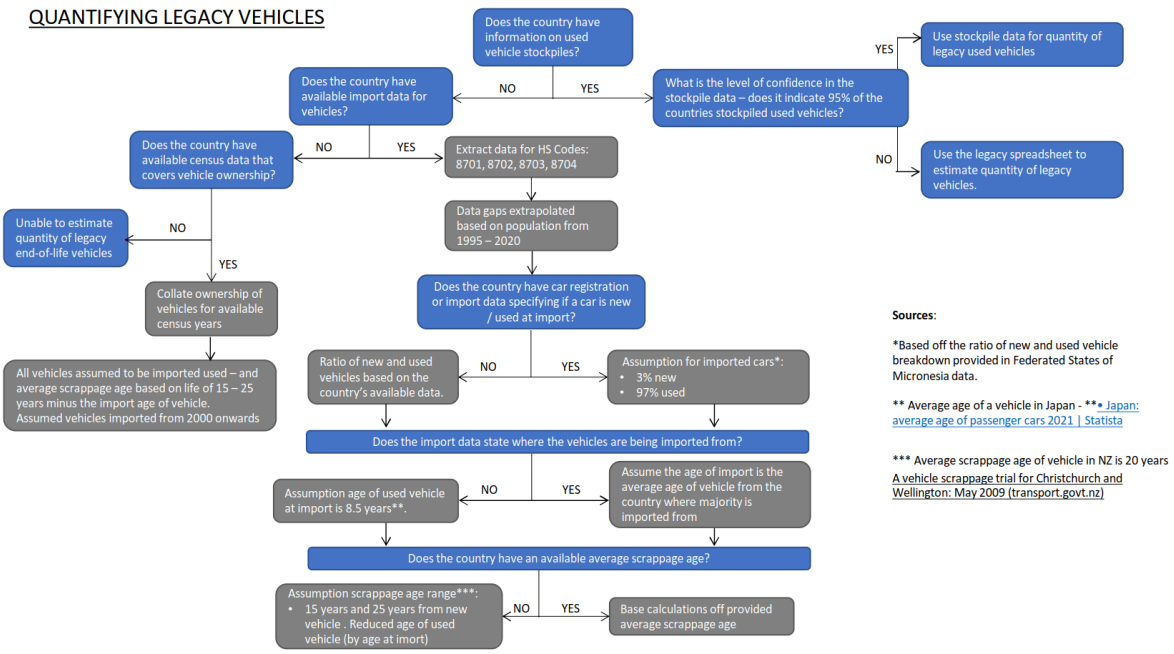


Figure Appendix B.1: Decision flow chart for quantifying legacy vehicles

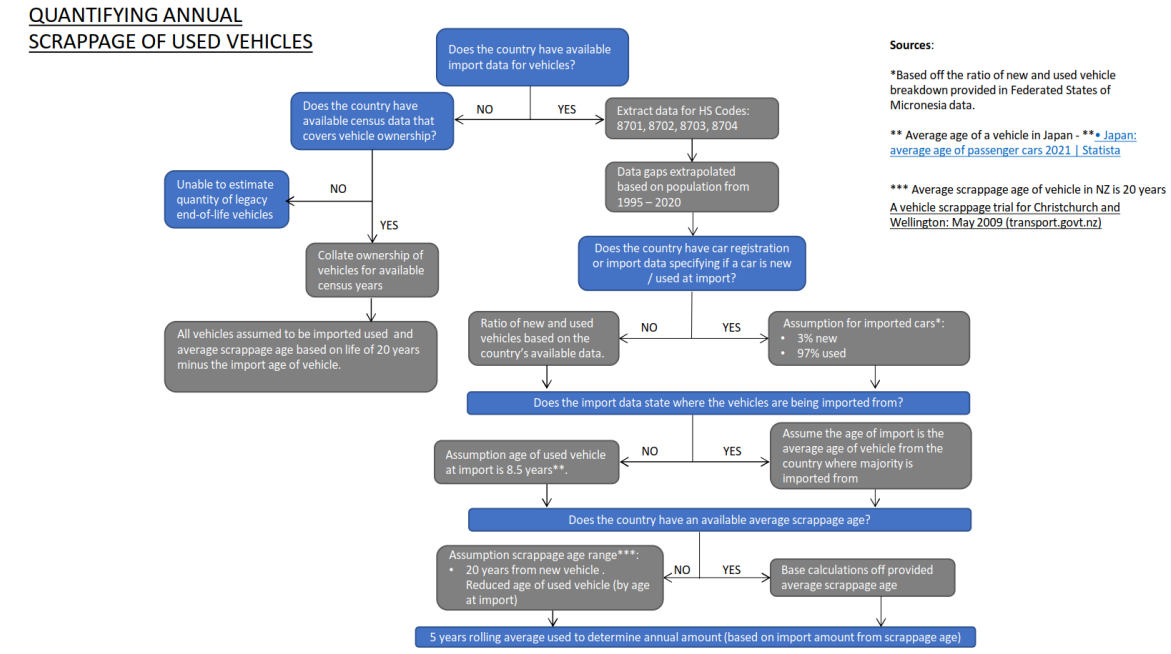


Figure Appendix B.2: Decision flow chart for quantifying annual scrappage of used vehicles

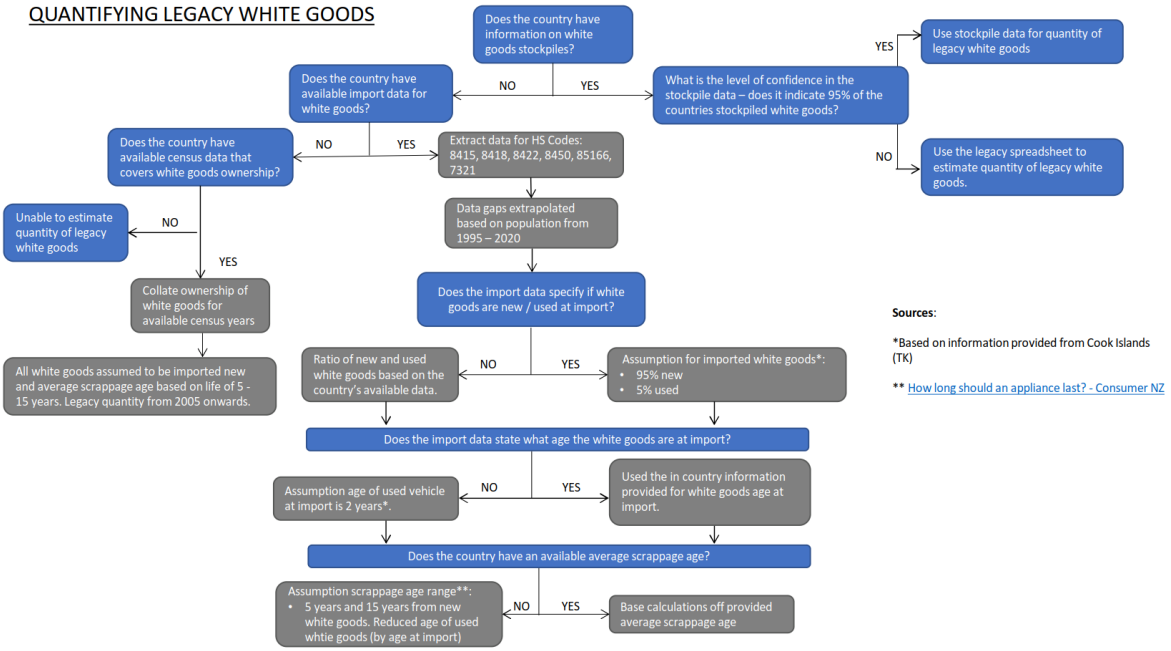


Figure Appendix B.3: Decision flow chart for quantifying legacy white goods

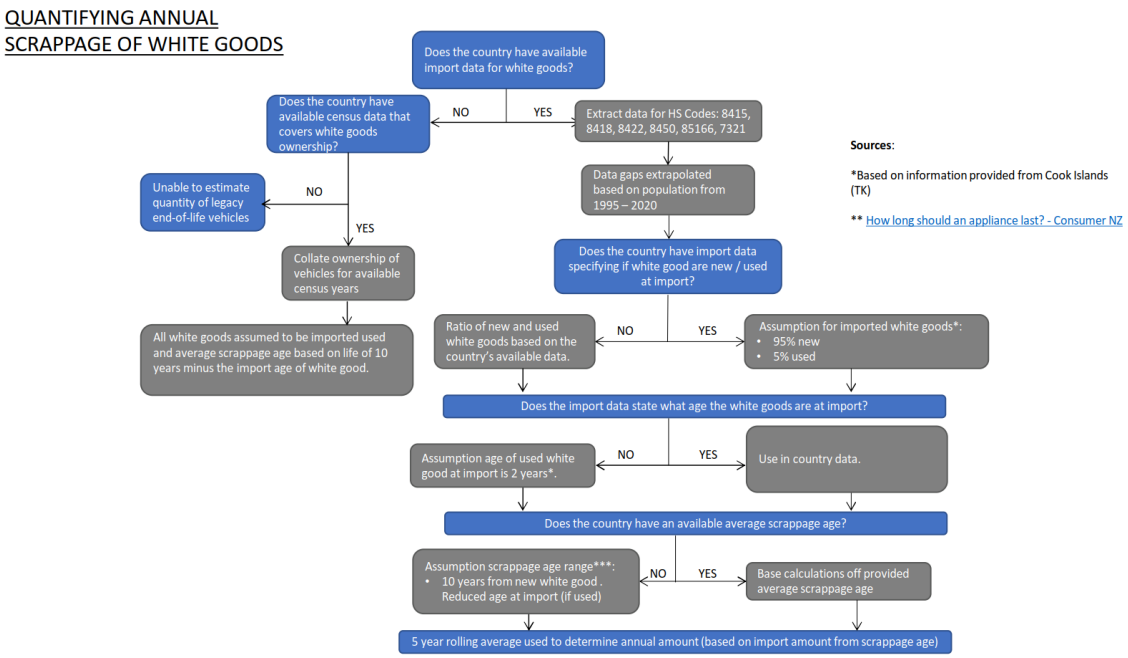


Figure Appendix B.4: Decision flow chart for quantifying scrappage of white goods

Key assumptions for estimation of material generation provided in the tables below.

Appendix B Table 1: Summary of HS codes used to estimate material quantities

HS Heading Code	Description
8701	Tractors (Other than tractors of heading 8709).
8702	Motor vehicles for the transport of ten or more persons, including the driver.
8703	Motor cars and other motor vehicles principally designed for the transport of persons (other than those of heading 8702), including station wagons and racing cars.
8704	Motor vehicles for the transport of goods.
8415	Air conditioning machines, comprising a motor driven fans and elements for changing the temperature and humidity, including, those machines in which the humidity cannot be separately regulated.
8418	Refrigerators, freezers and other refrigerating or freezing equipment, electric or other; Heat pumps other than air conditioning of machines of heading 8415.
8422	Dish washing machines; Machinery for cleaning or drying bottles or other containers; Machinery for filling, closing, sealing or labelling bottles, canes, boxes, bags or other containers; Machinery for capsuling bottles jars, tubes and similar containers.
8450	Household or laundry-type washing machines, including machines which both wash and dry Machines, each of a dry linen capacity not exceeding 10 kg.
8516	Electric instantaneous or storage water heaters and immersion heaters; Electric space heating apparatus and soil heating apparatus; Electro-thermic hair-dressing apparatus (for example hair dryers, hair curlers, curling tong heaters) and hand dryers (electric).

Appendix B Table 2: Country specific assumptions for assessment of export data

Country	Import	Export	Years of data	Data type
Fiji	Received	Received	2020, 2021	Units used as per HS code
Kiribati	Received	Received	2015-2021. Excluded 2020, 2021 data for white good as the data was incorrect	Units used as per HS code. HS code only provided to 4 digits
Nauru	Received	Received	2019 only	Units used as per HS code. HS code only provided to 4 digits
Cook Islands	Received	Received	2015-2021	CIF value in NZ $ provided. Assumptions applied on the value in NZ $ of item by HS code. HS codes provided to 4 digits
Federated States of Micronesia	Received	Received	2019, 2020, 2021	CIF value provided in US $. Quantity data advised as incorrect. Value of item by HS code applied to derive number of units (Samoan customs data used to derive item value). HS codes provided to 8 digits
Niue	Received	Received	2017, 2018, 2019, 2020	TEU units per year (20 foot containers). No breakdown by HS code, just descriptions, no data available for white goods. Volume of item by HS used to derive units.
Palau	Received	Received	2017, 2018, 2019, 2020	Principal imports in US $. Imports by HS code high level – i.e. down to - Motor cars and other motor vehicles principally designed for the transport of persons. No data by HS code. Units derived from item value for 8703.
PNG	Received	Received	2017, 2018, 2019, 2020, 2021	Statistical value provided in Papua New Guinea kina. HS codes provided to 8 digits. Quantity data provided, but advised not to use. Value of item by HS code applied to derive number of units (Samoan customs data used to derive item value)
Marshall Islands	Received some data for imported cars only	None	2006-2012	Units of number of vehicles imported only

Country	Import	Export	Years of data	Data type
Samoa	Received	Received	2020, 2021	CIF value provided in Samoan Tala. Average value per HS code used to determine item value for 8701-8704 only. Value of white goods used as per value of bulky items table below. HS codes provided to 8 digits
Solomon islands	None received from customs	None	Units per year – Yearly average from trademap.org	T+TI Solomon Islands ARFD Feasibility Study
Tonga	None	None		
Tuvalu	None from customs	None from customs	2010-2017 average number of units estimated	Tuvalu waste audit report
Vanuatu	Received	Received	2018, 2019, 2020, 2021	Units provided and used. Export use of codes: DE / 1 EX / 1 used. HS codes provided to 8 digits

Appendix B Table 3: Weight of bulky waste item assumptions applied where required (Niue only)

Description as no HS code	Assumed volume in m3	Assumption
Machinery	24	Based on information provided by CIGT, Rarotonga for the average volume
MACHINERY LARGE	24	
MACHINERY MEDIUM	24	
Vehicles	7.5	Volume assumed as per vehicles 0-15m3
Vehicles / Machinery	17.5	Middle volume assumed as per description
Vehicles 0-15m3	7.5	
Vehicles 15.01-20.0m3	17.5	
Vehicles over 20.01m3	20	Volume assumed as per description

Appendix B Table 4: Value of bulky waste item assumptions (Cook Islands)

HS code	Unit cost in NZ $	Unit cost US $ (0.68 exchange)	Assumption
8701	80,000		Tractor cost in NZ (assumed no mark up, so assuming approx. CIF)
8702	100,000		Small minibus/bus price in NZ
8703	14400	9,790	New vehicle price for Cook Islands, minus tax (est at 40% mark up on value of imported good) - New Vehicles - Cook Islands Motor Centre Ltd
8704	150,000		Small lorry/truck for transport of goods

HS code	Unit cost in NZ $	Unit cost US $ (0.68 exchange)	Assumption
White goods - Prices from NZ in NZ $			
8422	1,000	700	dishwasher domestic size
8450	1,500	1050	laundry washing machine
8418	850	595	fridge freezer
7321	1500		standalone oven - as per pictures from stockpiles – evidence in country of the types of goods.
8415	4000	2800	air conditioning machine

Appendix B Table 5: Value of bulky waste item assumptions (Samoa)

HS code	Unit cost in Samoan Tala	Unit cost US $ (0.38 exchange)	Assumption
8701	35500	13490	Tractor cost in NZ (assumed no mark up, so assuming approx. CIF)
8702	37200	14136	Small minibus/bus price in NZ
8703	5100	1938	New vehicle price for Cook Islands, minus tax (est at 40% mark up on value of imported good) - New Vehicles - Cook Islands Motor Centre Ltd
8704	57000	21660	Small lorry/truck for transport of goods
White goods			
8422		700	Units for data for Samoa uncertain therefore used costs of items in NZ $
8450		1050	Units for data for Samoa uncertain therefore used costs of items in NZ $
8418		595	Units for data for Samoa uncertain therefore used costs of items in NZ $
7321	100	38	Based on Samoa customs data
8415		2800	Units for data for Samoa uncertain therefore used costs of items in NZ $
85166	60	22.8	Based on Samoa customs data

Appendix C: Summary of bulky waste legislation

Country	Planning ARFD	ARFD Implemented	Key legislation relating to bulky waste	Key pipeline activities	Updates to pipeline activities
Cook Islands	Yes	No	• NSWMS 2017 - 2026 (Policy) • Litter Prohibition Act 1983 • Environmental Management and Climate Change Act 2020 • Environment Act 2003	• Introduction of sustainable waste financing mechanism • *Solid and Hazardous Waste Bill*: Dedicated legislative framework for solid and hazardous waste management in the Cook Islands. Implementing legislation for MEAs. (ready for submission 2021) • Introduction of ban on Single Use Plastics: Incorporated as part of Solid and Hazardous Waste Bill	• MoU signed between Cook Islands Ministry of Infrastructure, Cook Islands National Environment Service and SPREP to progress the implementation of the Sustainable Financing for Waste Management (ARFD) (July 2021)
Republic of Marshall Islands	Yes	No	• Littering Act 1982 • Styrofoam Cups and Plates, and Plastic Products Prohibition, and Container Deposit Act 2016 [7 MIRC Ch 5] • Solid Waste Regulations 1989	• Finalisation of National Waste Management Strategy • Container deposit scheme (on-going)	• No updates
Fiji	No	No	• Environmental Management Act 2005 • Environmental and Climate Adaptation Levy Act 2015 • Litter Act 2008 • Environmental Management (Container deposit) regulations 2011 • **Summary:** some gaps in terms of provisions directed to specific wastes such as plastics and bulky wastes[1]	• Single-use plastic bag ban (In place, but they are monitoring the effectiveness) • Increase of plastic ban levy (from $0.20 to $0.50) • Fiji recycling hub: Proposal for Fiji to be regional recycling hub with support from Moana Taka Partnership • Implementation of Waigani Convention	• Plastic bag levy for bags > 50 microns increased to $0.50 on 1st Jan 2020 (see source) • Ban on Polystyrene products came into effect 1 Jan 2021 • "An evaluation of the Waigani Convention" published by SPREP July 2021 stating status of Fiji implementing legislation was "unknown"

Country	Planning ARFD	ARFD Implemented	Key legislation relating to bulky waste	Key pipeline activities	Updates to pipeline activities
Kiribati	NA	Yes[2]	• Special Fund (Waste Materials Recovery) Act 2004 Kiribati Development Plan 2016-19 • Environment Act 1999, Environment (Amendment) Act 2007 – not consolidated so need to be read together. • Kiribati Development Plan 2016-2019	• Review of Environment Act • Revised National Waste Management strategy • Review of integrated Environmental Policy • National information sharing system (UNEP chemicals and waste management program) • Initiatives to reduce plastic waste (community based awareness- ongoing)	• Environment act amendment published 2021 • Draft National Solid Waste Management Strategy published (see source column)- references bulky waste/ scrap metals, various plastics, and white goods • "4R's Bazzar" to educate and encourage to repurpose waste materials (including plastics)
Nauru	No	No	• Customs Proclamation (Prohibition of Export of Scrap Metal) 2007 • Environmental Management and Climate Change Act 2020 • Environmental Management and Climate Change (Ban on Single Use Plastic Shopping Bags) Regulations • 2021National Solid Waste Management Strategy 2017-2026 • Ozone Layer Protection Act 2017 • Derelict Sites Management Act 2017 • Nauru Roads Act 2017	• Single use plastics strategy	• Environmental Management and Climate Change (Ban on Single Use Plastic Shopping Bags) Regulations 2021

Country	Planning ARFD	ARFD Implemented	Key legislation relating to bulky waste	Key pipeline activities	Updates to pipeline activities
Niue	No	No	• **Summary:** "It is apparent that there are major resourcing gaps in areas such as bulky waste collection and monitoring and compliance across many waste streams" [1] • Environment Act 2015 • Customs Import Prohibition (Plastic Shopping Bags) Order 2020.	• Development of Niue Waste Recycling Facility and potential supporting legislation. • Ratification of MEAs (including Basel)	• NWRF due for completion March 2022 and open mid-2022
Palau	NA	Yes[3]	• Specific provisions for plastics and bulky waste · Palau Beverage Container Recycling Regulations (2009) · Solid Waste Management Regulations 2013 (Chapter 2401-31) · Plastic Bag Use Reduction Act 2017 · 'Zero Disposable Plastic' Policy Executive Order No. 417 (2018)	• Review of national Solid Waste Management Strategy: The roadmap towards a clean and safe Palau 2017 to 2026 (to ban importation of single use plastics) • Expansion of CDS	• Importation and distribution of plastic bags began Nov 8 2019 • CDS was last updated in 2019
Papua New Guinea	No	No	• Environment (Ozone Depleting Substances) Regulation 2007 • Customs Act 1951 (as at 2005) • Environment (Control of) • Biodegradable Plastic Shopping Bags) Regulation 2011 (commenced 2011)	• Plastic bag import ban Adoption of specific waste management legislation	• Plastic bag import ban introduced on 1 November 2019, and total ban on use of plastic bags on 16 March 2020

Country		Planning ARFD	ARFD Implemented	Key legislation relating to bulky waste	Key pipeline activities	Updates to pipeline activities
Federated States of Micronesia	National	NA	NA	• Solid Waste Management Strategy 2010-2015 • Plastic products ban 2020	• National Waste Policy • Zero-waste policy in National Environment Act • Export of recyclable waste (under Moana Taka)	• No updates
	Kosrae	NA	Yes[5]	• Control of Plastic Wastes Act 2017 • Container Deposit Legislation (2006)	• None	• NA
	Pohnpei	NA	Yes[6]	• Pohnpei State Law S.L No 6L-66-06 Section 6,7,15,17 • Litter Abatement Regulations (Pohnpei EPA) Sections 2, 7, 9	• None	• NA
	Chuuk	No	No	• Clean Environment Act 2018, Section 6 • Plastic bag ban (2011)	• New State legislative initiatives (Littering Law and Solid Waste Regulations under the Clean Environment Act) • Container Deposit State • Chuuk Recycling Act of 2020 (plastics)	• No updates
	Yap	NA	Yes[7]	• Environment Protection Act, Title 14 • Yap EPA Plastic Bag Regulations	• Proposed expansion of Container Deposit State	• No updates
Samoa		Yes	No	• Waste Management Act 2010 (as at 2018) • Waste (Plastic Bag) Management Regulations 2018 • National Waste Management Strategy 2019-2023	• Container deposit scheme • Enforcement improvements (more on the spot fines)	• Mission Pacific Programme launched by Samoa Breweries offering $1.00 per kilo for clean bottles of brands sold by Samoa Breweries - but no official government-based scheme

Country	Planning ARFD	ARFD Implemented	Key legislation relating to bulky waste	Key pipeline activities	Updates to pipeline activities
			• Waste Deposit Regulations		
Solomon Islands	Yes	No	• **Summary:** "Stronger measures are required to control bulky waste entering the country is required to free up resources for implementation and dealing with legacy wastes"[1] • Environment Act 1998 • Honiara City Council (Litter) Ordinance 2009	• Development of a National Waste Strategy for the period 2021-2025 • Western province initiative to ban single use plastics	• Implementation Plan for 2021-2025 was published in July 2020 (see source) • Process to ban single use plastics has been initiated from November 2019
Tonga	No	No	• Environment Management Act Cap 47.01 (as at 2016) • Ozone Layer Protection Act Cap 47.10 (as at 2016) • Waste Management (plastic Levy) Regulations 2013 Cap 32.18.1	• Single use plastics - 'No Pelesitiki' (plastic) Campaign	• No Pelesitiki ongoing (spearheading clean-up campaigns)
Tuvalu	NA	Yes[4]	• Waste Management Act 2017 (Levy) • Environment Protection Act (2008 Revised Edition), Cap 30.25 • Ozone Layer Protection Act (2008 Revised Edition), Cap 30.30 • Waste Management (Levy Deposit) Regulation 2019	• Accession to Basel Convention	• Tuvalu had their accession to the Basel Convention on 21/08/2020
Vanuatu	Yes	No	• Waste Management Act 2014 • Ozone Layer Protection Act 2010 (as at 2010) • Ozone Layer Protection (Amendment) Act 2014 • National Waste Management and	• Second phase of plastics ban (dealing with implementation issues) • Container Deposit Scheme for recycling of beverage containers internally	• Plans to introduce disposable nappy ban were delayed due to covid • ARFD planning is on-going

Country	Planning ARFD	ARFD Implemented	Key legislation relating to bulky waste	Key pipeline activities	Updates to pipeline activities
			• Pollution Control Strategy and Implementation Plan 2016-2020 • Vanuatu National Oceans Policy 2016		

Notes

1 Assessment of Legislative Frameworks Governing Waste Management country report

2 The ARFD scheme in Kiribati includes aluminium cans, PET bottles, and used lead acid batteries

Appendix D: Country bulky waste profiles

Appendix E: Cost model assumptions and outputs

E1.1 Modelling assumptions overview

The cost modelling uses several components to build up an estimate of the net cost or revenue from the capture, processing, shipping and recycling of bulky waste items.

The model uses a number of parameters to develop an estimate of net cost. The parameters and data sources used to develop estimates are noted in **Appendix E Table 1**.

Appendix E Table 1: Model assumptions summary

Model input	Data source(s)
Quantity of legacy items	Developed for this study drawing on waste audit reports and additional research - addressed in Section 3.2.5 and Appendix D.
Quantity of target items	Developed for this study drawing on waste audit reports and additional research - addressed in Section 3.2.5 and Appendix D..
Typical weights for target items	Standard weights adopted, refer Appendix E
In-country shipping costs	Not relevant for all study countries Developed based on research completed for this study and advice from Country focal points. Refer Appendix E
Processing cost for each item	Estimate developed based on key tasks to process/dismantle item, refer Appendix E
Shipping cost (to market)	Broad estimates developed based on typical shipping rates provided by Swire Shipping, refer Appendix E
Material value	Estimates of value per item based on full item, partially stripped (component values) and fully stripped scenarios. Low end estimates based on 'retail' value for target components and materials, refer Appendix E

E1.2 In-country shipping cost

A mixture of container shipping and charter (barge or similar) costs have been used to derive indicative per tonne cost. The in-country shipping costs have been used as a guide where there is container based in-country shipping options. Where in-country shipping is bulky, or barge based we have adopted approximate costs based on vessel hire and operating costs for 2–3-year return visit schedule (for an ongoing programme).

Container loading assumes 20 tonnes per 20 tonne containers with bale density assumed to be in the order of 0.8 - 1 T per m^3. A standard 20-foot container has an internal volume of around 33 m^3, meaning the loaded density at 20 tonnes payload is around 600 kg/m^3.

Where specific shipping costs have been identified we have used these to set country shipping costs at $50 or $100 per tonne. In general, $50 per tonne applies where distances are small (such as within Samoa or Fiji) or there are regular shipping movements. The Cook Islands have significant shipping distance to their Northern Group and very low volumes mean the per unit shipping cost has been estimated as very high.

E1.3 Processing cost for each item

Appendix E Table 2: Processing Costs - light vehicle

Activity			Cost	Unit	Comment
Full item export	De-pollution	Est	$20	ea	1.4T per car, 4 T per commercial
	Crushing	Est	$20	ea	$20 per T (equipment, staff)
	TOTAL		$29	T	
			$40	ea	
Partial Strip	De-pollution	Est	$20	T	1.4T per car, 4 T per commercial
	Remove radiator		$5	ea	
	Remove tyres		$5	ea	
	Crushing	Est	$20	T	$20 per T (equipment, staff)
	TOTAL		$47	T	
			$66	ea	
Full strip	De-pollution	Est	$20	T	1.4T per car, 4 T per commercial
	Remove radiator		$5	ea	1-1.5 hr
	Remove tyres		$5	ea	1-1.5 hr
	Remove engine		$25	ea	4-6 hr
	Remove wiring		$10	ea	2-3 hr
	Strip car		$15	ea	2-3 hr
	Crushing	Est	$20	T	$20 per T (equipment, staff)
	TOTAL		$83	T	
			$116	ea	

Appendix E Table 3: Processing Costs - heavy vehicle

Activity			Cost	Unit	Comment
Full item export	De-pollution	Est	$40	ea	additional hydraulics with commercial
	Crushing	Est	$30	ea	Cutting may be required
	TOTAL		$18	T	
			$70	ea	
Partial Strip	De-pollution	Est	$40	ea	additional hydraulics with commercial
	Remove radiator		$5	ea	
	Remove tyres		$15	ea	assume 6 x wheels
	Crushing	Est	$30	ea	Cutting may be required
	TOTAL		$23	T	
			$90	ea	
Full strip	De-pollution	Est	$40	ea	additional hydraulics with commercial
	Remove radiator		$5	ea	1-1.5 hr
	Remove tyres		$15	ea	1-1.5 hr, assume 6 wheels
	Remove engine		$30	ea	4-6 hr
	Remove wiring		$15	ea	2-3 hr, assume additional wiring

Activity			Cost	Unit	Comment
	Strip		$10	ea	2-3 hr, predominantly cab
	Crushing	Est	$30	ea	Cutting may be required
	TOTAL		$106	T	
			$425	ea	

Appendix E Table 4: Processing Costs - white goods

Activity			Cost	Unit	Comment
Full item export	De-pollution	Est	$20	ea	
	Crushing	Est	$5	ea	Multiple items to single bale
	TOTAL		$167	T	
			$25	ea	
Partial Strip	De-pollution	Est	$20	ea	
	Remove motor		$5	ea	
	Crushing	Est	$5	ea	Multiple items to single bale
	TOTAL		$200	T	
			$30	ea	
Full strip	De-pollution	Est	$20	ea	
	Remove motor		$5	ea	1-1.5 hr
	Strip		$10	ea	2-3 hr
	Crushing	Est	$5	ea	Multiple items to single bale
	TOTAL		$292	T	
			$44	ea	

E1.4 Shipping cost (to market)

Container shipping has been assumed for all materials exported to market with market pricing (confidential) provided by Swire Shipping for selected routes used to derive indicative per tonne costs.

As for in-country shipping, container loading assumes 20 tonnes per 20 tonne containers with bale density assumed to be in the order of 0.8 - 1 T per m3. A standard 20-foot container has an internal volume of around 33 m3, meaning the loaded density at 20 tonnes payload is around 600 kg/m3.

Where specific shipping costs have been identified we have used these to set indicative shipping costs on a per tonne basis. In general shipping costs per tonne were estimated at in the range $150 - $180 with a mix of shipping to Asia and Australia/New Zealand. The two exceptions to this range (for modelling purposes) were the Cook Islands (higher costs, in the order of $300 per Tonne to New Zealand) and Papua New Guinea (shipping costs in the order of $75 per Tonne to Asia).

The shipping rates are all based on ‘guideline’ rates, effectively the starting point for negotiation. These would apply for time critical or similar scenarios. This means there is potential to negotiate lower shipping costs subject to available capacity and timing flexibility. Shipping companies will have some ability to adjust rates, but the figures also incorporate handling and port costs that are non-negotiable.

E1.5 Material value

Materials value is difficult to define with materials traded as commodities internationally. The approach adopted has been to develop a per item (light vehicle, heavy vehicle, white good) value based on the value of the components. We have used published 'buy' prices as a conservative estimate of value of different components or materials. These prices are what a scrap metal dealer will pay i.e. are lower than that dealer will get for trading the items in volume on local or international markets. This approach provides a conservative view on the value of the target item or components, reflective of the small scale of recycling activities in the Pacific on a global scale.

Appendix E Table 5: Indicative material values

Item	Currency	Unit	Unit Value	Comment
Complete Car	USD	ea	$70	$50 - $200/ea, PRIF Study using USD167
White goods (150 kg ea)	USD	ea	$0	$15 - $30 de-gassing, motor and steel wiring approx. $10 - $20 value, residual materials.
Battery	USD	ea	$5	5-10 each, 10-20 for truck batteries, 0.8/kg, PRIF Study using USD800/T
Aluminium radiator	USD	kg	$0.5	No plastic 1.0/g
Copper radiator	USD	kg	$2	Clean 4/kg
Alloy rims	USD	ea	$5	With tyres, 10-15 without tyre
Copper wire	USD	kg	$1	30-35% up to 4/kg for over 70%
Electric motor (fridge)	USD	kg	$0.4	
Steel shredder feed	USD	MT	$0	
Steel, light gauge	USD	MT	$90	range $50 - $200 for mixed scrap
Steel	USD	MT	$150	In gauge i.e. no cutting required
POPs containing materials	USD	MT	$200	Range $$150 - $250 per tonne

Appendix E Table 6: Light vehicle value (all USD)

	Qty	Unit	Unit value	Full car	Partial strip	Full strip	Comment
Total weight	1.4	MT	$50	$70	$56		
Engine	160	kg	$0			$24	
Battery	1	No.	$5		$5	$5	
Radiator	6	kg	$1		$3	$3	
Rims	40	kg	$1		$20	$20	without tyre, 10 kg each
Wiring	50	kg	$1			$50	incl insulation
Residual - seats, panels, tyres	381	kg				$-	Tyres @ 14kg ea, 25kg per seat *5, lining @ 200 kg
Body panels + chassis	0.745	MT	$90			$67	
Total (USD) per Tonne				$50	$60	$121	
Recommend adopting				$50	$60	$120	

Appendix E Table 7: Heavy vehicle value (all USD)

	Qty	Unit	Unit value	Full car	Partial strip	Full strip	Comment
Total weight	4	MT	$50	$200	$163		
Engine	300	kg	$0			$45	
Battery	2	No.	$5		$10	$10	
Radiator	15	kg	$1		$8	$8	
Rims	240	kg	$0		$36	$36	without tyre, 40 kg each, assume 6, heavy steel
Wiring	150	kg	$1			$150	incl insulation
Residual - seats, panels, tyres	775	kg	$-		$-	$-	Tyres @ 50kg ea, 25kg per seat *3, lining @ 400 kg
Body panels + chassis	2.484	MT	$90			$224	
Total (USD) per Tonne				$50	$54	$118	
Recommend adopting				$50	$50	$120	

Appendix E Table 8: White goods value (all USD)

	Qty	Unit	Unit value	Full item	Partial strip	Full strip	Comment
Total weight	150	kg	$-	$-	$-		Average weight
Electric motor	10	kg	$0.40		$4.00	$4.00	
Wiring	1	kg	$1.00		$1.50	$1.00	
Steel	70	Kg	$0.09			$6.30	
Insulation, plastic	70	kg	$-			$-	Residual, no value.
Total (USD) per Tonne	69	kg		$-	$36.67	$75.33	
Recommend adopting				$-	$40.00	$70.00	



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