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PacWastePlus
PACIFIC WASTE MANAGEMENT

This initiative is supported by **PacWastePlus**-a 72 month project funded by the European Union (**EU**) and implemented by the Secretariat of the Pacific Regional Environment Programme (**SPREP**) **to sustainably and cost effectively improve regional management of waste and pollution.**

Recycling Market
RESEARCH REPORT

November 2021

The intention of this report is to assist the PacWastePlus programme in providing recommendations to Pacific Island Countries (PICs) and Timor-Leste policymakers to improve waste export activities and enable access to international markets.

SPREP Library Cataloguing-in-Publication

Recycling market research report. Apia, Samoa:
SPREP, 2022.
63 p. 29 cm.

ISBN: 978-982-04-1032-9 (print)
978-982-04-1033-6 (ecopy)

1. Recycling (Waste, etc.) – Technical reports.
2. Waste management – Refuse and refuse disposal.
I. Pacific Regional Environment Programme
(SPREP). II. Title.

363.728 2

Acknowledgment: We acknowledge the services of MRA Consulting Group (MRA) for the compilation of this report. This report has been prepared by MRA Consulting Group for Secretariat of the Pacific Islands Regional Environmental Program. MRA (ABN 13 143 273 812) does not accept responsibility for any use of, or reliance on, the contents of this document by any third party.

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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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Glossary

Terminology	Definition
CDS	Container deposit scheme
ELT	End-of-life tyres
ELV	End-of-life vehicles
FSM	Federated States of Micronesia
HDPE	High-density polyethylene
IBC	Intermediate bulk container
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 II
LDPE	Low-density polyethylene
LIB	Lithium-ion batteries
MEA	Multilateral Environmental Agreement
MTP	Moana-Taka Partnership
NZ	New Zealand
PET	Polyethylene terephthalate
PICs	Pacific Island countries
PNG	Papua New Guinea
POP	Persistent organic pollutant
PRIF	Pacific Regional Infrastructure Facility
PS	Polystyrene
PVC	Polyvinyl chloride
RMI	Republic of the Marshall Islands
TDF	Tyre derived fuels
ULAB	Used lead-acid batteries

PacWastePlus Programme

The Pacific – European Union (EU) Waste Management Programme, PacWastePlus, is a 72-month programme funded by the EU and implemented by the Secretariat of the Pacific Regional Environment Programme (SPREP) to improve regional management of waste and pollution sustainably and cost-effectively.

About PacWastePlus

The impact of waste and pollution is taking its toll on the health of communities, degrading natural ecosystems, threatening food security, impeding resilience to climate change, and adversely impacting social and economic development of countries in the region. The PacWastePlus programme will generate improved economic, social, health, and environmental benefits by enhancing existing activities and building capacity and sustainability into waste management practices for all participating countries.

Countries participating in the PacWastePlus programme are: *Cook Islands, Democratic Republic of Timor-Leste, Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Palau, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu*.

KEY OBJECTIVES

Outcomes & Key Result Areas

The overall objective of PacWastePlus is "to generate improved economic, social, health and environmental benefits arising from stronger regional economic integration and the sustainable management of natural resources and the environment".

The specific objective is "to ensure the safe and sustainable management of waste with due regard for the conservation of biodiversity, health and wellbeing of Pacific Island communities and climate change mitigation and adaptation requirements".

Key Result Areas

- **Improved data collection, information sharing, and education awareness**
- **Policy & Regulation** - Policies and regulatory frameworks developed and implemented.
- **Best Practices** - Enhanced private sector engagement and infrastructure development implemented
- **Human Capacity** - Enhanced human capacity

Learn more about the PacWastePlus programme by visiting

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PACIFIC WASTE MANAGEMENT

https://pacwasteplus.org/

Executive Summary

Small island nations face a host of logistic and financial barriers in attempts to increase local recycling rates. The exportation of recycled material presents a range of benefits for nations with the inability to dispose or reuse waste in an environmentally beneficial manner. This could be due to a shortage of landfill capacity on-island, the risk of hazardous chemical pollution or the lack of primary industries in the Pacific region. For some waste streams, there is a potential for commodification if export is achieved efficiently.

To understand the potential opportunities and barriers for Pacific Island Countries (PICs) and Timor-Leste to export waste and recycling to international markets the following was undertaken:

- Legislative review to understand regulatory barriers to accessing recycling markets and to determine the most viable export destinations.
- High level cost model to calculate the viable tonnage for commodification based on the identified market destinations.
- Recommendations for PICs made based on the cost-model results combined with a high-level infrastructure gap analysis of existing PIC resources.

The review covers six major waste streams identified as having potential for export commodification or are seen as having essential transport requirements due to the lack of disposal capacity on island nations.

Table E1 Waste types included in the recycling market research study

Waste Category	Sub-categories
Asbestos	• Friable • Non-friable
Hazardous Wastes	• Used oil • Used batteries (such as lead-acid and lithium ion)
Tyres	• Whole end of life tyres (ELT) • Tyre derived fuel (TDF)
E-waste	• Whole products • Dismantled materials • End-of-life solar panels
Plastics	• Single stream plastics, identified by resin identification codes 1 to 7 • Mixed or unsorted plastics
Metals	• Aluminium cans • Scrap ferrous metal • White goods • End of life vehicles (ELV)

Legislative Review

Table E2 summarises how specific Multilateral Environmental Agreement (MEAs) and the Moana-Taka Partnership (MTP) relate to the waste streams investigated in the current project.

Table E2 Relevant MEAs and MTP eligibility for waste streams

Waste Type	Relevant MEA	Eligibility under MTP
Asbestos	• Basel Convention (Annex I) • Rotterdam Convention (Annex III) • Waigani Convention (Annex I)	Yes
Hazardous Wastes	• Stockholm and Rotterdam Conventions: various pesticides, industrial chemicals and leaded fuels • Basel and Waigani Conventions: a wide range of hazardous wastes including clinical wastes, used oils and mercury or lead containing materials • Montreal Protocol: materials containing ozone depleting substances	Yes
Tyres	• Potential future consideration under the Basel Convention	Yes*
E-Waste	• Basel Convention (Annex VIII) • Waigani Convention	Yes
Plastics	• Basel Convention	Yes
Metals	• Basel Convention: batteries, used oil, electronic equipment, and hazardous components in appliances and ELV • Montreal Protocol: ozone depleting refrigerants	Yes – low value scrap No – high value single stream materials

**not currently listed, but could seek permission if the transport meets MTP non-commercial transaction test*

Potential Market Destinations

For each waste stream, different export options have been suggested based on the relative degree of regulatory requirements and an initial assessments of waste management infrastructure. These are presented as Easy, Moderate or Difficult export destinations. These rankings are not prohibitive; in most cases exemptions or permits can be obtained that would allow for waste importation.

Although, this additional administrative requirement will result in a higher cost burden to access these 'difficult' markets.

Table E3 Summary of asbestos export destinations

Waste Material	Easy	Moderate	Difficult
Asbestos	Nil due to strict MEA requirements	Australia: metropolitan city inert landfill facilities New Zealand: metropolitan city inert landfill facilities	Countries further removed from the PIC region although still capable of receiving asbestos (such as Indonesia and Malaysia).
Used Batteries	Nil due to strict MEA requirements	Korea, Philippines, Hong Kong	Japan, Australia, New Zealand
Waste oil	Nil due to strict MEA requirements	Fiji, Indonesia, Nauru, Philippines	New Zealand
Tyres	Malaysia Japan	Australia, New Zealand, Philippines, Hong Kong, Indonesia	Korea
E-waste	Korea Malaysia	Japan, Hong Kong, Philippines, Indonesia	Australia New Zealand
Solar Panels	Malaysia	No market identified	No market identified
Mixed/ unsorted plastics	Nil due to strict MEA requirements	Philippines Malaysia	Indonesia Australia
Single stream plastics (low contamination)	Philippines Malaysia	Indonesia Australia	New Zealand Korea
Non-Ferrous Metal	Australia, New Zealand, Korea, Philippines, Hong Kong, Malaysia	Indonesia Japan	None identified
Ferrous metals (incl. de-polluted white goods and ELVs)	Australia Hong Kong Korea	New Zealand, Philippines, Malaysia, Indonesia, Japan	None identified

Market Assessment

Different export destinations or target processors will have different requirements for waste transportation. The major requirements include:

- the quality standard of the material imported for recycling;
- risk mitigation measurements;
- shipping logistics; and
- the expected cost of export.

The combination of the various requirements in each of the export destinations identified above, form the basis for the recommendations for viable recycling markets for PIC waste.

Summary of Findings

The following waste materials have been identified as being potentially financially feasible for export:

- Used batteries
- Waste oil
- Shredded ELTs
- Whole e-waste
- Baled PET
- Baled HDPE
- Baled mixed plastics
- Baled aluminium cans
- Baled ferrous scrap

The remaining waste types would incur a negative cost to PIC governments (at the time of this study) due to a range of market barriers, including:

- Low sale value at the export destination does not cover necessary shipping expenses even with the assistance of the MTP (as seen in baled ELTs);
- High processing costs exceed the material resale value (such as dismantled e-waste and ELVs); and
- Materials which incur a disposal cost at the export destination (such as asbestos).

However, this does not exclude them from being exported for recycling/ disposal for environmental and socially responsible reasons, or if these costs are covered through development donor support.

Infrastructure Gaps

PICs currently collect and export a range of commodifiable waste streams through a mixture of private and public operations. The opportunities for additional infrastructure to achieve best practice standards and increase the viability of material exports, are outlined in Table E4. Each PIC is recommended to consider expected material generation rates and how additional infrastructure, or technology will be implemented to inform decisions around their application.

Governments are also advised to make additional consideration around financial mechanisms, such as import levies or Advance Recovery / Extended Importer Responsibility schemes, or international aid, to cover the cost of material exports or fund infrastructure improvements.

Table E4 Proposed technologies to address infrastructure gaps in each waste stream

Material	Infrastructure or technology recommendation
Asbestos	On-island disposal would require hazardous waste landfills aligned with US EPA standards and strict environmental controls. PICs typically lack the space and resources necessary to operate such facilities, as such, exportation and regulated disposal is the recommended treatment option. To facilitate export, access to polyethylene bags and PPE for the preparation of asbestos prior to export is required. Alternative construction materials, such as amorphous silica fabrics and cellulose fibres, should be investigated for their applicability in the region to decrease reliance on asbestos containing materials. PacWastePlus is developing guidance materials to support implementing importation bans on asbestos and asbestos containing materials to assist with eliminating the ongoing need to manage this material type.

Material	Infrastructure or technology recommendation
Hazardous wastes (e.g. ULABs and used oil)	Many PICs currently export used oil and ULABs to foreign markets. This is achieved through a mixture of public and private operations. It is recommended that best practice management of hazardous waste stockpile facilities are implemented to prevent harm to public health and the environment. This includes, at a minimum: • Impermeable floors and stormwater runoff management to prevent seepage of toxic and corrosive chemicals; • Access to spill kits and PPE including training to respond to spills and remediation of contaminated materials; and • Sufficient personnel training and resources to sort, repair or separately contain damaged batteries. Access to pallets, corrugated cardboard, stretch wrap and material labelling is required to prepare hazardous materials for export. On-island management approaches present alternatives to waste oil exports. Sustainable financing or polluter-pays principles can be implemented to fund collection and storage systems. Oils can be burned in industrial kilns, boilers, or burners for the generation of heat. Larger generators or consolidation islands can also consider implementing mobile waste oil processing units, waste-oil generators or bioremediation techniques for the higher value recovery of remediated oil, electricity or fertilisers.
Tyres	Some evidence of tyre shredding currently occurring in PICs. If tyres are to be exported on a larger scale, it is recommended to introduce baling or shredding technology to increase transport efficiencies and decrease disposal costs. At a minimum, these should be implemented at proposed "hub" nations for pre-processing prior to export. Baling and shredded tyres also decreases the risk of disease vectors at stockpile sites. There exist opportunities to utilise baled or shredded tyres on-island as TDF or in engineering applications. Baled tyres can be used in civil engineering applications such as embankment or road foundations. Shredded tyres have additional potential as feedstocks in cement clinker production or as drainage layers at landfill sites. Please see the PacWastePlus website to access reports and research related to the alternative use of ELTs (www.pacwasteplus.org).
E-waste	Private recyclers in the Pacific region currently export whole and dismantled e-waste. It is recommended that facilities and operations are monitored to ensure environmental compliance to reduce the pollution of mercury or ozone depleting substances. Further processing technology is not recommended for small island nations due to significant capital expenditure and potential environmental impacts. Manual separation, sorting and de-pollution activities provide potential employment opportunities, although require strict monitoring of health and safety procedures to avoid associated risks. Items suitable for reuse can also be identified and removed from the waste stream.
Plastics and metals	It is recommended that single stream/ low contamination plastics and metals are baled prior to export to increase transport efficiencies and acceptance at recycling end markets. All PICs either currently possess balers (whether owned by government facilities or private recyclers) or are in the process of developing recycling facilities with baling technology. It is recognised that baling infrastructure is not likely present on outer islands. At a minimum, balers should be available at proposed "hub" nations to prepare materials prior to export. This will increase the expected revenue from these materials and increase their market acceptance. There exists potential for larger nations to implement on-island processing technology capable of shredding plastic for efficient transport or pelletising plastics for use as feedstock in primary industry. These applications are most suitable for countries current manufacturing PET bottles to decrease reliance on virgin materials. Other technologies targeting mixed/unsorted plastics can significantly increase island recycling rates, such as the production of building material aggregate.

Material	Infrastructure or technology recommendation
ELV	To achieve best practice de-pollution standards, stockpile and processing facilities should at a minimum have impermeable floors to prevent pollution from oil runoff. It is recommended to implement industry standard vehicle lifts to increase the safety and efficiency of de-pollution activities conducted by trained personnel. The application of metal cutting tools can be considered for the recovery of ferrous scrap. Additional disposal arrangements should be in place to deal with residual streams from ELV de-pollution such as used oils, foam seats (particularly those containing POPs), mixed plastics or window glass. Whole ELV transport efficiencies can be increased through use of mobile vehicle crushers or heavy-duty balers. More efficient transportation of ELVs will significantly increase its export viability and profitability.

Recommendations

To develop PIC access to international recyclate markets and material exports the following recommendations have been made:

- Review the collection network of preferred materials to understand the limitations of capturing waste materials for local processing and export. Additional collection and sorting networks would need to be in place to capture the maximum potential quantities. This will include:
    - Resources for domestic transport for the consolidation of materials from outer islands to a port facility capable of international transport;
    - Land-based collection and transportation of materials; and
    - Backloaded vessel travelling from outer islands.
- Review the minimum best practice material quality requirements for material storage, processing, and transport for each PIC. These should be compared with current island resources in both private and public operations.
- Identify financial incentives/ programs to make it financially feasible to export difficult to manage waste streams. Such systems could include advanced recovery fees, reverse logistics options, aid funding or sustainable financing mechanisms.
- The consolidation of materials within the Pacific region prior to export is a possibility for PICs which have high international freight rates or are not currently serviced by the MTP (or similar arrangements with other shipping companies such as Kyowa).
- Conduct further research into potential on-site reuse and recycling of certain waste streams (such as used oil, ELTs, e-waste and ELVs) in PIC region to encourage circular economy opportunities.

Recycling Options Feasibility

A Pacific regional consolidated recycling network is proposed based on the findings and recommendations from this report. This work is the basis of detailed investigations by partner donor projects led by J-PRISM II and PRIF). This network will rely on coorporation between nations to form a hub-and-spoke coordinated system, whereby material is shipped within the region from a "spoke" nation, to be consolidated at a larger "hub" nation prior to export to an international market.

This model has been designed using considerations of access to the MTP, current recycled material generation rates and average shipping rates to international markets. Some nations are classified as "variable", signifying their capacity for either "hub" or "spoke" operations dependent on the waste stream.

Figure E1 represents a proposed model for this coordinated network, showing recommended and alternative shipping routes for the consolidation of waste material prior to export. Existing shipping lanes and backfilled containers could be utilised to transport waste from hub locations to international markets. This approach will be further developed by future work conducted in the Pacific region.

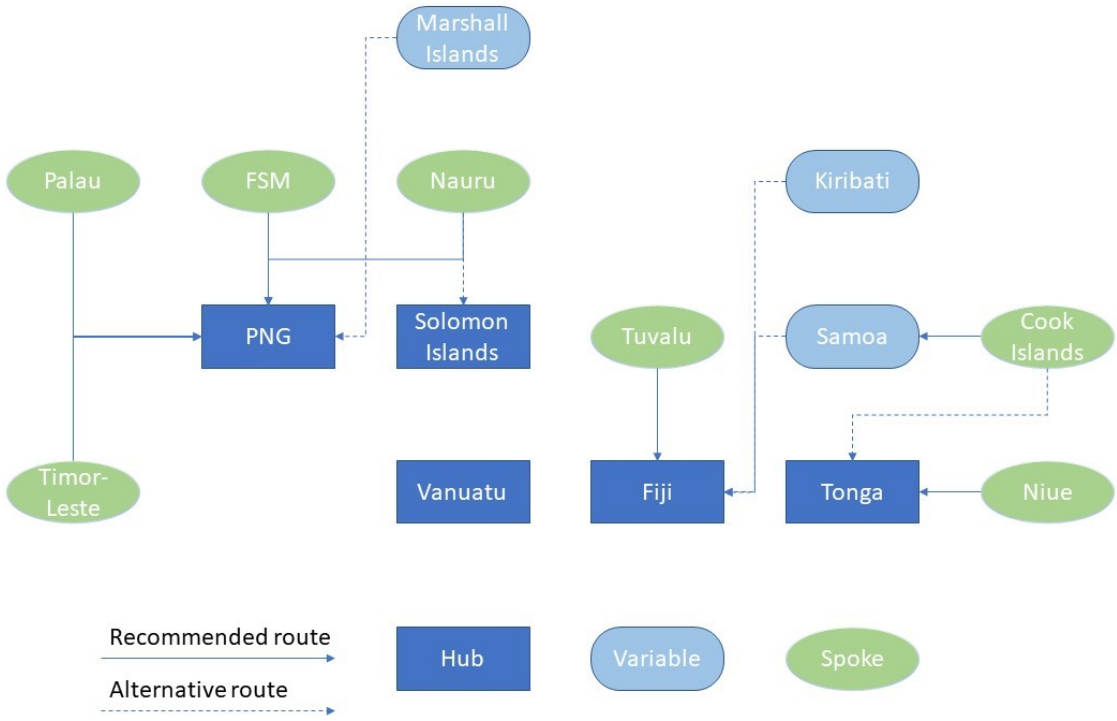

Figure E1 Potential Pacific Region hub-and-spoke coordinated waste network

Introduction

Small island nations face a host of logistic and financial barriers in attempts to increase local recycling rates. The exportation of recycled material presents a range of benefits for nations with the inability to dispose or reuse waste in an environmentally beneficial manner. This could be due to a shortage of landfill capacity on-island, the risk of hazardous chemical pollution or the lack of primary industries in the Pacific region. For some waste streams, there is a potential for commodification if export is achieved efficiently.

The intention of this report is to assist the Secretariat of the Pacific Regional Environmental Program (SPREP) in providing recommendations to Pacific Island Countries (PICs) and Timor-Leste policymakers to improve waste export activities and enable access to international markets. This process begins with a legislative review to understand regulatory barriers to accessing recycling markets and to determine the most viable export destinations. A cost model was developed to calculate the viable tonnage for commodification based on the identified market destinations. Finally, recommendations for PICs are made based on the cost-model results combined with a high-level infrastructure gap analysis of existing PIC resources. The report has focused on PICs participating in the PacWastePlus Program.

Waste Types and Sources

The review covers six major waste streams identified as having potential for export commodification or are seen as having essential transport requirements due to the lack of disposal capacity on island nations.

Readily commodifiable resources primarily include:

- Single stream materials with low contamination rates, such as source separated aluminium cans and PET bottles;
- Materials with potential commodifiable value if correctly pre-processed such as white goods, end-of-life vehicles (ELV) and tyre derived fuels (TDF).

Waste requiring offshore disposal include:

- Wastes such as asbestos and end-of-life batteries which require regulated and controlled disposal which exceeds the capacity and capability of small island nations;
- Currently stockpiled wastes that pose a risk to public health and the environment; and
- Wastes with high projected growth rates, such as e-waste, exceeding island processing and disposal capacities.

The major waste categories included in the study are outlined in **Table 1**, along with examples of sub-categories.

Table 1 Waste types included in the recycling market research study

Waste Category	Sub-categories
Asbestos	• Friable; and • Non-friable.
Hazardous Wastes	• Used oil; and • Used batteries (such as lead-acid and lithium ion).
Tyres	• Whole end of life tyres (ELT); and • TDFs.
E-waste	• Whole products; • Dismantled materials; and • End-of-life solar panels.

Waste Category	Sub-categories
Plastics	• Single stream plastics, identified by resin identification codes 1 to 7; and • Mixed or unsorted plastics.
Metals	• Aluminium cans; • Scrap ferrous metal; • White goods; and • ELVs

Data Limitations

The research and data used throughout this report is based on a desktop review of publicly available resources, data provided by SPREP and MRA industry knowledge. Due to the variety of countries and waste types included in this study, several data quality and limitation concerns were encountered throughout the desktop review.

Available data was often more than five years old and overall, significant gaps existed in the availability of data for each nation or each nation's major islands. Therefore in many cases, assumptions have been made to extrapolate waste data from nations of a similar size that have a higher quality of data.

Recent audit data provided by SPREP was considered the most accurate data available, although these studies would need to be expanded to every nation in the region to provide the highest quality of understanding.

Legislative Review

A range of international and local legislative controls regulate the transboundary movement of waste out of the Pacific region. A review of both current legislation and foreseeable alterations that directly impact waste exports are presented to inform decisions of viable export destinations. Further details of the legislative review are provided in the **0**.

The export destinations presented do not capture the entire scope of possible waste export options. The countries chosen as part of the initial review are those with strong existing trade and shipping relations with the Pacific region. Additional countries can be considered outside of the current studies scope, although a similar process of reviewing international and local legislation should be conducted prior to engaging with new markets.

International Agreements

Multilateral Environmental Agreements

The major multilateral environmental agreements (MEAs) governing the transboundary movement of wastes include the Basel, Stockholm, Rotterdam, and Waigani Conventions which are summarised in **Table 2**.

Further details of each countries status of having signed or ratified the Conventions is provided in **0.**

Table 2 MEAs regulating the transboundary movement of waste

MEA	Scope	Participating PICs	Participating export destinations
Basel Convention	Regulates the transboundary movement of hazardous chemicals through requirements for tracking documentation and prior informed consent.	9	8
Stockholm Convention	Eliminates the production, import and export of chemicals containing Persistent Organic Pollutants (POPs) listed in Annex A with additional measures to reduce the unintentional release of Annex C chemicals.	15	8
Rotterdam Convention	Promotes shared responsibility in the international trade of hazardous chemicals by establishing measures such as standardised labelling and safe handling protocol. Exporting countries are obliged to ensure compliancy within their jurisdiction.	5	8
Waigani Convention	The regional implementation of the Basel Convention for the Pacific region.	11	2
Montreal Protocol	Controls the generation and release of ozone depleting substances.	15	8

Notably, all investigated export destinations have ratified the major MEAs, apart from the Waigani Convention which is geographically limited to the Pacific region. Hence any intended export of wastes will require adherence to Convention protocols, reporting requirements and prior consent.

Additional procedures and controls will need to be followed for shipments travelling to member countries of the Organisation for Economic Co-operation and Development (OECD), which includes Australia, New Zealand (NZ), Japan and South Korea.[1]

Shipping and port management requirements may also be regulated under additional Conventions, such as:

- The International Convention for the Prevention of Pollution from Ships (MARPOL);
- The International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS);
- The International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC);
- The International Convention for the Control and Management of Ships' Ballast Water and Sediments; and
- The International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER).

It is suggested that PICs conduct a detailed review of these Conventions and the local legislations which enforce their obligations prior to selecting an export destination. These may reveal additional quality standard requirements, authorisation requirements or export licenses.

Moana-Taka Partnership

A Memorandum of Understanding between the Swire Shipping Pte. Ltd. and SPREP has been developed to address critical waste management issues in the Pacific Islands. The agreement, known as the Moana-Taka Partnership (MTP), enables Swire Shipping vessels to backfill containers with recyclable waste from eligible Pacific Island ports, free of charge, to be sustainable treated and recycled in suitable ports in the Asia Pacific.

The MTP aims to alleviate the financial burden of international waste exports from the Pacific region while encouraging responsible recycling practices and circular economy principles. The agreement currently covers 14 categories of non-commercial waste not intended for commodification.

Swire Shipping currently services 13 Pacific islands and territories and connects with a broad shipping network which includes Korea, Japan, USA, China, Australia, NZ, Indonesia, Singapore, and Malaysia.[2]

[1] More details on OECD requirements available: https://www.oecd.org/env/waste/guidance-manual-control-transboundary-movements-recoverable-wastes.pdf

[2] More details of the Moana-Taka Partnership can be found through the SPREP resources https://www.sprep.org/sites/default/files/documents/publications/moana-taka-partnership.pdf

International Agreements Summary

Error! Not a valid bookmark self-reference. summarises how specific MEAs and the MTP relate to the waste streams investigated in the current project.

Table 3 Relevant MEAs and MTP eligibility for waste streams

Waste Type	Relevant MEA	Eligibility under MTP
Asbestos	• Basel Convention (Annex I) • Rotterdam Convention (Annex III) • Waigani Convention (Annex I)	Yes
Hazardous Wastes	• Stockholm and Rotterdam Conventions: various pesticides, industrial chemicals and leaded fuels • Basel and Waigani Conventions: a wide range of hazardous wastes including clinical wastes, used oils and mercury or lead containing materials • Montreal Protocol: materials containing ozone depleting substances	Yes
Tyres	• Potential future consideration under the Basel Convention[3]	Yes*
E-Waste[4]	• Basel Convention (Annex VIII)[5] • Waigani Convention	Yes
Plastics	• Basel Convention[6]	Yes
Metals	• Basel Convention: batteries, used oil, electronic equipment, and hazardous components in appliances and ELV • Montreal Protocol: ozone depleting refrigerants	Yes – low value scrap No – high value single stream materials

**not currently listed, but could seek permission if the transport meets MTP non-commercial transaction test*

Potential Market Destinations

The following section details the regulatory considerations for each waste stream within the scope of the present study. For each waste stream, different export options have been suggested based on the relative degree of regulatory requirements and an initial assessments of waste management infrastructure. These are presented as Easy, Moderate or Difficult export destinations. These rankings are not prohibitive; in most cases exemptions or permits can be obtained that would allow for waste importation. Although, this additional administrative requirement will result in a higher cost burden to access these 'difficult' markets.

The findings of this section have been summarised in Figure 1.

[3] Recent legal advice provided to the Australian Tyre Recycling Association (ATRA) however suggests Basel may consider control of used tyre exports under certain conditions including those prescribed by the exporting country, the importing country, or any of the countries of transit.

[4] Particular attention is required around the transport of solar panels containing hazardous substances such as lead, cadmium, and other toxic chemicals.

[5] Refer to the technical guidelines adopted during the twelfth Conference of Parties (May 2015) for distinctions between electrical waste and non-waste. Sorting and classifications under the guidelines may allow exception for electrical non-waste shipments.

[6] During the fourteenth Conference of Parties (May 2019), the Convention was amended to include plastic waste in a legally binding framework for transparent and regulated global trade. Only plastic wastes listed in Annex IX entry B3010 (unmixed, uncontaminated, halogen-free and destined for recycling) are not subject to the Basel Convention's prior informed consent procedure and other controls.

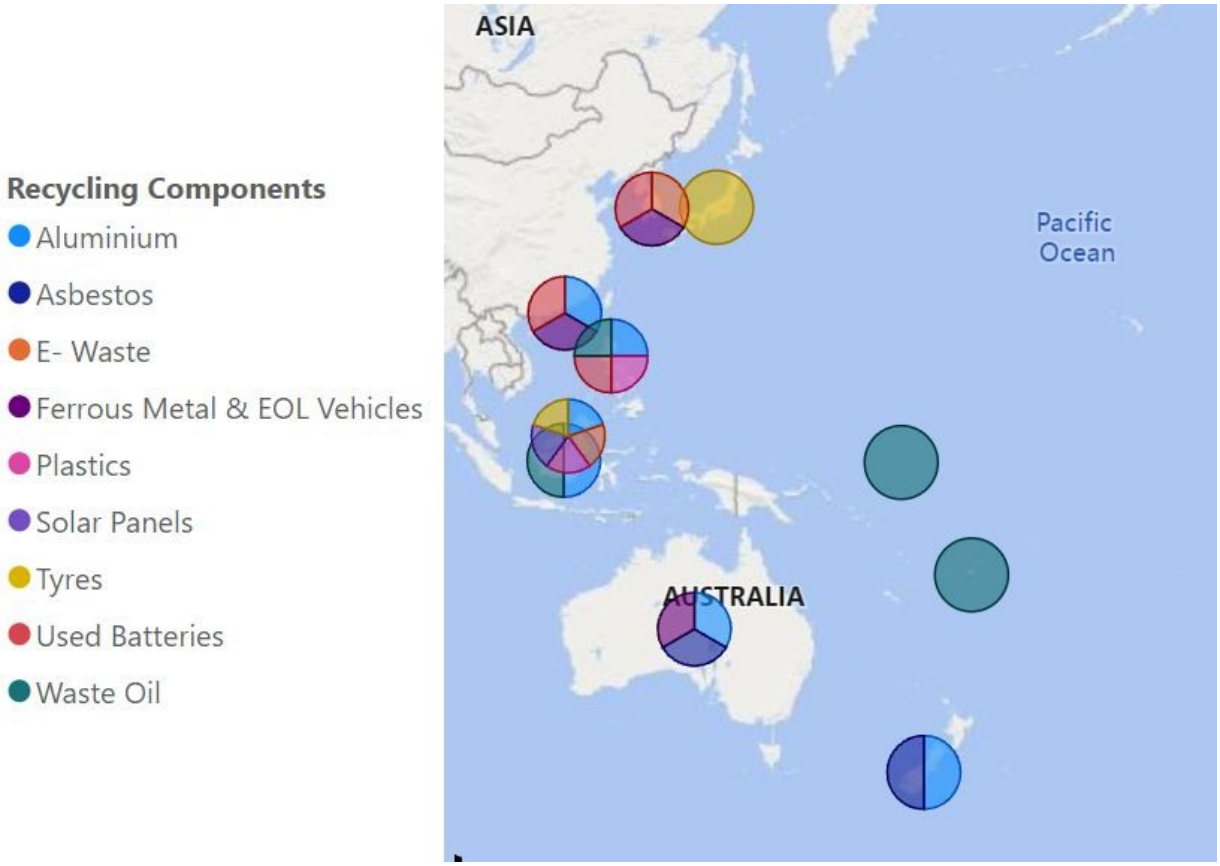

Figure 1 Visual representation of identified target markets

Asbestos

All investigated destination countries have ratified the Basel Convention, with many enacting specific legislations governing the importation of hazardous wastes. An example includes the Australian *Customs (Prohibited Imports) Regulation 1956*, which bans asbestos imports and establishes the agency responsible for administering exemptions. Hence, strict legislative controls will require prior agreement and consent for the acceptance and disposal of asbestos from PICs.

Certain specialist companies (such as SOCADIS LTD in NZ), can arrange both the transport and disposal of asbestos at a premium cost.

Many PIC signatories currently lack national legislations to domesticate their obligations to MEAs controlling the movement of wastes. Some are currently working to ratify MEAs and enact national legislation for their enforcement. Future changes to legislative requirements should be consulted prior to export operations.

MTP and PIC resources can be used to transport the waste to a metropolitan city port, where it can be collected and disposed by a local accredited asbestos waste management company.[7]

[7] It will be necessary to contract licensed asbestos transporters for the collection and disposal of imported asbestos. These contractors should be chosen based on the quality of their service, proximity to the destination port and their service fee.

The most viable market destinations are summarised in **Table 4.**

Table 4 Summary of asbestos export destinations

Easy	Moderate	Difficult
Nil due to strict MEA requirements	Australia: metropolitan inert landfill facilities NZ: metropolitan inert landfill facilities	Countries further removed from the PIC region although still capable of receiving asbestos (such as Indonesia and Malaysia).

Hazardous Chemicals

Local laws enact specific legislation and legal frameworks to regulate the transboundary movement of hazardous wastes and administer licenses or permits. Certain PICs – including Palau, FSM, PNG, Nauru, Kiribati, and Vanuatu – are currently implementing various institutional strengthening activities for chemicals and hazardous wastes under the UNEP Special Program. Wastes can also be considered hazardous under specific legislation when classified as a biosecurity risk.

Certain governments such as Korea and the Philippines encourage the import of used batteries as a source of valuable resources to support local recycling industries. Care must be exercised in selecting reputable recyclers due to the potential for environmental and health impacts caused by hazardous chemicals. Other countries such as Australia and NZ also have the capability to collect and recycle used batteries, although lower government support can mean greater difficulty in acquiring prior export consent.

Market destinations for waste oil include both fuel stock for primary industries (such as steel manufacturing) or feedstocks in waste oil re-refinery. Local destinations of primary industries in the Pacific region, such as steel manufacturing in Fiji (BlueScope Pacific Steel Pty. Ltd.) or phosphate mining in Nauru, are considered attractive export destinations due to lower shipping distances and the ability to leverage the benefits of the MTP.

The most viable market destinations are summarised in **Table 5.**

Table 5 Summary of hazardous chemical export destinations

Waste Type	Easy	Moderate	Difficult
Used Batteries	Nil due to strict MEA requirements	Korea, Philippines, Hong Kong	Japan, Australia[8], NZ
Waste oil	Nil due to strict MEA requirements	Fiji, Indonesia, Nauru, Philippines	NZ

Tyres

Tyre exports include used tyres (which have the potential for reuse or re-treading), ELTs and TDF. It is assumed that PICs will have suitable capability to sort tyres into these categories for maximum resource recovery. Custom controls often reference tyres as requiring quarantine controls due to their risk as disease vectors (e.g., providing breeding habitats for mosquitoes). Shipments will be required to adhere to specific quality and quarantine requirements of the destination port. There has been recent interest in the Pacific region for exploring opportunities of waste-to-energy projects.[9] Island incineration or pyrolysis technology could be used to process ELTs and TDF and would present an attractive export destination for other PICs. Existing technology applications in Malaysia and Japan are the most currently viable end-markets. Other countries are considered Moderate to Difficult due to lower developments in tyre recycling infrastructure or additional regulatory requirements for importation.

[8] Bilateral arrangement exists between Australia and Timor-Leste for the transboundary movement of hazardous waste (Hazardous Wastes (Imports from East Timor) Regulations 2003). This would make Australia the most feasible export destination for hazardous wastes from Timor-Leste.
[9] Examples include *Navigating our Energy Future: Marshall Islands Electricity Roadmap* (December 2018)

The most viable market destinations are summarised in **Table 6.**

Table 6 Summary of ELT export destinations

Easy	Moderate	Difficult
Malaysia, Japan	Australia, NZ[10], Philippines, Hong Kong, Indonesia	Korea[11]

E-waste

E-waste processing and dismantling represents an opportunity to extract valuable commodities such as gold and copper from electrical appliance, while improving local employment and environmental benefits when conducted responsibly. Dismantled and de-polluted materials also represent a benefit of avoiding some restrictions enforced by MEAs. Further details of e-waste dismantling are outlined in Section 0.

Although many countries restrict the import of e-waste, others such as Korea and Malaysia have stated their intention to continue the unrestricted import of waste batteries, metals and e-waste due to the presence of high commodity value materials.[12]

The Malaysian government have also expressed their commitment to developing private industry solar panel recycling.[13] Care must be exercised in selecting reputable recyclers to maintain the safety of public health and the environment.

International companies such as Tes-Amm are also identified as potential end-market partners due to their large international presence, including operations located in Indonesia, Malaysia, Australia, NZ, Philippines, Hong Kong, Japan and Korea.

The most viable market destinations are summarised in **Table 7.**

Table 7 Summary of e-waste export destinations

Waste Type	Easy	Moderate	Difficult
E-waste	Korea, Malaysia	Japan, Hong Kong, Philippines, Indonesia	Australia, NZ
Solar Panels	Malaysia[14]	No market identified	No market identified

Plastics

Almost all participating Basel Convention countries have ratified the recent Plastic Waste Amendments to the Convention.[15] Following China's National Sword policy, post-consumer plastic will also be banned from export to China and Hong Kong.

Many PICs have enacted import bans on plastic bags and other single-use plastic items, including FSM, Fiji, Niue, RMI, Palau, Samoa, Tuvalu, and Vanuatu.

[10] New Zealand's Import Control (Tyres) Conditional Prohibition Order 1996 establishes specific standards for tyre imports and consent agreement requirements.
[11] News reports state that Korea plans to prohibit the import of ELTs in 2023, reported by Yonhap News Agency https://en.yna.co.kr/view/AEN20210108009400315
[12] Details of planned import prohibitions in Korea reported by Yonhap News Agency https://en.yna.co.kr/view/AEN20210108009400315
[13] Details of the Malaysian governments commitment to solar panel recycling reported by PV Monitoring System https://pvms.seda.gov.my/pvportal/news/first-solar-panel-recycling-facility-in-next-10-years-yeo/
[14] The Malaysian government is current supporting private solar panel recycling infrastructure, with some companies such as Tex Cycle Technology currently operational.
[15] Details of the Plastic Waste Amendments are provided through the Basel Convention website http://www.basel.int/Implementation/Plasticwaste/Amendments/Overview/tabid/8426/Default.aspx

These bans are expected to limit the generation of single-stream plastics viable for commodification. Other regional developments include Timor-Leste's intention to become the first 'plastics-neutral' economy[16] and the development of recycling facilities[17].

The primary export markets for plastic waste (mixed or single stream) are the Philippines[18] and Malaysia. Indonesia and Australia also have the potential to accept plastic waste, although only of a very high quality and sorting standard.

The most viable market destinations are summarised in **Table 8**.

Table 8 Summary of plastics export destinations

Waste Type	Easy	Moderate	Difficult
Mixed/ unsorted plastics	Nil due to strict MEA requirements	Philippines, Malaysia	Indonesia[19], Australia
Single stream plastics (low contamination)	Philippines, Malaysia[20]	Indonesia, Australia	NZ, Korea[21]

Metals

Similar to e-waste, there are numerous benefits to the de-pollution of white goods and ELVs prior to export, such as higher material value and fewer regulatory restrictions. Further details of ELV de-pollution are outlined in Section 0.

Many countries accept scrap metals for recycling purposes due to their high commodity value. If goods have been de-polluted to adhere to MEAs, very few legislative barriers will prevent scrap metal imports.

The most viable options are countries with strong metal production and recycling industries. Some of these options are summarised in **Table 9.**

Table 9 Summary of metal export destinations

Waste Type	Easy	Moderate	Difficult
Non-Ferrous Metal	Australia, NZ, Korea, Philippines, Hong Kong, Malaysia	Indonesia, Japan	None identified
Ferrous metals (including de-polluted white goods and EOL vehicles)	Australia, Hong Kong, Korea	NZ, Philippines, Malaysia, Indonesia, Japan	None identified

[16] The Government of Timor-Leste has signed a memorandum of understanding with the University of Sydney with Mura Technology for the development of a $US40 million chemical recycling plant. Details TL's intentions around reducing plastic waste reported by Waste Management Review https://wastemanagementreview.com.au/timor-leste-aims-to-become-worlds-first-plastic-neutral-country/

[17] The Niue Recycling Facility (funded by the Government of Australia) will initial recycle glass and PET plastic bottles. Later developments will expand the recycling operations to other types of materials. Details on the development of Niue's recycling infrastructure reported by SPREP https://www.sprep.org/news/new-waste-initiatives-niue-horizon

[18] More details of the status of the Philippine waste import and recycling industry is outlined in the Waste Trade in the Philippines Report (Greenpeace Philippines and EcoWaste Coalition, 2020) https://www.greenpeace.org/static/planet4-philippines-stateless/2020/03/da311344-waste-trade-in-the-philippines-report-v2.pdf

[19] Indonesia's Ministry of Trade Regulation No. 84/2019 establishes strict quality requirements for imported plastic waste: having been generated from industry (not household), is not B3 (hazardous, toxic or dangerous), will be used only for secondary raw materials production and licensing and approval requirements for waste importers. Indonesia have announced plans to eventually stop all waste imports from other countries, reported by Inside Indonesia https://www.insideindonesia.org/buried-under-the-weight-of-indonesia-s-recycling-crisis

[20] Malaysian single stream plastic recyclers include EPD Plastic and IPOH S.Y Recycle Plastic Sdn Bhd (primarily single film polyethene products)

[21] Korea plans to prohibit plastic waste imports in 2022, reported by Yohnap News Agency https://en.yna.co.kr/view/AEN20210108009400315

Recycling Market Study

Different export destinations or target processors will have different requirements for receiving waste materials for recycling. The major requirements include:

- the quality standard of the material imported for recycling;
- risk mitigation measurements;
- shipping logistics; and
- the expected cost of export.

The combination of these requirements in each of the export destinations, form the basis for the recommendations for viable recycling markets for PIC waste. An initial survey of recycling processors capable of receiving PIC material is provided in **0.**

Material Quality Requirements

To assist the maximum market value (at the point of sale) being achieved, the responsible management of waste (storage, pre-processing, and transport) is encouraged. These material management considerations encompass a broad variety of best practice principles with varying applicability to different waste streams.

For example, hazardous materials require strict packaging and handling protocols aligned with MEAs to prevent the risk of human exposure to toxic substances, damage to the environment or the potential for unexpected incidents such as explosions. Other waste streams such as plastics will often be rejected at the destination port due to unsuitable contamination rates.[22]

In general, material contamination rates should be kept close to negligible by stockpiling materials in sheltered areas and sorting waste prior to export. This can be achieved by private contractors or in government managed material recovery facilities. The source separation of materials, such as providing separate drop-off locations for certain waste streams, can decrease the requirement for prior sorting.

MEAs provide some guidance for the preparation and handling of certain waste types, although specific quality standards are often mandated in local legislation (of both the export and import nations), conditions of use for shipping and port infrastructure and requirements specified by the recycler. It is necessary to consult with contractors, local legal agencies, shipping companies, port authorities and end-market recyclers to determine any additional material quality requirements.

[22] Notable examples include 103 containers of recyclable plastic scrap sent from Canada to the Philippines that were found to be contaminated with hazardous materials. It was determined that Canada was in violation of the Basel Convention even though the shipments were arranged by a private entity. In 2019, 69 of the containers were returned to Canada at the Canadian governments expense.

This section will summarise the minimum level of best practice material quality requirements, while providing resources for further consultation. **Error! Not a valid bookmark self-reference.** summarises the primary storage, pre-processing and safety considerations for each waste type.

Table 10 Minimum best practice material quality requirements

Material	Storage	Pre-processing	Safety Considerations	Further resources
Asbestos	• All asbestos must be contained in new heavy duty polyethylene bags or sheeting (minimum 200-micron thickness); • Adhesive tape used to tightly secure bags and sheets; and • Material stored in a solid waste drum, skip or shipping container ensuring that warning labels are placed on the exterior of each receptacle.	• Estimated cost USD$60/t to prepare asbestos for export.[23] • No additional pre-processing requirements are necessary for asbestos aside from its secure storage.	• Airborne asbestos fibres are highly hazardous (can cause asbestosis, lung cancer and mesothelioma); • PPE required during handling and preparation including disposable coveralls, gloves, safety footwear and respiratory protective equipment; • Adequate training and information to all personnel; • Labelling requirements aligned with the Rotterdam and Basel Conventions; and • Controlled wetting of the asbestos waste should be carried out to minimise asbestos dust emissions when polyethylene bags are sealed or during any subsequent rupture of the bag or wrapped bundles.	• Rotterdam Convention Factsheets for each type of regulated asbestos available under Annex III;[24] • Safe Work Australia *How to Remove Asbestos* Code of Practice (July 2020); and • Relevant custom clearance and documentation requirements of the destination country.
Used 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	• Damaged batteries must be identified, stored in salvage drums or repaired to prevent leakage; • Batteries must be stacked no more than 3 layers high on appropriate pallets; • Thick corrugated cardboard placed on pallets and between each layer of	• Components and chemicals inside used batteries are highly hazardous (often corrosive and toxic); • PPE required during handling and preparation including acid-resistant clothing, safety footwear, gloves, face and eye protection;	• Basel Convention Factsheet for hazardous wastes;[26] • Technical Guidelines for the Environmentally Sound Management of Waste Lead-Acid Batteries, developed under the Basel Convention;

[23] Estimated Asbag cost as part of a *Survey of the Regional Distribution and Status of Asbestos - Contaminated Construction Material and Best Practice Options for its Management in Pacific Island Countries* (SPREP, 2015)
[24] Available: http://www.pic.int/TheConvention/Chemicals/AnnexIIIChemicals
[26] Available: http://www.basel.int/Implementation/CountryLedInitiative/EnvironmentallySoundManagement/ESMToolkit/Factsheets/tabid/5843/Default.aspx

Material	Storage	Pre-processing	Safety Considerations	Further resources
	place, with missing caps replaced or sealed with foam; and • Terminals insulated with tape or cardboard to prevent short-circuiting.	batteries and secured with clear stretch wrap; and • Pallets must not exceed a maximum load of 1,500 kg. • Estimated cost USD$27/t to prepare batteries for export.[25]	• Adequate training and information to all personnel; • Labelling and consent requirements aligned with the Rotterdam and Basel Conventions; and • Chemical spills kits at storage and transport locations.	• Best Practice guidelines provided by Australian Battery Recycling Initiative (ABRI);[27] and • United Nation Recommendations on the Transport of Dangerous Goods, Model Regulations.[28]
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).	• Measurements of oil contaminants and quality assurance standards can be implemented to increase market acceptance (e.g. U.S. "Used oil specification");[29] • Recommended to transport used oil in 55-gallon drums or Intermediate Bulk Container (IBC) totes certified for the transport of hazardous chemicals; • Prepare oil drums for shipment by placing them on pallets (spill control pallets are recommended), one layer high, and tightly securing with clear stretch wrap. • Estimated cost USD$32/t to prepare used oil for export.[30]	• Used oil is often hazardous (commonly containing carcinogens and heavy metals); • Labelling and consent requirements aligned with the Basel Conventions; • If used oil is to be used as fuel, air emissions should be carefully monitored to prevent harm to human health and the environment; and • Oil spill kits at storage and transport locations.	• Basel Convention Factsheet for hazardous wastes; • Technical Guidelines on Waste Oils from Petroleum Origins and Sources, developed under the Basel Convention; and • United Nations recommendations on the Transport of Dangerous Goods, Model Regulations.
Tyres	• Maximum outdoor pile dimensions should be 6m by 20 m with a maximum height of 3m; • Buffer distances of 60m should be allowed between piles and buildings;	• Tyres should be sorted to determine those appropriate for reuse or re-treading;	• Firefighting equipment at storage and transport locations, including a water system capable of delivering 3780 L/min for a duration of 6 hours;	• Revised Technical Guidelines for the Environmentally Sound Management of Used and Waste Pneumatic Tyres,

[25] Cost estimate based on average prices for an export shipping pallet, plastic wrap and labour required to prepare the package.
[27] Available: http://www.batteryrecycling.org.au/wp-content/uploads/2013/11/ULAB-packaging-standard-2013-final21.pdf
[28] Available: https://unece.org/about-recommendations
[29] Title 40 of the Code of Federal Regulations (CFR) Part 279, Standards for the Management of Used Oil. Available: https://www.ecfr.gov/current/title-40
[30] Cost estimate based on average prices for an export shipping pallet, plastic wrap and labour required to prepare the package. Estimate excludes the cost of 55-gallon steel drums as backfilling arrangements can be organized.

Material	Storage	Pre-processing	Safety Considerations	Further resources
	• Fire breakers and strict ignition controls should be implemented at storage sites; and • Piles should be covered with impermeable barriers to Minimise disease vectors.	• Tyres requiring disposal can be prepared for efficient transport through bailing or shredding; • Baled tyres should conform with PAS108 Standards,[31] requiring capital expenditure on baling equipment (approximately USD$25,000) and estimated operating cost of USD$16/t;[32] • Shredded tyre specification must conform with intended end-use, whether drainage material, construction filler or TDF; • Tyre shredders require capital expenditure on equipment (approximately USD$25,000 to over USD$1 million) and estimated operating cost of USD$15/t.[33]	• Quarantine and disease vector controls required if tyres are stored incorrectly and allowed to accumulate water; and • If tyres are processed through baling or shredding, appropriate work health and safety measures must be in place.	developed under the Basel Convention; • Tyre Stewardship Australia's guidelines for best practice tyre storage;[34] • British Standards for baled tyres (PAS 108);[35] and • Relevant quarantine and custom legislation of the destination country.
E-waste	• 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.	• Whole e-waste should be prepared for transport by stacking on pallets and tightly securing with clear stretch wrap in a manner that prevents breakage and the release of hazardous components to the environment; • If e-waste is to be dismantled, compliance with local legislation and	• Components and chemicals inside e-waste are highly hazardous (often corrosive, poisonous and toxic); • Whole e-waste and components must follow labelling and consent requirements aligned with the Basel and Stockholm Conventions;	• Australian Standard AS/NZS 5377:2013;[38] • Dismantling guide for e-waste developed by Sustainable Recycling Industries;[39] and • Technical guidelines on Transboundary Movement of Electrical and Electronic Waste

[31] Available: https://www.westerntyres.co.uk/assets/pdf/PAS108.pdf
[32] Cost estimate based on average bailing equipment power and labour requirements.
[33] Cost estimate based on average shredding equipment power and labour requirements. Estimate excludes equipment maintenance or replacement costs.
[34] Available: https://www.tyrestewardship.org.au/wp-content/uploads/2020/04/guidelines-for-tyre-storage-report-mar19.pdf
[35] Available: westerntyres.co.uk/assets/pdf/PAS108.pdf
[38] AS/NZS 5377:2013 Collection, storage, transport and treatment of end-of-life electrical and electronic equipment
[39] Available: https://www.sustainable-recycling.org/wp-content/uploads/2020/09/2015_Schluep_et_al_SRI_DismGuide_IT_Equipment.pdf

Material	Storage	Pre-processing	Safety Considerations	Further resources
		consent requirements must be consulted; • Due to the lack of sophisticated processing capacity in the Pacific region, it is recommended that the extent of e-waste dismantling is limited to the removal of hazardous components[36] and high value components[37]. • Estimated cost of USD$26/t for whole e-waste export and USD$211/t for dismantled e-waste.	• Chemical spills kits at storage and transport locations; • Prevention of fugitive emissions of mercury and ozone depleting substances during dismantling; • PPE required during dismantling including coverall clothing, safety footwear, gloves, eye protection and dusk masks.	and Used Electrical and Electronic equipment developed under the Basel Convention.
Plastics	• Plastics can be stockpiled in bins, skips or containers prior to export; and • Mixing of different plastic resins or environmental contamination should be prevented.	• Mixed plastics should be sorted to separate high value fractions of PET and HDPE; and • Plastics should be baled to increase transport efficiency. • Baled plastics require capital expenditure on baling equipment (prices starting at approximately USD$5,000) and estimated operating cost of USD$20/t.[40]	• Adequate work health and safety measures should be in place for the operation of baling equipment; • If plastics are contaminated or otherwise fall under regulation by the Basel Convention, they must align with labelling and consent requirements.	• Plastic Waste Amendments to the Basel Convention;[41] and • Plastic baling specifications developed by The Association of Plastic Recyclers.[42]
Metals	• Metals can be stockpiled in bins, skips or containers prior to export; and	• Metals (especially aluminium cans) should be baled to increase transport efficiency.	• Adequate work health and safety measures should be in place for the operation of baling equipment.	• National Ag Safety Database guidelines for compacting and baling safety.[44]

[36] Hazardous fractions of e-waste to be removed and separately contained include batteries, mercury switches, capacitors, cathode-ray tubes, phosphor layers, cold cathode fluorescent lamps, cartridges, photoconductive drums and electron gun. These must be removed and stored in a manner that prevents damage to the components that could cause the release of hazardous substances.
[37] High value components of e-waste include printed circuit boards, plastics, ferrous metal, aluminium and copper. These can be direct to specialized markets for reuse or further processing.
[40] Cost estimate based on industry insights, available: https://www.recyclingtoday.com/article/baler-supplement----adding-it-all-up--the-cost-of-baling/
[41] Available: http://www.basel.int/Implementation/Plasticwaste/PlasticWasteAmendments/FAQs/tabid/8427/Default.aspx
[42] Available: https://plasticsrecycling.org/model-bale-specifications
[44] Available: https://nasdonline.org/124/d001658/preventing-deaths-and-injuries-while-compacting-or-baling.html

Material	Storage	Pre-processing	Safety Considerations	Further resources
	• Mixing of metal streams or environmental contamination should be prevented.	• Baled metals require capital expenditure on baling equipment (prices starting at approximately USD$180,000 for ferrous balers) and estimated operating cost of USD$35/t.[43]		
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.	• ELV inspected for leaks or unwanted materials upon arrival; • Leaks must be collected in drip trays; • De-pollution must occur on an impermeable surface, preferably on a support frame or lifting device although pits can be used (if vapor build-ups are minimised by encouraging ventilation); and • ELV de-polluted to remove hazardous components;[45] • Used oils and fuels should be kept in separate containers; and • Separate containment required for mercury and asbestos containing components.	• The isolation of used batteries, waste oil and hazardous during de-pollution should follow their respective safety considerations and responsible disposal arrangements; • Management and capture arrangements of fluorocarbon refrigerants aligned with the Stockholm Convention; and • Adequate work health and safety measures should be in place during de-pollution activities, including considerations for vapor build-up and potential exposure to hazardous components.	• Guidance on the Standards for Storage and Treatment of End-of-Life Vehicles;[46] • Guidance and considerations of different ELV dismantling activities reported in *The Economic and Ecological Impacts of Dismantling End-of-Life Vehicles in Romania* (Rovinaru *et al.*, 2019)[47]

[43] Cost estimate based on industry insights, available: https://www.recyclingtoday.com/article/baler-supplement----adding-it-all-up--the-cost-of-baling/

[45] The following steps should be followed to de-polluted ELVs: remove battery, remove fuel filler cap and oil filler cap, set heater to maximum, remove wheels and tyres, remove mercury containing parts, drain engine oil, drain transmission oil, drain coolant, drain brake fluid, drain washer bottle, drain brake/ clutch reservoir, drain power steering reservoir, drain fuel tank and suspension fluid, remove oil filter, de-gas air conditioning unit, remove catalyst, deploy and remove airbags and other pyrotechnics.

[46] Available: https://www.sepa.org.uk/regulations/waste/end-of-life-vehicles/

[47] Available: https://www.mdpi.com/2071-1050/11/22/6446/pdf

Shipping Logistics

Several logistical requirements exist that will enable PICs to access international recycling markets. The applicability of MEAs and the MTP on specific waste streams is discussed in Section 0, although there are additional requirements applicable to all waste shipments.

All cargo shipments are subject to certain expenses regardless of their contents. These include:

- Freight rates, which are often dependent on factors such as shipping distance, material weight and density, commodity classification (determined by the Harmonized Commodity Description and Coding System) and operator base rates. Freight rates vary regularly, such as recent dramatic increases due to the COVID-19 pandemic which have impacted marine fuel prices and shipment delays.
- Wharf fees (also known as wharfage charge) that must be paid at both export and import ports where material is loaded or unloaded from the vessel. They are not inclusive of any additional service charges such as stevedore rates. Wharfage can be calculated on a weight (tonnes), volume (cubic metres) or unit (TEU) rate.
- Stevedore fees for labourers responsible for un/loading containers from ships, securing goods on the vessel and un/berthing the vessel from the port. Depending on the circumstances their services are provided by the shipping company, port authority or a separate private entity. Fees are usually charged on a per unit (TEU) basis.
- A bunker adjustment factors is a surcharge levy set by shipping operators to compensate for fluctuations in marine fuel prices. Fees are usually charged on a per unit (TEU) basis and accounts for the specific conditions of the shipment (i.e. the route, distance, transit time, vessel size and build and fuel efficiency).
- Customs duties or tariffs determined by a specified rate unique to each country. Rates vary based on the value and volume of the cargo. **0** provides examples of different tariff rates in proposed export destinations.
- Administration costs associated with applications for import permits and prior consent. These are depended on the material types and project timeframe to achieve approval.

Exporting nations are required to provide financial guarantees in accordance with national or international law requirements. This guarantee is necessary to provide immediate funds for alternative recycling, disposal, or other means of environmentally sound management of the wastes in cases where the transboundary movement and the recovery operations cannot be carried out as foreseen. Certain countries require by domestic law that all transboundary movements be subject to the provision of a financial guarantee (e.g. insurance policy, bank letters, bonds or other means of compensation).[48]

Liability insurance should, at a minimum cover:

- Damages to other parties for which the exporter is responsible; and
- Costs imposed by law on the exporter to mitigate damage caused by accidental material release to the environment.

Specific country requirements should be consulted prior to export to determine the amount and duration of insurance requirements. For example, Canadian law requires insurance coverage of at least $1,000,000 for hazardous recyclable material valid until the nominated recycling facility accepts the material.[49]

[48] See *Study on Inspection Requirements for Waste Shipments* (IEEP, 2008, available: https://ec.europa.eu/environment/pdf/waste/shipments/report_august09.pdf) for more details0020

[49] More details available: https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/permit-hazardous-wastes-recyclables/fact-sheets-international-movement/insurance-requirements.html

Insurance and liability requirements for hazardous waste shipments will exceed equivalent requirements for non-hazardous transport. The consequences associated with an incident involving the release of hazardous materials can be especially severe to human and environmental health. The degree of severity depends largely on specific circumstances such as the type and quantity of material released, the location and time of the incident, the availability of containment measurements and atmospheric conditions. Examples include contingencies during bulk oil transportation for marine spillages and resultant environmental damages which are often regulated by MEAs. Hence authorities responsible for the transport of these materials are required to maintain insurance policies that are sufficient to meet any potential liability.

Cost Model

A cost model tailored to the Pacific context was developed to determine the minimum necessary volume of recycled material needed to render exportation economically viable. This model informs recommendations of different market options and regional feasibility options.

The purpose of the model is to:

- Compare the commercial viability of exporting recycled materials to different target markets.
- Determine the minimum quantity of material necessary for export expenses and profits to break even (for materials intended for commodification).
- Determine the cost incurred by PIC governments for materials not intended for commodification.

The model encapsulates the shipping leg of accessing recycled materials export markets. It does not include land-based or inter-island transport requirements to consolidate materials at an international port prior to export. The model was constructed from a nominated "hub" location in the Pacific region. Section 0 describes the additional steps required for the applicability of the model to each of the 15 PICs.

Inputs and variables to the model include:

- The material type;
- The material form and condition;
- The intended export destination;
- The existence of MEA restrictions on the shipment; and
- Whether the material is eligible under the MTP.

The model follows the process flow described by Figure 2. It is recommended that market feasibility studies conducted outside the scope of this report use a similar staged approach to determine the true shipment value of exporting waste materials.

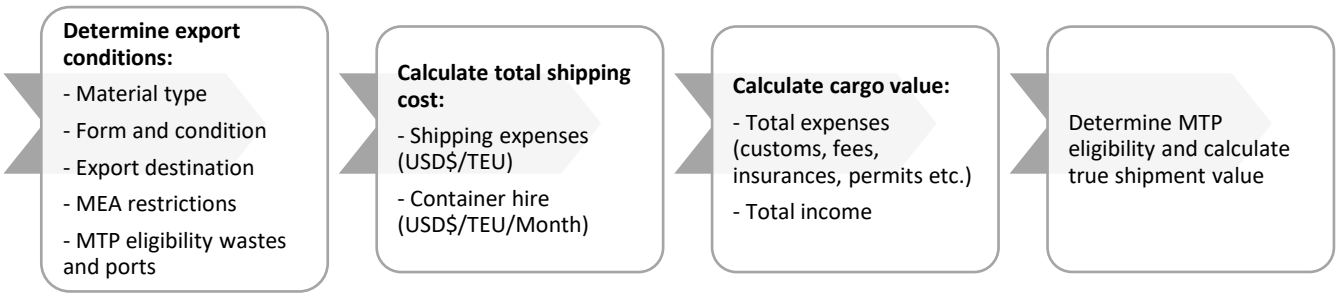

Figure 2 Cost model process flow

Assumptions

The following assumptions were used in creating the model:

- Shipping fees for non-hazardous materials are based on averages provided in the *Pacific Region Solid Waste Management and Recycling Report* (PRIF, 2018) and include stevedore charges and bunker adjustment factors;
- Recycled material sale prices are based on international commodity value averages, rather than specific sell-prices in each market destination;
- Commodity prices are a current average and expected to vary, although they are assumed to be static while the model remains relevant;
- A minimum shipment comprises of one full 20-foot shipping container;
- That a one-month container rental period would be required to transport the container to the material stockpile facility, load the container and return it to the port for export;
- Average density factors are used to convert material tonnage to twenty-foot equivalent units (TEU);
- Customs, permits, licensing and insurance requirements for hazardous wastes will result in an elevated shipping expense compared to non-hazardous wastes;
- Material quality requirements mandated by legislation at each market destination will satisfy the specific recycling facility quality expectations (i.e. facilities will accept materials pre-processed to a quality standard required for international export);
- PICs will have adequate resources to transport, store, pre-process (if required) and load materials into shipping containers for export; and
- Sorted and bailed plastics will be free from contamination and hence not require MEA exemption.

Details of assumed shipping rates can be found in **0**.

Results

The calculated results of the cost model are summarised in **Table 11.**

Of the 13 waste streams analysed by the cost model, eight were determined to have a positive commercial return upon export to an external recycling market. The remaining five would incur a negative cost to PIC governments due to a range of market barriers, including:

- Low sale value at the export destination does not cover necessary shipping expenses even with the assistance of the MTP (as seen in ELTs);
- High processing costs exceed the material resale value (such as dismantled e-waste); and
- Materials which incur a disposal cost at the export destination (such as asbestos).

The shipping expenses of these non-commodifiable materials (including wharf fees, container cleaning and pre-processing costs) is greater than the expected income earned at the destination market. Hence any quantity of material shipped would incur a cost to PICs, even if tonnages or number of units was varied.

For commodifiable materials, the minimum viable tonnage to achieve a positive return has been provided along with the percentage capacity of a shipping container. For these materials, a container must be filled to this minimum capacity to gain a positive return. Whether or not this capacity is exceeded will be determined by the material's relative generation rate, the costs and impacts of material storage and whether other materials are available to be loaded into the same container.

Finally, the model was able to determine which of the proposed export markets would be most profitable based on shipping rates and access to MTP shipping routes. It is recommended that responsible and reputable recyclers are contacted in these markets prior to arranging material export.

Table 11 Recycling market cost model results

Waste Type	Most viable export market	MTP Trade	Shipment Value (USD$/TEU)	Viable Tonnage (t/TEU)	% TEU
Asbestos	Australia or NZ	Yes	-4,480	N/A	N/A
Used batteries	Hong Kong	No	1,503	10.8	72%
Waste oil	Indonesia	Yes	1,507	4.4	34%
Baled tyres	Malaysia	Yes	-231	N/A	N/A
Shredded tyres	Malaysia	Yes	529	10.9	51%
Whole e-waste	Malaysia	Yes	3,036	3.2	20%
Dismantled e-waste	Malaysia	Yes	-372	N/A	N/A
Baled PET	Philippines or Malaysia	No	221	12.5	95%
Baled HDPE	Philippines or Malaysia	No	5,874	4.9	37%
Baled mixed plastics	Malaysia	Yes	311	9.6	72%
Baled aluminium cans	Philippines	No	10,494	2.5	25%
Baled ferrous scrap	Australia	Yes	617	8.5	49%
De-polluted ELV	Australia	Yes	-332	N/A	N/A

Some materials are eligible MTP trades, meaning shipment value does not exceed to total shipment cost. Other high value materials, such as baled aluminium cans, are not eligible MTP trades due to their commercial nature.

Regional Implications

The results summarised in Section 0 are modelled from an assumed central location in the Pacific region serviced by the MTP. Additional considerations are required for the applicability to each PIC within the scope of the present study. Firstly, PICs will have to factor domestic transport for the consolidation of materials from outer islands to a port facility capable of international export.

This will include land-based collection and transport of materials and backloaded vessels travelling from outer islands. Secondly, PICs which have high international shipping fees, or which not serviced by the MTP should consider consolidating materials within the Pacific region prior to export. This measurement could decrease the final shipping cost if an integrated shipping network was in place.

Error! Not a valid bookmark self-reference. provides an indication of each countries deviation from shipping rates used in the cost model. More details on a consolidated regional network are provided in Section 0.

Table 12 Shipping rate sensitivity analysis based on known shipping rates

PICs	Shipping rate deviation range from model baseline
PNG, Timor-Leste	-20% to -10%
Vanuatu, RMI and Cook Islands	-10% to 0%
Fiji, Kiribati, Samoa, Solomon Islands, Tuvalu and Tonga	0% to +10%
Palau, Nauru and Niue	+10% to +20%
FSM	Greater than +20%

Finally, each nation should consider its current recycled material generation rate compared with the viable tonnages calculated in **Table 11**. This will determine the minimum storage requirement for material to be aggregated prior to export. Longer storage periods may result in additional shipment costs and environmental impacts.

Table 13 outlines the potential average tonnes of material that could be recovered for recycling. Additional collection and sorting networks would need to be in place to access these materials, although values are provided to give an indication of the maximum number of viable export shipment that could occur in the region each year.

Asbestos has been excluded from this estimate due to insufficient data relating to its current generation rate. Asbestos lacks import legislative controls in many PICs and is sporadically generated during building demolition and natural disasters.

It is recommended that PICs prioritise the removal of asbestos stockpiles that pose a danger to public health.[50]

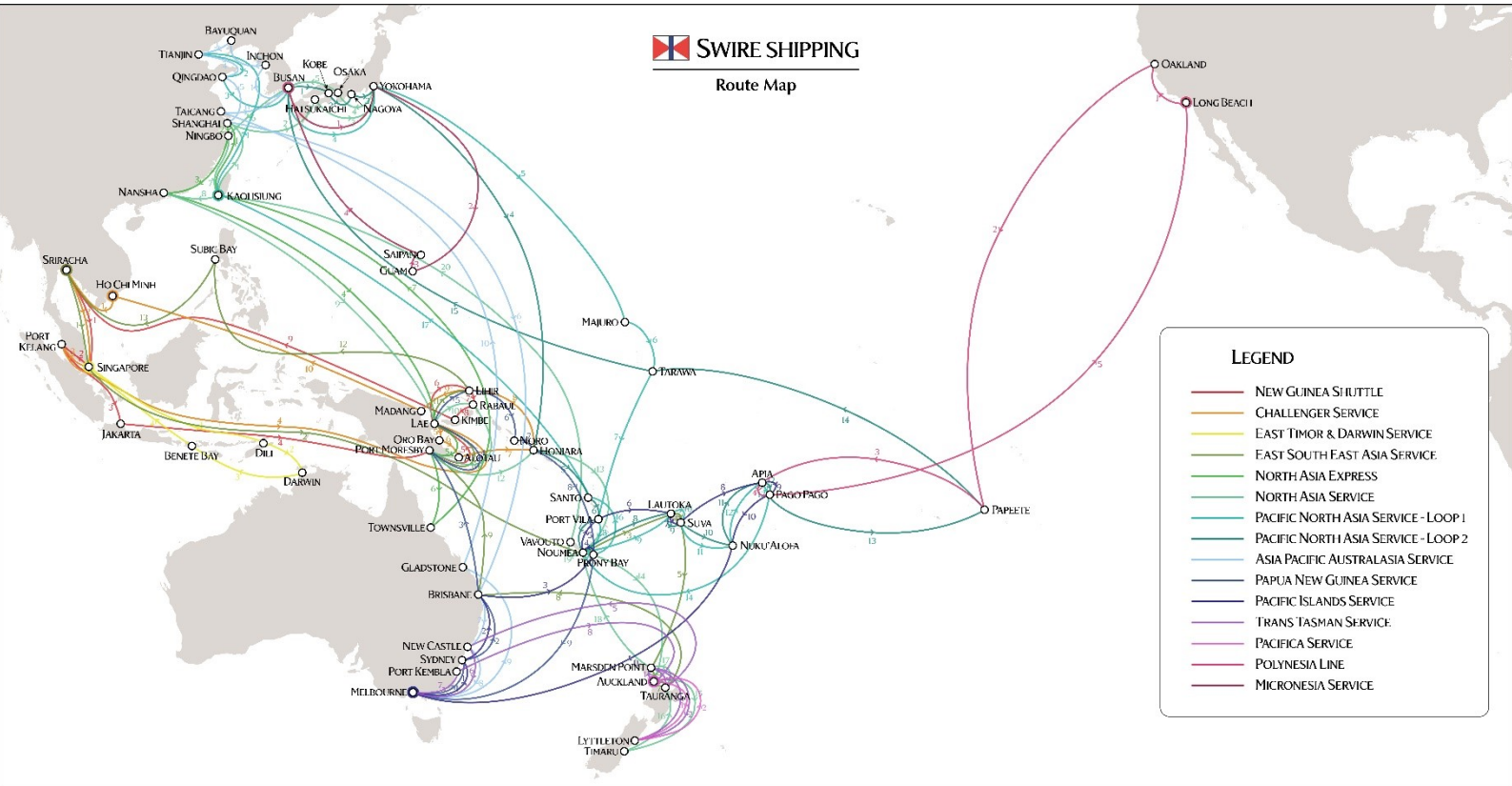

Table 13 Potential metric tonnes per annum available for capture and export, developed from import data (PRIF, 2018)

Country	ULAB	Used oil	E-waste	PET	Aluminium Cans	Ferrous Scrap	ELT	ELV
Cook Islands	21	118	2	60	118	400	21	337
Timor-Leste	61	1,584	53	279	501	597	61	3,967
FSM	24	626	3	69	124	148	24	380
Fiji	649	3,332	125	1,588	4,318	5,144	647	9,454
Kiribati	18	563	3	122	219	261	18	346
RMI	19	307	3	229	322	384	19	330
Nauru	12	ND	ND	103	45	692	ND	ND
Niue	7	ND	ND	5	4	158	ND	ND
Palau	18	99	2	58	114	136	18	307
PNG	320	23,760	65	1,484	2,666	3,175	319	9,360
Samoa	78	983	28	94	170	202	78	2,085
Solomon Islands	33	1,055	15	111	200	239	33	1,973
Tonga	104	579	13	138	583	695	104	1,872
Tuvalu	4	63	0.54	25	49	59	4	72
Vanuatu	47	839	12	301	818	974	47	1,581
Total	**1,415**	**33,908**	**325**	**4,666**	**10,251**	**13,264**	**1,393**	**32,064**
Tonnes/ TEU	**15.0**	**12.9**	**15.8**	**13.2**	**9.9**	**17.5**	**21.5**	**2.0**
Shipments/yr	**94**	**2,636**	**20**	**353**	**1,035**	**758**	**65**	**16,443**
Max. viable Shipments/yr	**134**	**7,642**	**100**	**373**	**4,130**	**1553**	**127**	**N/A**

Data based on disposal rates to landfill captured by SPREP Waste Audits (2021)

Note: calculations for the number of annual shipments are reported for whole e-waste/ ELVs, shredded ELTs and baled PET/ aluminium cans/ ferrous scrap

Table *14* summarises the estimated number of shipping containers which could be exported each year by PICs based on the available tonnes provided in Table 13 and waste density per container. Capacity for each PIC to undertake export of this material requires further investigation into collection infrastructure, storage facilities and logistics with shipping frequency to ensure regular shipments in line with generation rate so storage is not required for extended periods of time.

Based on available waste generation data the following is noted:

- Nauru, Niue, Tuvalu do not generate sufficient tonnes of the waste / recyclables to feasibly export of material directly. Therefore, aggregation on larger islands is recommended.
- E-waste is not generated in sufficient volumes on 11 of the 15 PICs. Therefore, it is recommended that options for aggregation in Timor-Leste, Fiji, PNG and Samoa are explored further.
- ELV account for the greatest tonnage of materials on the PICs.
- The PICs generate sufficient tonnes of waste/ recyclables to fill approximately 21,000 shipping containers per year.
- Fiji and PNG generate the highest volumes of waste.

Table 14 Estimated shipping containers per PIC based on waste generation per year

Country	ULAB	Used oil	E-waste	PET	Aluminium Cans	Ferrous Scrap	ELT	ELV	Total
Cook Islands	1.4	9	0.1	4.5	11.9	22.9	1.1	168.5	220
Timor-Leste	4	122.8	3.4	21.1	50.6	34	3.3	1,983.5	2,223
FSM	1.6	48.5	0.2	5.2	12.5	8.5	1.3	190	268
Fiji	43.3	258.3	8	120	436	294	35	4,727	5,922
Kiribati	1.2	43.6	0.2	9.2	22	15	1	173	265
RMI	1.3	23.8	0.2	17.3	32.5	22	1	165	263
Nauru	0.8	ND	ND	7.8	4.5	39.5	ND	ND	53
Niue	0.5	ND	ND	0.4	0.4	9	ND	ND	10
Palau	1.2	7.7	0.1	4.4	11.5	7.8	1	153.5	187
PNG	21.3	1,842	4	112.4	269.3	181.4	17.2	4,680	7,128
Samoa	5.2	76.2	1.8	7	17.2	11.5	4.2	1,042.5	1,166
Solomon Islands	2.2	81.8	0.9	8.4	20.2	13.7	1.8	986.5	1,115
Tonga	7	45	0.8	10.5	59	39.7	5.6	936	1,103
Tuvalu	0.3	4.9	0.0	1.9	4.9	3.4	0.2	36	52
Vanuatu	3.1	65	0.8	22.8	82.6	55.7	2.5	790.5	1,023

**Highlighted cells identify PICs where less than one container is generated per year. In addition, based on breakeven tonnes of material these countries generated less than one TEU per year.*

Regional Infrastructure Analysis

Overview of Pacific Island Processing Technology

Current PIC recycling and material processing operations are primarily handled by private companies. Some islands operate government recycling facilities, such as the Rarotonga Waste Management Facility in the Cook Islands, which primarily collect, sort, bale and export PET bottles and aluminium cans. Cooperation between private and public entities will be necessary in the commercialisation of certain waste streams (such as those outlined by Table 13). Non-commercial streams will need additional government incentivisation to encourage private recycling, such as advance recovery or levy schemes.

A total of four national or state container deposit schemes (CDS) or advance recovery schemes have been implemented in Kiribati, Palau, Pohnpei (FSM), Yap (FSM) and Kosrae (FSM), RMI, and Tuvalu. These schemes increase the capture of potentially commodifiable materials and can be supplemented by public or private processing prior to export. Revenue generated through the schemes can also be utilized in the exportation of non-commodifiable waste streams.

Currently, few islands responsibly manage ELTs. Common practices include stockpiling and illegal burning. These practices pose serious health risks to the public by providing habitats for mosquito breading during stockpiling and damaging air quality during burning.

Similarly, used oil is commonly exported rather than recycled or repurposed on island. If used oil were to be utilised on-island in power generation, this would mitigate additional emissions generated during its export while also offsetting emissions from virgin fuel sources (such as diesel).

There is limited available resources on current responsible management options for asbestos in the Pacific region, as materials are typically informally buried, stockpiled or disposed at landfills. There is an available contractor base to support clean-up operations, although there is a lack of controlled landfills for its responsible disposal.

Table 15 summarises current PIC recycling activities and infrastructure for tyres, e-waste, plastics, metals and used oil.

Table 15 Overview summary of current PIC recycling activities and infrastructure[51]

Country	Tyres	E-waste and batteries	Plastic	Metal	Used Oil
Cook Islands	Often burnt or dumped with some evidence of reuse.	Private companies (e.g., Cook Island General Transport) stockpile e-waste, batteries and EOL solar panels for export to NZ.	Aluminium cans and PET bottles collected through free weekly recycling service, sorted at the Rarotonga Waste Management Facility, baled and exported to NZ. Private recyclers (e.g., Cook Island Trading Corporation Ltd.) similarly operate dry recyclable collection, baling and export services. Exported 130 tonne of PET and 400 tonne scrap metal during 2015-16.		Evidence of export to Fiji steel mill. Exported 62 tonne of cooking oil in 2015-16.
Timor-Leste	Tyres stockpiled or burnt. Reports of 2 tyre recycling companies (no details of method of recycling).	Private company collecting and dismantling of e-waste and ULAB for export.	Two private companies currently shredding and bailing plastic bottles for export.	Private company collects and export scrap metal and aluminium to China.	ND
FSM	Often dumped or burnt. Stockpiles located at dumpsites are over capacity.	CDS collects used car batteries and e-waste.	CDS collects PET bottles. FSM landfill facilities (Dekehtik, Tofol and Yap State) operate shredders and balers capable of processing plastics.	CDS collects aluminium cans. The KTG Recycling Centre (Pohnpei) operates a recycled aluminium can press.	Used on-island as generator fuel (7.5 kL/yr).
Fiji	Stockpiled at landfill and burnt in kilns. ELT major island export.	Private recycling companies collect and export ULABs (e.g., Pacific Batteries Ltd).	Multiple private recycling companies collecting, baling and exporting PET bottles (e.g., Waste Recyclers and J.P.T Enterprise). Fiji is a major PET bottle manufacturer, exporting 116,000 tpa.	Multiple private recycling companies collecting, baling and exporting scrap metal and aluminium cans (e.g., Pacific Scrap Metal Buyers and Ace Recycling).	BlueScope Pacific Steel Pty. Ltd. and other industries accept used oil for fuel in primary industry. Oil also exported overseas (1.6 ML/yr).
Kiribati	Currently stockpiled.	CDS collects ULAB, white goods and e-waste. Currently stockpiled at Kaoki Mange Waste Recycling Facility.	CDS collects PET and aluminium cans, which are sorted and baled at the Kaoki Mange Waste Recycling Facility. Export 1 TEU of aluminium cans to Australia monthly.		Currently exporting to India (21 kL/yr) and Fiji via Oil Companies - Pacific Energy and Total Limited

[51] Data sources from PRIF (2018), Audit Reports (2021) and Used Tyre Report (2021)

Country	Tyres	E-waste and batteries	Plastic	Metal	Used Oil
RMI	Some shredding operations (Majuro Atoll) with illegal dumping and stockpiling.	Majuro Atoll local government collects and export ULABs.	ND	Majuro Atoll local government collects and bale aluminium cans for export. Majuro Atoll Waste Company utilise compactors and plasma arc technology for scrap metal recovery.	Consumed as power plant fuel or exported (130 kL/yr).
Nauru	Currently stockpiled.	ND	ND	ND	Nauru Phosphate Corporation accepts used oil as phosphate burner fuel (20 kL/yr).
Niue	ND	Biannual e-waste collection and disposal service provided by The Environment Department	Government provided crates for the collection of metal cans and plastic bottles. Niue Waste Recycling Facility currently in development.		Government entity collects and stores waste oil.
Palau	Tyre shredding at M-Dock Landfill, tyre shreds currently stockpiled.	Private recyclers collect e-waste and used batteries.	CDS collects plastic and aluminium beverage containers. Koror Redemption Centre sorts and bales materials for export. Private companies also operate collection and export businesses (e.g., Palau Waste Company and Belau Garbage and Scrap Company).		Consumed as power plant fuel.
PNG	Private companies shredding and granulating off-road tyres.	Private recyclers collect, bale (where necessary) and export e-waste, used batteries, metal, aluminium cans and PET bottles for export to Asia (China, Indonesia, India, Japan, South Korea, and Myanmar). Estimated 1,600-2,000 tonne of scrap metal and 300 tonnes of aluminium cans exported per month.			Private company operational for refining and recycling waste oil. Waste oil also exported.
Samoa	Stockpiling with tyre shredded operations currently being implemented.	Private recyclers collect, bale (where necessary) and export used batteries, e-waste, PET bottles, metals and ELVs. For example, Waste Management Co. export 9 tpa of e-waste, 20 tpa of batteries, 21 tpa of aluminium cans and 11 tpa of PET bottles to South Korea, Bangladesh, and India.			Currently exported
Solomon Islands	Currently stockpiled or illegally burnt. Potential pyrolysis plant development with NZ-based Nufuels.	ND	Ranadi Landfill possess a small warehouse and PET bottle bailer. Employs landfill waste pickers for collection.	Three private companies in Honiara collect metal, with a focus on aluminium cans for export. BJS Recycling ship two TEU of non-ferrous metals monthly.	Currently exported
Tonga	Stockpiled and illegally burnt.	Private company collects ULABs. In 2013, 50.4 tonne were exported to South Korea and NZ.	Private company collects and bales plastic bottled for export.	Private company collects scrap metal and aluminium cans. In 2013, 1,470 tonne	Private company collects used oil. In 2013, 54 kL were exported to

Country	Tyres	E-waste and batteries	Plastic	Metal	Used Oil
		E-Waste Tonga (non-profit organization) operates a recycling program.		of steel, 9.5 tonne of copper and 15.5 tonne of aluminium were exported to NZ.	India or to Fiji via Oil Companies - Pacific Energy and Total Limited
Tuvalu	Exported to other countries.	Advance recovery scheme collects PET, aluminium cans, car batteries and certain e-waste items, which are sorted and baled at the Funafuti Transfer Station. The scheme is new, and no export data is yet reported.			Exported to Fiji (4 kL/yr).
Vanuatu	Stockpiled at landfill and illegally burnt.	Private recyclers with international relations (with Australia and Korea) operational. For example, Recycle Corp collects aluminium cans, scrap metal, batteries and some e-waste utilizing landfill waste pickers. Currently exporting 2-3 TEU monthly to Asia.			Exported to India (125 kL/yr).

Conclusion

The following waste materials have been identified as being potentially financially feasible for export:

- Used batteries
- Waste oil
- Shredded ELT
- Whole e-waste
- Baled PET
- Baled HDPE
- Baled mixed plastics
- Baled aluminium cans
- Baled ferrous scrap

The remaining five waste types would incur a negative cost to PIC governments (at the time of this study) due to a range of market barriers, including:

- Low sale value at the export destination does not cover necessary shipping expenses even with the assistance of the MTP (as seen in baled ELTs);
- High processing costs exceed the material resale value (such as dismantled e-waste and ELVs); and
- Materials which incur a disposal cost at the export destination (such as asbestos).

However, this does not exclude them from being exported for recycling/ disposal for environmental and socially responsible reasons, or if these costs are covered through development donor support.

Infrastructure Gaps

PICs currently collect and export a range of commodifiable waste streams through a mixture of private and public operations (**Table 15**). There are opportunities for additional infrastructure to achieve best practice standards outlined in **This section** will summarise the minimum level of best practice material quality requirements, while providing resources for further consultation. **Error! Not a valid bookmark self-reference.** summarises the primary storage, pre-processing and safety considerations for each waste type.

*Table **10.*** These recommendations, along with additional technology applications with the potential to increase the viability of material exports, are outlined in **Table 16**.

Each PIC is recommended to consider expected material generation rates and how additional infrastructure, or technology will be implemented to inform decisions around their application.

Governments are also advised to make additional consideration around financial mechanisms, such as import levies, Advanced Recovery/ Extended Importer Responsibility Schemes or international aid, to cover the cost of material exports or fund infrastructure improvements.

Additional potential technology applications are outlined in *Assessment of Small-Scale Technology Suitable for Waste Management in the Pacific and Timor-Leste* (SPREP, 2020).

Table 16 Proposed technologies to address infrastructure gaps in each waste stream

Material	Infrastructure or technology recommendation
Asbestos	On-island disposal would require hazardous waste landfills aligned with US EPA standards and strict environmental controls. PICs typically lack the space and resources necessary to operate such facilities, as such, exportation and regulated disposal is the recommended treatment option. To facilitate export, access to polyethylene bags and PPE for the preparation of asbestos prior to export is required. Alternative construction materials, such as amorphous silica fabrics and cellulose fibres, should be investigated for their applicability in the region to decrease reliance on asbestos containing materials. PacWastePlus is developing guidance materials to support implementing importation bans on asbestos and asbestos containing materials to assist with eliminating the ongoing need to manage this material type.
Hazardous wastes (e.g. ULABs and used oil)	Many PICs currently export used oil and ULABs to foreign markets. This is achieved through a mixture of public and private operations. It is recommended that best practice management of hazardous waste stockpile facilities are implemented to prevent harm to public health and the environment. This includes, at a minimum: • Impermeable floors and stormwater runoff management to prevent seepage of toxic and corrosive chemicals; • Access to spill kits and PPE including training to respond to spills and remediation of contaminated materials; and • Sufficient personnel training and resources to sort, repair or separately contain damaged batteries. Access to pallets, corrugated cardboard, stretch wrap and material labelling is required to prepare hazardous materials for export. On-island management approaches present alternatives to waste oil exports. Sustainable financing or polluter-pays principles can be implemented to fund collection and storage systems. Oils can be burned in industrial kilns, boilers, or burners for the generation of heat. Larger generators or consolidation islands can also consider implementing mobile waste oil processing units, waste-oil generators or bioremediation techniques for the higher value recovery of remediated oil, electricity or fertilisers.[52]
Tyres	Some evidence of tyre shredding currently occurring in PICs. If tyres are to be exported on a larger scale, it is recommended to introduce baling or shredding technology to increase transport efficiencies and decrease disposal costs. At a minimum, these should be implemented at proposed "hub" nations for pre-processing prior to export. Baling and shredded tyres also decreases the risk of disease vectors at stockpile sites. There exist opportunities to utilise baled or shredded tyres on-island as TDF or in engineering applications. Baled tyres can be used in civil engineering applications such as embankment or road foundations. Shredded tyres have additional potential as feedstocks in cement clinker production or as drainage layers at landfill sites. Please see the PacWastePlus website to access reports and research related to the alternative use of ELTs (www.pacwasteplus.org).
E-waste	Private recyclers in the Pacific region currently export whole and dismantled e-waste. It is recommended that facilities and operations are monitored to ensure environmental compliance to reduce the pollution of mercury or ozone depleting substances. Further processing technology is not recommended for small island nations due to significant capital expenditure and potential environmental impacts. Manual separation, sorting and de-pollution activities provide potential employment opportunities, although require strict monitoring of health and safety procedures to avoid associated risks. Items suitable for reuse can also be identified and removed from the waste stream.

[52] More details of waste oil management approaches and stewardship scheme structures are available in the *Establishment of Used Lubricants and Oil Management System in Papua New Guinea* (SPREP, 2017)

Material	Infrastructure or technology recommendation
Plastics and metals	It is recommended that single stream/ low contamination plastics and metals are baled prior to export to increase transport efficiencies and acceptance at recycling end markets. All PICs either currently possess balers (whether owned by government facilities or private recyclers) or are in the process of developing recycling facilities with baling technology. It is recognised that baling infrastructure is not likely present on outer islands. At a minimum, balers should be available at proposed "hub" nations to prepare materials prior to export. This will increase the expected revenue from these materials and increase their market acceptance. There exist potential for larger nations to implement on-island processing technology capable of shredding plastic for efficient transport or pelletising plastics for use as feedstock in primary industry. These applications are most suitable for countries current manufacturing PET bottles to decrease reliance on virgin materials. Other technologies targeting mixed/unsorted plastics can significantly increase island recycling rates, such as the production of building material aggregate.
ELV	To achieve best practice de-pollution standards, stockpile and processing facilities should at a minimum have impermeable floors to prevent pollution from oil runoff. It is recommended to implement industry standard vehicle lifts to increase the safety and efficiency of de-pollution activities conducted by trained personnel. The application of metal cutting tools can be considered for the recovery of ferrous scrap. Additional disposal arrangements should be in place to deal with residual streams from ELV de-pollution such as used oils, foam seats (particularly those containing POPs), mixed plastics or window glass. Whole ELV transport efficiencies can be increased through use of mobile vehicle crushers or heavy-duty balers. More efficient transportation of ELVs will significantly increase its export viability and profitability.

Recommendations

To develop PIC access to international recyclate markets and material exports the following recommendations have been made:

- Review the collection network of preferred materials to understand the limitations of capturing waste materials for local processing and export. Additional collection and sorting networks would need to be in place to capture the maximum potential quantities. This will include:
    - Resources for domestic transport for the consolidation of materials from outer islands to a port facility capable of international transport;
    - Land-based collection and transportation of materials; and
    - Backloaded vessel travelling from outer islands.
- Review the minimum best practice material quality requirements for material storage, processing and transport for each PIC. These should be compared with current island resources in both private and public operations. See Section 0 for more details.
- Identify financial incentives/ programs to make it financially feasible to export difficult to manage waste streams. Such systems could include advanced recovery fees, reverse logistics options, aid funding or sustainable financing mechanisms.
- The consolidation of materials within the Pacific region prior to export is a possibility for PICs which have high international freight rates or are not currently serviced by the MTP (or similar arrangements with other shipping companies such as Kyowa).
- Conduct further research into potential on-site reuse and recycling of certain waste streams (such as used oil, ELTs, e-waste and ELVs) in PIC region to encourage circular economy opportunities.

Recycling Options Feasibility

A Pacific regional consolidated recycling network is proposed based on the findings and recommendations of the previous Sections. This work is the basis of more detailed investigations by partner donor projects lef by J-PRISM II and PRIF.

This network will rely on coorporation between nations to form a hub-and-spoke coordinated system, whereby material is shipped within the region from a “spoke” nation, to be consolidated at a larger “hub” nation prior to export to an international market.

This model has been designed using considerations of access to the MTP, current recycled material generation rates and average shipping rates to international markets. Some nations are classified as “variable”, signifying their capacity for either “hub” or “spoke” operations dependent on the waste stream.

Figure 3 represents a proposed model for this coordinated network, showing recommended and alternative shipping routes for the consolidation of waste material prior to export. Existing shipping lanes and backfilled containers could be utilised to transport waste from hub locations to international markets.

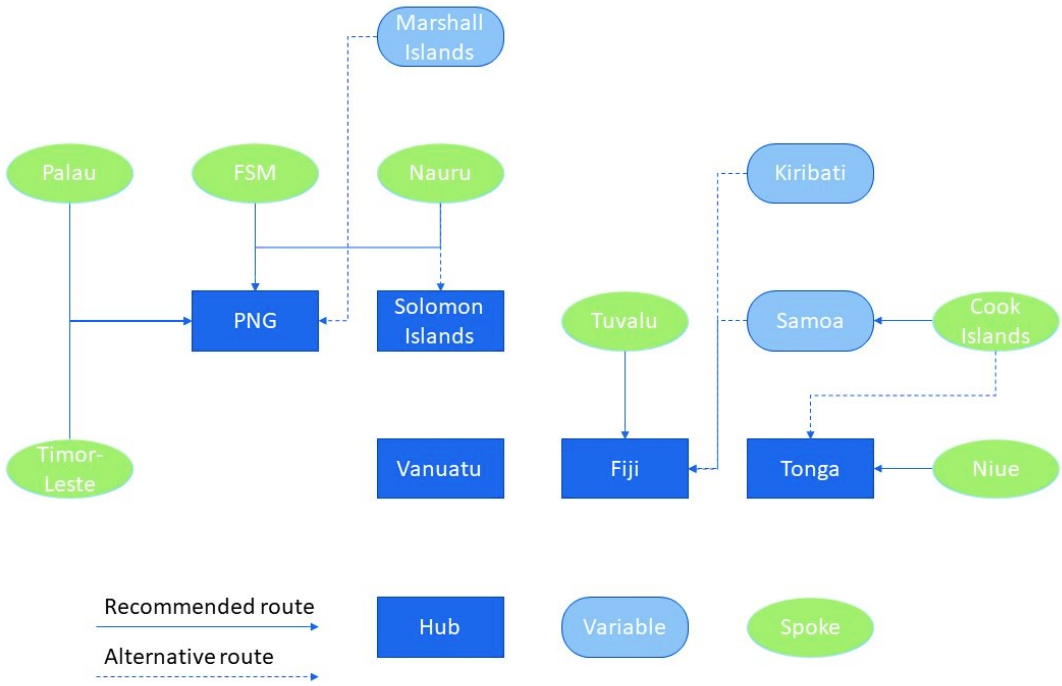

Figure 3 Potential Pacific Region hub-and-spoke coordinated waste network

References

Data Source	Relevance
Cleaner Pacific Strategy 2025 **(SPREP, 2016)**	Data concerning waste disposal infrastructure, asbestos stockpiles, used oil generation and disposal, legislation and conventions per country
State of the 3Rs in Asia and the Pacific **(SPREP, 2017)**	Breakdown of recycling streams for Fiji, Samoa, Tonga, Tuvalu and Vanuatu. Guidance regarding international markets for recycled material.
Data Collection Survey on Reverse Logistics in the Pacific Islands **(JICA, 2017)**	International/ domestic port infrastructure and private recycling companies operational in Fiji, Samoa, Tonga, Tuvalu and Vanuatu. Additional information regarding export destinations and material selling prices.
Fact sheets on specific waste streams developed by the Basel Convention[53]	Information on the handling, storage and safety of waste streams classified under the Basel Convention
Waste Trade In The Philippines: How Local And Global Policy Instruments Can Stop The Tide Of Foreign Waste Dumping In The Country **(Greenpeace, 2020)**	Details of Philippines waste import market
Overview of Basel Convention Plastic Waste Amendments[54]	Details of the recent changes to the Basel Convention to include plastic wastes
SPREP Waste Audit Reports (2021)	Data and information on PIC infrastructure, stockpiles and waste disposal rates (FSM, Nauru, Niue, PNG, RMI, Samoa, SI, Vanuatu)
Solid Waste Management and Recycling **(PRIF, 2018)**	Overview of country recycling activity and infrastructure. Average international shipping rates and additional details of port infrastructure. Estimated metric tonnes of recoverable materials.

[53] Available: http://www.basel.int/Implementation/CountryLedInitiative/EnvironmentallySoundManagement/ESMToolkit/Factsheets/tabid/5843/Default.aspx
[54] Available: http://www.basel.int/Implementation/Plasticwaste/Amendments/Overview/tabid/8426/Default.aspx

Appendix A: Legislative Review Matrix

Country	SC	BC	WC	RC	MP	MC	AFC	Other waste export/ shipping legislation and policy
Cook Islands	x	x	x	x	x		x	Solid and Hazardous Waste Bill (currently under development): will introduce single use plastic bans and establish sustainable financing mechanisms for waste management.
Democratic Republic of Timor-Leste	x				x			Legislative Authorisation on Environmental Matters: prohibits the importation of dangerous wastes. Subjects' special legislation to its transportation, storage, and export. Decree-Law 21/2003 - Quarantine and Sanitary Control on Goods Imported and Exported: establishes judicial regime of quarantine to prevent/ control the spread of disease
Federated States of Micronesia (FSM)	x	x	x		x			Plastic Products Ban 2020: prohibits import of single use plastics and PS Yap Container Deposit Legislation 2008: sustainable financing system for the collection of beverage containers, car batteries, home appliances and e-waste. Pohnpei Container Deposit Legislation 2011: sustainable financing system for the collection of aluminium cans Kosrae Container Deposit Legislation 2006: sustainable financing system for the collection of beverage containers, car batteries, home appliances and e-waste.
Fiji	x		x		x			Environment and Climate Adaptation Levy (Plastic Bags) Regulations 2017: point of sale levy for single use plastic bags Environmental Management (Container Deposit) Regulations 2011: sustainable financing model with point-of-sale levy and refund scheme for beverage containers. Future bans to PS will be introduced under the Climate Change Act
Kiribati	x	x	x		x	x	x	Kiribati Development Plan 2016-19: strengthening the countries capacity for waste collection and processing for export. Special Fund (Waste Material Recovery) Act: levy program for cans, bottles, and batteries (*Kaoki Maange* scheme and recycling fund)
Marshall Islands	x	x		x	x		x	Styrofoam Cups and Plates, and Plastic Products Prohibition, and Container Deposit Act 2016: bans the import of single-use plastic/ PS items. Establish container deposit scheme and recycling fund.
Nauru	x	x	S		x			Customs Proclamation (Prohibition of Export of Scrap Metal) 2007: encompasses copper, aluminium steel and ULAB with possible impacts on e-waste. Customs Act 2014: regulates export of asbestos and deposit fees on import of recyclable drink containers (recycling fund)
Niue	x		x		x		x	Customs Import Prohibition (Plastic Shopping Bags) Order 2020: prohibits import of plastic shopping bags and phased roll out of organic bag alternatives.

Country	SC	BC	WC	RC	MP	MC	AFC	Other waste export/ shipping legislation and policy
Palau	x	x	S		x	x	x	Beverage Container Recycling Regulations: regulates the ban of single-use plastic shopping bags and enforces the beverage container deposit scheme. Encourages other recycling activity through recycling fund.
Papua New Guinea	x	x	X		x			Environmental Act 2000: governs import/ export of hazardous contaminants. Only current relevant regulations concern ozone depleting substances and pesticides, which require environmental permits.
Samoa	x	x	x	x	x	x		Waste Management Act 2010: prohibits the import, manufacture, or export of plastic shopping bags, packing bags, straws, single use PS and toxic or hazardous substances. Encourages other recycling activity.
Solomon Islands	x		x		x			N/A
Tonga	x	x	x	x	x	x	x	Hazardous Wastes and Chemicals Act Cap 47.08: prohibitions and procedures for the import/export of hazardous wastes/ chemicals/ POPS. Waste Management (Plastic Levy) Regulations 2013: imposes levy on the import of plastic bags
Tuvalu	x		x		x	x	x	Ozone Depleting Substances (ODS) Regulations 2010: prohibits import/ export of certain plastic foams Waste Management (Levy Deposit) Regulations 2019: levies charged, and refunds provided to encourage recycling Waste Management (Prohibition on the importation of single-use plastics) Regulation 2019: bans to importation of a wide range of single-use items
Vanuatu	x		x	x	x	x	x	Waste Management Act 2014: prohibits the manufacture and import of a broad range of single-use plastic items
Australia	x	x	x	x	x	S	x	Hazardous Wastes (Regulation of Export and Imports) Act 1989: controls the implementation of the Basel Convention around the import of hazardous wastes and unsorted plastics, including the requirement for permits to be obtained prior to hazardous wastes being imported to Australia. Hazardous Wastes (Regulation of Export and Imports) (Imports from East Timor) Regulations 2003: bilateral arrangement between Australia and East Timor for the transboundary movement of hazardous waste Customs (Prohibited Imports) Regulations 1956: prohibits the import and export of asbestos with the Asbestos Safety and Eradication Agency responsible for administering permissions OECD Member Country
New Zealand	x	x	x	x	x	S		Imports and Exports (Restrictions) Act: controls the implementation of the Basel Convention around the import of hazardous wastes. and plastic wastes. Requires permits to be obtained prior to hazardous wastes being imported to New Zealand. Prohibition Order (No 2) extends the act to include materials covered under the Stockholm and Rotterdam Conventions. Hazardous Substances and New Organisms Act 1996: prohibits, except with the consent of the EPA, the import of asbestos. Import Control (Tyres) Conditional Prohibition Order 1996: prohibits, except with the consent of the Minister of Commerce, the importation of new or used tyres that do not meet specific standards OECD Member Country

Country	SC	BC	WC	RC	MP	MC	AFC	Other waste export/ shipping legislation and policy
Korea	x	x		x	x	x	x	Plans to implement restrictions on the import of 10 kinds of industrial waste. Roadmap will prohibit in 2022 the import of plastic waste, mixed wastepaper, and waste fibres. In 2023 tyres will be prohibited. Waste batteries, metals and e-waste will not be restricted due to high value materials. OECD Member Country
Philippines	x	x		x	x	x	x	Republic Act 6969 (Toxic Substances and Hazardous Nuclear Wastes Control Act) 1990: prohibits the import of hazardous wastes (not including plastics) No bulky waste import bans or steps to ratify the Basel Ban Amendment are in place.
Hong Kong	x	x		x	x	x	x	Waste Disposal Ordinance: outlines-controlled wastes imported for the purposes of recycling (such as e-waste, hazardous chemicals, batteries and used oil) as requiring a permit from the Environmental Protection Department. Hong Kong moving to implement bans around scrap plastic as per the updated Basel Convention
Japan	x	x		x	x	x	x	Japanese Basel Law (Law for the Control of Export, Import and Others of Specified Hazardous Wastes and Other Wastes): enforcement of Basel Convention Waste Disposal and Public Cleansing Act: only allows firms that dispose/ recycle wastes themselves to import wastes OECD Member Country
Indonesia	x	x		x	x	x	x	Ministry of Trade Regulation No. 84/2019: import of plastic waste must comply with set requirements - is generated from industry (not household), is not B3 (hazardous, toxic, or dangerous), will be used only for secondary raw materials production, importer holds an import licence and receives approval for import. Requires plastics to be homogeneous and uncontaminated (2% limit). Have prohibited the import of ULAB under the Basel Convention Plans to further ban the importation of wastes.
Malaysia	S	x		x	x	S	x	Solid Waste and Public Cleansing Management Act 2007: allows for the import of plastic waste to contribute to upgrades in local recycling industry. Requirements for import permits and maximum quotas. Permits not required for single type plastics, pellet, or flake.

**** Stockholm Conv (SC), Basel Conv. (BC), Waigani Conv (WC), Rotterdam Conv. (RC), Montreal Protocol (MP), Minamata Conv. (MC), Anti-Fouling Conv. 2001 (AFC)***

Appendix B: Target Recycling Companies Index

Waste Type	Country	Company
Asbestos	NZ	PRO Environmental Services - https://environmentalservices.nz/
		HAZMAT Asbestos - https://www.hazmat.co.nz/
		DEMASOL - https://www.demasol.co.nz/
		Asbestos Contracting Ltd - https://www.asbestoscontracting.co.nz/
Used Batteries	Australia	Dodd & Dodd - dodd.com.au
		Watts Batteries - https://www.wattsbatteries.com.au/
		IQ Renew - https://www.iqrenew.com/
		Envirostream Australia - https://envirostream.com.au/
		Eco Cycle - https://ecocycle.com.au/
	NZ	Upcycle - https://upcycle.co.nz/
		Ecotech Services Ltd - https://www.ecotechservices.co.nz/
		Junk Run -https://www.junkrun.co.nz/
		Remarkit - https://www.remarkit.co.nz/
	Philippines	Philippine Recyclers Inc.
		Ecoglobal Inc.- https://ecoglobal-group.com/
		Enviro Cycle Philippines - https://envirocycle-inc.com/
	Hong Kong	Hong Kong Battery Recycling Centre Ltd.- http://hkbr.com.hk/
		Li Shing Environment & Waste Control Co.
		CNA E-Cycling Ltd.
		Hong Kong Yi Fu Environmental Ltd.
		Wing Kai Destruction & Recycle Co.- http://www.wingkai.net/en/index.asp
		Alba Integrated Waste Solution - https://weee.com.hk/
	Korea	SungEel Hi Tech (for LIBs) - http://www.sungeelht.com/
	Japan	Volta Inc. (for LIBs) - https://www.env-volta.jp/en/
Waste Oil	NZ	The Oil Man - https://www.theoilman.co.nz/
		Fulton Hogan - https://www.fultonhogan.com/
		WPC (Waste Oil Recovery) - http://www.oilrecovery.co.nz/
		Ex Oil - http://www.petroleumservices.co.nz/ExOil
		Salters Cartage - https://www.salters.co.nz/
	Fiji	Bluescope Pacific Steel Pty. Ltd
	Indonesia	Wiraswasta Gemilang Indonesia - http://ptwgi.com/
	Philippines	Asia United Oil Industry Corporation - https://auoic.wordpress.com/about/
		Servo Treat Philippines
Tyres	Australia	BSV Tyre Recycling - https://www.bsvtyres.com.au/
		S & J Australian Scrap Tyre Disposal - http://www.astd.com.au/
		Tyrecycle - https://tyrecycle.com.au/
	NZ	Waste Management NZ Ltd. - https://www.wastemanagement.co.nz/
		Tyre Recycling Waikato - http://tyrerecyclingwaikato.co.nz/
		Flecher Building (industrial cement production) -https://fletcherbuilding.com/
		Revyre - https://www.revyre.co.nz/
	Korea	Kingtiger (Shanghai) Environmental Technology Co., Ltd. https://kingtigergroup.com/tyre-recycling-pyrolysis-plant-korea/
	Japan	Klean Industries - https://kleanindustries.com/
		Tyres S.p.A, - http://www.tiresspa.com/home.html
		Entry Co. Ltd.
		Hikari World Co. Ltd. - http://www.hikari-world.com/e/company.html
		Kokubu Shokai Co. Ltd. - https://www.kkb-tire.co.jp/eng/recycle/
	Malaysia	Green Rubber - https://www.greenrubbergroup.com/
		Eco Power Synergy Sdn Bh - http://www.ecopower.com.my/

Waste Type	Country	Company
		Evergreen Corporate Sdn Bhd - https://www.evergreencorporate.com/
E-Waste	Philippines	Jack Electronic Metal Inc.
	Honk Kong	Wai Mei Dat Recycling Co. Ltd.
		Chiho Eco Protection Ltd.- http://chihogroup.com/
		Li Shing Environment & Waste Control Co.
		P L Environmental Ltd.
		CNA E-Cycling Ltd.
		Hong Kong Yi Fu Environmental Ltd.
	Korea	JOY Advanced Materials Inc. - http://joyam.co.kr/eng/main.html
		S3R Co. Ltd. - https://s3r.co.kr/?lang=en
		RTECH Korea - https://www.diehdd.co.kr/english/main.htm
	Indonesia	Eco Beringin - http://ecoberingin.com/en/
	Malaysia	Cycle Trend Industries Sdn Bhd - https://www.cycle-trend.com/
		Shan Poornam Metals Sdn Bhd
		UrbanR Recycle - http://getfitkl.com/urbanr-recycle/
		Metech Recycling Pty Ltd. - https://metechrecycling.asia/
		TEX Cycle (including solar panels) - http://texcycle.com.my/texcycle/
Mixed plastics	Philippines	EnviroTech Waste Recycling Inc.
		Green Antz Builders Inc. (including soft plastics)
	Malaysia	Aspen Recycle - http://aspenrecycle.com/
		Chi Yang Global Recycle - https://www.cygrecycle.com/
		Plasticycle Industries Sdn Bhd - http://plasticycle.com.my/
Single stream plastics	Australia	Valera Recycling - https://www.valerarecycling.com.au/
		Replas Recycled Plastic Products - https://www.replas.com.au/
	Indonesia	Polindo Utama (PET) - https://polindoutama.com/
		PT Production Recycling Indonesia (PET) - https://www.pt-pri.com/
		CreaSolv Sachet Recycling (single film polyethene) - https://www.creacycle.de/en/
	Malaysia	EPD Plastic (single film polyethene) - https://www.epdplastic.com/
		IPOH S.Y Recycle Plastic Sdn Bhd (single film polyethene) https://ipohsy.com/
Non-ferrous metals	Australia	E-planet Scrap Metal Sydney - https://www.scrapmetalsydney.com/
		Sims Metal Management - https://www.simsmm.com/
		Yennora Copper Recycling - https://ycrcopperrecycling.com.au/
		Infra Build Recycling - https://www.infrabuild.com/en-au/our-businesses/about-us/
		Mr Metal Recycling - https://mrmetalrecycling.com.au/
	NZ	Metalman Auckland - https://metalman.co.nz/
		General Metal Recyclers Ltd - https://gmr.co.nz/
		Go Recycle - https://gorecycle.co.nz/
		Western Recycling - http://www.westernrecycling.co.nz/
		Metal Corp - https://www.metalcorp.co.nz/
	Philippines	Jgarcia Scrap Materials Trading - https://garcia-scrap-trading.business.site/
		IRI Philippines - https://www.iri.com.ph/index.php
	Hong Kong	Advanced Metal Alloys and Recovery Ltd. - https://amarlglobal.com/
		Fukutomi Co Ltd.- http://www.fukutomi.com/
		Powerstep Limited Recycling - https://www.powersteprecycling.com/
		SBE International - http://innoresources.com/
	Korea	Kumkang Kind - http://www.kumkangkind.com/eng/index.asp
		Dongnam Metal - http://www.dongnam-metal.co.kr/
	Japan	eCONeCOL Inc.- http://www.econecol.com/
	Malaysia	Cycle Trend Industries - https://www.cycle-trend.com/
		KCA Metal
		Johor Material Scrap - http://www.johormaterialscrap.com/

Waste Type	Country	Company
		PMK Muhibah Trading Sdn Bdh
Ferrous metals	Australia	Austip Recycling - https://www.austiprecycling.com/
		Australian Metal Co Pty Ltd - https://www.australianmetalco.com/
		Tecbo Group - https://www.tecbogroup.com.au/
		Sydney Metal Traders - https://www.sydneymetaltraders.com.au/
	Hong Kong	Chung Yue Steel Group Co. - http://www.chungyue.com/
		China Metal Recycling (Holding) Ltd.
	Malaysia	Cycle Trend Industries – https://www.cycle-trend.com/
EOL Vehicles	Australia	Auto Recycling Industries Pty Ltd - https://autoriptyltd.com.au/
		Scrap Car Removal (Cash for Cars) -https://www.scrapcarsremoval.com.au/
		Danny Scrap Metal - https://dannyscrapmetal.com.au/
		Scrappy's Metal Recycling - https://scrappys.com.au/
	Hong Kong	Yuanfa Automobile Recycling Co Ltd. - https://www.hkyfcar.com/
		HK Best Scrap Car Co. - https://hkscrapping.wixsite.com/scrapcar/bestscrapcar
		YHH Scrap Car – http://www.hkscrapcar.com/
		Speed Scrap - https://speedscrap.com/
		HK Recycles - https://www.hkrecycles.com/
	Korea	Joengkwan Car Scrapping Station Co Ltd. https://www.gmdu.net/corp-453937.html
		KADRA - http://www.kadra.or.kr/kadra/eng/contents/sub01/01_01.html
		DAEHAN Steel and Recycling - http://www.daehansr.com/

Appendix C: Cost Model Assumptions

Average Shipping Rate	Import Country								
	Australia	**NZ**	**Korea**	**Philippines**	**Hong Kong**	**Japan**	**Indonesia**	**Malaysia**	**Fiji**
Cook Islands	ND	3150	ND	ND	ND	ND	ND	ND	ND
Timor-Leste	ND	ND	ND	ND	ND	ND	ND	ND	ND
FSM	ND	ND	4210	ND	4210	4210	ND	ND	ND
Fiji	3325	3250	3725	2865	3725	3725	2865	2865	950
Kiribati	3350	ND	3565	ND	3565	3565	ND	ND	2896
Marshall Islands	2900	ND	3080	ND	3080	3080	ND	ND	3425
Nauru	ND	ND	ND	ND	ND	ND	ND	ND	ND
Niue	ND	ND	ND	ND	ND	ND	ND	ND	ND
Palau	ND	ND	3860	ND	3860	3860	ND	ND	ND
PNG	2950	3150	2500	2800	2500	2500	2800	2800	ND
Samoa	3625	3641	3000	3450	3000	3000	3450	3450	ND
Solomon Islands	3400	ND	ND	ND	ND	ND	ND	ND	3110
Tonga	3625	3641	3000	ND	3000	3000	ND	ND	3450
Tuvalu	ND	ND	ND	ND	ND	ND	ND	ND	3200
Vanuatu	2875	3500	3025	ND	3025	3025	ND	ND	3500

Source: *Solid Waste Management and Recycling Report* (PRIF, 2018). Note all costs reported in USD$/TEU for non-hazardous goods, inclusive of un/loading and a bunker adjustment factor. Values exclude custom clearance duties and quarantine inspections. It is assumed the 'North Asia' region includes Korea, Hong Kong and Japan while the 'South Asia' region includes the Philippines, Indonesia and Malaysia.

Appendix D: Recycling Markets Option Matrix

Focus area	Asbestos	Hazardous chemicals (incl ULAB and used oil)	Tyres	E-waste (incl EOL solar cells)	Plastics	Metals (incl whitegoods, EOL vehicles, aluminium, tin/steel cans)
International conventions and agreements	Basel Convention (Annex I) Rotterdam Convention (Annex III) Waigani Convention (Annex I)	Stockholm and Rotterdam Conventions: various pesticides, industrial chemicals, and leaded fuels Basel and Waigani Conventions: a wide range of hazardous wastes including clinical wastes, used oils and mercury or lead containing materials Montreal Protocol: materials containing ozone depleting substances	- Recent legal advice provided to the Australian Tyre Recycling Association (ATRA) however suggests Basel may consider control of used tyre exports under certain conditions including those prescribed by the exporting country, the importing country, or any of the countries of transit.	Basel and Waigani Convention (Annex VIII) Montreal Protocol: control the release of ozone depleting substances (found in refrigerants and air-conditioners).	- Basel Convention: regulate the transboundary movement of plastics. Only plastic wastes listed in new Annex IX entry B3011 (unmixed and not contaminated and destined for recycling) are not subject to the Basel Convention's prior informed consent procedure and other controls. Requires plastics to be sorted, mostly halogen-free and "almost free from contamination" of any kind.	- Basel Convention: required the removal of car batteries, used oils and electronic equipment prior to transboundary movement.
Waste shipping/ export legislation per participating nation	See 0 for details of legislation per participating nation.					
Future changes to legislation	- Niue working to ratify the Basel, Minamata and Rotterdam Conventions, which will	- FSM developing a Chemical Management System and the role of a Chemical Waste	- Recent interest in a number of PICs for exploring opportunities for waste-to-energy	None identified	- The Cook Islands are currently developing the Solid and Hazardous Waste bill	None identified

Focus area	Asbestos	Hazardous chemicals (incl ULAB and used oil)	Tyres	E-waste (incl EOL solar cells)	Plastics	Metals (incl whitegoods, EOL vehicles, aluminium, tin/steel cans)
	require changes to national legislations regarding hazardous wastes.	Management Officer who could oversee the export of hazardous wastes - CI are planning to pass the Solid and Hazardous Waste Bil in 2021 to provide legislative framework for hazardous waste management and commitments under relevant MEAs. - Kiribati developing a national information sharing system under the UNEP Chemicals and Waste Management Program, assist in the data analysis and reporting requirements for waste shipments.	projects, such as the "Navigating our Energy Future: Marshall Islands Electricity Roadmap" report. Island incineration or pyrolysis technology could be used to processes ELT given the necessary changes to supportive legislative frameworks.		that will introduce a ban on the import of single use plastics. - The Environment and Conservation Division in Kiribati is working on various initiatives to reduce plastic waste. These include a new 'seeds for plastic' swap scheme, efforts to ban the import of single use plastic shopping bags, and implementation of the Plastic Free School initiative. - Future bans to polystyrene imports to Fiji will be introduced under the Climate Change Act. - Timor-Leste have announced intentions to become the first 'plastics-neutral' economy, assisted by the Government of Timor-Leste signing a memorandum of understanding at the	

Focus area	Asbestos	Hazardous chemicals (incl ULAB and used oil)	Tyres	E-waste (incl EOL solar cells)	Plastics	Metals (incl whitegoods, EOL vehicles, aluminium, tin/steel cans)
					University of Sydney with Mura Technology for the development of a $US40 million chemical recycling plant.	
Market destination (incl facility names and contact details were available)	All investigated destination countries have ratified the Basel Convention and put in place specific legislation governing the movement of hazardous wastes. Hence, strict legislative controls will limit the viability of asbestos export and disposal. Certain specialist companies (such as SOCADIS LTD in NZ), will accept hazardous waste at a premium cost.	Batteries (pursuant to government permits under the Basel Convention) - Australia, NZ, Korea, Philippines, Hong Kong, and Japan Used oil - Fiji, Indonesia, Nauru, NZ, Philippines Bilateral arrangement between Australia and East Timor for the transboundary movement of hazardous waste. Otherwise, ratifications of the Basel Convention will prevent the transboundary movement of other hazardous wastes (such as medical or biological wastes).	Australia, NZ, Malaysia, Korea, Japan	Korea and Malaysia the most likely export destinations. This is due to a lack of regulatory enforcements of the Basel Convention for the import of e-waste and the governments encouragement of the local recycling industry. Although care should be taken in selecting reputable recyclers for the safety of public health and the environment. Private company Tes-Amm potential logistics partner (locations in Indonesia, Malaysia, Australia, NZ, Philippines, Hong Kong, Japan, and Korea).	The primary export markets for plastic waste (mixed or pre-pre-processed) are the Philippines and Malaysia. Indonesia and Australia also have the potential to accept plastic waste, although only of a very high quality and sorting standard.	Aluminium cans - Australia, NZ, Korea, Philippines, Hong Kong, Indonesia, and Malaysia Ferrous scrap metal - Australia, Hong Kong, Korea

Focus area	Asbestos	Hazardous chemicals (incl ULAB and used oil)	Tyres	E-waste (incl EOL solar cells)	Plastics	Metals (incl whitegoods, EOL vehicles, aluminium, tin/steel cans)
Insurance	It is necessary for both exporters and importers to provide financial guarantees in accordance with national or international law requirements. This guarantee is necessary to provide immediate funds for alternative recycling, disposal, or other means of environmentally sound management of the wastes in cases where the transboundary movement and the recovery operations cannot be carried out as foreseen. Certain countries require by domestic law that all transboundary movements be subject to the provision of a financial guarantee (e.g., insurance policy, bank letters, bonds, or other means of compensation). Liability insurance should at a minimum cover: damages to other parties for which the exporter is responsible; and costs imposed by law on the exporter to mitigate damage caused by accidental material release to the environment. Specific domestic laws will need to be consulted to determine the quantity and duration of insurance requirements.					
Tariffs	Average asbestos fibres (HS 6812): 6.82% Australia: 0.76%	Average scrap batteries (HS 854810): 0%	Average used pneumatic tyres (HS 401220): 15.2% Australia: 3.42% NZ: 1.21% Malaysia: 24.4% Korea: 4.52% Japan: 0%	Average electrical waste scrap (HS 8548): 5.7% Korea: 2.16% Malaysia: 10%	Average scrap plastic (HS 3915): 8.89% Philippines: 3.65% Malaysia: 20% Indonesia: 4.73% Australia: 3.41%	Average scrap aluminium (HS 7602): 2.83% Average ferrous (HS 720449): 2.59% All target countries: 0%
Shipping rates (incl wharf fees and stevedore charges)	See relevant cost model assumptions for average shipping rates in the Pacific Region. These values are inclusive of port stevedore charges and bunker adjustment factors. Stevedores are labourers responsible for un/loading containers from ships, securing goods on the vessel and un/berthing the vessel from the port. Depending on the circumstances their services are provided by the shipping company, port authority or a separate private entity. Fees are usually charged on a per unit (TEU) basis. A bunker adjustment factors is a surcharge levy set by shipping operators to compensate for fluctuations in marine fuel prices. Fees are usually charged on a per unit (TEU) basis and accounts for the specific conditions of the shipment (i.e., the route, distance, transit time, vessel size and build and fuel efficiency). Wharf fees (also known as wharfage charge) must be paid at both export and import ports where material is loaded or unloaded from the vessel. They are not inclusive of any additional service charges such as stevedore rates. Wharfage can be calculated on a weight (tonnes), volume (cubic metres) or unit (TEU) rate.					
Recyclate quality standards (incl minimum quantities, storage requirements,	All asbestos must be contained in new heavy duty polyethylene bags or sheeting (minimum 200-micron thickness).	ULAB: Must be stored inside an acid resistant container or placed on pallets/ pallets/ another impermeable	Maximum height of outdoor piles should be 3 m, maximum pile width should be 6 m, and maximum pile	Storage areas should be sheltered and have an impermeable surface with sealed drainage system.	Mixed plastics should be sorted to separate high value fractions of PET and HDPE. Plastics should be baled to	EOL Vehicles: Storage must have spillage containment including sealed drainage and spill kits for oils, fuels

Focus area	Asbestos	Hazardous chemicals (incl ULAB and used oil)	Tyres	E-waste (incl EOL solar cells)	Plastics	Metals (incl whitegoods, EOL vehicles, aluminium, tin/steel cans)
material form and contamination rates)	Adhesive tape used to tightly secure bags and sheets. Material stored in a solid waste drum, skip or shipping container ensuring that warning labels are placed on the exterior of each receptacle.	surface. Collection containers should be used where possible to avoid spillage. Batteries should be stacked in an upright orientation with all the vents and inspection caps firmly in place (missing caps should be replaced or sealed with foam). Terminals should be insulated with tape or cardboard. Prior to packaging, batteries need to be inspected for damage. Thick corrugated cardboard should be placed on pallets and between each layer of batteries and secured with clear stretch wrap. Damaged batteries should be transported in compatible salvage drums or repaired to prevent leakage. standard-2013-final2.pdf	length should be 2- m. Regulations also apply for the spacing required between piles and buildings (60 m). Fire breakers required to reduce the spread of fires with strict fire safety practices to remove possible ignition sources. Piles should be covered with an impermeable barrier or follow a vector control plan (to reduce the risks of disease bearing mosquitos). Sorting should be based on suitability for direct reuse, reuse following retreading, require disposal/ recycling.	Batteries, PCB/ PCT-containing capacitors, mercury containing components and other hazardous components should be stored in dedicated, labelled, and appropriate containers. Care must be taken with flammable or explosive components (such as batteries) by ensuring storage minimises risk of fire, heat, or sparks. Specific considerations need to be made around used lithium-ion batteries to protect against short circuiting and fires. Some recyclers require e-waste to be pre-processed. This would require the manual dismantling of products and the removal of hazardous substances. Operations must	increase transport efficiency.	and acids. Silt traps and oil separators should be installed for the treatment of storm water runoff. Regular site clean-up and housekeeping practices are necessary to Minimise storm water pollution. Upon arrival, EOL vehicles must be inspected for leaks or unwanted materials. Leaks need to be collected in drip trays. Dismantling must occur on an impermeable surface. If the engine, transmission, or hydraulic systems are not disturbed, dismantling can occur on a hard-standing surface. De-pollution (removal of fluids and components which may be explosive or corrosive) should occur

Focus area	Asbestos	Hazardous chemicals (incl ULAB and used oil)	Tyres	E-waste (incl EOL solar cells)	Plastics	Metals (incl whitegoods, EOL vehicles, aluminium, tin/steel cans)
		Used oil: Community drop off locations with separate tanks for common oil types recommended. Mixing waste oils should be prohibited in order not to compromise downstream treatment processes. Must stipulate the allowable limit contents of chlorine, polychlorinated biphenyls (PCBs), carcinogenic polycyclic aromatic hydrocarbons (PAHs), POPs and heavy metals.		comply with environmental best practices, such as prevention of fugitive emissions of mercury or ozone depleting substances.		on a support frame or lifting device. A pit can be used although has health and safety concerns such as the build-up of vapours. The procedure includes remove battery, remove fuel filler cap and oil filler cap, set heater to maximum, remove wheels and tyres, remove mercury containing parts, drain engine oil, transmission oil, coolant, brake fluid, washer bottle, brake/ clutch reservoir, power steering reservoir, fuel tank and suspension fluid, remove oil filter, de-gas air conditioning unit, remove catalyst, deploy and remove airbags and other pyrotechnics. Fuels, oils, brake fluids and antifreeze should be kept in separate containers (preferably

Focus area	Asbestos	Hazardous chemicals (incl ULAB and used oil)	Tyres	E-waste (incl EOL solar cells)	Plastics	Metals (incl whitegoods, EOL vehicles, aluminium, tin/steel cans)
						steel drums). Fuels should be stored in a separate, well-ventilated area. Separate handling and storage considerations are required for mercury containing components and asbestos-containing brake shoes.
Commodity values for expected material forms and market destinations	See relevant cost model assumptions for average international commodity values for different materials. No commodity values were found for loose plastics or metals, as these materials are commonly baled prior to international shipment. For some materials, such as ELTs, additional pre-processing increases the commodity value of the material dependent on whether tyres were loose, baled or shredded prior to export. For others, such as dismantled e-waste, commodity values are depended on the level of pre-processing and the fate of different valuable components. It is likely that PICs could utilize copper and other valuable metals from dismantled e-waste on-island. Remaining lower value residuals (i.e., plastic and metal casings) would resultingly have a lower commodity value on the international market. Additionally, the separation of hazardous components can decrease shipment expenses by reducing MEA requirements, although they will likely incur negative disposal or processing fees at the destination country.					
Potential human health and environmental impacts from shipping/ export (incl. storage, labelling, PPE)	Airborne asbestos fibres are highly hazardous (can cause asbestosis, lung cancer and mesothelioma). PPE required during handling and preparation including disposable coveralls, gloves, safety footwear and respiratory	ULAB: Components and chemicals inside used batteries are highly hazardous (often corrosive and toxic); PPE required during handling and preparation including acid-resistant clothing, safety footwear, gloves,	Firefighting equipment at storage and transport locations, including a water system capable of delivering 3780 L/min for a duration of 6 hours. Quarantine and disease vector controls required if tyres are stored incorrectly and	Components and chemicals inside e-waste are highly hazardous (often corrosive, poisonous, and toxic). Whole e-waste and components must follow labelling and consent requirements aligned with the Basel and	Adequate work health and safety measures should be in place for the operation of baling equipment. If plastics are contaminated or otherwise fall under regulation by the Basel Convention, they must align with labelling and consent requirements.	ELV: The isolation of used batteries and waste oil during de-pollution should follow their respective safety considerations. Adequate work health and safety measures should be in place during de-pollution activities, including

Focus area	Asbestos	Hazardous chemicals (incl ULAB and used oil)	Tyres	E-waste (incl EOL solar cells)	Plastics	Metals (incl whitegoods, EOL vehicles, aluminium, tin/steel cans)
	protective equipment. Adequate training and information to all personnel. Labelling requirements aligned with the Rotterdam and Basel Conventions. Controlled wetting of the asbestos waste should be carried out to minimise asbestos dust emissions when polyethylene bags are sealed or during any subsequent rupture of the bag or wrapped bundles.	face and eye protection; Adequate training and information to all personnel; Labelling and consent requirements aligned with the Rotterdam and Basel Conventions; and Chemical spills kits which include (at a minimum) neutralizer (e.g., soda ash), absorbent (e.g., sand), shovel or scoop and polyethylene disposal bags at storage and transport locations. Used oil: Often hazardous (commonly containing carcinogens and heavy metals). Labelling and consent requirements aligned with the Basel Conventions. If used oil is to be used as fuel, air emissions should be carefully monitored to	allowed to accumulate water. If tyres are processed through baling or shredding, appropriate work health and safety measures must be in place.	Stockholm Conventions. Chemical spills kits at storage and transport locations. Prevention of fugitive emissions of mercury and ozone depleting substances during dismantling. PPE required during dismantling including coverall clothing, safety footwear, gloves, eye protection and dusk masks.		considerations for vapor build-up and potential exposure to hazardous components.

Focus area	Asbestos	Hazardous chemicals (incl ULAB and used oil)	Tyres	E-waste (incl EOL solar cells)	Plastics	Metals (incl whitegoods, EOL vehicles, aluminium, tin/steel cans)
		prevent harm to human health and the environment. Oil spill kits at storage and transport locations.				
Additional financial considerations	A number of PICs have enacted sustainable waste financing systems capable of funding the export of non-commodifiable recyclate material. These take the form of import levies and Extended Producer Responsibility frameworks. Countries that have currently enacted legislation to develop sustainable funding models include FSM, Fiji, Kiribati, Palau, Nauru, RMI, Tonga and Tuvalu. See SPREP resources on "Sustainable Financing Mechanisms for Waste Management" for more details of applicability of these systems.					
Necessary tonnage for economic viability (tpa)	Not applicable, as asbestos export will always incur a negative disposal cost (estimated USD$4,480 per shipment).	ULAB: 10.8 tonne Used oil: 4.4 tonne	Shredded ELTs: 10.9 tonnes Not applicable to baled ELTs, as export will always incur a negative disposal cost (estimated USD$231 per shipment)	Whole e-waste: 3.2 tonne Not applicable to dismantled e-waste, as export will always incur a negative disposal cost (estimated USD$372 per shipment)	Baled PET: 12.5 tonne Baled HDPE: 4.9 tonne Baled mixed plastics: 9.6 tonne	Baled aluminium cans: 2.5 tonne Baled ferrous scrap: 8.5 tonne Not applicable to ELV, as export will always incur a negative disposal cost (estimated USD$332 per shipment of de-polluted ELVs).
Local Landfill fees ($/t)	Few PICs charge landfill disposal fees as dump sites are often open to the public and insufficiently managed. There is evidence of fees charged in the Cook Islands, Nauru, and Vanuatu, although it is unknown how well these practices are enforced. *Waste Management in Developing Countries: A Review of Global Issues* (Ferronato & Torretta, 2019) provide details on the impacts of poor waste management practices on environmental contamination, social issues, and health risks. The *Cleaner Pacific Management Strategy* (SPREP, 2016) provides additional insights specific to the Pacific region.					

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Overview of available Pacific Island processing technology	See Section 0 for details of each PIC current processing capacity. It is known that inadequate stockpile management and storage facilities have a negative impact on recyclate material quality and contamination rates. It is generally recommended to, at a minimum, stockpile materials on an impermeable surface with stormwater management to prevent environmental contamination. Additional covered storage considerations, including bins, skips and containers can be introduced for hazardous materials (such as ULABs) or materials that have strict contamination controls at export markets (such as baled PET).					
Major infrastructure gaps and technology solutions	PICs lack controlled hazardous waste disposal landfill facilities to responsibly dispose of asbestos. Hence, it is recommended to export asbestos to overseas landfills for regulated disposal.	Many PICs current export used oil and ULABs to foreign markets. This is achieved through a mixture of public and private operations. It is recommended that best practice management of hazardous waste stockpile facilities are implemented to prevent harm to public health and the environment. This includes provisions for impermeable floors, PPE, and pollution containment kits.	Some evidence of tyre shredding currently occurring on PICs. If tyres are to be exported on a larger scale, it is recommended to introduce baling or shredding technology to increase transport efficiencies and decrease disposal costs. At a minimum, these should be implemented at proposed "hub" nations for pre-processing prior to export. Baling and shredded tyres also decreases the risk of disease vectors at stockpile sites.	Private recyclers in the Pacific region current export whole and dismantled e-waste. It is recommended that facilities and operations are monitored to ensure environmental compliancy to reduce the pollution of mercury or ozone depleting substances. Further processing technology not recommended for small island nations due to significant capital expenditure and potential environmental impacts.	It is recommended that plastic and metals are baled prior to export to increase transport efficiencies and acceptance at recycling end markets. Most islands currently possess plastic and metal balers, whether owned by government facilities or private recyclers. No evidence was found of current material baling in Nauru, Niue, or Tuvalu. Niue is currently developing a recycling facility equipped with baling technology, while Tuvalu had a previous recycling program (although it is unknown whether the technology used in still in place). At a minimum, balers should be available at proposed "hub" nations to prepare materials prior to export. This will increase the expected revenue from these materials and increase their market acceptance.	

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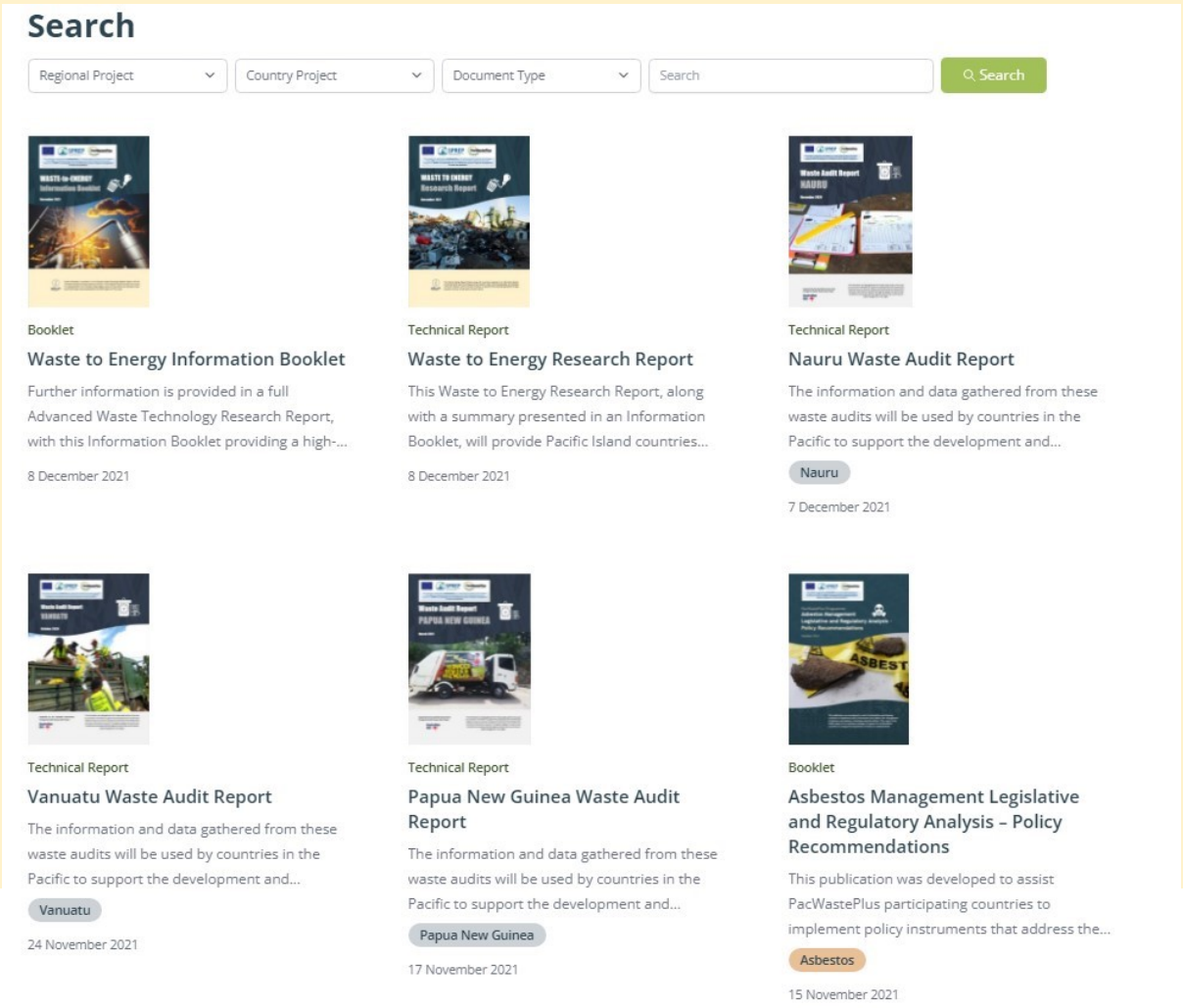
Key opportunities		For an alternative to exporting waste oil, on-island generators can be utilized for conversion to electricity (https://www.interstateenergyinc.com/)	There exist opportunities to utilize baled or shredded tyres on-island as TDF or in engineering applications. Baled tyres can be used in civil engineering applications such as embankment, road foundations or artificial reefs. Shredded tyres have additional potential as feedstocks in cement clinker production or as drainage layers at landfill sites.	Manual separation, sorting and de-pollution activities provide potential employment opportunities, although require strict monitoring of health and safety procedures to avoid associated risks. Items suitable for reuse can also be identified and removed from the waste stream.	Larger countries, such as Fiji, have the potential to introduce sterilization or palletisation technology for the reuse and recycling of PET bottles. These applications are most suitable for countries current exporting PET bottles, in order to decrease reliance on virgin materials.	Recommended implementation of vehicle lifts to increase the safety and efficiency of de-pollution activities. Potential implementation of metal cutters, heavy duty balers and mobile vehicle crushers to increase transport efficiencies prior to export.



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ISBN 978-982-04-1032-9

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