



Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in Timor-Leste.

Timor-Leste is part of the Southeast Asia region, occupying approximately half of the eastern side of the island of Timor. It is the smallest and most eastern island of the Malay Archipelago and includes the enclave of Oecussi-Ambeno on the western (Indonesian) part of the island, as well as the islands of Atauro and Jaco.

Timor-Leste stretches over 15,000km² with a combined coastline of 2,538km. The capital, Dili, is located on the country's mid-north coast.



Source: Google Maps.
(A) Dili

Socioeconomic background

Timor-Leste has an extremely rugged landscape with a mountainous backdrop that rises to over 2,000 metres in altitude. Steep slopes dominate most of the country, other than a narrow plain around the coast. Slopes of 40 degrees or more make road construction and agriculture extremely difficult. Subsistence farming and coffee production are predominant.

Timor-Leste's gross domestic product in 2015 (OEC, 2017) was US\$1.44 billion/US\$2,400 per capita. It had a trade balance deficit of US\$3.47 million, with exports at US\$306 million (+35.5% annualised) and imports at US\$310 million (-18.7% since 2010). Contributions to gross domestic product largely came from the petroleum sector. Manufacturing, as a value adding sector, inputs approximately 1% to the country's economy (GlobalEDGE, 2017).

The primary export market destinations for 2015 were Canada, Japan, Singapore, Thailand and the United States. The main import origins for the same year were Australia, the People's Republic of China, Malaysia, the Republic of Singapore and Thailand. (OEC, 2017).

Timor-Leste had a population in 2010 of 1,066,409 (GoTL, 2010). An estimated 316,086, or 30%, of the population lives in urban areas, with 70% in rural areas. The approximate population distribution across districts is presented in the table below.

Timor-Leste	
District	Population
Ainaro	58,147
Aileu	43,664
Baucau (including city of Baucau)	110,160
Bobonaro	91,199
Cova Lima	59,045
Dili (including city of Dili)	228,559
Ermera	116,937
Liquiça	63,171
Lautem	59,776
Manufahi	48,614
Manatuto (including city of Manatuto)	41,709
Oecusse	63,514
Viqueque	69,476

Source: GoTL, 2010

Tourist visitors to Timor-Leste numbered 71,680 in 2016 (SPTO, 2017), which represented a 17.4% increase over the previous year.

Solid waste management

The regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate Timor-Leste's potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

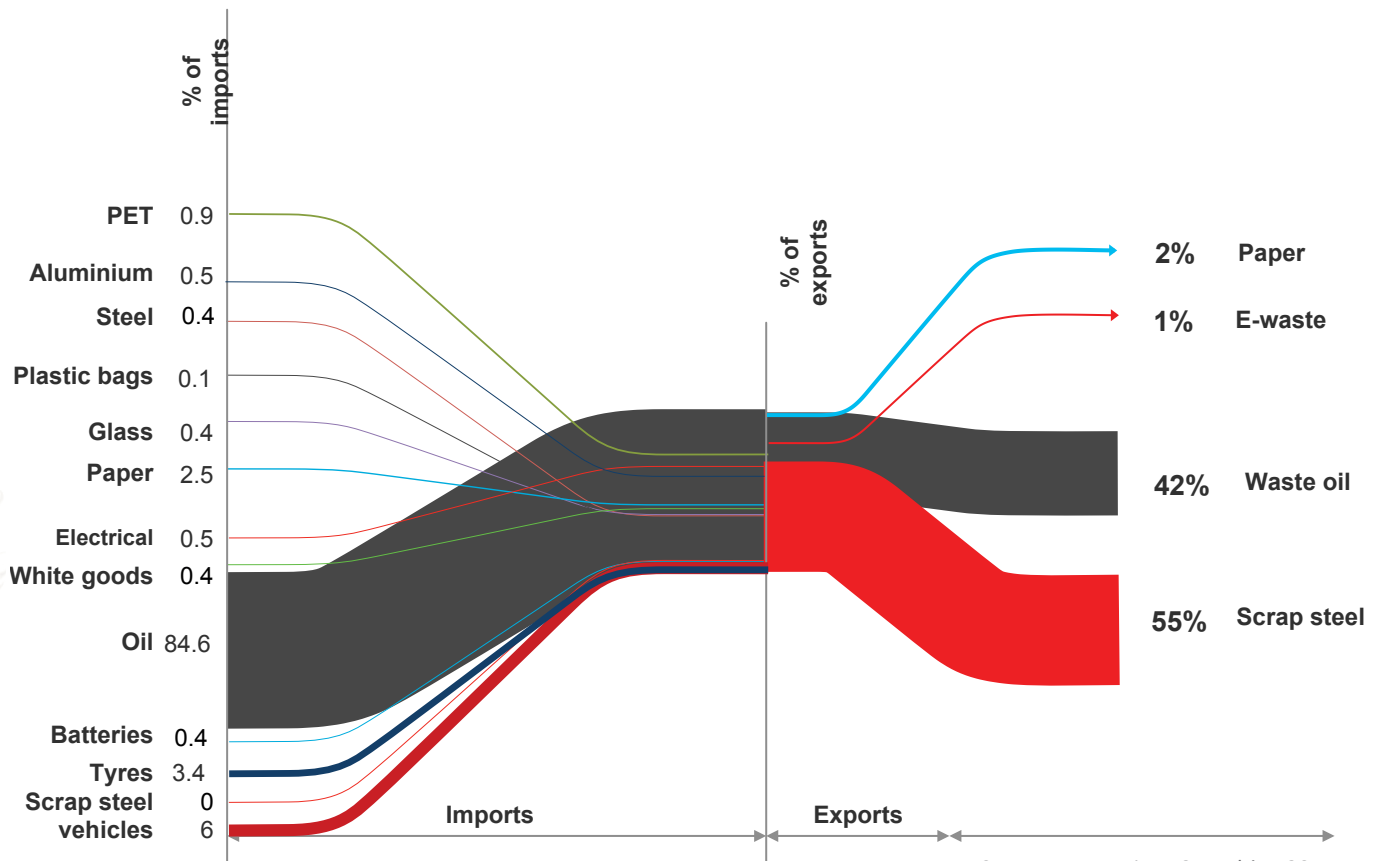
The material flow chart below is based on an analysis of Timor-Leste's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. (UN Comtrade, 2017).

Import data from 2013 onwards shows that paper and cardboard imports have held steady, as has been the case in most countries. The import of vegetable oil has increased over time, as has particular vehicles (e.g., those that carry more than 10 passengers).

Other than paper and cardboard, Timor-Leste exported cooking oil and scrap steel in substantial amounts over the course of 2014-16. This indicates that most beverage containers remain on the island and should be recycled.



Material flow - Timor-Leste




Source: Anne Prince Consulting 2017

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 0.79kg (*World Bank, 2012*). It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. (*JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013*).



Timor-Leste	
Recyclable Material Forecast	Estimated Metric Tonnes
Polyethylene terephthalate (PET) beverage containers	279
Aluminium cans	501
Glass beverage containers	354
Steel cans	398
Plastic shopping bags	181
End-of-life (EOL) renewable energy equipment	-
Paper/cardboard	1,665
E-waste	53
Whitegoods	269
Used motor/cooking oil	1,584
Used lead-acid batteries	61
Lithium batteries	348
Scrap steel/nonferrous metals	597
EOL tyres	61
EOL vehicles	3,967
Total	10,318



Timor-Leste's National Waste Management and Pollution Control Strategy indicates that the generation of waste oil is estimated at 247,500 litres per annum. India receives 125,000 litres (51%) of this.

Future waste management

Future increases in recovered materials are expected to result from the PacWaste (2014-17) programme, implemented by the Secretariat of the Pacific Regional Environment Programme. The programme aims to improve the management of e-waste and develop a national e-waste strategy (SPREP, 2017).

Between 2003 and 2014, electrification rates increased from 22% to 71% (ADB, 2017), providing sufficient capacity to connect all households and meet peak demand. Approximately 60% of the power generated, however, is not billed to the consumer. The Electricity Strengthening and Sustainability Program, supported by the Asian Development Bank and the Government of Timor-Leste, aims to improve transmission and distribution infrastructure and metering services to achieve financial sustainability (ADB, 2017). Increased access to electricity, however, may give rise to greater levels of household electrical items in the waste stream.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste-water outfalls or is transported by wind and tide. Rigid and lightweight plastic from products that are consumed or used on a daily basis become marine debris if not managed appropriately. An estimated 13% of Timor-Leste's waste stream is made up of plastic.

Timor-Leste has a coastline of 2,538km, and a recent study (Jenna et al., 2015) indicates a daily plastic waste generation of approximately 68.4 tonnes (t). An estimated 56.6t are mismanaged daily and are predicted to enter the marine environment through release from uncontained disposal sites or by direct littering. Approximately 20,690t of plastic waste were released in the waters around Timor-Leste in 2010. If not addressed, the amount is expected to rise to 64,205t by 2025.

Of the 68.4t of plastic waste generated each day, approximately 7.5t may comprise polyethylene terephthalate (PET) or high-density polyethylene (HDPE) plastic that is eligible for recycling under a container deposit scheme (CDS). Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 2.51t of PET and HDPE plastic could be recycled each day. This could increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would still result in approximately 19,774t of plastic becoming marine debris each year.

The outcome of mismanaged plastic can be divided into three primary groups: plastic that remains on the surface of the sea as floating debris, plastic that sinks to the ocean floor, and plastic that washes up on beaches. A CDS that

recovers 40% of HDPE and PET bottles in Timor-Leste may achieve the following reductions in marine debris each year:

- 137t in floating plastic
- 641t in sunken plastic
- 137t in beach plastic.

Further benefits attributed to a CDS are possible with a reduction in annual damage costs for Timor-Leste's 328 local fishing vessels (approximately US\$2,557). If beaches were cleaned up, over US\$232,224 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

Villages around Dili have access to municipal solid roadside containers or skip bins that are placed on public sites and in neighbourhoods for the disposal of solid waste. Waste is manually emptied by collectors and transferred to waste collection vehicles.

An aging and poorly maintained fleet of hook lifts, compactors, open trucks, and three-wheel vehicles suggest that services are irregular, often resulting in waste left on footpaths and roads. A large fleet of private vehicles (around 40) on contract to the Municipality provides a collection service, transferring waste to Tibar Dump.

Other private waste collection companies account for approximately 10% of the waste that enters Tibar Dump. They provide drums for waste storage on street curbs, which are then emptied for a fee. Tibar Dump, with its two bulldozers, is located approximately 25km from Dili and is managed by the Dili District administration, which employs around 20 people.

Dili has various recycling companies, two of which reprocess plastic bottles that are shredded and bailed for export (there is no evidence of whether or not this occurs on a regular basis). The price of each kg of PET bottles is US\$0.30. A third company is seeking to remanufacture plastic within Timor-Leste, and has recently received the necessary moulding equipment to produce plastic chairs.

Yet another firm collects and exports scrap metal and aluminium to the People's Republic of China. Steel, whitegoods, e-waste, and aluminium cans are purchased from a network of individuals, using trolleys for collection and transport. This business also sees to the disassembly of e-waste items and used lead-acid batteries for export. There are, however, some safety and environmental concerns to this effort.

It appears that there are two startup businesses that intend to buy and export steel, thus competing for market share. The recycling companies have warehouse, shredding, and baling facilities.

Various micro-enterprises remanufacture some of the waste materials. Paper is recycled to produce envelopes, of which approximately 3,000-4,000 per annum are exported to Australia. Manufactured notebooks and book marks are sold locally. One entity is partnering with Engineers Without Borders and the Embassy of the United States to examine the potential of an automated production line.

Other remanufactured products include arts and crafts that are made from shredded office paper and sold through various retail outlets in Timor-Leste. One micro-business plans to expand and install a second paper shredder.

Compost is created from green waste, used by a few producers to make briquettes from such materials as the husks of coffee, rice, and coconut, as well as bamboo waste. Used engine oil and vehicle tyres are recycled by another two firms.

Logistics

Timor-Leste has one international seaport and a container terminal. These are operated by the Port Authority of Timor-Leste, located in Dili.

The terminal at the Port of Dili is approximately three hectares and has a main quay, 280 metres long by 5-9 metres deep, and a warehouse. There is neither a shore crane nor quarantine incineration facility, although private stevedore services are available. A new port is being constructed to handle a larger capacity.

The Port of Dili is capable of handling 70,000 twenty-foot equivalent units (TEU) per year. The port has a current throughput of approximately 18,000 import, 1,000 export and the return of 16,850 empty containers each year, which may potentially be made available for reverse logistic arrangements. The port also loads and unloads approximately 50 trans-shipment containers each year.

The Port of Dili is serviced by two international shipping lines (table below). A privately owned domestic shipping service operates weekly to Atauro Island and twice weekly to the Oecusse region.

Estimated TEU shipping container rates, presented below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor. They do not account for customs clearance, duties, and quarantine inspection.

Timor-Leste: Shipping Lines		
Swire Shipping; AUSPAC Consortium, including SOUTH PAC; KYOWA-NYK; Polynesia Line		
Destination	Schedule	Est. USD per TEU
Australia (Darwin only)	21-day	TBA
Southeast Asia	21-day	TBA

Source: AMSTEC Pty Ltd

Notes: USD = U.S. dollar;

TEU = twenty-foot equivalent unit.

Institutional framework

Timor-Leste's Strategic Development Plan 2011-2030 (GoTL) sets a pathway to improve the management of waste and the environment. While yet to be implemented, Decree Law 3/2016 and Decree Law 2/2017 stipulate the legal framework for the Urban Solid Waste Management system for the Municipality of Dili and other municipalities and territories. Decree Law number 2/2017 prescribes the location and type of waste containment and broadly schedules collection in urban and rural areas. It also stipulates which municipalities may contract services and which are to provide services. The Decree also limits collection to 1,100 litres, with prior requests to be made with waste collectors for bins exceeding this volume. The Decree will not come into force until solid waste services are in place, likely to be in 2018.

The National Directorate of Basic Sanitation Services, under the Ministry of Public Works, is responsible for planning and policymaking. It also accounts for National Sanitation Policy 2012 that outlines the roles and responsibilities of relevant agencies and sets standards and guidelines. The policy specifies a five-year strategy, with corresponding investment plans to support policy implementation and the reduction, reuse, and recycle of solid waste.

The National Directorate for Climate Change, under the Ministry of Industry, Commerce and Environment, is responsible for the policy and laws that relate to environmental management and pollution control. Environmental Licensing Decree Law 5/2011 provides for environmental impact assessments, management plans, and licensing for proposed developments.

Ministerial Diploma 04/2008/MAEOT establishes the structure and operation of district administrations. It also assigns waste collection responsibilities to the municipalities and territories under the National Directorate for Local Administration.

The National Directorate of Community Health Services is responsible for protecting public health in terms of solid waste. Hygiene and Public Order Decree Law 33/2008 prohibits the dumping of waste on public sites and on the roadside, imposing fines of between US\$5 and US\$500.

Decree Law number 21/2003 provides quarantine and sanitary control of imported and exported goods. These include, in particular, live plants and animals, animal or vegetable products, merchandise, and organisms.

Timor-Leste is a party to a couple of multilateral environmental agreements and conventions. These are listed in the table below.



Timor-Leste	
Multilateral Agreements and Conventions	Status
Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified
Kyoto Protocol	Ratified

While Timor-Leste is not a signatory to the 1995 Waigani Convention, it is a Special Observer to the Pacific Islands Forum. Timor-Leste is not a signatory to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. Australia will set in place provisions that relate to the import of hazardous waste from Timor-Leste, included in “Hazardous Waste (Regulation of Exports and Imports) (Imports from East Timor) Regulations 2003” of the Government of Australia (GoA, 2003).

Financial mechanisms

Currency: United States dollar (US\$)

The new Urban Solid Waste Management Decree imposes a levy on the use of electricity at a rate of US\$0.01 per kilowatt/hour for domestic and US\$0.02 per kilowatt/hour for nondomestic users. It is unclear whether the charge will be ring-fenced to cover the cost of providing domestic and nondomestic solid waste and recycling services, including the collection, transport and disposal, as well as the management and maintenance of landfills.

The Ministry of Finance is responsible for preparing the annual operating budget for each municipality. Revenue from the electricity levy for the collection of solid waste is centralised and then redistributed to each municipality. Additional revenue is raised from fines that are imposed for littering and the burning of solid waste (US\$115) and for the misuse of garbage bins (US\$50). The Penalty for destroying garbage bins is US\$115 and for the illegal removal of a bin, US\$75.

Conclusions

The Government of Timor-Leste recently passed waste management legislation. It is in the process of examining various financial mechanisms to support ongoing improvements of solid waste management and increased access to services.

Timor-Leste’s national strategic plan identifies the need to upgrade and expand its waste management system. It promotes the development of infrastructure for composting and the recycling of plastic, paper and glass.

The island nation is on a somewhat cost-efficient shipping route, limited to destinations in Australia and Southeast Asia. With a new port under construction, however, TEU handling capacity should increase shipping services significantly.



Abbreviations

ADB	Asian Development Bank
CDS	Container deposit scheme
DOEE	Department of Environment and Energy (Australia)
EOL	End of life
GoA	Government of Australia
GoTL	Government of Timor-Leste
HDPE	High-density polyethylene
ICSHP	International Centre on Small Hydro Power
kg	kilogram
km	kilometre
km ²	square kilometre

MAEOT	Ministry of State Administration and Territorial Planning (Timor-Leste)
OEC	Observatory of Economic Complexity
PET	Polyethylene terephthalate
PRIF	Pacific Region Infrastructure Facility
RTRC	Regional Tourism Resource Centre
SPREP	Secretariat of the Pacific Regional Environment Programme
T	tonne
TEU	Twenty-foot equivalent unit
UNIDO	United Nations Industrial Development Organisation
USD	United States dollar

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