



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 Tonga.

Tonga is in the Polynesia region of the Central Pacific Ocean, covering 749km² and with a coastline of 419km. It has more than 170 islands, of which 45 are inhabited. Nuku’afola, the capital, is located on the main island of Tongatapu.

There are four main island groups, including Tongatapu, Ha’apai, Vava’u, and Niua, running somewhat north to south in two parallel chains. The western island chain is volcanic, with islands rising to 1,033 metres in altitude (e.g., Kao) and the eastern chain is encircled by coral reefs.



Source: Google Maps.

Socioeconomic background

Tourists to Tonga in 2015 numbered 53,752 representing an increase of 6.6% over the previous year (SPTO, 2015), and contributing only 15% to the country’s gross domestic product. A small number of hotels have been built on the main island of Tongatapu, and cruise ships regularly visit the northern island of Vava’u.

Tonga’s gross domestic product in 2015 was US\$435 million/ US\$5,530 per capita (OEC, 2017). It had a trade balance deficit of US\$155 million, with exports at US\$11.5 million (-4.6% annualised) and imports at US\$167 million (-3.1% since 2010).

The primary export market destinations for 2015 were Australia, Japan, the Republic of Korea, New Zealand and the United States. The main import origins for the same year were Australia, the People’s Republic of China, Fiji and New Zealand (OEC, 2017). The services sector is a major contributor to Tonga’s economy, at 61%. Manufacturing, a value addition input, contributed 7% (GlobalEDGE, 2017).

Tonga’s population was 103,252 in 2011, most of whom live on the island of Tongatapu, with more or less 76% (or 78,471) on the outer islands (GoT, 2011). The approximate population distribution across the districts and Islands of Tonga is shown in the table below.

Tonga		
District: Tongatapu	Total	75,416
Kolofo’ou		18,957
Kolomotu’a		17,088
Vaini		12,949
Tatakamotonga		7,233
Lapaha		7,380
Nukunuku		7,733
Kilovai		4,076
District: Vava’u	Total	13,833
Neiafu		5,774
Pangaimotu		1,325
Hahake		1,197
Leimatua		2,436
Hihifo		2,105
Motu		985
District: Ha’apai	Total	6,616
Pangai		2,410
Foa		1,359
Lulunga		1,055
Mu’omu’a		609
Ha’ano		511
’Uiha		672
District ‘Eua	Total	5,016
’Eua Motu’a		5,774
’Eua Fo’ou		1,325
District: Ongoniua	Total	1,282
Niuatoputapu		759
Niuafo’ou		523

Solid waste management

A 2008 survey on the characteristics of waste found the daily per capita waste generation rate to be 0.47kg. A 2012 study of Vava'u rated the daily household generation at 0.5kg per day, made up of over 51% organic waste and 13.4% plastic waste.

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 Tonga'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 Tonga'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*).

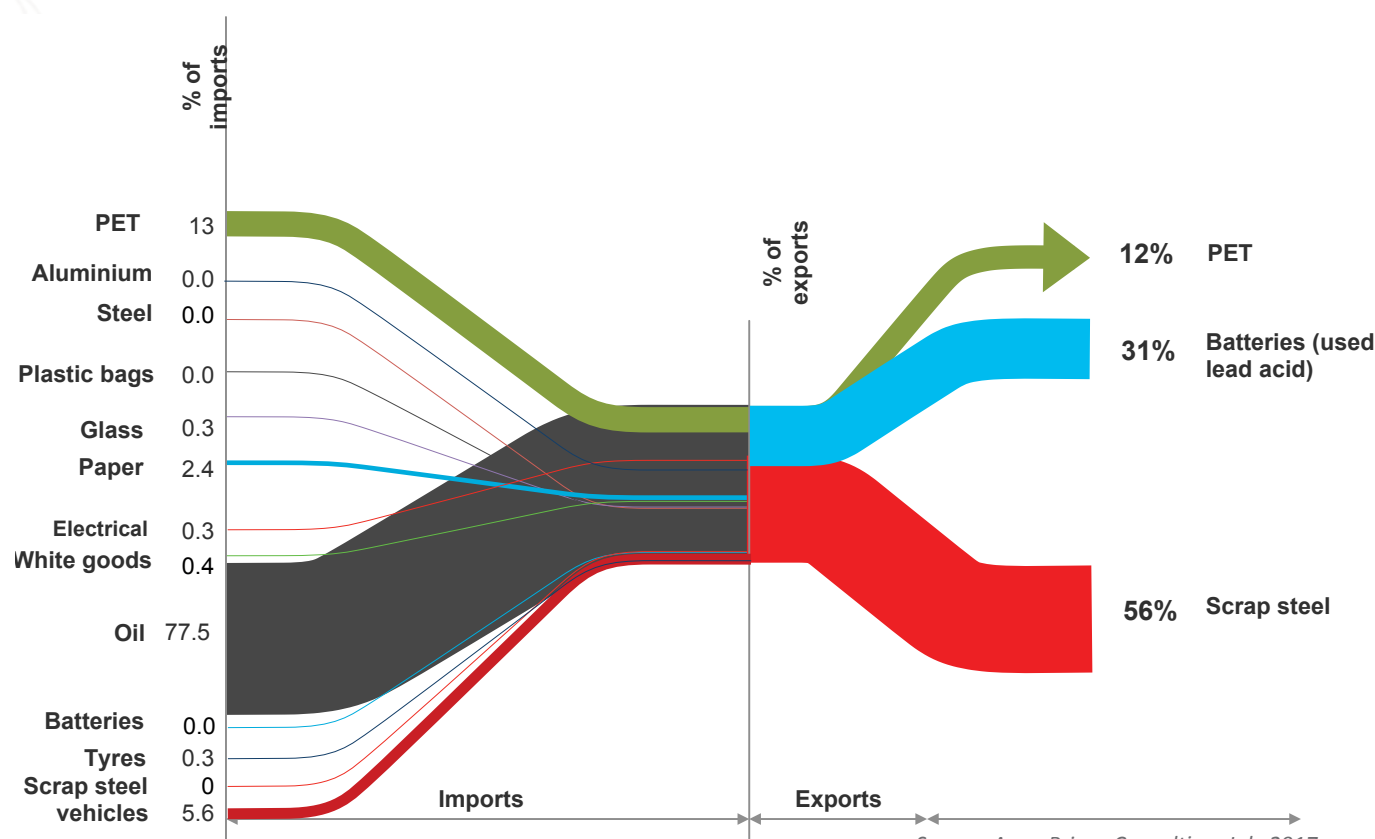
The number of imported polyethylene terephthalate (PET) beverage containers remained relatively steady until 2014, when it began to decrease, except for the pellet form of PET, which increased sharply. This indicates that a large number of PET bottles are being manufactured in Tonga.

Importation of aluminium cans remains low, and there is evidence that the entry of glass beverage containers is decreasing. Paper product imports are cyclical, remaining within the same margin. While electronic and whitegoods demonstrate a mostly steady trend, palm oil and refined petroleum oil imports have risen sharply in the last couple of years. Tonga is increasingly importing renewable energy equipment, as reflected in the last couple of years.

Tonga's exports reflect a similar pattern to a majority of Pacific Island Countries. Its major exports are PET containers, scrap steel, and used lead-acid batteries.

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 3.71kg (*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*).

Material flow - Tonga



Source: Anne Prince Consulting, July 2017
 Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports



Tonga	
Recyclable Materials Forecast	Estimated Metric Tonnes
Polyethylene terephthalate (PET) beverage containers	138
Aluminium cans	583
Glass beverage containers	412
Steel cans	463
Plastic shopping bags	89
End-of-life (EOL) renewable energy equipment	2
Paper/cardboard	1,939
E-waste	13
Whitegoods	73
Used motor/cooking oil	579
Used lead-acid batteries	104
Lithium batteries	103
Scrap steel/nonferrous metals	695
EOL tyres	104
EOL vehicles	1,872
Total	7,169

Tonga receives significant assistance for the development of waste management policies and the improvement of waste management collection services and landfill infrastructure. Much of this originates from Australia's Department of Foreign Affairs and Trade, Japan International Cooperation Agency (Phase 1 of the Promotion of Regional Initiative Solid Waste Management project (J-PRISM I)), and Asian Development Bank (Nuku'alofa Urban Development Sector Project).

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 e-waste management by establishing a nongovernment organisation to receive and process e-waste, implementing a pilot project for the safe dismantling and export of e-waste, and creating a public awareness campaign (SPREP, 2017).

The second phase of the Promotion of Regional Initiative Solid Waste Management (J-PRISM II) project, implemented in early December 2016, supports capacity building in waste management. Target initiatives include improved governance and human resource development, which are expected to generate increased volumes of recoverable materials.

The Government of Tonga is targeting a 50% reduction in fossil fuel imports for power generation, with 100% access to electricity by 2020. To date, 89% of the population has access to power, and 13% is expected to draw from renewable energy sources by 2018.

The Outer Island Renewable Energy Project, supported by the Asian Development Bank, DANIDA (Danish International Development Agency), and European Union, as well as the Government of Australia and Government of Tonga, provides for the construction of solar photovoltaic power plants on the eight outer islands of Ha'apai, 'Eua, Uiha, Nomuka, Ha'ano, Ha'afeva, Niuatoputapu, and Niuafu'ou (ADB, 2017; MFAT, 2016). Increasing reliable power distribution will likely result in rising levels of end-of-life renewable energy equipment, household electrical appliances, computers, and communication 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 light-weight plastic materials from products that are daily consumed or used become marine debris if not managed appropriately. An estimated 6% of Tonga's waste stream is made up of plastic.

The islands of Tonga have a combined coastline of 419 kilometres, and a recent study (Jenna et al., 2015) indicates a daily plastic waste generation of approximately 22.7 tonnes (t). An estimated 18.1t are mismanaged daily and are predicted to enter the marine environment through release from uncontained disposal sites or by direct littering. Approximately 6,624t of plastic waste were released in Tongan waters in 2010. If not addressed, the amount is expected to rise to 10,272t by 2025.

Of the 22.7t of plastics generated each day, approximately 2.5t may comprise PET or high-density polyethylene (HDPE) plastic that is eligible for recovery under a container disposal scheme (CDS). Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 0.80t 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 result in approximately 6,331t of plastic becoming marine debris each year.

The outcome of mismanaged plastic can be divided into three 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 Tonga may achieve the following reductions in marine debris each year:

- 44t in floating plastic
- 205t in sunken plastic
- 44t in beach plastic.

Further benefits attributed to a CDS are possible with a reduction in annual damage costs to Tonga's 146 local fishing vessels (approximately US\$1,139). If beaches were cleaned up, over US\$74,348 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

Tongatapu Island is serviced by a single integrated solid waste management system, managed by Waste Authority Ltd. (WAL). WAL provides a collection service to approximately 65% of urban households in Nuku'alofa and 25% of the rural areas on the island of Tongatapu. The low percentage reflects the inoperability of WAL's three compactor vehicles from time to time, with the need for private collectors to step in. Furthermore, burning and illegal dumping appear to be a persistent issue. The private sector provides waste collection to the commercial sector, delivering the waste to the Tapuhia Landfill, established as part of the Tongan Solid Waste Management Project and operated by WAL.

Approximately 170 community recycle cages are spread across most villages and throughout Nuku'alofa. Householders deposit their recyclables in cages that are cleared by a private recycling company. Refunds are made to a local community organisation. Neither WAL nor the private sector appears to offer household recycle collection services.

E-waste Tonga, a nonprofit organisation, was established in Nuku'alofa in 2010. Together with the outer islands of Ha'apai and Vava'u, it has created an e-waste recycling programme, apparently charging one company T\$0.10 Tongan pa'anga per kg.

While five companies have been issued recycle licenses, only one of them operates in Ha'apai and Vava'u. It collects ferrous and nonferrous metal scrap, plastic bottles, paper and cardboard, used lead-acid batteries, e-waste, and used oil for export. The company has one full-size and two half-size vehicle crushers, a baler for cardboard/paper, and another for plastic. In 2013, the company exported approximately 1,470t of steel, 9.5t of copper, and 15.5t of aluminium to New Zealand. A total of 54,000 litres of used oils were exported to India, while 50.4t of used lead-acid batteries were sent to the Republic of Korea and New Zealand.

Logistics

Tonga has three international seaports and one domestic, operated by Ports Authority Tonga. These are the following:

- Port of Neiafu in the District of Vava'u;
- Port of Nuku'alofa, a container terminal in the District of Tongatapu;
- Port of Pangai in the Ha'apai Group
- Port of Eua Island (domestic).

The terminal at the Port of Nuku'alofa is approximately 3 hectares and includes a main quay, 110 metres long by 11 metres deep, and a warehouse. There is neither a shore crane nor are there private stevedore services available.

The Port of Nuku'alofa is capable of handling 20,000 TEU per year. The port has a current throughput of approximately 8,000 import, 1,000 export and the return of 7,000 empty containers each year which may potentially be made available for reverse logistic arrangements. The port also loads and unloads approximately 1,000 trans-shipment containers each year.

The Port of Nuku'alofa is on a cost-effective route, regularly serviced by various international shipping lines. Estimated TEU shipping container rates, presented below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor, although they do not account for customs clearance, duties, and quarantine inspection.

Tonga: Shipping Lines		
AUSPAC Consortium, including SOUTHPAC; Kyowa Shipping Co. Ltd.		
Destination	Schedule	Est. USD per TEU
Australia	16-day	2,650 to 4,600
Fiji	21-day	2,500 to 4,400
North Asia	14-day	2,400 to 3,600
New Zealand	7-day	2,682 to 4,600

Source: AMSTEC Pty Ltd

Notes: USD = U.S. dollar;

TEU = twenty-foot equivalent unit.

Friendly Island Shipping Agency is a public sector entity that provides weekly passenger and cargo services, using a roll-on/roll-off vessel between Nuku'alofa and the islands of Nomuka, Ha'afeva, Pangai, and Vava'u. It also has a bimonthly run to Niuaus. The freight rate for a 20 foot shipping container is approximately US\$546 between Nuku'alofa and Vava'u.

A second shipping company, Tonga Exports Shipping Agency Ltd., operates a cargo ship that provides inter-island services. It has the potential to offer services across the region.

Institutional framework

Data relating to the institutional framework of Tonga have been gathered from the database of the Pacific Islands Legal Information Institute (*PacLII*, 2017). ECOLEX is also an information service that relates to environmental law (*ECOLEX*, 2017), from which various data also have been collected.

The Kingdom of Tonga is a constitutional monarchy with two levels of government. The local government, however, has no formal structure, requiring only an election of 23 district officers and 155 town officers every three years.

Legislative provisions for local government are held in Fonos Act 1988 and District and Town Officers Act 1988. The Ministry of Internal Affairs oversees the work of the district, and town officers are empowered to organise a *fono*, or public meeting, to discuss local matters of priority. They may be requested to organise a grand *fono* at which public officials may preside.

The Ministry of Health is responsible for waste management on the outer islands until such time as service areas are declared. WAL, as previously mentioned, manages the solid waste management system on Tongatapu Island.



Waste Management Act 2005 provides legislation for the development of the waste management sector with wide ranging powers and responsibilities for WAL. The Act establishes waste management service areas and relates to waste collection and disposal services; contracting arrangements; fees to be levied and collected; preparation of operating plans and reports; development of codes of practice; community awareness raising; and monitoring of public health and environmental impacts.

Waste Management (Plastic Levy) Regulations 2013 impose a 10% levy on the import of certain plastic bags, empowering authorised officers to ensure that correct payments are made. WAL is the collection authority.

Public Health Act 1992 regulates the collection of waste and waste containers, as well as the disposal of solid and hazardous waste. It also prohibits the import of toxic and hazardous waste and ensures that recyclers are issued licenses. The provisions of the Act also extend to ships. Amendment 2005 designates service areas under Waste Management Act 2005.

Biosafety Act 2009 establishes the national Biosafety Advisory Committee, giving effect to the Cartagena Protocol on Biosafety to the Convention on Biological Diversity. It also regulates the transboundary movement of materials and goods that may contain living organisms.

Marine Pollution Prevention Act 2002 provides for the response to marine pollution from ships and land-based sources; places restrictions on the dumping and incineration of waste at sea; and gives effect to international marine pollution conventions. Environment Management Act 2010 establishes Tonga's Ministry of Environmental and Climate Change, its functions, and its powers. These include the (i) monitoring of environmental impacts; (ii) regulation or prohibition of pollution to air, water, or land, as well as dumping of litter and rubbish, and movement or disposal of hazardous waste and chemicals; and (iii) protection of coastal areas.

Environment Management (Litter and Waste Control) Regulations 2016 define the activities and offences that relate to waste pollution. These include the dumping of waste and hazardous waste, waste that causes pollution, and the burning of litter and waste. Provisions for landfill improvements are prioritised in Tonga's National Infrastructure and Investment Plan 2013-2023.

Tonga is a party to various multilateral environmental agreements and conventions. These are included in the table below.

Tonga	
Multilateral Environmental Agreements and Conventions	Status
Stockholm Convention on Persistent Organic Pollutants	Ratified
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Ratified
1995 Waigani Convention	Ratified
Rotterdam Convention	Ratified
Montreal Protocol	Ratified
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annexes I, II, III, IV, V, and VI)	Ratified
London Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter 1972	Ratified
1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Protocol)	Ratified
Intervention on the High Seas in Cases of Oil Pollution Casualties (Intervention 1969): Protocol 1973	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (renewed 1992)	Ratified
Protocol of 1992 to Amend The International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971	Ratified
International Convention on Oil Pollution Preparedness, Response and Co-operation Convention 1990	Ratified
Convention on Hazardous and Noxious Substances by Sea 1996	Ratified
International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER) 2001	Ratified
International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention) 2001	Ratified
International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) 2004	Ratified
Nairobi International Convention on the Removal of Wrecks 2007	Ratified

SPREP. 2016.

Financial mechanisms

Currency: Tongan pa'anga (T\$)

A household levy of T\$10 a month and commercial levies, ranging from T\$17 to T\$128 a month, are charged for waste management collection services. Fees are also charged at the landfill, with revenue paid directly to WAL.

A private sector waste collection company charges between T\$100 and T\$300 for regular collection services from commercial customers. Newly adopted littering regulations came into effect in April 2017, imposing fines of between T\$20 and T\$2,000 per infringement.

Conclusions

Tonga has improved significantly its waste management sector, as well as has achieved the relocation of its disposal infrastructure and the enactment of its Waste Management Act 2005. Initiatives are supported by a number of development projects.

Relatively robust user-pays mechanisms are in place, particularly since waste management fees are included

in Tonga Water Board bills. Rural areas may, in future, be charged solid waste management tariffs in their electricity bills. Nonetheless, a budget shortfall appears to continue, with costs insufficient to cover the provision of services and maintenance of infrastructure.

Tonga lacks a solid waste management and pollution control policy or strategic plan. If such were in place, a CDS could be implemented.

The Port of Nuku'alofa is a relatively small port with a capacity of 20,000 TEU per annum. It has insufficient capacity to handle increased cargo volume, although wharf infrastructure and handling equipment are considered to be of a reasonable standard. The port has reverse logistic or backload export potential and is considered to be on a reasonably cost-efficient route.

Abbreviations

ADB	Asian Development Bank	km ²	square kilometre
AFS	Anti-fouling systems	MARPOL	International Convention for the Prevention of Pollution from Ships
BWM	Ballast Water and Sediments	MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
CDS	Container disposal scheme	OEC	Observatory of Economic Complexity
DANIDA	Danish International Development Agency	PET	Polyethylene terephthalate
DOEE	Department of Environment and Energy (Australia)	PRIF	Pacific Region Infrastructure Facility
EOL	End of life	SPREP	Secretariat of the Pacific Regional Environment Programme
GoT	Government of Tonga	SPTO	South Pacific Tourism Organisation
HDPE	High-density polyethylene	t	tonne
ICSHP	International Centre on Small Hydro Power	TEU	Twenty-foot equivalent unit
J-PRISM	Promotion of Regional Initiative Solid Waste Management	UNIDO	United Nations Industrial Development Organisation
kg	kilogram	WAL	Waste Authority Ltd.
km	kilometre		



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