



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 territory 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 Guam.

The island of Guam, located in the Western Pacific, is the southernmost island in the Mariana Island chain and is the largest island in the Micronesia region. Guam is a territory of the United States, covering a land area of 541km², with a coastline of 125.5km.

Hagåtña (or Agana), the territory’s capital city, is located on the mid-west coast of the island. While it has the second smallest village population, it is one of the island’s most advanced commercial districts.

Socioeconomic background

Guam’s total population was estimated at 174,900 in 2013 (SPREP, 2016). The rural population (Knoeme, 2017) was approximately 8,745, or 5% of the total, in 2015.

Guam is divided into 19 municipalities, referred to as villages. The approximate populations are provided in the table below.

Guam	
Municipality	Population
Agana Heights	3,808
Agat	4,917
Asan-Maina	2,137
Barrigada	8,875
Cahlan-Pago-Ordot	6,822
Dededo	44,943
Hagatna (Capital)	1,051
Inarajan	2,273
Mngilao	15,191
Merizo	1,850
Mongmong-Toto-Maite	6,825
Piti	1,454
Santa Rita	6,084
Sinajana	2,592
Talofofo	3,050
Tamuning	19,685
Umatac	782
Yigo	20,539
Yona	6,480

Source: US Census Bureau

Guam has a significant tourism sector. It represents over 50% of the economy and was in excess of 1.53 million in 2016.

Guam’s gross domestic product in 2011 was US\$25,420 per capita. In that year, Guam had a negative trade balance (OEC, 2017) of US\$714 million, with exports at US\$21.8 million (+7.7% annualised) and imports at US\$735 million (+4.4% since 2010).

The primary export market destinations in 2015 were Australia, Hong Kong (China), the Republic of Korea, Palau, and Singapore. The main import origins in the same year were Hong Kong (China), Japan, the Republic of Korea, the Philippines, and the Republic of Singapore. Guam’s key economic drivers are tourism and the military. (OEC, 2017)

Solid waste management

The Guam Zero Waste Plan estimates rates for municipal solid waste to be between 2kg and 2.39kg per capita per day. Non-municipal solid waste is estimated at between 1.27kg and 3.35kg per capita per day.

This 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 Guam’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 Guam’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 and export data were not specifically available for Guam within this study. It is likely this data is calculated within the data for U.S. imports, given that Guam is a territory.

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 2.1kg (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).

Guam	
Recyclable Material Forecast	Estimated Metric Tonnes
Polyethylene terephthalate (PET) beverage containers	1,177
Aluminium cans	2,318
Glass beverage containers	1,637
Steel cans	1,841
Plastic shopping bags	763
End-of-life (EOL) renewable energy equipment	--
Paper/cardboard	7,706
E-waste	75
Whitegoods	421
Used motor/cooking oil	1,052
Used lead-acid batteries	738
Used lithium batteries	216
Scrap steel/nonferrous metals	2,762
EOL tyres	735
EOL vehicles	10,788
Total	32,229

Future waste management

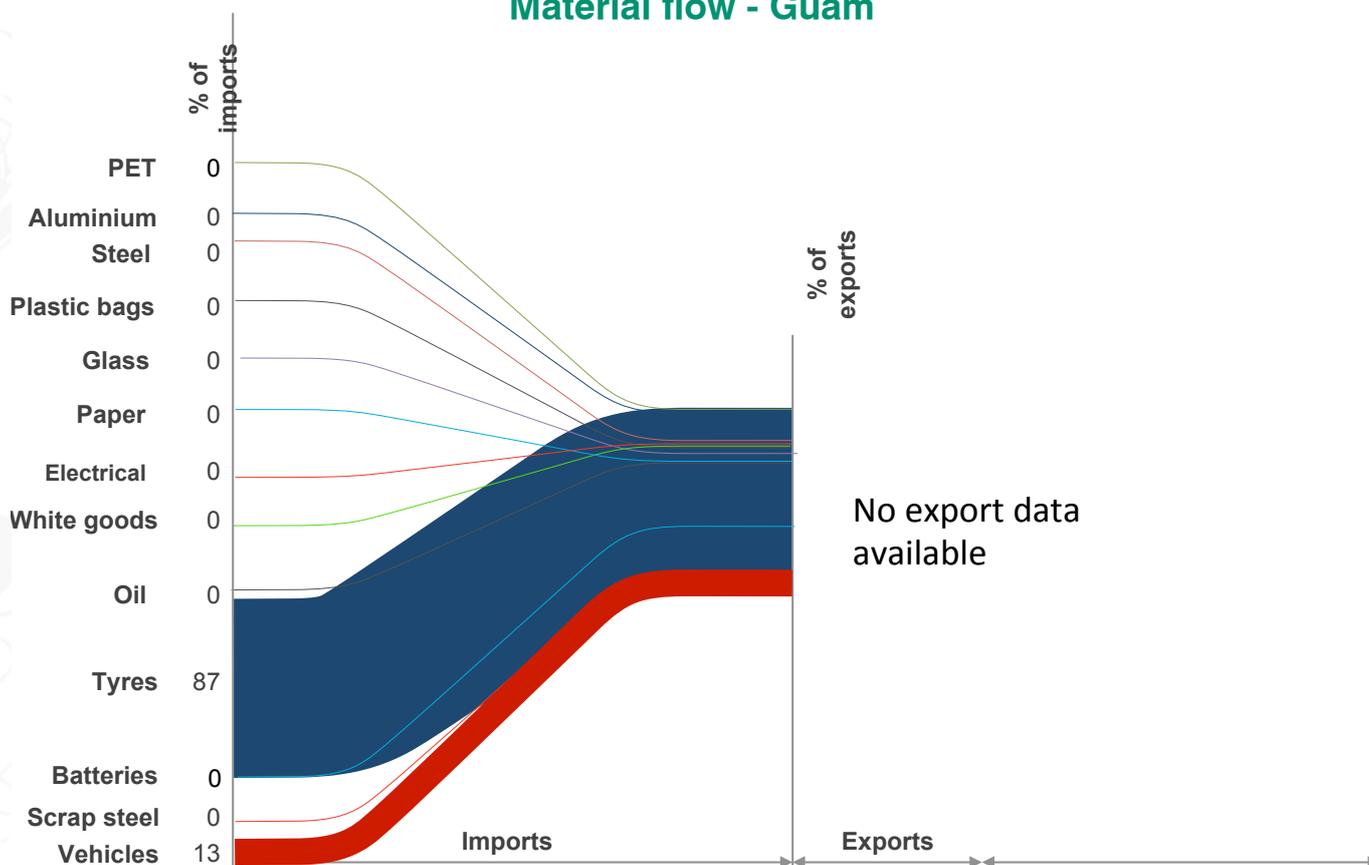
Guam's Zero Waste Plan 2013 outlines future initiatives that include the erection of a construction and demolition processing facility and the reprocessing of tyres, and glass for the paving of roadways. Extended producer programmes for e-waste and packaging material are expected to increase recycled materials (GoG, 2013).

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 material from products consumed or used on a daily basis become marine debris if not managed appropriately. An estimated 12% of Guam's waste stream is made up of plastic.

A recent study (Jenna et al., 2015) indicates that Guam generates approximately 47.9 tonnes (t) a day of plastic waste. An estimated 1.1t is predicted to enter the marine environment due to waste mismanagement and direct littering. As such, an estimated 393t of plastic waste is predicted to become marine debris in Guam waters in 2010. If not addressed, the amount is expected to rise to 574t by 2025.

Material flow - Guam



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



Of the 47.9t of plastic generated each day, approximately 5.3t may derive from polyethylene terephthalate (PET) or high-density polyethylene (HDPE) plastic bottles. These products are 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 0.05t 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 375t of plastic becoming marine debris each year.

The outcome of mismanaged plastic is split 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 the beach. A CDS that recovers 40% of HDPE and PET plastic bottles in Guam may achieve the following reductions in marine debris each year:

- 3t in floating plastic
- 12t in sunken plastic
- 3t in beach plastic.

Further benefits attributed to a CDS are a potential reduction in annual damage costs for Guam’s 191 local fishing vessels (approximately US\$1,487). If beaches were to be cleaned up, over US\$4,408 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

The Guam Solid Waste Authority (GSWA) is an autonomous public agency, responsible for providing solid waste management (SWM) services to 100% (16,000 households) of the population. This service takes place on a weekly bases and waste is collected from the curbside for recycling.

For those households that do not pay for curbside collection, there are three residential transfer stations in place for the recycle of cardboard, paper, aluminium and steel cans, and PET and HDPE plastic. The GSWA manages the operating contracts of the Layon Landfill and the hauler transfer station that receives only commercial waste. Disposal is banned for hazardous and liquid waste, construction and demolition debris, and recoverable materials. A household hazardous waste facility is located at the Harmon Residential Transfer Station. The GSWA also operates a material recovery facility where recyclables are consolidated and baled for export.

There are various recycling services managed by the private sector, under public/private partnerships, and by nonprofit organisations. These, together, achieve an estimated waste diversion rate of 17.85%. Recyclers collect and export scrap steel, whitegoods, e-waste, PET and HDPE plastic, cardboard, vehicle batteries, tyres, aluminium cans, and waste oils.

There is some on-island glass reprocessing which, once crushed, is used at the Layon Landfill as an alternative cover or as backfill for landfill roads and other civil works. Cardboard and paper are combined with green waste for composting. Gresco, Guam’s environmental services company, accepts used oil from individuals and businesses for treatment and processing into a diesel-type product.

Logistics

Guam has one international seaport, operated by the Port Authority of Guam. It is located at Piti.

Apra Harbour



Source: Google Maps.

Port Apra terminal is approximately 15 hectares and is equipped with high-standard facilities. Included are a quay (591 metres long by 10 metres deep), a warehouse, shore cranes, and private stevedore services.

The Port of Apra is capable of handling 250,000 twenty-foot equivalent units (TEU) per year. The port has a current throughput of approximately 50,000 import, 2,000 export and the return of 22,950 empty containers each year which may potentially be made available for reverse logistic arrangements. The port also loads and unloads approximately 1,000 transshipment containers each year.

The Port of Apra is serviced by various international shipping lines. Estimated TEU shipping container rates, presented in the table 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.

Guam: Shipping Lines		
Swire Shipping; Guam Saipan Express (GSX); Kyowa Shipping Company; Matson Inc.		
Destination	Schedule	Est. USD per TEU
North Asia	14-day	3,260
New Zealand	21-day	4,250
South East Asia	14-day	TBA
West Coast USA	7-day	TBA

Source: AMSTEC Pty Ltd

Notes: USD = U.S. dollar; TEU = twenty-foot equivalent unit.

Institutional framework

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

The Solid Waste Management and Litter Control Act is administered by the Guam Environmental Protection Authority. The Act provides the legal framework for solid and hazardous waste and stipulates the development and implementation of SWM plans. The Act also regulates the management of hazardous waste and the issuance of permits for solid waste activities. It prohibits open dumping, littering, and burning of waste, and sets penalties for doing so. In addition, a Solid Waste Management Fund has been established to fund implementation of the Act.

Guam Solid Waste Disposal Regulations establish operating and permit requirements for landfill disposal operations. They also relate to the planning, permit, and operating requirements for the collection of solid waste, excluding hazardous waste.

Guam Beverage Container Recycling Act 2010 provides for a deposit fee of US\$0.05, to be paid on the retail price of specific beverage containers (PET, HDPE, glass, and aluminium). Eighty percent of this fee is redeemed on delivery of empty containers at redemption centres.

The issuance of permits for the collection, storage, processing, purchasing, and resale of containers is set by Guam Beverage Container Regulations. The regulations, however, may be limited to only aluminium cans.

The GSWA was established under Public Law 31-20 and had been operating under the administration of a Receiver, appointed by the U.S. District Court of Guam. The Receiver oversaw the government's compliance with a Consent Decree, imposed in 2004, to prevent the discharge of contaminants from the Ordot Dump. Since then, however, an integrated waste management system has been put in place and the Ordot Dump has been closed. Rehabilitation of the site has taken place and construction of leachgate and gas capture systems has been completed.

Guam Zero Waste Plan 2013 is a comprehensive framework document that relates to various waste minimisation initiatives, to be phased over a 20-year period. Focus is placed on accelerating the circular economy by further encouraging the on-shore remanufacturing of recyclable material. The plan also sets out a range of administrative premises that include the improvement of GSWA resourcing and the strengthening of enforcement of litter control laws, green public procurement, 3R (reduce, reuse, recycle) building sustainability, and Zero Waste Plan funding.

The Zero Waste Plan has introduced a pay-as-you-throw system for households that opt to downsize from 96-gallon wheelie bins. Moreover, a single-use plastic bag ban will be put in place at retail and wholesale outlets.

As a Territory of the United States, Guam is a party to various multilateral environment agreements, listed in the table below.

Guam	
Multilateral Environmental Agreements and Conventions	Status
Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified
Minamata Convention on Mercury	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, V, and VI)	Ratified
London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972	Ratified
International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (Intervention 1969):	Ratified
Protocol 1973	Ratified
International Convention on Oil Pollution Preparedness, Response and Co-operation 1990	Ratified
International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention) 2001	Ratified
Noumea Convention	Ratified
Protocol on Dumping	Ratified
Protocol on Combatting Pollution Emergencies	Ratified

Source: SPREP. 2016.

Guam is neither a direct party to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal nor to the 1995 Waigani Convention. As a territory of the United States, however, it comes under the ratification of that party.



Financial mechanisms

Currency: United States dollar (US\$)

The GSWA levies residential curbside collection service fees on a monthly basis. The weekly fee for a single bin is US\$30; a dual bin, \$45; and a garbage bag, US\$4.

Transfer station fees are volume-based, from US\$7.50 to US\$22.50. An amount of US\$7.50 is charged for sofas and mattresses, whereas cardboard and glass containers are free.

Guam’s Recycling Revolving Fund law stipulates a recycling fee of US\$3-US\$30 to be levied on annual motor vehicle registrations. Revenue is directed to the Recycling Industry Economic Stimulus programme, Guam’s Zero Waste Plan, as well as towards grants for environmental education and awareness programmes.

The Deposit Beverage Container Fee is managed independent of other public funds. Eighty percent of the funds is reimbursed to redemption centres, with the remaining 20% applied to the administrative, audit, compliance, and recycling promotion activities of the programme.

Conclusions

Guam has a comprehensive SWM plan in place, with waste minimisation initiatives that will be phased over a 20-year period, to be funded by the Recycling Revolving Fund. The plan provides for economic development in the waste, recycling, and remanufacturing sectors.

Guam is one of two ports in the Pacific that has excellent facilities, with the capacity to handle increased cargo volume. It is currently a transshipment port that is located on mostly cost-effective routes between New Zealand, North America, and North Asia.

Abbreviations

3R	Reuse, reduce, recycle	MARPOL	International Convention for the Prevention of Pollution from Ships
AFS	Anti-fouling systems	MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
CDS	Container disposal scheme	OEC	Observatory of Economic Complexity
DOEE	Department of Environment and Energy (Australia)	PET	Polyethylene terephthalate
FY	Financial year	PRIF	Pacific Region Infrastructure Facility
GoG	Government of Guam	SPREP	Secretariat of the Pacific Regional Environment Programme
GSWA	Guam Solid Waste Authority	SWM	Solid waste management
HDPE	High-density polyethylene	t	tonne
ICSHP	International Centre on Small Hydro Power	TEU	Twenty-foot equivalent unit
JICA	Japan International Cooperation Agency	UNIDO	United Nations Industrial Development Organisation
kg	kilogram	USD	United States dollar
km	kilometre		
km ²	square kilometre		

References

- DOEE. 2017. Department Of Environment and Energy, 2017, Recycling Your Oil, <http://www.environment.gov.au/protection/used-oil-recycling/recycling-your-oil>, (accessed 7 August 2017)
- ECOLEX. 2017. Information Service on Environmental Law. Database. Food and Agriculture Organization of the United Nations; International Union for Conservation of Nature; and UN Environment. <https://www.ecolex.org>.
- GoG. 2013. Guam Zero Waste Plan. Vol. 1 and Vol 2. Government of Guam.
- GoG. 2017. Regional Resource Circulation and Recycling Network Project Survey Return, Guam
- Jambeck et al. 2015. (as per reference below)
- Jenna R. Jambeck, Roland Geyer, Chris Wilcox, Theodore R. Siegler, Miriam Perryman, Anthony Andrady, Ramani Narayan, Kara Lavender Law. 2015. "Plastic Waste Inputs from Land into the Ocean". *Science*, Vol. 347(6223). pp. 768-771. DOI: 10.1126/science.1260352.
- JICA. 2013. Japan International Cooperation Agency, 2013.
- Knoema. 2015. World Development Indicators (WDI), September 2015. Database. <https://knoema.com/WBWDIGDF2015Aug/world-development-indicators-wdi-september-2015?tsId=1037970>, (accessed April 25, 2017).
- MFAT 2016. Government of New Zealand. NZMFAT, 2016. Ministry of Foreign Affairs and Trade, Government of New Zealand, Pacific Energy Country Profiles, 2016. Wellington, New Zealand
- Mobile Muster, Mobile Australia, A Report on how we use and recycle our mobiles, 2013.
- OEC. 2017. "Guam". Observatory of Economic Complexity <http://atlas.media.mit.edu/en/profile/country/gum/> (accessed May 2017).
- PaclII. 2017. Legal database. Pacific Islands Legal Information Institute, University of the South Pacific School of Law. www.paclii.org/.
- SPREP. 2016. Cleaner Pacific 2025: Pacific Regional Waste and Pollution Management Strategy 2016–2025. Apia, Samoa: Secretariat of the Pacific Regional Environment Programme. www.sprep.org/attachments/Publications/WMPC/cleaner-pacific-strategy-2025.pdf.
- SPTO. 2017. [Annual Review of Visitor Arrivals in Pacific Island Countries, 2016. SPTO, May 2017) South Pacific Tourism Organisation, <https://corporate.southpacificislands.travel/wp-content/uploads/2017/02/2016-Annual-Visitor-Arrivals-ReviewF.pdf>.
- UN Comtrade. 2017. United Nations Commodity Trade Statistics Database. www.trademap.org, accessed 2017.
- UNIDO 2013. United Nations International Development Organisation /International Center on Small Hydro Power, World Small Hydro Power Development Report 2013; Pacific Island Countries and Territories.
- US Census Bureau, Census Data 2000 and 2010, accessed 20 April 2017
- World Bank. 2012. "What a Waste: A Global Review of Solid Waste Management". Open Knowledge Repository. Washington D.C.: World Bank. <https://openknowledge.worldbank.org/handle/10986/17388> (accessed September 2017).