Small Island Developing States

WASTE MANAGEMENT Outlook

UN environment

Technology for Environment

Small Island Developing States Waste Management Outlook

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*The **International Environmental Technology Centre** works with developing countries to implement sustainable solutions to environmental challenges, with focus on holistic waste management.*

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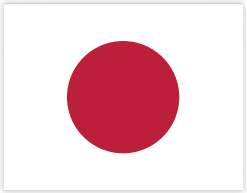

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FOREWORD

Effective waste management is a key challenge facing Small Island Developing States. The remoteness of many of these islands and their vulnerability to climate change often make the handling and transport of waste both expensive and difficult. The challenge is particularly acute for hazardous waste.

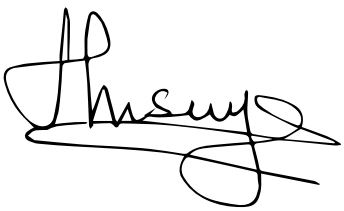
The Small Island Developing States Waste Management Outlook provides an assessment of solid, liquid and gaseous waste generated in 58 Small Island Developing States. It also recommends a series of initiatives that can be adopted by islands to put in place cost-effective waste management systems that protect land, sea and air from pollution.

The publication highlights the many gains that can be realized through effective waste management systems. In the landfills on the Tarawa Islands in Kiribati, waste pickers would often collect rubbish by hand, and the absence of segregated waste meant that medical waste was mixed with domestic waste. Assistance provided by New Zealand's Ministry of Foreign Affairs and Trade introduced a series of initiatives that have helped achieve remarkable health and safety gains for the waste pickers and also local communities.

Evidence also suggests that regional cooperation is critical in helping many islands handle, transport and manage waste effectively. In the Pacific islands, groups of islands act as hubs for hazardous waste collection and shipments from remarkably remote islands to regional centres. Here waste is either processed or again exported to nearby countries with better facilities. Such an approach could be useful for other island states in other regions.

Effective waste management can help improve human health, reduce our environmental footprint, tackle climate change and boost economic growth and employment. By championing better waste management systems, the Small Island Developing States could pioneer means to bring about a circular economy, in which products and materials are used for as long as possible.

I hope this publication will inspire policymakers, businesses, communities and all other stakeholders to strengthen regional cooperation and take a circular economy approach to production and consumption, thereby protecting both people and the ecosystems that sustain life for us all.



Joyce Msuya

Acting Executive Director of the
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EXECUTIVE SUMMARY

Waste management is a major issue globally, and the situation in Small Island Developing States (SIDS) is no exception. The SIDS Waste Management Outlook has been developed as a follow-on to the Global Waste Management Outlook to provide an overview of the current challenges and opportunities for waste management in SIDS. The findings of the SIDS Waste Management Outlook can be applicable beyond SIDS and can be relevant to countries which have populated islands within their boundaries. Such islands number approximately 11,000 worldwide.

The SIDS Waste Management Outlook adopts an **integrated approach** covering emissions to air, water and land.

It is indeed recognized that emissions from one medium can transfer to other media (e.g. incinerating solid waste can produce air emissions which can impact pollution levels of both land and water). Thus, optimal environmental management occurs when policy and regulatory control coordinates waste in all three media.

The SIDS Waste Management Outlook follows the key concepts of life cycle thinking, sustainable consumption and production and integrated waste management. These concepts are interwoven throughout the document to promote a paradigm shift to transition from a dumping society to a circular economy.

This Outlook promotes the involvement of multiple stakeholders as well as regional and sub-regional cooperation and focuses on achieving the following **objectives**:

- Adopt an integrated approach to waste management by addressing wastes in all media (solid, liquid and gas);
- Examine how to capitalize on improvements in the waste sector to achieve sustainable development in SIDS and take on other challenges including mitigating climate change, improving water quality, overcoming resource scarcity, ensuring sound chemicals management and alleviating poverty by creating job opportunities;
- Identify policies, governance strategies and tools for integrated waste management; and
- Examine the available approaches to waste management finance.

KEY FINDINGS

Waste management affects all aspects of society such as **public health**, the **economy**, **industry**, **environment**, **climate change** and **disasters**. SIDS' waste management-related issues are not uncommon within global trends. However, their locations and environmental sensitivity often intensify the impacts of waste, creating complicated situations that require innovation, collaboration and regional solutions.

Waste management is integral to sustainable development and effective, **integrated waste management contributes to all 17 UN Sustainable Development Goals** (SDGs). Effective contribution to the SDGs requires a transition to a circular economy. Recent research supports 'leapfrogging' by developing countries from their current status, which is characterized predominantly by waste dumping, to a circular economy.

Although SIDS are spread across the world, they share some common issues that are directly or indirectly related to waste management. These include the **environmental issues** of:

- overexploitation of natural resources;
- limited land availability for waste management activities;
- freshwater shortages and decreasing water quality;
- climate change vulnerability;
- susceptibility to natural and environmental disasters; and
- increasing levels of imported non-biodegradable goods resulting in escalating waste issues.

In the **social** domain, key common issues include:
- the increasing adverse health effects from unsafe water and poor sanitation;
- poverty; and
- lack of expertise to address waste issues.

Economically, SIDS struggle with:
- limited economic development opportunities and dependence on tourism, mining, forestry, fishing and agriculture;
- increasing urbanization that stresses island resources, generating adverse health effects;
- lack of adequate governance capacity;
- transboundary issues from pollutants generated far from where the effects are felt; and
- significant importation of fossil fuels for energy generation.

Most waste ends up in either dumpsites or the marine environment.

Locally, **wastewater** presents one of the most serious challenges to the marine environment and is also a serious public health issue in many SIDS. Better water supply networks and adequate wastewater treatment are the first steps towards adopting more sustainable practices. Addressing the wastewater issue will require a more regional approach.

Significant quantities of **marine pollutants**, both organic and inorganic, end up on and around SIDS. Understanding pathways to the pollution and undertaking relevant action in international fora that will lead to waste reduction at source, as well as recognition of polluter responsibilities, is essential.

While SIDS are the source of only a very small portion of **greenhouse gases** (GHG), averaging only 47% of the global average emissions per capita, the impact of greenhouse gas emissions on them is significant, including sea level rise and increasingly severe weather events. Inter-regional collaboration will be needed to effectively adapt to climate change and reduce the emissions of greenhouse gases. Extreme weather events are expected to increase as climate change progresses, requiring more response planning by SIDS to manage the wastes generated during these events. While actions by SIDS to reduce GHG emissions may result in reductions that are relatively minor in view of total global emissions, such measures can result in significant effects for the countries concerned. For example, replacing fossil fuels with renewable energy sources saves substantial amounts of foreign currency. Also, organic matter sent to dumpsites can result in the release of, and exposure to, hazardous and biological pollutants, while diverting it away from dumpsites can improve soil quality and thereby enhance crop production.

Each of the major industries on SIDS lead to significant waste issues:
- Mining produces tailings that wash downstream, affecting water quality;
- Forestry degrades the land, leading to depleted water quality;
- Agriculture and farming affect the land and waterways;
- Fishing boats' ballast water affects marine biodiversity;
- Lead from smelting waste, lead-acid batteries and sinkers affect human health;
- Waste fishing nets affect marine organisms; and
- Tourism drives an increase in consumer waste products that are difficult for SIDS to manage,

Waste provides opportunities for job creation, particularly for the informal sector. Effective waste management in SIDS requires an **integrated approach**, bringing together industry stakeholders, the public health sector, oil and other industries, international organizations, and local communities. Inclusion of the informal sector is crucial for successful waste diversion and for fostering job opportunities. For integrated waste management practices to take root in SIDS, an innovative, circular economy community-based approach has promise, particularly through its easily recognizable, immediate economic benefits for local communities.

The average waste generation of SIDS inhabitants is 2.30 kg per person per day, which is 48% higher than the world average of 1.55 kg. As with the rest of the world, increasing incomes in SIDS corresponds to higher waste generation. The higher the income, the lower the proportion of organic waste and the higher the percentage of paper waste. Management of the waste problems will require incentives and regulations that cover solid, liquid and gaseous wastes.

For example, at present, the cost of shipping recyclable materials to markets is generally prohibitive for individual SIDS. In addition, water supply networks currently reach only about three-fifths of SIDS populations; less than half have access to wastewater collection and treatment. Thus the potential impact of insufficient water treatment on the population's health is significant. Gaseous emissions from fossil fuel burning contribute to climate change and acid rain formation.

This Outlook identifies the waste streams that most SIDS regard as high priority. A top priority is **hazardous waste**, including chemical, medical and electronic waste as well as lead-acid batteries, asbestos and used oil. However, SIDS lack the capacity to effectively manage this high priority waste and implement specific management practices. Effective management of hazardous waste requires coordination between SIDS. Already developed regional hazardous waste management models have the potential to be transferred to other waste streams as well, such as to recycling. Further regional cooperation and management models that utilize synergies between countries are required.

Other priority waste requiring action includes **construction and demolition** waste that has a high potential for diversion from the waste stream; **tourism waste** that is not easily managed by SIDS; **plastics**, which represent only 8% of the waste stream but are very difficult to manage; **disaster waste**, which can produce the equivalent of several years' worth of **waste** in a very short time; **tyres**, which are a growing problem requiring alternatives to landfilling; and **nanomaterials**, an emerging waste stream. Waste prioritization will require a framework that takes into consideration economic and social development as well as governance and waste management issues.

Governance is a crucial institutional enabler to implement the complex frameworks needed for effective waste management. Most SIDS structure their environmental and waste legislation based on international agreements and regional, sub-regional and national policy initiatives. Uptake and implementation of legislation varies across countries and sectors. Waste-specific regional and sub-regional bodies to facilitate attaining a critical mass for delivery would be beneficial. A greater focus on reduction and reuse rather than recycling and disposal in legislation would also lessen the amount of waste needing to be dealt with by SIDS.

Audit and **enforcement** of legislation and regulations are important components of effective waste management. While many legislative tools have enforcement provisions, they are generally poorly enforced. Some of the lack of enforcement is a reflection of the lack of capacity and coordination at the end of life of materials as well as the low levels of expertise of operators and the competition among priorities for government officials and departments.

Implementation of policy is often constrained by **financial challenges** to initiate and maintain integrated waste management programmes that lead to a circular economy. Most legislation is targeted at safer waste disposal, but SIDS struggle financially to achieve that objective. Additionally, it is expensive to send recyclable materials such as plastic bottles to markets where the economic value can be extracted. Even at the operational level, a sustainable charging system for waste services remains a challenge for many SIDS communities. However, while the costs of financing waste development policies can be high, the often invisible costs of inaction are considerably greater. These costs include the loss of ecosystems, acceleration of climate change effects, loss of national revenue (in the area of tourism, for example), and the cost of healthcare for affected populations. Those costs are commonly borne by society rather than the polluters.

Funding for waste management initiatives can come from international funding bodies, the private sector or community contributions. One of the emerging mechanisms is through Public-Private-Partnerships, which can be challenging to establish but might present opportunities for infrastructure planning and improvements. However, whatever is chosen, there must be clear win-win outcomes for the recipients and the funding providers.

A good starting point is the estimate that waste reduction can save SIDS municipalities between **USD 35** and **USD 400** per tonne, depending on the location and the waste management technologies used. A key part in the identification of suitable **technologies** is ensuring they are sustainable, environmentally sound solutions and appropriate to the local context.

USD 35 **USD 400**

Average savings per tonne of waste reduced

A real key to moving to a circular economy is extensive coordination and cooperation among all levels of government, the private sector, community groups and other stakeholders in order to change the focus of waste management. Also necessary are a clear definition of roles for each of the stakeholders, the separation of regulatory and operational functions, and cross-government coordination. Furthermore, identifying the key stakeholders and securing their appropriate engagement enables governments to share the load and achieve more sustainable results. The best results are achieved by building local capacity using locally acceptable solutions.

The key activities for SIDS to engage in to move towards a circular economy are to:

- take a whole of life approach for all solid, liquid and gaseous wastes.
- develop environmentally sound National Integrated Waste Management Strategies and Action Plans based on Best Available Techniques.
- cooperate with other SIDS to learn from each other's experiences by working regionally.
- engage in inter-generational long-term education programmes and education as part of programme delivery.
- use technologies to reduce waste that are appropriate for SIDS; this typically includes using items that are simple to operate, reliable, and easy to repair and maintain with local parts and skills.
- remediate dumpsites, which can provide materials having value and jobs and which can reduce environmental impacts.
- enforce current waste legislative provisions to provide a significant step towards better waste management.
- collect waste data to improve knowledge of the waste problem and facilitate evidence-based decision-making.
- monitor and evaluate progress to stimulate further buy-ins for changes in waste practices.

Transitioning to a circular economy will require regional cooperation and management models that utilize synergies between countries to manage hazardous waste, recycling, marine litter, greenhouse gas emission reductions, and wastewater.

The development of a business case substantiating the value of funding initiatives is vital to making progress. The lack of data for SIDS is a major hindrance in identifying the scale of the problem and the potential benefits that programmes can achieve. The additional hurdle of little agreement between countries or regions on terms and data collection methods makes the task of building a business case much harder. Regional cooperation to establish these could go a long way to smooth the way for data-led decision making.

While regional programmes are necessary, country-based programmes are key to moving towards a circular economy. Externally, governments need to engage with stakeholders in meaningful ways to share knowledge and gain their support. Internally, government officials responsible for waste management need to design programmes that will contribute to higher priority government workstreams such as job creation, skills development and economic development.

Circular economy thinking emphasizes closed material flows, efficient natural resources use, low energy consumption and low emissions. When SIDS adopt this sort of thinking, they will not only start to solve their waste issues but also contribute to the achievement of all 17 UN Sustainable Development Goals.

AUDIENCE AND COVERAGE

This Outlook is relevant to all 58 SIDS as well as all countries that have inhabited off-shore islands, as these islands often have similarities to SIDS. Geographically, the scope of the SIDS Waste Management Outlook includes the Caribbean, Pacific and Atlantic, Indian Ocean, Mediterranean, and South China Sea regions as shown in **Figure 1.1**.

Figure 1.1 The 58 small island developing states

This Outlook places particular emphasis on low- and middle-income countries, which struggle to address waste management challenges.

Development was informed by stakeholders from the region. To elicit key current issues and desired outcomes, two international workshops were held in the Caribbean and the Pacific, while inputs from SIDS in the Atlantic, Indian Ocean, Mediterranean and South China Sea region were collected through online consultations.

The Outlook is primarily targeted at decision-makers at both the national and local government levels but will be useful for other key stakeholders in the waste sector including businesses, financial institutions, the manufacturing sector, civil society organizations (not-for-profit and non-governmental organizations, community-based organizations, research organizations, professional associations, networks, etc.), the waste industry and academia.

1. SIDS: WASTE MANAGEMENT AND ALIGNMENT WITH GLOBAL GOALS

KEY MESSAGES

The following are key messages regarding **waste management in SIDS** and the alignment with the **Sustainable Development Goals:**

1

The SIDS Waste Management Outlook adopts an integrated approach to waste management addressing **solid, liquid and gaseous wastes**

2

Waste management in SIDS needs to **bring all the stakeholders together**, including factories, transportation, oil and other industries, the public health sector and international initiatives, as well as local communities

3

SIDS have many **waste management related issues** in common with global trends. However, their unique geography and environmental sensitivity often exacerbate the impacts, creating more complex situations that require innovation, collaboration and regional, community-based solutions

4

Common features of SIDS are:

ENVIRONMENTAL

- overexploitation of natural resources
- limited land availability for waste management activities
- freshwater shortages and decreasing water quality
- climate change vulnerability
- susceptibility to natural and environmental disasters
- increasing levels of imported non-biodegradable goods posing increasing waste issues
- pollutants generated internationally affecting the islands

SOCIAL

- increasing health impacts from unsafe water and poor sanitation
- poverty
- lack of expertise to address waste issues

ECONOMIC

- limited economic development opportunities dependent on tourism, mining, forestry, fishing and agriculture
- increasing urbanization stressing island resources and producing adverse health effects
- inadequate governance capacity
- significant importation of fossil fuels to run generators

5

SIDS cover all four income brackets from low income to high income, with three-quarters of SIDS in the top half of the income scale

6

Litter ending in the ocean and on coastlines has significant **impacts** on **tourism**

7

Waste generated by SIDS end-up primarily in **dumpsites** and the **marine environment**, making these two the primary disposal sites for waste in SIDS. **Eliminating these disposal sites** is vital for environmental protection

8

The integrated waste management approach **contributes to all 17 UN Sustainable Development Goals**

1.1 SIDS: COMMON FEATURES

Although SIDS are found all around the world, they share some common issues including those listed below[1].

Natural resources

Overexploitation of resources causes, among other effects, land use change, harmful coastal development, coastal erosion, uncontrolled mining polluting rivers and the land, marine pollution, loss of endemic species, deforestation, diminishing freshwater, increased eutrophication and the loss of soil and soil productivity. For many SIDS their exclusive economic zones provide important resources such as minerals and natural gas, as well as extensive fisheries. SIDS account for seven of the world's ten countries most dependent on seafood consumption[2]. Seafood can be significantly affected by waste entering the marine environment.

Land availability

In many SIDS, land for waste management activities is limited through customary land tenures, thus exacerbating institutional barriers to waste management development[3]. In addition, soil is often at a premium in these states which results in a lack of material to cover waste. Without waste cover, sites are more likely to be a source of odours as well as disease, which can spread by means of birds, vermin and insects.

Water

Increasing shortages of freshwater and decreasing water quality due to discharges of human and animal waste, and the limited capability of waste management on SIDS, present significant problems. In addition, the over abstraction of water and sea level rise allowing for saline intrusion contribute to water stress and diminishing water quality on SIDS.

Climate change vulnerability

While producing less than 1% of greenhouse gases, SIDS are some of Earth's most vulnerable countries for climate change[4], resulting in rapid changes in a short time such as waste-generating extreme storm events, and longer-term events such as sea level rise (particularly noticeable in low-lying countries such as Tuvalu and Kiribati), saltwater intrusion into groundwater systems in low-lying atolls, coastal erosion, inundation, coral bleaching, ecosystem destruction, ocean acidification, diminished crops and fisheries and increases in vector-borne diseases. The socio-economic effects of these changes have negative impacts on agriculture, ecosystems, financial services, fisheries, health, tourism, infrastructure, and water supply and sanitation[5]. In addition, women are more likely to be negatively affected by the impacts of climate change because they often have less influence and fewer resources than men[6].

Natural and environmental disasters

Natural disasters (e.g. earthquakes, tsunamis, hurricanes, landslides and volcanic eruptions) have significantly affected SIDS, such as through the generation of large quantities of waste requiring management. Such disaster waste includes not only debris from the disaster-affected areas but also waste resulting from relief items. In response to the 2010 earthquake in Haiti, the pre-existing waste issues were exacerbated by relief items provided through humanitarian operations, such as plastic water bottles and styrofoam (polystyrene) food packaging.[7] In addition, poor management of industrial activities has increased hazards resulting from the disposal of chemicals, waste and other pollutants.

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[1] United Nations Environment Programme (2014a)
[2] Burke et al. (2011)
[3] Asian Development Bank (2014f)
[4] Intergovernmental Panel on Climate Change (2014)
[5] Intergovernmental Panel on Climate Change (2014)
[6] United Nations Women Fiji Multi-Country Office (n.d.)
[7] Joint United Nations Environment Programme-United Nations Office for the Coordination of Humanitarian Affairs Environment Unit (2016)

Waste

Importation of products and technologies inappropriate for small communities often present problems for those groups, leading to significant human health and environmental risks. Rising imports of non-biodegradable goods including industrial and agricultural chemicals pose a waste problem. Increasing amounts of hazardous waste and marine plastics are symptomatic of rising living standards. In addition, tourism brings significant increases in waste and wastewater from cruise ships, yachts and hotels[8]. This fluctuation also creates a challenge for SIDS in planning adequate waste management. For instance, waste incineration is not feasible unless there is a reliable quantity of waste. Technologies and innovations to manage the increased waste quantities and diversity are often not available to SIDS and the lack of qualified people makes maintenance and operation problematic. Appropriate waste management is essential for sustainable development in SIDS. Inadequate waste management impacts negatively on public health, atmospheric, terrestrial, coastal, freshwater and marine environments, and economic sectors such as tourism, fishing and agriculture. Waste in SIDS has been recognized as a priority area for action where the lack of regulations, enforcement, infrastructure, limited diversion opportunities due to economies of scale, poor public attitudes and habits, and barriers to regional initiatives caused by legal regimes and definitions, all contribute to deficient waste management practices[9].

Transboundary issues

Pollutants that originate from thousands of kilometres away can significantly impact SIDS' environments. Air pollutants that can travel large distances include particulates, dust, organic compounds, ozone, sulfur oxides (SO_x), and nitrogen oxides (NO_x). In addition, climate sensitive microbial pathogens have traversed national boundaries to infect, for example, coral reefs in the Indo-Pacific and Caribbean regions. Micro-plastics are becoming a significant issue in that they can absorb and accumulate substances, such as persistent organic pollutants (POPs), concentrating them by about one million times. Ingestion can result in transfer to marine organisms and subsequent bioaccumulation in the food chain[10].

Health

Growing populations and increasing urbanization stress island resources producing adverse health effects of unsafe water and poor sanitation often resulting from inappropriate waste disposal. These practices are caused partly by lack of awareness of health and safety issues. Poorly constructed sewage systems, which are inadequate for the number of users in the fast-growing district centres, often result in coliform contamination of surface and ground waters. This is not only true for significant population centres, but also often evident in smaller SIDS such as the Federated States of Micronesia[11].

Poverty

The challenges of poverty reduction in SIDS are rooted in some persistent historical factors, unresolved by modern market dynamics. For instance, primary land dispossession is a defining feature of Caribbean history. To add to this, some SIDS have high rates of unemployment, resulting in many youth leaving for other countries. This puts additional pressure on social support services, depletes the knowledge base and contributes to the continuation of unsustainable practices. Additionally, inbuilt discrimination against women both causes and results from inequality driving poverty[12].

[8] Nicholson-Doty (2013)
[9] United Nations (2015a)
[10] United Nations Environment Programme (2014b)
[11] Federated States of Micronesia (2010b)
[12] Oxfam International (2018)

Data and technical expertise
Lack of technical expertise and data to address complex interdependencies in SIDS can result in additional waste issues to solve and are often cited as some of the main reasons for the slow progress of environmental agendas. SIDS are trying to address this issue by compiling more comprehensive data on various issues and by developing the relevant technical skills and expertise.

Sustainable economic development
SIDS are highly dependent on a few sectors including tourism, mining, forestry, fishing and agriculture[13]. However, isolation of the islands means that supply lines to and from markets are extensive and transport costs are high. In addition, tourism is often seasonal, resulting in a heavy burden on waste infrastructure at concentrated times. Barriers to trade through global product standards also negatively affect SIDS. One solution SIDS use for the lack of easy access to global markets is providing services that are not location dependent, such as the establishment of offshore tax havens and related financial services markets. However, few SIDS have sustainable economic structures with adequate budgetary planning and are often dependent on international aid and remittances from overseas workers.

Urbanization
The increasing rate of urbanization is a strong determinant of the need for well-managed urban waste management systems for all media. The rate of urbanization in the Caribbean is the highest anywhere in the Americas where, at the start of this millennium, 62% of the population lived in urban areas, increasing to 70% in 2015 and projected to reach 75% in 2025. Projections indicate that this trend will continue until around 2060 before stabilizing[14]. This trend is likely to be repeated in other regions. Urbanization has also increased the proximity of industry and residential neighborhoods with resultant waste and health issues.

Institutional capacity and technology transfer
Governance issues present major issues for SIDS since they have small, often scattered populations trying to cover a variety of competencies like health, education, foreign affairs and industry with their associated waste issues. A 2014 World Bank worldwide governance indicators survey[15] showed that, of the 38 countries surveyed, only nine had increased capacity over the 18-year survey period. With fragmentation, typical of SIDS, hindering communication and community building, few highly educated staff and a high degree of staff turnover, governments are unable to cope with requirements to engage at the local and national level to provide a resilient society.

Energy
The variables in providing efficient energy in SIDS are a significant challenge for the islands. With fossil fuels being the major energy source for island activities, hindrances caused by long supply lines, price fluctuations, high energy costs, aging infrastructure and poor economies of scale mean that energy is a scarce commodity in most SIDS. These countries remain highly susceptible to fuel price fluctuations especially when the cost of oil imports can reach 60 to 70% of gross domestic product and there is no concessionary finance available to modify the impact. These costs translate to the average householder spending 20% of his income on energy[16]. Many SIDS are pursuing renewable energy resources which have the dual benefits of reduced fossil fuel imports and reduced air emissions, fuel spillages and the associated environmental effects.

Many of the environmental and economic vulnerabilities that SIDS face disproportionally affect women, who are often more susceptible to the impacts of climate change and to food security issues.

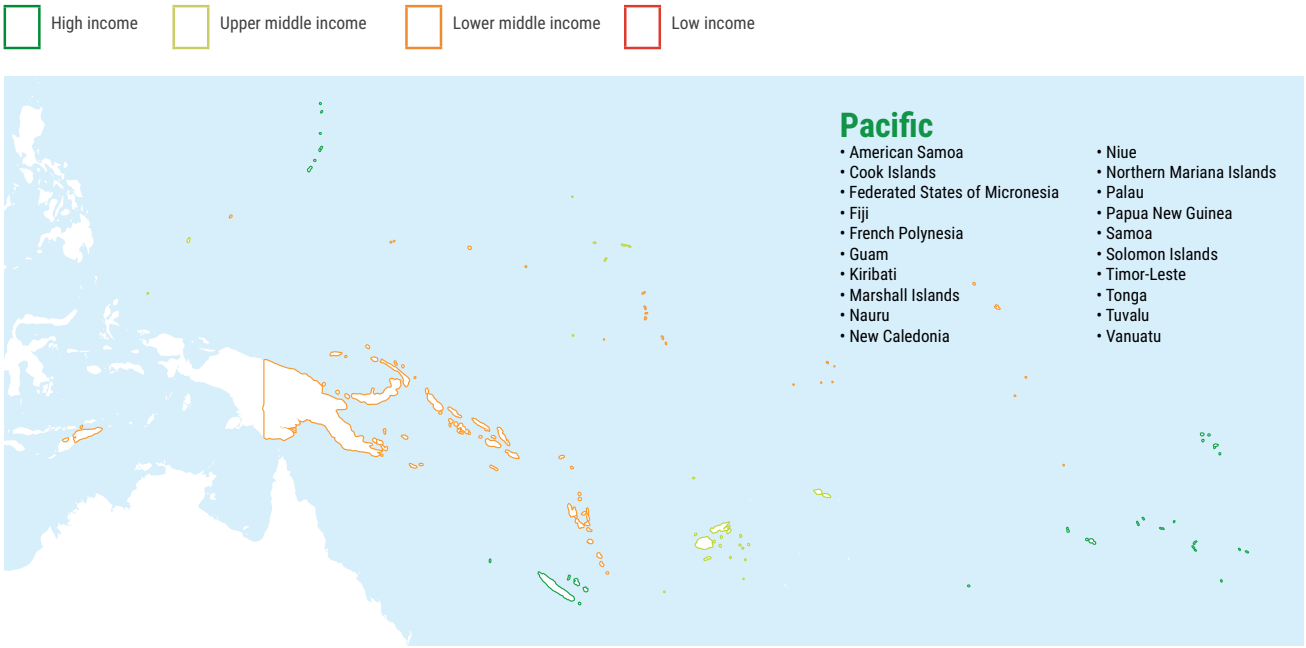
[13] United Nations (2012)
[14] United Nations Environment Programme (n.d.)
[15] World Bank (2014)
[16] SPC Energy Programme (2009)

1.2 SIDS: INCOME DISTRIBUTION

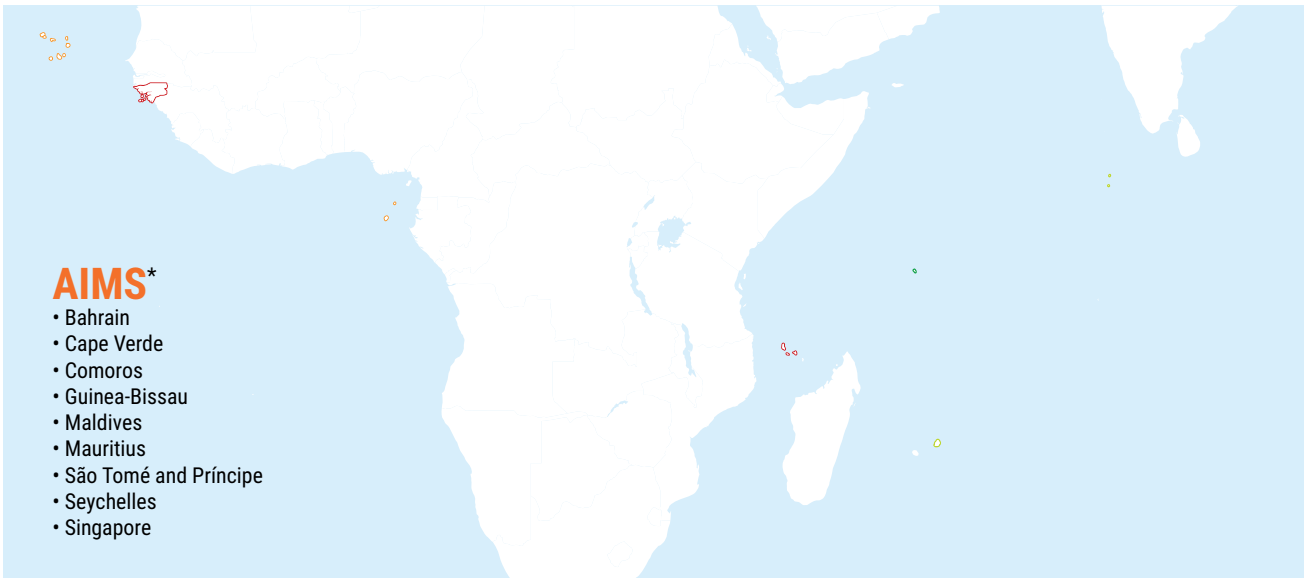
There is a strong correlation between the waste generated by a country and the income level of its population. The typical pattern is the higher the income, the greater the amount of waste expected to be generated. As can be seen from **Figure 1.2**, SIDS income distribution varies across the entire spectrum of income levels, with **39% of SIDS being in the high-income bracket, 36% in the upper middle, 12% in lower middle, 5% in the low-income bracket and for 8% the data is unavailable**. From a regional perspective, the Caribbean SIDS are primarily in the two upper brackets, with only Haiti in the low-income bracket. The Pacific has a more even spread across the top three categories, while the Atlantic, Indian Ocean, Mediterranean, and South China Sea region (AIMS) countries range evenly over all categories.

> ***75% of SIDS are in the upper income class; 17% of SIDS are in the lower income class; 8% of data unavailable***

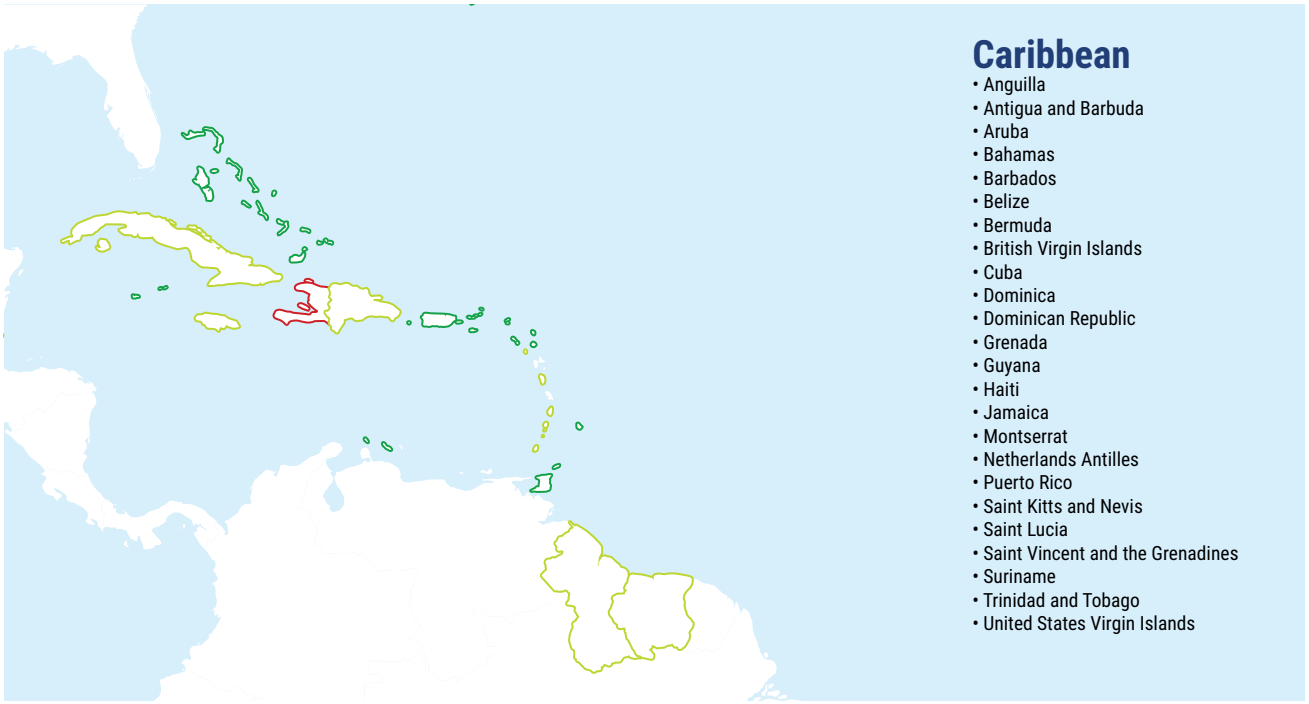
Figure 1.2 Income levels of small island developing states[17]



[17] World Bank (2016a)



*AIMS: The Atlantic, Indian Ocean, Mediterranean, and South China Sea region



1.3 WHERE SIDS' WASTE ENDS UP

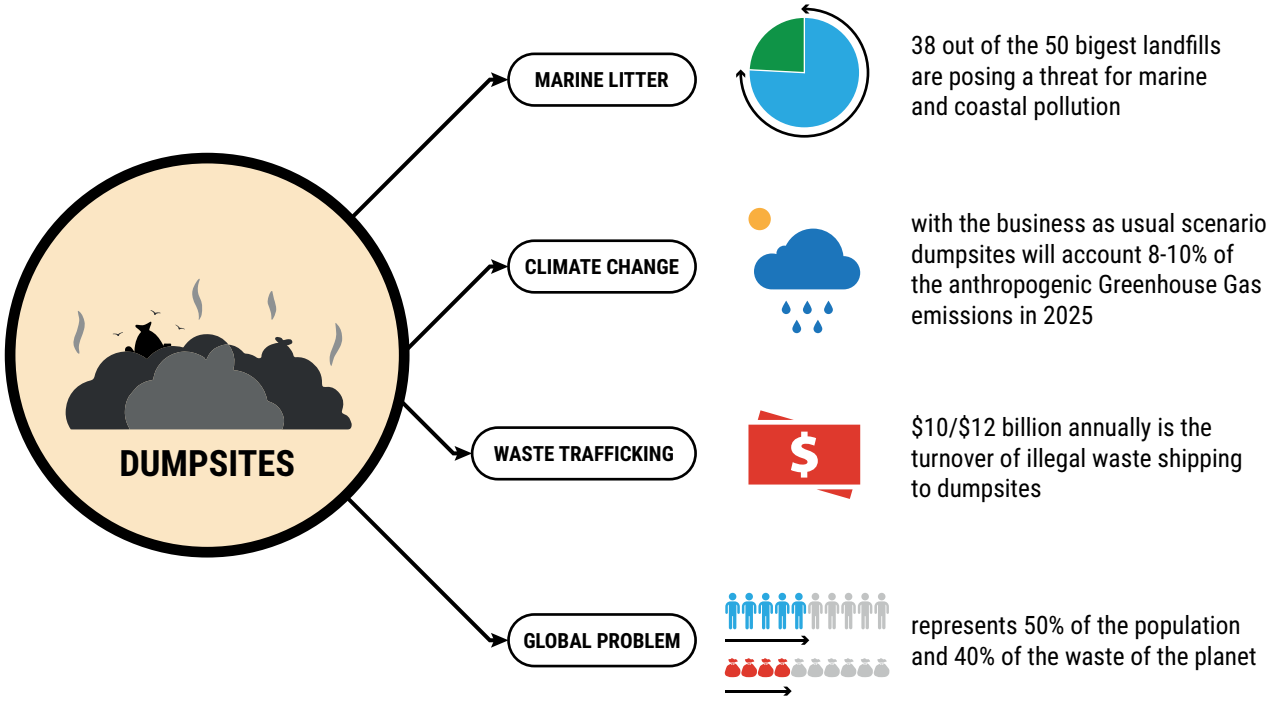
SIDS' waste primarily ends up in either dumpsites or the marine environment.

1.3.1 DUMPSITES

Although dumpsites are unfortunately still a widely used way for disposing waste, they represent a particularly acute issue for SIDS because of limited land availability, proximity to oceanic waters and waterways and limited availability for soil cover. It is not an easy matter to determine or control all the materials entering a dumpsite.

Dumpsites also normally do not feature protective measures for the surrounding environment. The impact of open dumps extends beyond the dumpsite itself. Strong odours, pollution from stormwater runoff, lack of leachate control, poor access roads, scavenging and lack of security are all issues resulting in significant health and environmental issues for SIDS.

Figure 1.3 Dumpsites as a global challange



Rehabilitation of dumpsites and landfills is possible and it has proven successful, as in the case of Namara Landfill in Fiji, shown in **Box 1.1**.

Box 1.1 Landfill Rehabilitation: Namara, Fiji

The Namara Landfill site is surrounded by mangrove vegetation on a bank of the Labasa River. Prior to its rehabilitation in 2014, the Namara Landfill was an open dumpsite for the town of Labasa for over 35 years. The open dumpsite was re-designed using the Fukuoka method, transforming it into a semi-aerobic landfill that produces clearer leachate and much less methane. It was also rehabilitated to receive more waste without compromising the health of local residents or the sensitive environment around the area.[18]

Rehabilitation involved building an all-weather access road, installing a security gate and fence, building a separate storage area for e-waste and hazardous wastes, establishing an office for staff to undertake administrative functions and constructing washing facilities for landfill workers and users.

In order to reduce leachate generation, surface water runoff is diverted outside the landfill through protective dykes, culverts and other structures. Leachate is reticulated to a pond, allowing containment within the landfill and treatment if required. The all-weather access road built around the perimeter also serves as a storm water bund and leads through to the active landfill cells. Gas vents are installed in the two cells intended for general waste.

This landfill presents unique climate-resilient features compared to other disposal facilities in the Pacific. The landfill has a distinct facility designated to receive disaster waste in case of need. The dedicated cell for disaster waste is large enough to allow for waste sorting and recovery. There are distinct signs within the cell to direct workers and users on how to sort the waste appropriately.

(Labasa Town Council, Fiji)

To protect the environment, it is vital to **eliminate open dumping and halt the disposal of waste in unsanitary or uncontrolled dumpsites**. Dumpsites near water streams, spontaneous combustion of waste at the dumpsites, and deliberately burning waste to reduce its volume are routes to exacerbate pollution. Burning waste produces **toxic gases**, such as persistent organic pollutants (POPs), nitrogen oxides (NO_x) and sulfur oxides (SO_x), and emits **heavy metal particles** into the atmosphere. The cost to society of improper waste management is five to ten times that of implementing proper waste management in a middle- or low-income city[19].

An initiative to close the world's 50 biggest dumpsites by 2030 was launched by the International Solid Waste Association (ISWA) in 2016[20] and a roadmap to guide the closure of the dumpsites has been developed. Carrying through on this initiative requires joint effort and immediate action. Three of those sites are in SIDS, as shown in **Table 1.1**.

Table 1.1 Three of the world's 50 largest dumpsites found in SIDS[21,22]

Dumpsite and location	Quantity (thousands of tonnes)	Type	Size (ha)	Number of informal sector workers	Population within 10 km	Natural resources at risk
Tibar, in Timor Leste	770 – 1,100	Municipal Solid Waste, Hazardous, E-waste	3.6	100	240,000	Banda Sea Mota Comoro River Tasitolu Lake
Trutier, in Port au Prince, Haiti	2,100 – 3,000	Municipal Solid Waste, Hazardous	94	2,000	1,300,000	Crise River, sea
La Duquesa, in Santo Domingo, Dominican Republic	14,700 – 21,000	Municipal Solid Waste, Hazardous	128	N/A	225,000	Isabela River

[18] The rehabilitation of the Namara Landfill is a pilot project implemented by the Secretariat of the Pacific Regional Environment Programme (SPREP) through the Integrated Climate Change Adaptation Initiatives Project funded by the Australian Agency for International Development (AusAID) and technical assistance from the Japanese Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries (J-PRISM).

[19] United Nations (2015a)

[20] International Solid Waste Association (2016)

[21] Waste Atlas Report (2014)

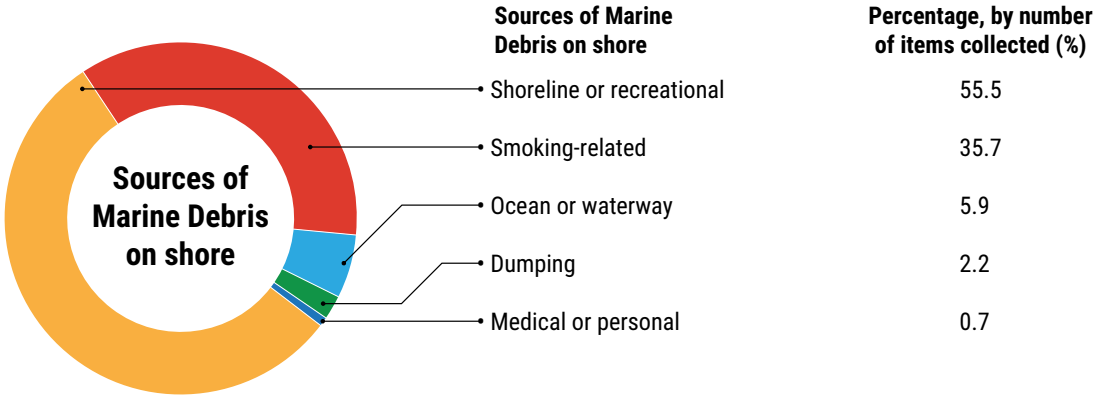
[22] International Solid Waste Association (2016)

1.3.2 Marine Environment

SIDS are particularly prone to the effects of marine and costal pollution as the distance from the pollution source to marine environments is often very short, so very little filtering occurs. Marine litter has become a worldwide waste management topic, particularly long-lasting litter like plastics. It is estimated that about 2% of the plastics produced annually end up in the marine environment and about 80% of marine litter originates from land-based sources[23]. An unknown quantity of microplastics also enters the marine environment to wash up on shores or make its way into the food chain. Although waste can enter the marine environment because of human negligence or weather-related events, such as waste blown away by the wind or carried to the sea by heavy rain or natural disasters, in SIDS, waste can also enter the marine environment from dumpsites which are often located alongside rivers or adjacent to the sea. SIDS pollution in coastal and marine areas can often also be caused by permissive management practices inland which lead to industrial outfalls, untreated municipal sewage, wastewater and nutrient runoff. **Nutrients** emanate from a variety of sources including fertilizers and fossil fuel burning, while **wastewater** comes from humans, livestock, industry and aquaculture. Wastewater directly impacts the biological diversity of aquatic ecosystems, resulting in disruption to life support systems; this in turn affects a range of sectors[24]. Coastal erosion of dumpsites through wave action and storm surges, as well as wind, are significant pathways into the marine environment[25].

SIDS are often the recipients, rather than the large-scale generators, of litter. For example, Henderson Island, an uninhabited island in the Pitcairn group in an isolated part of the Pacific Ocean, was recently reported to have 38 million pieces of plastic that drifted through oceanic currents onto the island, originating from Russia, the United States, Europe, South America, Japan, and China[26]. Characterization of marine debris showed that the majority of it was generated from shoreline and recreational events, followed by smoking-related activities, as shown in **Figure 1.4**.

Figure 1.4 Relative percentages of marine debris collected in the APEC region economies during the 2007 International Coastal Cleanup[27]



[23] International Solid Waste Association (2017)
[24] World Bank and United Nations Department of Economic and Social Affairs (2017)
[25] United Nations (2015a)
[26] Lavers and Bond (2017)
[27] McIlgorm, Campbell and Rule (2008)

Action designed to manage marine litter has already started in several SIDS, as shown in **Box 1.2**

Box 1.2 West Indian Ocean Litter[28,29,30]

A marine litter assessment in the West Indian Ocean concluded that there was little data on the types, quantities, trends or sources of marine litter. For the West Indian Ocean, surface runoff from urban areas was the most significant source of marine litter, followed by commercial and fishing vessels. The recommendations of the study included the following: i) address land-sourced and marine-sourced litter differently as the applicable laws and relevant approaches are generally different; ii) ensure adherence to existing international instruments, particularly the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V, the London Convention and the Nairobi Convention; iii) develop assistance programmes with a focus on marine litter abatement strategies when applying for foreign funds; and iv) standardize monitoring methods.

Following the assessment, SIDS in the West Indian Ocean have started taking action to reduce marine pollution. For instance, in 2016 Mauritius banned plastic bags designed to carry goods purchased at shops[31].

Progress on pollution reduction requires environmental auditing. The **lack of effective monitoring** leading to tangible remediation actions increases vulnerability of the poor by increasing the risks of pollution and associated health and flood damage.

[28] United Nations (2015a)
[29] United Nations Department of Economic and Social Affairs (2010)
[30] United Nations Environment Programme (2016c)
[31] Eleven types of bags for essential use, hygienic and sanitary purposes are exempted from the ban in Mauritius

1.4 Sustainable Development Goals

Waste management is an important part of sustainable development. Of particular note is that integrated waste management can contribute to all the Sustainable Development Goals, as shown in **Figure 1.5**.

Figure 1.5 Contribution of integrated waste management to the Sustainable Development Goals

Graphic supplied with assistance from Zoë Lenkiewicz, WasteAid UK and contributor to Be Waste Wise

A transition from dumping waste to a circular economy must occur in order to contribute to attaining the Sustainable Development Goals in the most meaningful way. A circular economy strives to reduce waste in all its forms – solid, liquid and gas. Waste is a manifestation of inefficiency in material life cycles. The traditional pathway to a circular economy follows a progressive path starting with the first step of organized disposal as summarized in **Figure 1.5**. This trajectory could be used by SIDS to identify where along the trajectory they are, and define the strategies and actions that have to be implemented to achieve leapfrogging to a circular economy.

Box 1.3 Key Sustainability Principles

Sustainable consumption and production helps to achieve overall development plans, reduce future sustainability costs, enhance economic effectiveness and alleviate poverty. A key feature of sustainable consumption and production is to adopt a **life cycle thinking** approach which starts at the product design process and finishes at the end of the product's life. Life cycle thinking considers the impact of a product from environmental, social and economic perspectives to provide a holistic picture and motivate decision-makers and private sector actors to make improvements that move society closer towards a circular economy.

Circular economy thinking emphasizes closed material flows, efficient natural resources use, low energy consumption and low emissions.

Moving to a circular economy requires a different type of thinking, for which SIDS will need targeted assistance.

Figure 1.6 Progression of waste management practices, from disposal to a circular economy[32]

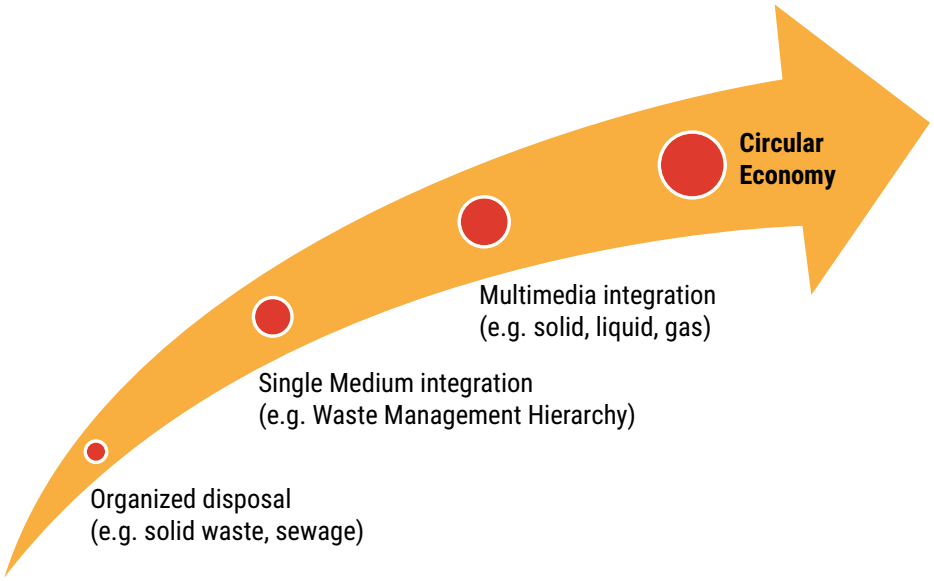


Figure 1.6 shows how waste management practices typically transition over time, from dumping waste to a circular economy. The typical transition starts when health issues prompt governments to build environmentally sound disposal sites (SDG 3), specifically landfills for solid waste, while treatment and control mechanisms are installed for wastewater and air emissions (SDGs 6, 11, 14 and 15). While these measures do contain the problem, waste quantities usually keep increasing. Governments then move to a more integrated mode by diverting waste before it reaches disposal through the use of a waste management hierarchy. Governments then adopt similar strategies across all media, enabling the creation of a circular economy. These strategies provide side benefits of added economic value, job creation (SDG 8), upskilling opportunities and reduced risks across media. **Figure 1.6** demonstrates a clear direction for many governments aiming at a circular economy. The figure also illustrates a challenge for countries with uncontrolled dumping that lack organized disposal, which are not yet on the path to a circular economy. Such nations require a long-term vision for their waste management strategy, supported by adequate financial planning by the national or local treasury to achieve a circular economy.

[32] United Nations Environment Programme (2016d)

2. WASTE MANAGEMENT: ISSUES AND OPPORTUNITIES

Waste management is a cross-cutting issue affecting many sectors in society. For SIDS, the limited availability of land and the distance from markets make waste management a challenge. The accumulation of waste, especially liquid and hazardous, threatens public health, natural ecosystems and biodiversity. It is expected that, until adequate waste management systems and infrastructure are established, isolated islands such as Nauru will continue to have problems with waste resulting from imported products such as vehicles and air-conditioning units, along with their associated packaging. The following sections analyze the respective linkages between waste management and the industrial sector, public health, and climate change, as well as the economic opportunities improved waste management might offer.

KEY MESSAGES

The following are the key messages regarding **issues and opportunities for waste management in SIDS**:

1

Industries can be responsible for significant waste issues:

Mines can have unstable dams and the tailings washing downstream affect water quality and waste disposal

Forestry can result in land and soil degradation and depletion of water quality

Agriculture and farming have similar problems to forestry plus generating hazardous wastes

Fishing produces waste ballast water, negatively impacting **marine biodiversity**. **Human health** problems derive from smelting waste lead-acid batteries and sinkers. Waste **fishing nets** affect marine ecosystem.

Tourism is driving an increase in consumer waste products that are not easily managed by SIDS

2

Wastewater presents a serious public health and environmental problem in many SIDS. Regional action seems to be necessary to address this widespread issue. **Reticulation** and **adequate treatment** are the first steps towards adopting more sustainable practices

3

SIDS are among the **smallest global contributors of GHGs**, however the impact of these emissions on them is significant, including the **dumpsites** which can cause the release and exposure to **hazardous and biological pollutants**

4

SIDS are overall recipients of significant quantities of **marine pollutants**, both **organic** and **inorganic**. Understanding pathways to the pollution and undertaking relevant action in international fora will lead to waste reduction at source, as well as recognition of relevance of recognizing polluter responsibilities. The **informal sector** is crucial to waste diversion and job opportunities, particularly for women.
The role of the informal sector needs to be better recognized and those who are engaged need to be protected, in terms of health impact, economic stability at household and social perception.

5

Waste provides an opportunity for **job creation**, particularly in the **informal sector**

2.1 Waste and Industry

Many SIDS' environmental problems can be traced to stresses resulting from industries and activities that exploit their natural resources. Dumping solid and untreated industrial waste can contaminate inland freshwater, coastal wetlands (e.g. lagoons and estuaries) and associated marshes. Waste discharge can have considerable effects on SIDS' ecosystems making aquatic environments uninhabitable for freshwater species, with impacts on the food value chain.

2.1.1 Primary Industries

Mining. Some islands have significant mining and quarrying operations, as in the cases of Papua New Guinea and formerly Nauru. Mining industry operations are typically a mixture of large and boutique mining operations, with waste often generated outside the control of national waste regimes and data typically unreported.

Mining has effects on water quality, waste disposal, and environmental pollution. Mining carries significant waste management issues, as tailings dams are often unstable and the tailings become washed downstream. Additionally, mining results in significant pollution risks including flooding, deforestation, sedimentation, siltation and increasing instances of waterborne diseases. Lack of adequate waste management in mining operations means that the waste footprint becomes much greater than the actual waste generation site[33]. Contaminants can be found at significant distances from the point of discharge. In Papua New Guinea for instance, contaminants have been found more than 1,000 km downstream from the Porgera and Tolukuma mines[34]. Dedicated efforts to better manage mining waste can bring about far-reaching improvements. However, at times, governments must face the opposition of large corporations that have significant resources and considerable political influence, which can constitute a significant barrier to change. In addition, the level of expertise on waste matters in SIDS is often inadequate to counter efforts from corporations.

The health and environmental impacts of mining waste are shown in **Box 2.1**, based on the experience of the Papua New Guinea's Government with the Ok Tedi Mine.

Box 2.1 Ok Tedi Mine, Papua New Guinea[35, 36]: Health and Environmental Impacts of Mining Waste

The Ok Tedi Mine in Papua New Guinea has been in operation since 1984, when it was opened by BHP Billiton to produce gold and copper. Because of inadequate waste retention facilities, 80 million tonnes of mining waste per year until 1997 were discharged into local waterways, impacting downstream villages, agriculture and fisheries along the 1,000 km route. The river bed rise caused by accumulating mine sediment resulted in flooding and sediment deposition on the flood plain, leading to forest vegetation dieback in an area of up to 3,000 square kilometres that will take up to 200 years to recover. Flooding carried contaminants from mine tailings downstream, depositing them on riverbanks and affecting taro, bananas and sago palms, all of which are important food sources for local villagers. Likewise, chemicals from the tailings killed or contaminated fish that are a staple food for local communities. In addition, a high concentration of copper was detected on floodplains. This pollution is of a persistent nature and will be impacting ecosystems for a long time to come.

Since BHP Billiton transferred ownership to the people of Papua New Guinea in 2013, a billion dollars has been spent by Papua New Guinea on environmental remediation, with about 40% of that on preventing further contaminated material from entering the waterways.

[33] Alfthan et al. (2016)
[34] Papua New Guinea (n.d)
[35] Hettler et al. (1997)
[36] Garrett (2013)

Forestry Industry, Land Clearing and **Logging** are significant activities for SIDS that contribute to many adverse effects including biodiversity loss, land and soil degradation, and degradation of water quality. The removal of native forests and replacement with monocrops such as palm trees can result in biodiversity loss. Additionally, when forest removal results in bare soil, the exposed fertile topsoil is easily washed off by the rain into waterways, reducing land fertility while also generating sediment flows. As an example, in the southern Marovo Lagoon, Solomon Islands, clearing land in unstable hill country resulted in increased sediment flows, which are not being monitored[37]. Forestry waste is usually managed close to the source. It is typically used either as soil improvers and nutrients or as biomass fuel[38] and therefore not noted in national inventories.

Agriculture and **Farming**. Similar to the forestry industry, chemicals and waste in agriculture and farming are generally managed at source. Specifically, waste is either returned to the soils or used to produce energy from biomass burning. Poor burn practices and improper discharge of animal sewage[39] can contaminate groundwater and waterways, contributing to land degradation and air pollution that extend far beyond the generation point. An alternative approach to deal with agriculture and farming waste, adopted by Timor-Leste, is the introduction of the Green Economy, whereby a range of sectors strive to attain the equivalent of sustainable agriculture[40]. Taking a wider view enabled Timor-Leste to send out a similar message for multiple sectors, thereby reinforcing the message from multiple angles. The establishment of a working group led by the prime minister's office and strong cross-government representation made it possible to provide a roadmap to implement the 17 SDGs in Timor-Leste while simultaneously stimulating the private sector to diversify into agricultural enterprises[41]. There were several components in the initial programme. Targeted specific watersheds to improve agriculture development planning provided the boundaries for action. Within these watersheds, local watershed management councils were either formed or strengthened to become governance bodies. Small farmer organization, advisory support and training was provided to enhance skills at the local level. On-farm investments were provided for equipment and technologies that reduced post-harvest losses, increased value addition, addressed soil erosion and promoted climate resilience. At the government level, assistance was provided to increase capacity in the Ministry of Agriculture and Fisheries for services, planning, programming, coordination and monitoring and evaluation functions[42].

Fishing. Increased pollution and overfishing result in fish stock depletion and ecosystem degradation[43]. The load and discharge of waste ballast water[44,45], by ships negatively impact marine biodiversity. The crude recovery of lead by smelting, which gives off lead fumes, from lead-acid batteries and fishing sinkers[46] has lasting health effects on the operators who breathe in those lead fumes. Abandoned fishing nets amount to hundreds of thousands of tonnes of waste annually and produce long-term negative economic and environmental impacts as they are non-degradable and remain in the marine environment because they are made of synthetic materials (nylon, polyethylene and polypropylene)[47]. These nets are thus a source of marine pollution and impact marine species.

[37] Solomon Islands (2008)
[38] United Nations (2015a)
[39] Solomon Islands (2008)
[40] Timor-Leste (2012)
[41] Timor-Leste (2015)
[42] World Bank (2016b)
[43] Solomon Islands (2008)
[44] Ballast water is water carried in ships' ballast tanks to improve stability and balance. It is taken up or discharged when cargo is loaded or unloaded, or when the ship needs extra stability due to difficult weather conditions. When ships take on ballast water, plants and animals that live in the ocean are also picked up and carried to the next destination.
[45] Mauritius (2010)
[46] United Nations Department of Economic and Social Affairs (2010)
[47] International Maritime Organization (2016)

2.1.2 Tourism

Land tourism, diving and cruises put significant stress on natural resources in SIDS and are significant generators of waste. Many SIDS rely on pristine beaches to attract tourists, but with marine litter deposits, the viability of this industry is endangered. For example, Barbados attracts over 1 million tourists each year, accounting for almost 50% of gross domestic product and employment. The Caribbean Tourism Organization with the support of the Ministry of Tourism of Barbados carried out a study which concluded that **beach litter creates economic costs because it reduces the likelihood for tourists to return**[48].

Increasing quantities of the waste commonly associated with consumer societies are entering SIDS through rising tourism. For example, while the average waste generated in the Maldives capital, Male, is 2.48 kg per person per day, tourist resorts generate an average of 7.2 kg per guest per day[49].

Without a proper waste management system, solid waste and wastewater from **cruise ships** and **yachts**, as well as waste from hotels, are disposed in dumps on the islands or discharged into the surrounding seas. Many tourism ventures cater to the higher end of the market resulting in large ecological footprints from waste production, water use, energy generation and dependence on imported goods. Most islands do not have the infrastructure to manage this imported waste.

Coastal tourism represents a significant source of litter, aggravated by poor waste management practices and a lack of resources in some jurisdictions. In addition, there is a disconnect between those profiting from tourist activities (e.g. restaurant owners and tour operators) and those tasked with managing the effects, particularly the local communities. The waste causing particular issues is food and drink packaging, electronic waste and construction waste from hotel renovations. The marketing of programmes that offset carbon emissions from tourism activities is still in its infancy[50] while eco-tourism is still a largely unexplored subsection of the market.

> ***Beach litter creates economic costs because it reduces the likelihood for tourists to return***

[48] United Nations (2015a)
[49] Maldives (2010)
[50] United Nations Department of Economic and Social Affairs (2010)

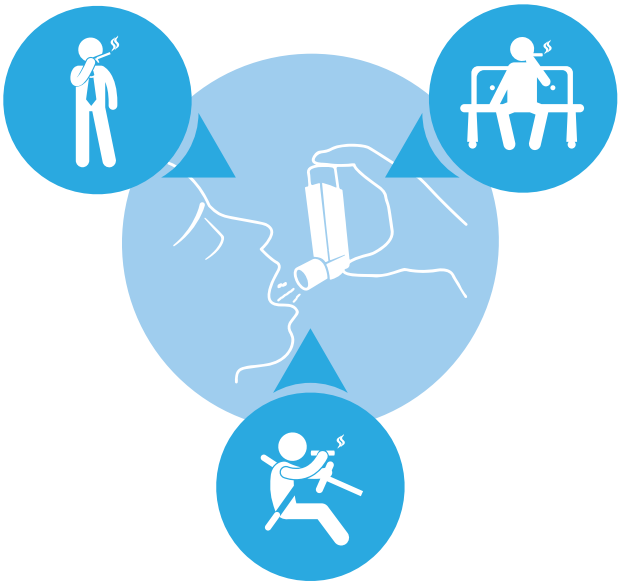
2.2 Waste and Public Health

Health issues have been one of the main drivers for governments to act on waste issues. The absence of waste collection systems and improper disposal of wastes are a concern in many SIDS having direct health impacts on residents, particularly children and the elderly. Waste builds up around drains and blocks them, allowing flies, rodents, and other pests to proliferate and infectious diseases such as **cholera** and **dengue fever** to spread. Similarly, uncontrolled dumpsites can lead to diseases spreading to neighboring settlements and job sites. In SIDS with lagoons, such as Tuvalu, additional adverse effects result from stormwater runoff[51]. Waste that has accumulated in lagoons can become a hidden source of diseases and a cause of other public health issues. Leachate runoff into soils and waterways can find its way into the food chain, with negative health impacts for humans.

Uncontrolled waste burning causes air pollution and, in addition, the indiscriminate use of pesticides containing persistent organic pollutants (POPs) contaminates freshwater resources and also has adverse effects on human health, island ecosystems, biodiversity and agricultural production. Some SIDS, for example ***Papua New Guinea***[52] ***and Bahrain***[53]***, have legislated for chemical management and established authorities for handling chemicals at the local and national levels, something that could be replicated by other SIDS***[54].

One of the health issues from waste is that of asthma, resulting from indoor and outdoor pollution. Palau recognized that asthma and other respiratory illnesses have been on the rise and that indoor air pollution could be a contributor to the increase in rates. The Tobacco Control Programme surveyed 206 people and found that 83% had frequent exposure to secondhand smoke. Of those exposed, 30% were exposed in cars, 28% in their homes, and 25% were exposed at work[55]. Another source of indoor air pollution causing significant health effects, particularly for poor people in rural areas, is from firewood used for cooking, lighting and heating as in, for example, Timor-Leste[56], shown in **Figure 2.1**.

Figure 2.1 Impact of waste on human health



[51] Tuvalu (2005)
[52] Papua New Guinea (n.d.)
[53] El-Karawy (2017)
[54] For lessons learned and best practices for replication please refer to the UN Environment publication 'Emerging issues for Small Island Developing States. Results of the UNEP Foresight Process' (2014)
[55] Palau (2004)
[56] Timor-Leste (2012)

2.3 Waste and Climate Change

Globally, waste management improvements can contribute 15 to 20% greenhouse gas emission reductions across the economy[57].

Direct SIDS contributions to global CO_2 emissions are generally insignificant. Even in countries like the Bahamas, where imported liquid fossil fuels accounted for 65% of its emissions[58], the climate change effect of those emissions is negligible on the global scale. However, **SIDS are highly vulnerable to climate change** impacts like sea level rise and the increasing frequency and magnitude of disasters. **Natural disasters** cause rapid and unpredictable increases in the amount of mixed waste and pollutants that have to be managed. In addition, **human-induced environmental disasters** require preparedness, early warning systems, communication tools and quick, coordinated responses to contain the effects of spillages and other events.

In parallel to adaptation efforts, SIDS are recently targeting reductions in greenhouse gas emissions and short-lived climate pollutants, such as methane and black carbon from open burning and dumping, to demonstrate their commitment to mitigating climate change.

A number of SIDS have developed **Nationally Determined Contributions (NDCs)** for reducing greenhouse gas emissions as part of global climate commitments stemming from the 21st session of the Conference of the Parties to the UN Framework Convention on Climate Change in 2015, also known as the Paris Climate Conference. For example, Kiribati committed to reducing emissions by 13.7% by 2025 compared to emissions expected from business as usual. Kiribati also noted that with appropriate international assistance, emissions reductions of 60% by 2030 could be achievable[59]. Another example is Fiji. As its Nationally Determined Contribution, Fiji aims to have renewable energy provide 81% of its grid electricity supply by 2020, and 100% by 2030[60].

Efforts to adapt to and mitigate the effects of climate change are demonstrated by Palau. The country adopted a participatory approach through a series of workshops and a national symposium to: i) raise public awareness on the causes of climate change and its impacts on Palau; ii) prepare a greenhouse gas inventory; and iii) conduct a vulnerability and adaptation assessment. These served to determine the effects of climate change on Palau and helped in identifying areas of high vulnerability and mitigation options. From this analysis, an adaptation framework was developed to address anticipated climate change trends[61].

[57] United Nations (2015a)
[58] Bahamas (2005)
[59] Kiribati (2015)
[60] Michalena et al. (2018)
[61] Palau (2004)

2.4 Waste and Job Creation

The waste sector is an important source of job opportunities in both the formal and the informal sectors. The formal sector includes government at both the national and local levels and larger private companies. The formal sector's failure to institute comprehensive waste management systems in several SIDS encouraged the rise of a robust **informal sector**, as poor material diversion from waste streams was a major driver for the development of the informal sector among the least wealthy portions of the population[62].

The devolution and formalization of waste management activities provide economic opportunities and can empower informal waste operators, who would otherwise work in unhygienic and hazardous conditions[63]. Decentralized waste processing provides an opportunity for more employment opportunities. It is also less capital intensive, thereby enabling a lower threshold for funding. In addition, decentralization leads to the provision of safe livelihoods for the urban poor and the informal sector.

Improvements in the health and safety procedures and the equipment used by waste operators are practical ways to demonstrate progress. The example of Kiribati is shown in **Box 2.2**.

Box 2.2 Disposal Site Health and Safety Improvements, Kiribati[64]

Although in recent years Kiribati introduced several measures to improve waste management on the island[65], the health and safety of waste workers on disposal sites was until recently one area still needing significant improvement.

The disposal sites on Tarawa Island in Kiribati are uncovered. People live on and gain income from the sites through waste picking, and children ride to school on the back of a working rubbish truck. Council workers used to collect rubbish in bare feet, and medical waste was not separated from domestic waste during collection. Short-term assistance to the Kiribati government, provided by the Local Government Association of New Zealand and the New Zealand Ministry of Foreign Affairs and Trade, helped the island achieve major health and safety improvements over a six-month period.

Improvements include the provision of personal protective equipment to waste operators and pickers, including boots, gloves and uniforms; the separation of medical and hazardous waste from general waste through separate collection schemes; the establishment of a separate hazardous waste area difficult for the public to access; and training of workers on health issues in collaboration with the island's Health Ministry as well as on how to manage medical and other hazardous wastes.

This has created more economic opportunities and made a real difference to the way waste is managed on the Island.

The economic benefits of instituting good waste management practices extend across the economy of a country. Increased investments for environmentally sound waste management, including the recycling of materials, will enable the creation or expansion of a formal waste industry with associated work opportunities. Likewise, the adoption of appropriate new technologies will facilitate capacity building of the local population.

[62] United Nations Environment Programme (n.d.)
[63] United Nations Environment Programme (2017)
[64] Way (2014)
[65] Waste management improvement measures introduced in Kiribati include: introduction of a significant tax on imported glass, a refund system on aluminium and polyethylene terephthalate (PET) packaging, waste collection fees paid by users at the local council, community access to compaction machinery and monthly waste management meetings between key stakeholders.

Some of the difficulties in implementing health and safety programmes are illustrated by the approach undertaken in Fiji, as shown in **Box 2.3**.

Box 2.3 Work Adjustment for Recycling and Managing Waste in Fiji

The city of Lautoka, Fiji has implemented an approach named "Work Adjustment for Recycling and Managing Waste" (WARM)[66] to improve health, safety and work conditions of waste management for council workers, contractors and the community. This approach builds on the assumption that better working conditions result in a more motivated and productive workforce, which in turn leads to a more efficient waste management system.

Key barriers to consider and overcome were the low literacy levels and limited skill sets of waste workers and the lack of commitment by organizations to invest in occupational safety and health.

Low cost improvements and a demonstration of good practices were well received by the community and the council, and practical training on options to improve occupational safety and health in the workplace proved effective in changing the mindset of workers and brought immediate changes to work practices.

Sustaining the WARM initiative requires continuous refresher training and monitoring, making the active consideration of occupational safety and health obligatory in the workplace. The training opportunities provided to the community enhanced ownership and commitment among stakeholders, strengthening cooperation towards more effective waste management.

(Lautoka City Council, Fiji)

[66] The "Work Adjustment for Recycling and Managing Waste" (WARM) approach is an initiative supported by the Japan International Cooperation Agency (JICA) and the International Labour Organization (ILO) through the Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries (J-PRISM) project.

3. THE STATE OF WASTE MANAGEMENT IN SIDS

This chapter describes and analyses the current state of waste management in SIDS. Wherever possible, data has been gathered for each small island state, but there are numerous data gaps which need to be filled to gain a better understanding of the direction each individual country is pursuing.

KEY MESSAGES

The weighted average waste generated by SIDS inhabitants is 2.30 kg/ca/day, **48% higher than the world average** of 1.55 kg/cap/day

SIDS show trends towards higher generation of waste with increasing income levels. That suggests that economic development initiatives must **integrate environmentally sound waste management solutions**, based on the principles of a circular economy

Composition data shows that the **higher the income the lower the portion of organic waste** and the higher the percentage of paper waste

Diversion from dumping or landfilling is **not measured effectively** across SIDS

Incentives and regulations are necessary to **encourage material reuse** as well as **diversion of waste** from disposal in landfills or dumping. Currently, the focus in solid waste is mostly on waste collection

The **cost to ship** recovered materials to markets vs the **market price** at the destination is a challenge to overcome

Lack of storage and disposal facilities, inadequate end-of-life management technologies, lack of data, shortage of qualified personnel are **some of the problems** that have to be addressed

Wastewater can **contaminate fresh water causing health issues** due to, on average, only three-fifths of the populations of SIDS are connected to reticulated water. In addition, on average, just under half of the populations of SIDS have wastewater collection and one-third have wastewater treatment resulting in potential health issues

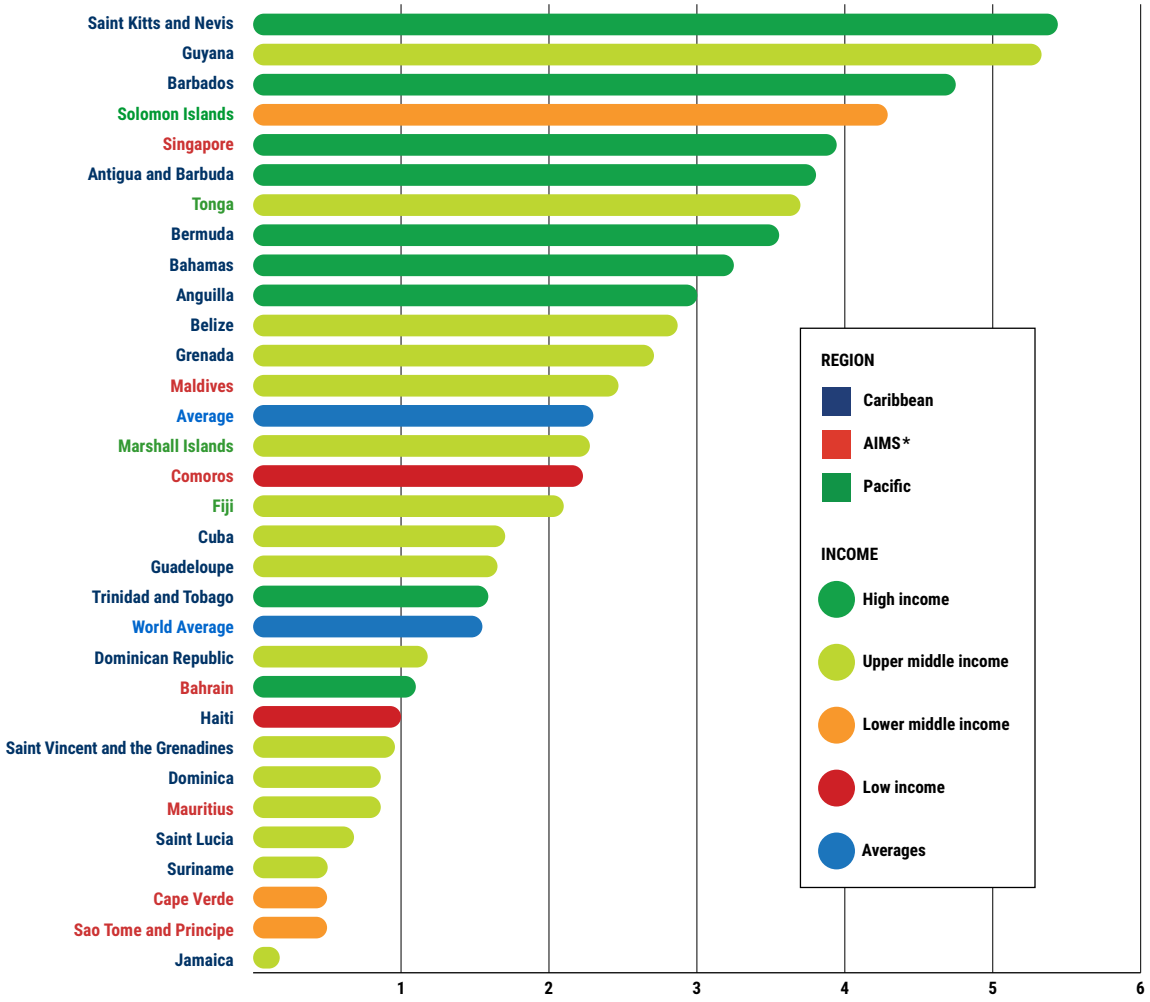
Gaseous emissions, particularly from fossil fuel burning, are contributors to climate change and acid rain formation

3.1 Municipal Solid Waste

3.1.1 Primary Industries

The amount of solid waste produced per capita per day in each SIDS is shown in **Figure 3.1**.

Figure 3.1 Municipal solid waste generation in 30 selected SIDS[67]



*AIMS: The Atlantic, Indian Ocean, Mediterranean, and South China Sea region

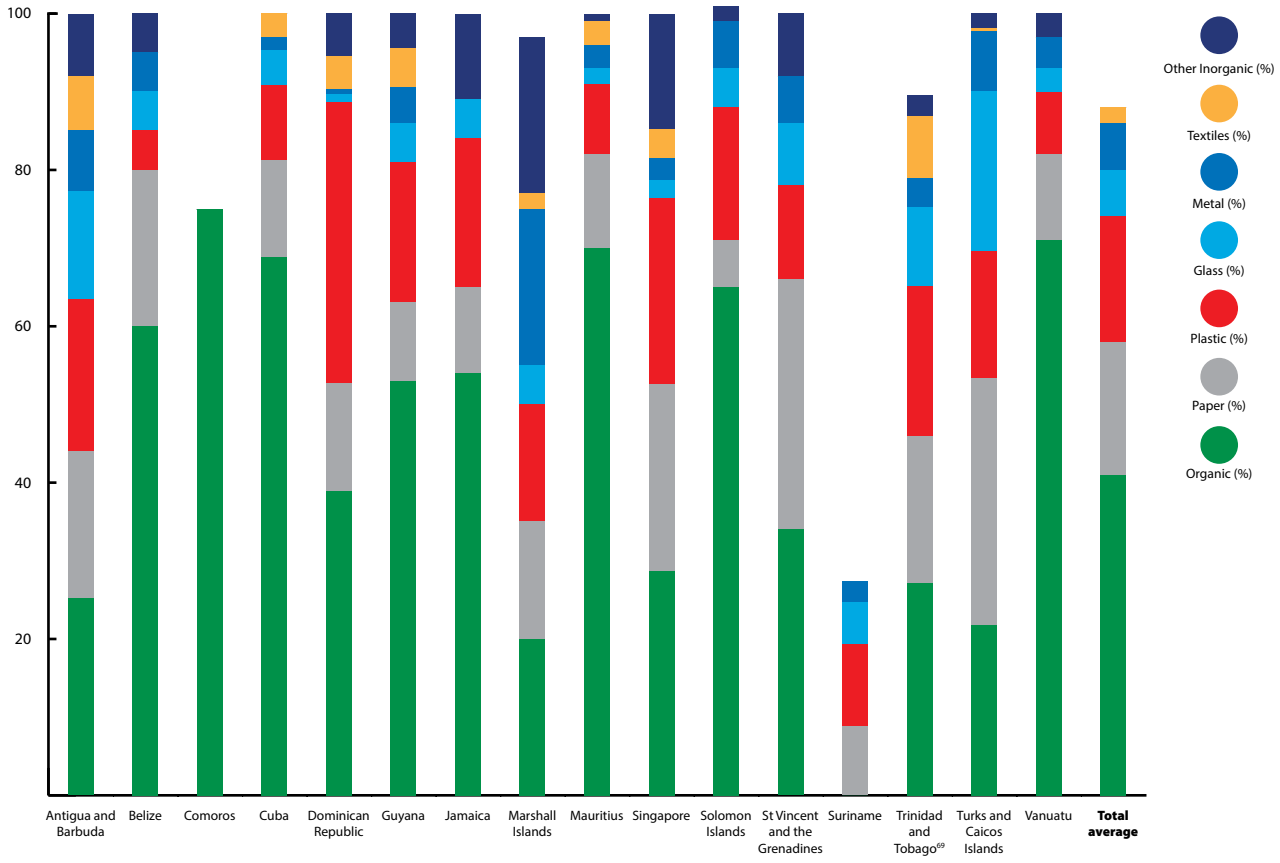
[67] United Nations Statistics Division (2017)

The weighted average amount of solid waste generated daily in SIDS is 2.30 kg per person. Regionally, on average, Atlantic, Indian Ocean, Mediterranean, and South China Sea region countries generate considerably less waste per person per day (1.65 kg) than the other two regions, with the Caribbean generating 2.37 kg and the Pacific, the largest amount, at 3.09 kg per person per day. While some countries are exceptions, waste generation generally follows the typical trend of increasing amounts of waste as income levels rise, with low-income SIDS averaging 1.61 kg, lower-middle 1.76 kg, and upper-middle and high-income 3.21 kg waste generated per person per day.

3.1.2 Municipal Solid Waste Composition

Improved standards of living in SIDS and higher tourism influx have led to the accumulation of significant quantities of non-biological material that does not break down with time. Without appropriate waste management practices for these types of waste, environmental pollution is inevitable. The composition of municipal solid waste in selected SIDS is shown in **Figure 3.2**.

Figure 3.2 Composition of municipal solid waste in 16 selected SIDS[68]

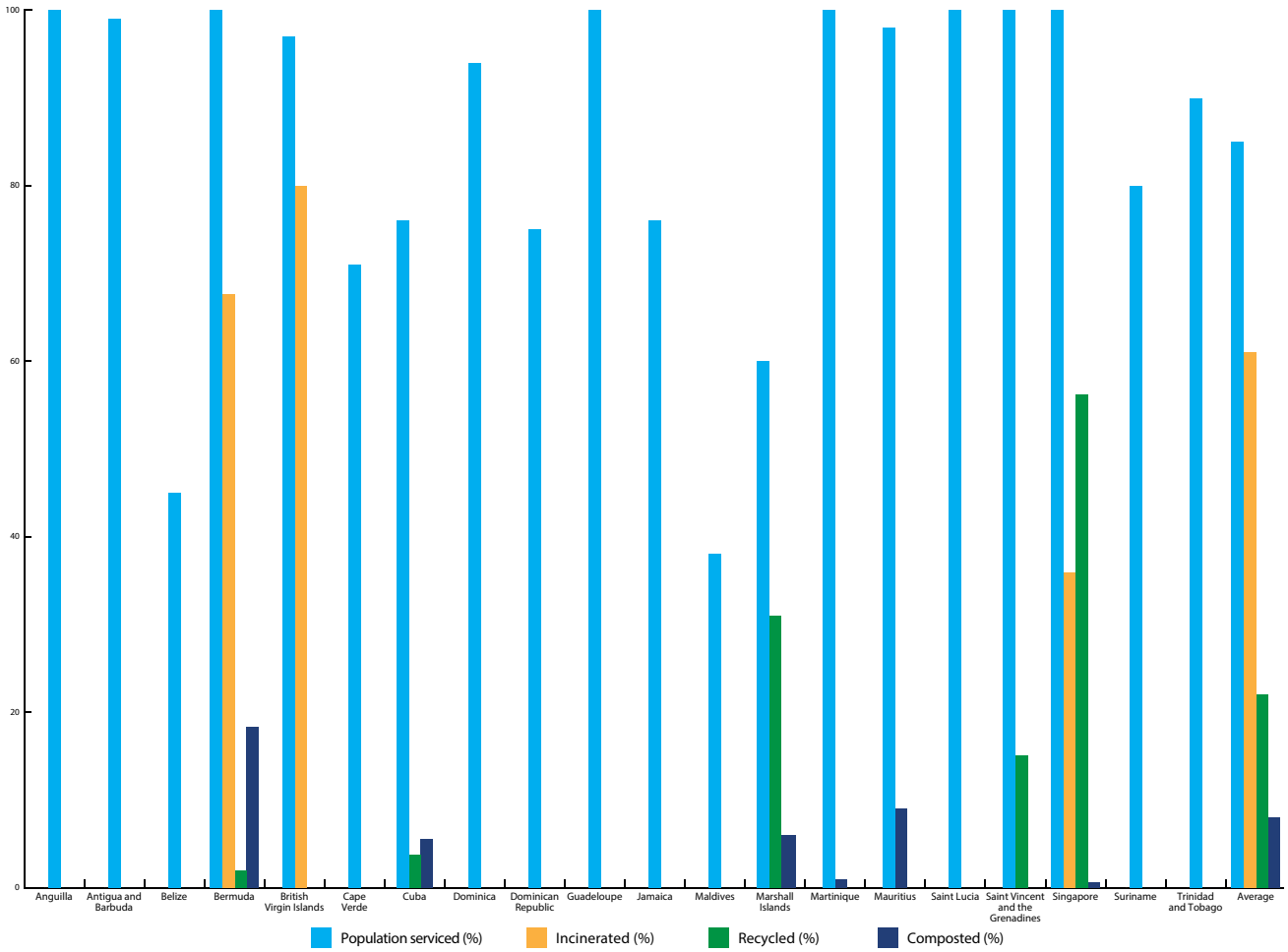


[68] Hoornweg and Bhada-Tata (2012)
[69] Trinidad and Tobago (2010)

3.1.3 Collection, Recycling and Disposal

Solid waste segregation and collection are activities that can provide employment for low-skilled people and give them the opportunity to improve their technical and management skills. For those SIDS that provide data, the average population serviced by collection is quite high, reaching a weighted average of about 85% (**Figure 3.3**).

Figure 3.3 Municipal solid waste collection and diversion in 20 selected SIDS[70]



[70] United Nations Statistics Division (2017)

The Atlantic, Indian Ocean, Mediterranean, and South China Sea region countries show an average collection rate of 77%, compared to 89% for the Caribbean and 60% for the Pacific, but it must be noted that the Pacific data is based on information for only one country because information for other countries is not available. Observation based on income levels shows that high income SIDS average 98% collection coverage, upper middle 77% and lower middle-income SIDS 71% (only one SIDS falls into this category among those reporting data).

Diversion from dumping or landfilling is not measured very effectively across SIDS. For those few countries that do report it, three incinerate 36% to 80% of their waste, five recycle 2% to 56% and five compost 0.6% to 18% of their waste. Judging from the levels of recycled and composted materials, **the majority of the collected waste ends up in dumps or landfills, if it is not openly burned or discarded in the environment**. An example of a recycling programme in the Caribbean is found in Trinidad and Tobago, as shown in **Box 3.1**.

Box 3.1 Recycling in Trinidad and Tobago

The exponential increase in the quantity and complexity of waste requires diverse treatment and disposal techniques. One of the key limiting factors to successful diversion is the cost of shipping recyclables offshore.

Faced with limited resources and lack of legislative support, the Trinidad and Tobago Solid Waste Management Company, took the strategic decision to establish transfer stations and material recovery facilities to collect and sort recyclable materials for **recycling** by sending them to manufacturing facilities that turn them into useful products. They would send only residual non-recyclables to an engineered landfill. In conjunction, the company's **public education programmes** target schools, business entities and communities to promote best practices in waste prevention, reduction and recycling.

To date, the company has established a **beverage container recycling facility** that accepts post-consumer beverage containers such as glass, plastic, aluminum cans and Tetra Pak containers. The major component of the beverage container recycling facility is a polyethylene terephthalate (PET) wash plant that processes PET input into high quality, marketable PET flakes usable in the manufacture of furniture, concrete pavers and much more.

The company has also established a material recovery facility at its Guanapo Landfill in East Trinidad – the first of its kind in Trinidad. There, incoming material from various recyclables collection programmes across the island are processed via conveyor belt where waste workers separate them by category. The sorted materials are then transported to the beverage container recycling facility for further processing. The company has also invested in two shredding machines, one for processing vehicle tyres and the other capable of shredding bulky waste items such as car parts, used appliances, and wood pallets.

(Gisele Telfer, Trinidad and Tobago Solid Waste Management Company)

Various options are used in developing countries for collection, including steel drums, large plastic bags and wheelie bins. In some countries such as Samoa, Papua New Guinea and Fiji, elevated storage platforms keep rummaging animals away from municipal solid waste. Timor-Leste has adopted brick storage facilities inside which municipal solid waste is transferred to smaller containers and onto collection vehicles[71].

[71] Asian Development Bank, Urban, Social Development and Public Management Division Pacific Department (2014e)

Collection services are highly variable, with anything from "daily" to "weekly" to "infrequently," as shown in **Table 3.1**[72].

Table 3.1 Municipal solid waste collection frequency in 13 selected SIDS[73]

Country	Urban area	Coverage	Frequency
Cook Islands	Rarotonga	High	6 times weekly
Fiji	Suva	High	3 times weekly; 6 times weekly in the central area
Kiribati	Tarawa		Once weekly; twice for large waste generators
Marshall Islands	Majuro	Low	Once weekly
Federated States of Micronesia	Kosrae	Low	Variable
	Pohnpei		Once weekly; twice for businesses
Nauru New Guinea	Yaren		Daily
Papua New Guinea	Port Moresby	Low	Twice weekly
Samoa	Apia	High	Twice weekly; daily for large waste generators
Solomon Islands	Honiara	Low	Variable
Timor-Leste	Dili		Daily
Tonga	Tongatapu	Medium urban, low rural	Once weekly
Tuvalu	Funafuti	High	Variable
Vanuatu	Port Vila	Medium	Variable

The results in **Table 3.1** show that large portions of the population are not yet receiving collection services. Inadequate collection has the potential to bring about various health and environmental impacts.

Trucks carrying waste are of variable sizes and are often open, allowing waste to escape and litter the environment. The pick-ups are generally manual. Although the **road conditions** are typically tough on vehicles, in many cases there is no system in place for undertaking regular **truck maintenance**, resulting in recurrent breakdowns and declines in the reliability of the collection services. These circumstances often increase the price per tonne of waste collections. Another waste collection hurdle to be overcome is the **scarce availability of trucks**. For example, a few years ago in St. Croix and St. Thomas, there were only a couple of trucks in operation. Despite the clear need to address ongoing mechanical issues, there were a lack of qualified mechanics and a lack of parts necessary to repair the trucks. This limited the ability for the service provider to add new routes or new source-segregated collection for organics or recyclables. That said, such situations may also be an opportunity for informal sector waste collectors to play a larger and more formally recognized role[74]. In addition, waste collection is not always handled in a **systematic manner**. For instance, new routes are often added ad hoc in response to changes in the necessity and availability of vehicles, resulting in inefficiencies.

An analysis of the collection system and the implementation of simple efficiency measures can make significant differences to coverage and productivity, leading to financial and reputational benefits for the waste collection entities. The case of Aruba is shown in **Box 3.2**.

[72] Asian Development Bank (2014e)
[73] Asian Development Bank (2014e)
[74] Keith Weitz (RTI) pers. comm.

Box 3.2 Efficient Residential Waste Collection, Aruba

(Photos by Michael Raymond)

Prior to 2012, Serlimar, the municipal solid waste company of Aruba, used to receive more than a hundred complaints daily pertaining to the lack of efficient waste collection services. Residents would complain to Serlimar and the local media, saying for example that more than two weeks had passed since the last time waste had been collected. This led to illegal dumping as well as overflowing trash containers on the streets.

Examination of the collection system showed that the issue was mostly linked to the trucks' size, which was too large for the narrow streets of Aruba. Based on the data gathered, new waste collection trucks were ordered. The collection trucks went from double-axle 17 m^3 capacity to single-axle 15 m^3 capacity, enabling better collection coverage. Serlimar updated the routes and added tracking devices in every truck to guide drivers when necessary and measure productivity. In addition, the company trained all its drivers and waste collectors on the functions of the new 15 m^3 waste collection trucks, which helped enhance professionalism and efficiency. Serlimar also experienced a fuel efficiency improvement of about 30%.

Since the implementation of the revised collection system there has been a drastic reduction in complaints lodged, from more than a hundred per day prior to 2012 to a current average of five per week.

(Michael Raymond, Environmental Engineer, Serlimar)

Transfer stations are quite rare in SIDS, but their benefits are clearly demonstrated in Barbados. A new transfer station opened on the island in 2009 featuring a materials recovery facility, composting and chemical waste storage. This has diverted approximately 70% of waste from landfill including construction and demolition waste, green waste, wood pallets and other recyclables (e.g. plastics, glass and metals)[75].

Material **recycling** is generally not well developed in SIDS. The issues of small quantities, transportation costs to get the materials to faraway markets, the lack of local recycling markets, the cost of technology and limited human capacity all add to the difficulties of establishing a viable recycling industry. Analysis of the movement of recyclables in the Pacific identified a number of **issues that hinder the development of material recycling**[76]:

[75] Barbados (2010)
[76] Riad (2017)

A survey has shown that only about 20% of Pacific SIDS recycle more than half their waste, but another 40% divert at least 15% of their recyclables from disposal[77]. Data for other regions is not available.

Litter is a substantial problem. In addition to the waste produced on each SIDS, wastes generated globally often reach the shores of SIDS and need to be collected and disposed of properly on the islands. It is, therefore, paramount that SIDS countries adequately prioritize and identify mechanisms to best address the waste streams affecting their wellbeing. This is particularly true in SIDS' urban areas where, during storm events, plastics and other materials can easily be swept away from dumps and trash bins into the sea and result in a hazard to marine flora and fauna as, for example, identified in Dili, Timor-Leste[78]. In addition, the open burning of waste can be another vector allowing waste and debris to pollute waterways. In Fiji, the Littering Decree allows the Department of Environment to appoint public officials as litter prevention officers with the authority to impose instant **fines** of USD 20 for littering. Despite this, illegal dumping and burning of waste are still common due to insufficient enforcement[79]. A different approach, geared towards **education** and citizen action, has been adopted by the state of Kosrae in the Federated States of Micronesia, as shown in **Box 3.3**.

Box 3.3 "SPIFFY the Talking Garbage Truck": An Approach for Reducing Litter in Kosrae, Federated States of Micronesia

The state of Kosrae in the Federated States of Micronesia together with partners[80] developed an educational booklet to raise awareness on the importance of not littering. The main character in the booklet is "SPIFFY," the talking garbage truck. SPIFFY means "clean" and has the mission to pick up litter to keep the island beautiful. The booklet guides Kosrae's science teachers and it is used for training and guided tours on the island.
The Kosrae State administration also distributed compost kits to all residents, helping to minimize the amount of waste going to the landfill. Periodical clean-ups are also organized around the island. These initiatives have made Kosrae one of the best-performing local areas, contributing to a clean Pacific.

(Kosrae Island Resource Management Authority, Federated States of Micronesia)

Final disposal of municipal solid waste in the Caribbean has improved significantly, particularly in urban areas through regulating disposal sites, although the adoption of sanitary landfills is less common. A first step towards **sanitary landfills** has been for some countries to develop what they term "controlled landfills" which include fences, signs and access controls.

As an alternative to landfills, some islands in the Caribbean, including Martinique, St. Bartholomew, Bermuda, Jamaica, Aruba and Barbados, have implemented, or plan to implement, **waste-to-energy** for municipal solid waste.

> ***The need for high calorific waste (greater than 7 megajoules per kg) is hard to achieve in developing countries, which typically have high portions of organic waste and low portions of high calorific materials***[81]

Waste-to-energy plants are controversial and this was also true in Mauritius, where public opposition resulted in a judicial review of the project[82]. A further influencing factor is that **wastes with the highest calorific values are often those with the greatest potential to be diverted from disposal** (paper, cardboard and plastics) **to create new products and generate employment**.

[77] United Nations Environment Programme (2014a)
[78] Timor-Leste (2002)
[79] Asian Development Bank (2014b)
[80] Kosrae Island Resource Management Authority, Ministry of Education and the Japan International Cooperation Agency (JICA)
[81] United Nations Environment Programme (n.d.)
[82] Mauritius (2011)

3.2 Water Supply Wastewater

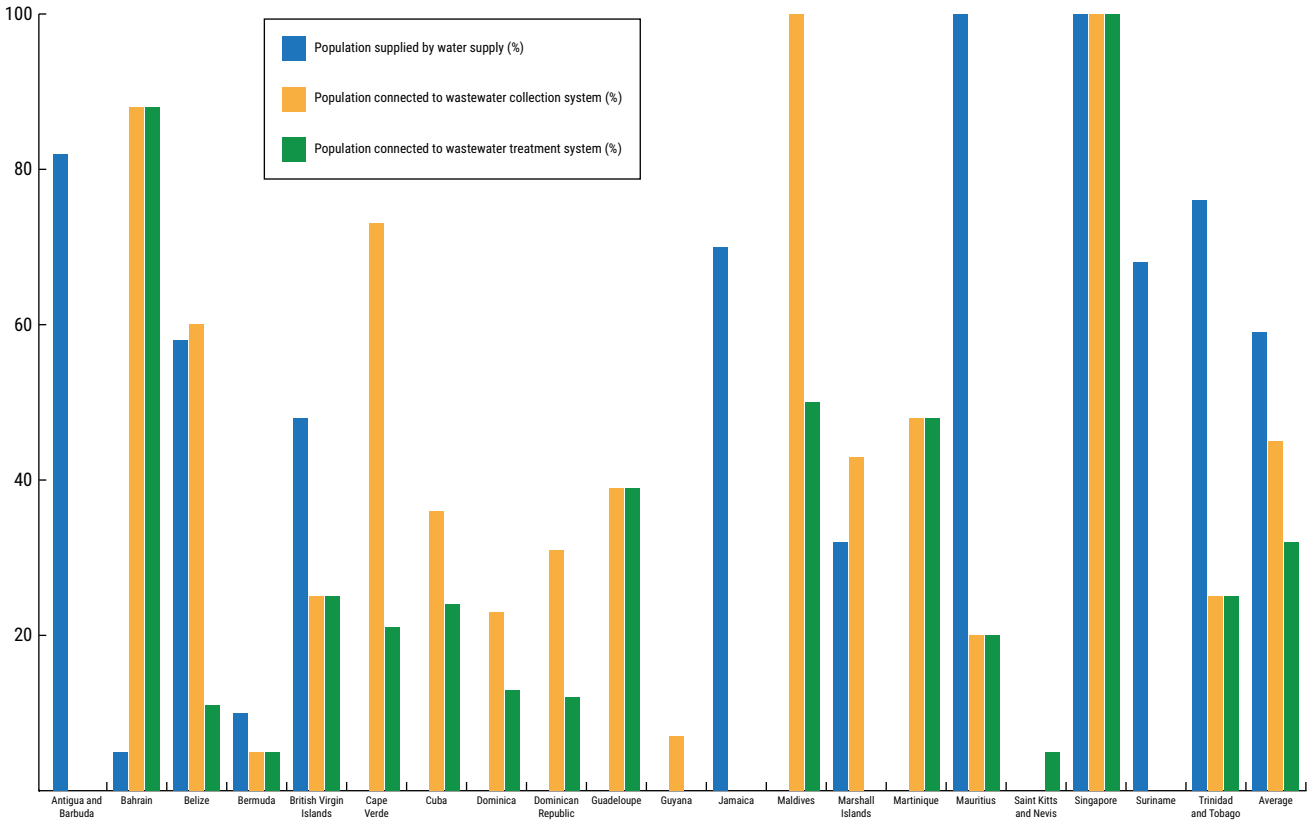
Water quality is a significant issue in some SIDS, with a combination of wastewater contaminating freshwater supplies and infiltration of seawater into groundwater due to sea level rise. Coastal zones, in particular, suffer from the effects of infiltration, as seen on the island of Santiago of the Galápagos Islands, as well as the islands of Santo Antão, São Nicolau and Maio in the Cape Verde group[83].

Sewage treatment plants are often inadequate or inoperative, as in the case of the Federated States of Micronesia. The effects of surface water pollution and damage to sensitive ecosystems, such as mangrove swamps and lagoons, is one of the more serious deterrents to tourism development[84].

The situation with water shows a different trend from that for solid waste. For those SIDS that report **water supply** rates, the average connection rate is 59%[85] as shown in **Figure 3.4**.

While on average about **59% of people in SIDS enjoy water supply**, **45% of them are connected to a wastewater collection system**, and **only 32% of them is connected to wastewater treatment systems**

Figure 3.4 Water and wastewater in 20 selected SIDS[86]



[83] Cape Verde (2014)
[84] Federated States of Micronesia (2004)
[85] United Nations Statistics Division (2017)
[86] United Nations Statistics Division (2017)

Considering water supply by region it can be seen that, for the 40% of Atlantic, Indian Ocean, Mediterranean, and South China Sea region SIDS reporting, on average 54% of the population has access to a piped water supply. For Mauritius and Singapore this figure rises to 100% of the population[87]. For the 21% of Caribbean countries reporting water supply data, on average 62% of the population uses piped fresh water supply services. In the Marshall Islands, the only Pacific SIDS reporting data on water supply, 32% of the population has a piped water supply.

Based on available information on wastewater in SIDS[88], on average, 45% of the population is connected to **wastewater collection systems** and 32% are connected to wastewater treatment systems[89]. Regional reporting shows that 64% of Atlantic, Indian Ocean, Mediterranean, and South China Sea region SIDS populations have access to wastewater collection systems, as do, on average, 32% of the populations in Caribbean SIDS[90]. Access to **wastewater treatment systems** shows that treatment systems have low access rates. On average, 47% of Atlantic, Indian Ocean, Mediterranean, and South China Sea region SIDS populations have access to treatment, while that figure drops to 22% for the Caribbean SIDS[91].

Wastewater is generated by not only the local population, but also hotels, yachts and significant quantities from cruise ships.

When wastewater collection is compared to solid waste collection, it can be seen that solid waste has significantly better coverage.

The low figures for wastewater suggest that **the majority of wastewater produced by SIDS is left uncollected and untreated**, potentially contaminating the ground and making its way into waterways that run into the surrounding seas, adding to their pollution levels. The effects of inadequate wastewater treatment can be seen in Antigua and Barbuda where it has been found that biodiversity around the islands is affected by sewage disposal[92].

The trend shows a diminishing rate of availability for services across media, with better services provided for solid waste, and decreasing service coverage for access to water and wastewater collection, with wastewater treatment being the least-available service. This diminishing trend is probably a reflection of the impact that community demands have on government decision-making. Solid waste is highly visible and attracts vermin, which people readily associate with health issues. Similarly, the availability of fresh water to communities has a significant bearing on the well-being of the communities served. By contrast, **wastewater** is more of **a silent actor**. If it pools it can produce bad odours, but if it flows away then there is no visible after effect. While sickness or diseases can be traced back to water quality, thereby underscoring its importance, wastewater collection and treatment generally require greater infrastructure investment than solid waste collection systems do.

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[87] United Nations Statistics Division (2017)

[88] Note that 50% of the Atlantic, Indian Ocean, Mediterranean, and South China Sea region SIDS and 43% of Caribbean SIDS reported on wastewater.
[89] United Nations Statistics Division (2017)
[90] Data from the Pacific SIDS are too sparse to show any regional trends.
[91] United Nations Statistics Division (2017)
[92] United Nations (2012a)

3.2.1 Water Pollution

Leachates are often an invisible source of pollution. Domestic, agricultural and industrial activities produce leachates that can affect watercourses and potentially groundwater, especially in islands with porous ground structures such as fissured volcanic rocks in Mauritius[93], or volcanic soils. In Mauritius' case, legislation enacted in the 1990s, backed up with more effective monitoring and enforcement, is reducing water pollution. In contrast, in the Pacific, groundwater sources of potable water in Tuvalu have been reportedly polluted by household wastewater leachates[94]. In addition, adjacent coral reefs are affected by pollution from land[95].

Water pollution is just one of the pollution issues caused by the mining industry that results in increased heavy metals concentrations in rivers. Those living downstream who rely on lakes and rivers for drinking, bathing, washing and fishing are disadvantaged by mining activities as well as discharges from urban settlements[96]. Eventually, river pollution makes its way to coastal areas, where it adds to the pollution that already exists in the marine environment.

Marine pollution from tanker traffic generates serious coastal management issues. One noteworthy situation is that about 30% of oil from the Middle East transits through the West Indian Ocean. As a precautionary measure, the World Bank funded the "Western Indian Ocean Islands **Oil Spill** Contingency Planning" project to build capacity in participating countries so that they are better able to address oil spillage accidents, should they occur[97]. The main activities of the initiative include establishing legal and institutional frameworks to ensure countries' compliance with marine conventions, developing regional and national contingency planning processes, building suitable regional and national oil spill response capacities, and establishing regional financial and institutional agreements[98].

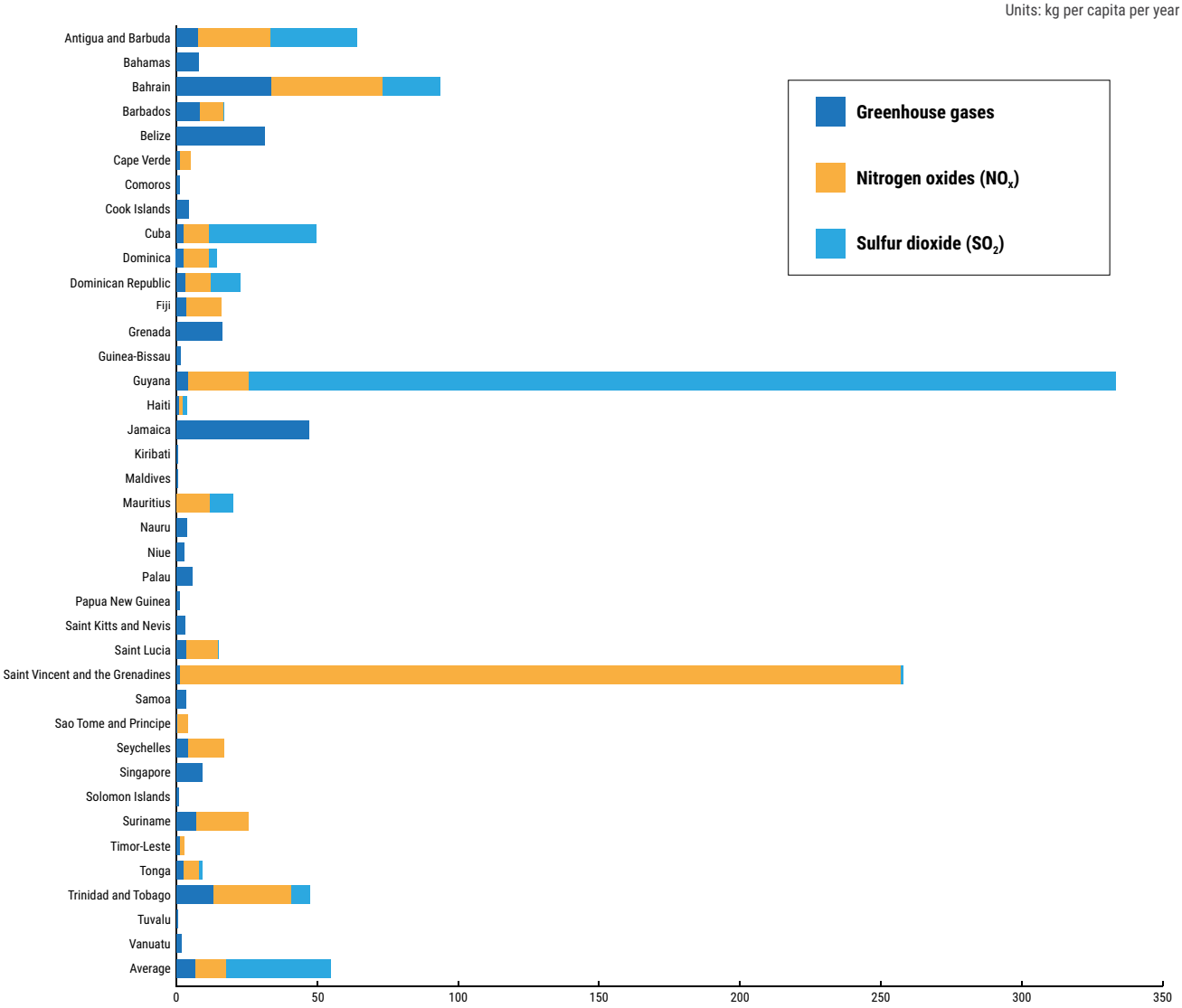
Of course, the threat of oil spillages to SIDS goes beyond the West Indian Ocean. Both Barbados[99] and Belize[100] have formulated contingency plans to prepare for oil spillages. Barbados has developed guidelines on fuel and waste oil handling, storage and disposal practices and Belize has implemented a strategic action plan for the Gulf of Honduras targeted at decreasing pollution from seafaring transport in the gulf.

[93] Mauritius (2010)
[94] Tuvalu (2005)
[95] Tuvalu (2005)
[96] Papua New Guinea (n.d)
[97] Global Environment Facility (1999)
[98] United Nations Department of Economic and Social Affairs (2010)
[99] Barbados (2010)
[100] Belize (2012)

3.3 Gaseous Emissions

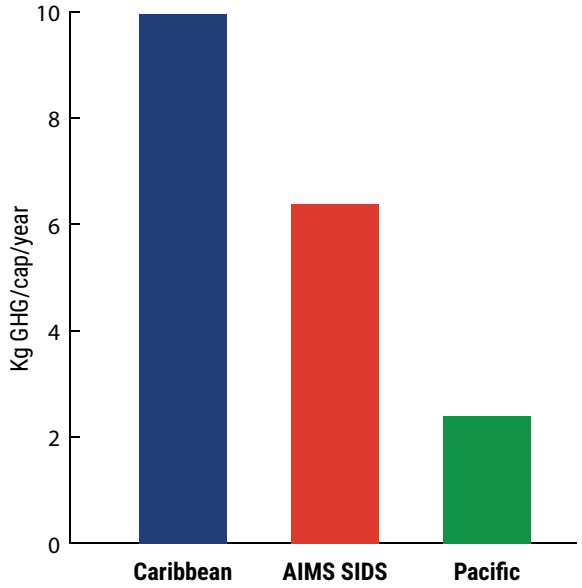
Gaseous emissions are yet another type of waste. For this report gases emitted through fossil fuel burning have been chosen as indicators: greenhouse gases (contributing to climate change), nitrogen oxides (NO_x) and sulfur dioxide (SO_2) (contributing to acid gas formation resulting in acid rain). The gases from fossil fuel generation come particularly from vehicles and diesel generators on the SIDS. The emission rates are shown in **Figure 3.5**.

Figure 3.5 Three kinds of gaseous emissions in 38 selected SIDS[101]



[101] United Nations Statistics Division (2017)

From **Figure 3.5** it can be seen that **the weighted average GHG emissions for the SIDS is 6.52 kg per capita per year**, which is higher than the world average of 5.0 kg per capita per year[102]. Those SIDS with higher levels tend to have oil production facilities, thus accounting for the higher greenhouse gas levels. Breaking greenhouse gas emissions into regions indicates 9.95 kg of emissions per person per year for the Caribbean, 6.36 kg per person per year for Atlantic, Indian Ocean, Mediterranean and South China Sea region SIDS (some of which have large oil operations like Bahrain and Singapore) and 2.40 kg per person per year for the Pacific SIDS.



Greenhouse gas emissions are largely due to combustion activities and hence those countries that have significant oil and gas operations (Bahrain, Belize, Jamaica and Trinidad and Tobago) also have the largest greenhouse gas emissions per capita.

Fossil fuel combustion is also responsible for the generation of nitrogen oxides (NO_x) and sulfur dioxide (SO_2). The trends in the regions for both of these follow the trends seen for greenhouse gases. The high average values for nitrogen oxides (NO_x) and sulfur dioxide (SO_2) in the Caribbean region are indicators of the significant combustion of fossil fuels, something not seen in the Pacific. It should be noted that many SIDS spend significant portions of their budgets on fuel imports, an unsustainable situation over the long term[103].

Air pollution is also a by-product of waste. For example, it is anticipated that the current 6.22% annual waste growth in Bahrain will increase methane emissions in 2050 by six-fold compared to 2015 unless effective control and mitigation measures are adopted[104]. As well as methane emissions, air quality at the Askar waste disposal site in Bahrain over the period December 2016 through January 2017 showed levels of hydrogen sulfide as high as 1,464 parts per billion, high enough to adversely affect local communities[105].

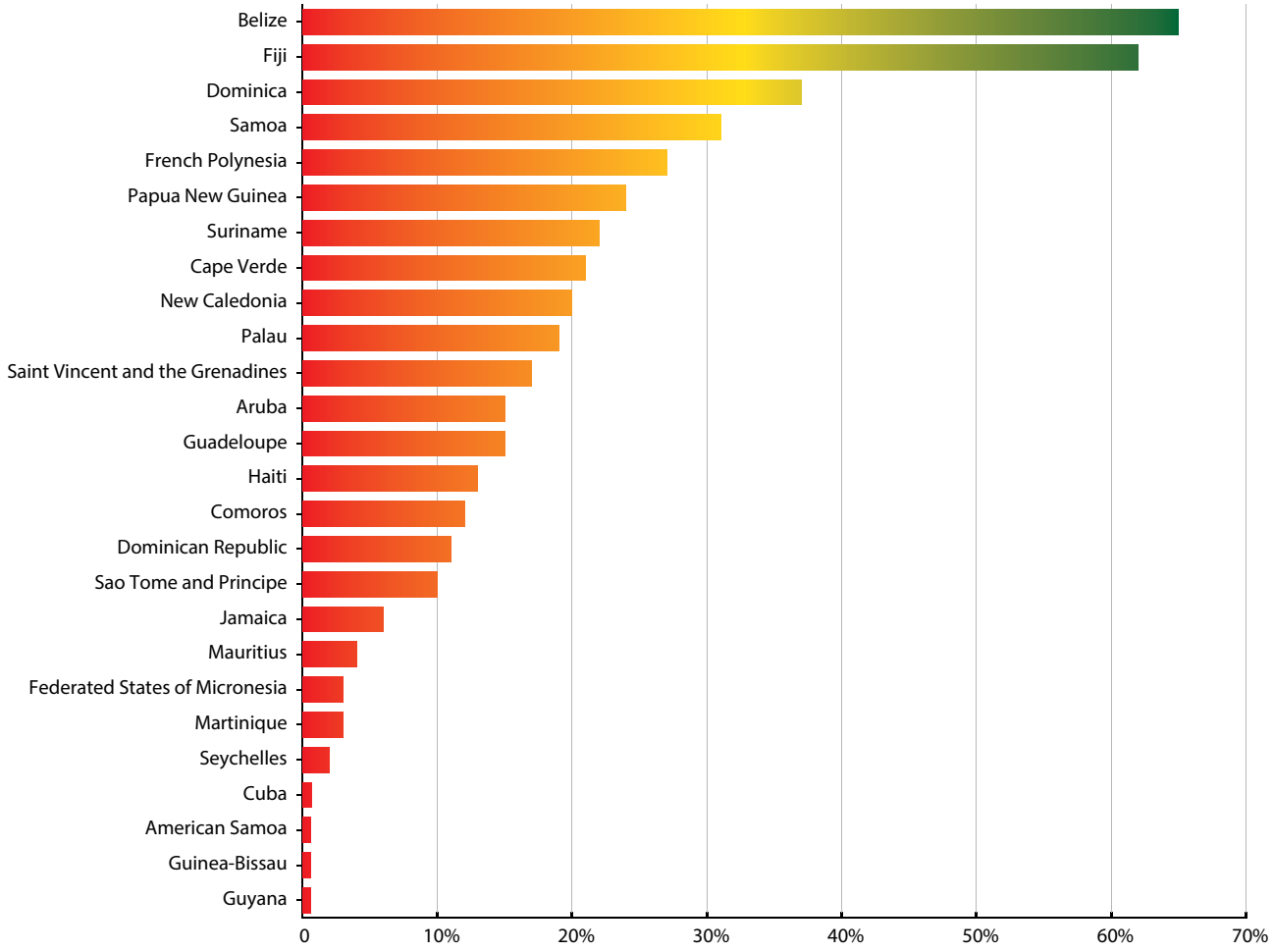
Vehicle emissions are a significant contributor to air pollution. Exhaust emissions from the transport sector in Mauritius cause significant urban pollution. Even though there are government subsidies for public transport and import duties on vehicles, this has not stemmed the growth in the number of vehicles. An aging public transport fleet, in which 40% of the bus fleet is between 10 and 18 years old, has also contributed to high emissions. In addition, low fuel quality, poor servicing, little maintenance and overloading are also contributors to air pollution[106]. The Fijian government has recognized that particulate emissions from poorly performing diesel engines in older vehicles pose a significant problem[107]. Furthermore, a recent exponential increase in vehicle numbers has contributed to diminishing urban air quality in Cape Verde[108].

[102] World Bank (2017)
[103] United Nations Environment Programme (2014)
[104] El-Karawy (2017)
[105] El-Karawy (2017)
[106] Mauritius (2011)
[107] Fiji (2010)
[108] Cape Verde (2014)

One of the most significant sources of particulates is from **burning waste in dumps**.[109] However, it is likely that these sources do not appear or are underestimated in inventories. Emissions from municipal solid waste burning are also expected to have significant quantities of persistent organic pollutants (POPs). UN Environment[110] called for parties to the Stockholm Convention to include municipal solid waste burning to Category 6 (Uncontrolled combustion processes), as open burning of waste is an important source of dioxin and furan released to the atmosphere. Some SIDS have reported their releases (e.g. Jamaica, with 31.79% of dioxins and furans produced from municipal solid waste burning[111]) but this data is not commonly collected.

There is a growing awareness among SIDS of the need to replace fossil fuels with renewable energy. In addition to the environmental benefits (reduced air emissions), there are clear economic benefits to the increased adoption of renewable energies, including that countries can save on fuel imports and reduce their vulnerability to sudden surges in fuel prices. For those countries that report using renewable energy, on average it accounts for 17% of total energy production, as shown in **Figure 3.6**.

Figure 3.6 Renewable energy production in selected 26 SIDS[112]



[109] United Nations Environment Programme (2014c)
[110] United Nations Environment Programme (2005)
[111] Maíz and Morales (2012)
[112] United Nations Statistics Division (2017)

Figure 3.6 shows that, on a regional basis, AIMS SIDS on average have 8% of their energy needs met by renewable energy, the Caribbean, 17%; and the Pacific, 23%. Of the 26 SIDS reporting renewable energy, the current highest levels of production are found in Belize (65%) and Fiji (62%). These efforts point the direction to the future for meeting energy needs in SIDS. As a move towards greater energy efficiency, Caribbean Community (CARICOM) member states in 2018 voted to follow Cuba's world lead in phasing out incandescent bulbs in 2008. This phase out is part of the move to implement a Regional Energy Efficiency Building Code which could reduce 15,000 barrels of imported oil and save around USD 1M in foreign exchange daily[113]. An example of how islands can move to renewable energy is shown in **Box 3.4**.

Box 3.4 Renewable Energy in Ta'u, American Samoa[114]

The island of Ta'u, American Samoa, with a population of between 200 and 600 people, has limited space and resources, so these must be managed efficiently if communities on the island are to succeed. Prior to 1972 the island was dependent on kerosene lamps. When the American Samoa Power Authority constructed a diesel power plant on the island, life changed for the residents. Activities around villages and in homes increased considerably and the people changed their diets with new ways of preparing and preserving food.

However, running the power supply required 416,000 litres of diesel annually, all of which had to be shipped in. This was a significant drain on the island's economy. In addition, although the diesel was scheduled to arrive fortnightly, frequent weather delays and mechanical problems, sometimes stretching for months, meant that fuel and food rationing occurred regularly.

In November 2016, a **solar microgrid** for the island costing USD 8 million, paid for by the US Department of the Interior, replaced the diesel generators. The 5,328 solar panels, generating 1.410 megawatts of electricity, located on 2.8 hectares of land, can withstand a category 5 hurricane. In addition, the installation of 60 Tesla **powerpacks** means that the island has enough power to withstand up to three days without sunshine.

This has meant a significant reduction in air emissions for the island, as well as significant savings in fossil fuels. One long-term impact from this change in technology that will have to be addressed is the eventual production of electronic (hazardous) waste.

(Gisele Telfer, Trinidad and Tobago Solid Waste Management Company)

[113] CARICOM Member States to phase out incandescent bulbs (2018)
[114] Lin (2017)

4. PRIORITY WASTE STREAMS IN SIDS

This section analyses the waste streams that have been identified in most SIDS as high priority. Based on the findings, waste characterization and quantification must be undertaken locally in order to prioritize the waste streams to be tackled and develop effective and economically sustainable programmes of action.

A summary of the main issues and high priority waste streams identified in earlier parts of this Outlook is shown in **Table 4.1**.

Table 4.1 Summary of waste issues and priority waste streams found in SIDS

Materials	Impacts on people		Environmental management	Links with governance actions
Hazardous waste	Health	Employment	Water quality	Data
Construction and demolition waste	Tourism		Waste disposal	Finance
Plastic waste	Informal waste operators		Environmental pollution	Enforcement
Tyres			Ecosystem degradation	Monitoring
Marine litter			Open dumps	Human capacity
Mining			Poor recycling	
Nanomaterials			Climate change	

The following sections discuss those materials that have not been discussed earlier in the Outlook.

KEY MESSAGES

1. SIDS generate **small quantities of hazardous waste** (chemical, medical, electronic, lead-acid batteries, asbestos and used oil) but **lack capacity and capability to effectively manage it** and implement waste-stream specific management practices

2. Audit and **enforcement of legislation** and regulations are important components of effective hazardous waste management

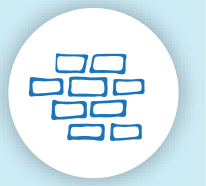
3. **Hazardous waste** should be considered a top **priority** requiring coordination between SIDS

4. Regional cooperation and management models that utilize **synergies between countries** are required

5. Already developed **regional hazardous waste management models** have a potential to be transferred to other waste streams as well, e.g. recycling

6

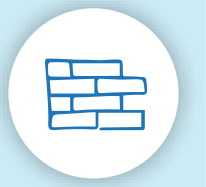
Construction and demolition waste represents a major waste stream for most SIDS. Methods to reduce it include:



deconstruction rather than demolition

on-site waste separation

reuse crushed stones and concrete as base material



reuse rocks, bricks and concrete for land reclamation or shore protection

give credit for returned unused construction materials

only order amounts needed for a job

7

Plastics are difficult to manage. SIDS lack technologies to adequately manage them onshore and international markets are becoming resistant to accepting plastic waste. Alternatives to single use plastics need to be encouraged

8

Disaster wastes often inundate local waste systems. **Extreme weather events** are expected to increase with climate change requiring more planning on responses by SIDS

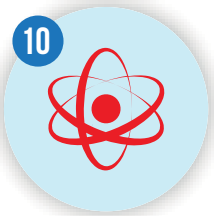
9

Waste tyres present a growing problem requiring alternative solutions to landfilling

11

Prioritizing waste is an important step in effective waste management. Waste prioritization requires a framework that takes into consideration economic development, social development, governance and waste management issues

10



Nanomaterials are an emerging waste stream that SIDS should be prepared to tackle

4.1 Hazardous Waste

Hazardous waste, though often small in quantity in SIDS, has significant health and environmental impacts and therefore, while recognized as a priority, presents difficulties in management. More developed SIDS, such as Singapore[116], have efficient systems for the collection, treatment and disposal of hazardous waste. For isolated islands with small populations, managing the waste is a substantial issue since the quantities produced do not warrant the investment needed for the appropriate technologies. For example, a 1996 persistent organic pollutant (POPs) survey in Palau revealed stockpiles of 18 tonnes of potentially polychlorinated biphenyl (PCB)-contaminated transformer oil, 4 tonnes of bitumen, 10 tonnes of waste oil, 4 tonnes of unwanted hypochlorite, 2 tonnes of old medical drugs, 1.2 tonnes of dichlorodiphenyltrichloroethane (DDT), 2,000 lead-acid batteries and 300 m^3 of asbestos pipe. In addition, oil contaminated sites were found at two power stations[117]. These sorts of wastes and quantities are common for SIDS and, along with the lack of capacity for identification and sound end-of-life management, demonstrate the issues that many SIDS face in managing hazardous wastes.

One of the keys to effective hazardous waste management is the enforcement of legislation and regulation. Many SIDS, such as Mauritius[118], lack institutional and expert capacity, human resources and infrastructure to ensure that legislation is adequately enforced.

Suitable management of **chemical wastes** from agriculture and manufacturing poses issues for SIDS as they often lack facilities for storage and disposal. Management of **transboundary waste** from **cruise ship** effluents visiting their ports as well as ships transiting through the territorial sea zones are matters of considerable concern for SIDS[119]. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal is an instrument that is relevant to the environmentally sound management of such wastes, but there is still the issue of the quantities of these wastes that a tourism-centric economy generates, including ship-generated wastes[120].

Medical waste management poses serious issues. This waste typically contains plastics including polyvinyl chloride, which when burnt at low temperatures releases carcinogenic vinyl chloride monomers and benzene, acidic hydrogen chloride gas and approximately 70 other compounds[121]. In addition, there is concern over abandoned pharmaceutical waste. Reports of inadequate end of life management are frequent. For example, most major health centres in Papua New Guinea either do not have incinerators, or their incinerators are often rundown or decommissioned, meaning that medical waste ends up in landfills[122]. In Mauritius medical waste generated by medical facilities is separated and six hospitals operate incinerators that manage the hazardous waste generated by all government healthcare facilities. In this way, 1,200 tonnes of medical waste is incinerated annually, generating 90 tonnes of hazardous incinerator waste that is disposed of to landfill. However, the close proximity of the incinerators to residential areas (15 m to 100 m) raises complaints from citizens about odours, noise and smoke, which indicates low temperature combustion. Most of these old incinerators had broken down by 2010, meaning that medical waste was all disposed of in the landfill until the incinerators were made operational again. Although action is still pending, performing regular maintenance and using newer incinerators have helped in providing improved service[123].

[116] United Nations Environment Programme (2017)
[117] Palau (2004)
[118] Mauritius (2011)
[119] World Bank and United Nations Department of Economic and Social Affairs (2017)
[120] United Nations Environment Programme (2017b)
[121] Huggett and Levin (1987)
[122] Papua New Guinea (n.d.)
[123] United Nations Environment Programme (2017)

In the Marshall Islands, medical waste is treated in inadequate facilities and operators lack training. A hospital incinerator had to be transferred from the hospital grounds to near the international airport after residents in the area surrounding the hospital complained of the foul emissions. However, the new situation is also problematic, with the incinerator producing odours and experiencing recurrent breakdowns. In addition, the waste used to be transported in a non-specialized truck by workers who did not have adequate personal protective equipment[124]. Similar problems occurred in Palau with untrained staff collecting, treating and disposing of medical waste frequently without using personal protective equipment[125]. However, there are glimmers of hope. In Saint Lucia, where generation of medical waste amounted to 45 tonnes in 2014, medical waste is first treated in autoclaves and then goes to disposal in a sanitary landfill[126].

Liquid chemical hazardous waste (e.g. **household chemicals**) poses another challenge. The difficulties in the management of hazardous wastes are compounded when taking into consideration the smaller scale, and less hazardous, residential-generated hazardous waste, which includes home cleaning chemicals, expired medicines, light bulbs and aerosol sprays that can contaminate municipal solid waste. This can make processing the waste hazardous. This is a problem that compounds as populations increase. In some instances, low cost options, such as neutralizing acids and bases, are used to manage these types of hazardous waste, but specialized expertise and processing or containment facilities are needed to properly manage them. This expertise is often lacking in SIDS.

Electronic waste, also known as "e-waste," is increasing as lifespans for both software and hardware shrink[127]. E-waste can contain over 1,000 different components, some of which are hazardous. Generally, e-waste forms a small portion of SIDS' waste. For example, e-waste represents only about 0.4% of the solid waste stream in Mauritius[128]. Integrated waste management of the waste stream requires adequate volumes of the waste and economic value and hence, most material ends up in landfills, sometimes in hazardous waste cells.

The use of **lead-acid batteries** for energy storage increases the volume of waste batteries, a volume which is further increased by vehicle batteries. The lead in used lead-acid batteries has a high market value, and while recycling rates vary from country to country, they can be as high as 80% to 90% for SIDS[129]. In places such as the Marshall Islands, the accumulation of used lead-acid batteries is posing a significant waste issue. A strategy has been introduced whereby the Marshall Electric Company operates a reverse logistics process to recover and export these batteries, similar to the systems found in Kiribati and on the island of Kosrae in the Federated States of Micronesia[130].

Used oil, both vegetable and mineral, if not managed appropriately, can cause significant environmental damage, as a single litre of oil can contaminate up to one million litres of water[131]. Used oil in SIDS can enhance fuel for boilers and diesel generators. From work done in the Pacific, it can be estimated that approximately 185 million litres of used oil are generated by SIDS. If the proportions across all SIDS are the same as in the Pacific, this leaves 83 million litres being stockpiled or dumped, with 45% being exported or used as fuel sources[132].

[124] Asian Development Bank (2014c)
[125] Asian Development Bank (2014d)
[126] United Nations Environment Programme (n.d.)
[127] Baldé, Wang, Kuehr, and Huisman (2015)
[128] Mauritius (2011)
[129] Secretariat of the Pacific Regional Environment Programme (2015b)
[130] Secretariat of the Pacific Regional Environment Programme (2014)
[131] Australia (2009)
[132] Secretariat of the Pacific Regional Environment Programme (2016)

While the lack of collection of used oil and other similar kinds of waste is a problem for many SIDS, some are moving towards addressing these problems. For example, in Cape Verde, by 2013, 100% of used oils in the main urban centres were collected and stored, with at least 50% treated. These results came along with other successes of the island, where, by the same year 100% of non-biodegradable wastes were treated and 100% of wastewater was reused[133]. The benefits from the removal of waste oil can be seen in a case study from Aruba in **Box 4.1**.

Box 4.1 Waste Oil Collections, Aruba

(Photo by Michael Raymond)

Fats, oil and grease used to cause major problems in Aruba's sewerage system. When disposed of down kitchen sinks, toilets or drains, such waste congeals and blocks pipes, leading to wastewater on the streets, the pollution of seawater and the accumulation of toxic hydrogen sulfide gas, producing the foul odour of rotten eggs.

Antilla Energy, a private company in Aruba specializing in the collection, processing and recycling of used cooking oil, started collecting used cooking oil from more than 200 locations all over the island, from large hotels to small cafés and restaurants. Collecting the waste oil significantly reduced the problems related to fats, oils and grease. The local police also got involved in giving verbal and written warnings to businesses that were non-compliant to the new rule of having their waste cooking oil collected by a specialized company.

To decrease the amount of waste fat, oil and grease being disposed of down sinks, toilets and drains in households, Antilla Energy and the Aruba Hotel and Tourist Association (AHATA) focused on educating the public through their oil recycling, or "O-Cycling," programme. The O-Cycling programme is a community-based waste cooking oil collection programme in which collection bins are placed at strategic locations to encourage residents to drop off their waste cooking oil for collection by Antilla Energy.

The blockages due to fat, oil and grease in Aruba's sewerage system have substantially decreased due to the services offered by Antilla Energy. Currently, Antilla Energy collects 350,000 litres of waste cooking oil per year, about 42% of the total generated on the island. Because the sewerage system experiences fewer blockages, the accumulation of hydrogen sulfide decreases, which in turn means neither streets nor the insides of buildings suffer from the smell of rotten eggs, and there is less wastewater flooding on the streets. This has reduced, or in many cases eliminated, contact between the public and the hazardous wastewater, as it ends up at the wastewater treatment plant where it is properly treated.

(Michael Raymond, Environmental Engineer)

[133] United Nations (2015a)

Used oil management practices are currently the subject of action in the Pacific region. Auditing shed light on a number of unsafe practices, including being used for line marking of sports fields, as wood preservative, and being disposed of in the ground and in water bodies. The audit also revealed unbunded storage sites[134], inadequate collection systems and socio-economic conditions that constrain user-pays systems for waste management[135]. A cost-benefit study for Samoa concluded that for the time being, the most environmentally sound technology for waste oil was to add it to diesel generators. However, once more sustainable electricity generation came online, export to a recycling facility funded through an advance disposal fee would be the preferred option[136].

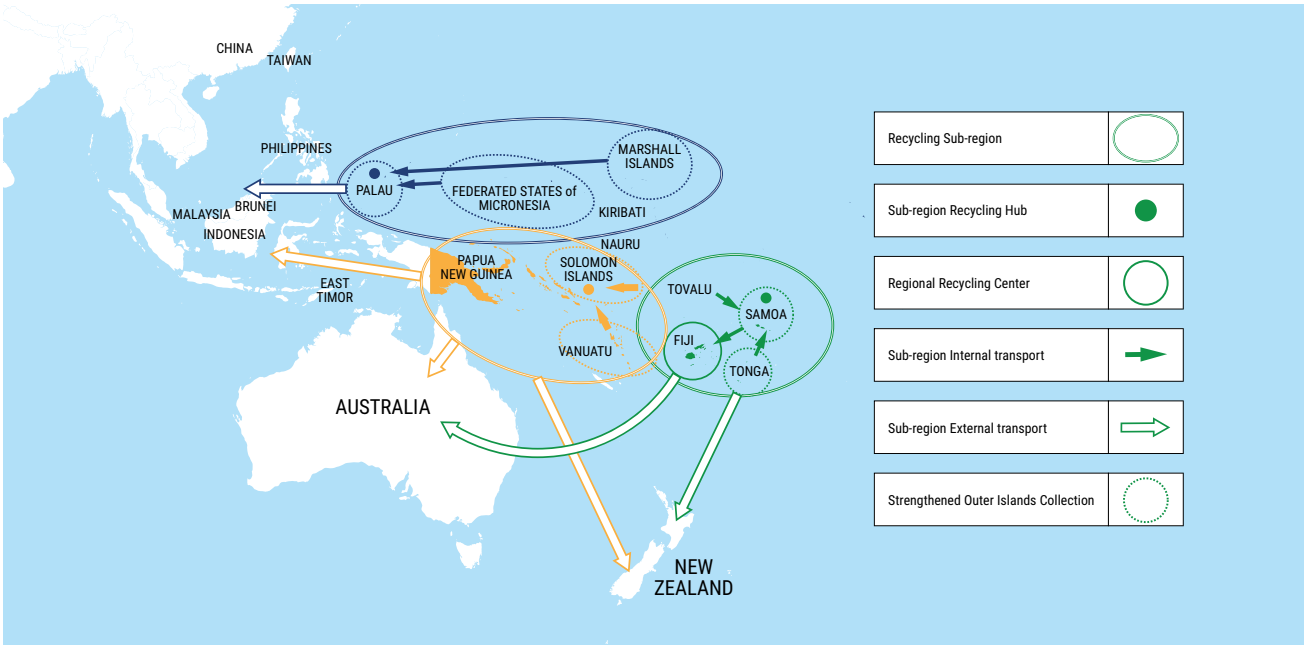
It is evident that state-level management of hazardous wastes is not a viable option for most SIDS.

A suggestion for better managing hazardous waste is the adoption of a "Hub and Spoke" regional cooperation model as presented for recycling in the Pacific (**Figure 4.1**), which can be equally applicable for hazardous waste that is not adequately managed on individual islands.

The model provides for identification of subregions (e.g. Micronesia) that serve as collection points for an efficient flow of materials from outer islands (e.g. Marshall Islands) to regional centres (e.g. Palau) and then to nearby countries with processing facilities (e.g. Malaysia) by utilizing a reverse logistics approach. This approach exploits the spare capacity of shipping in going from these islands to larger ports. Such an approach would require infrastructure to allow for secure storage of hazardous substances until a viable quantity is built up ready for transport. Additionally, education in the proper storage of hazardous wastes needs to be provided to storage facility personnel and companies so that they are aware of importing regulations at destination ports. Education for the general population is also necessary so that they become aware of the dangers of the substances they handle. Larger quantities of hazardous waste, such as sewage, are best treated on the island on which they are generated.

The system for hazardous materials can be applied equally to recyclables. Hence, costs can be further decreased by operating one system for both types of waste streams. Onshore partial processing of recyclables in a safe environment can produce employment opportunities for local communities, and upskilling of the workers can provide greater opportunities to add value to exported recyclables. This also applies in the case of informal waste operators.

Figure 4.1 Example of "Hub and Spoke" regional cooperation model for managing hazardous waste[137]



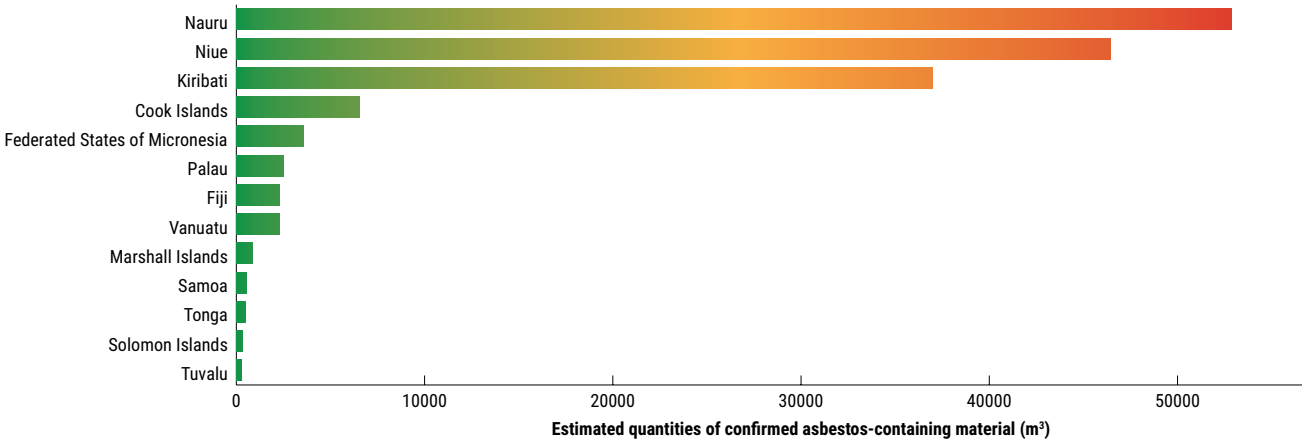
[134] Unbunded storage sites are defined as poor waste storage facilities unable to contain the unintended escape of materials and/or liquids until such time as remedial action can be taken
[135] Secretariat of the Pacific Regional Environment Programme (2016)
[136] Haynes and Vanderburg (2013)
[137] Riad (2017)

4.2 Construction and Demolition Waste

Construction and demolition waste represents a major waste stream in most SIDS, particularly evident when severe weather events occur on the islands. Under normal circumstances this type of waste is relatively benign compared to many of the other higher profile streams such as hazardous waste. In some places, such as the Mauritius capital, Port Louis, provision of a separate construction and demolition waste yard encourages some degree of source separation. Despite the significant volumes of construction and demolition waste incoming and the difficulties in transporting it, there is no fee to use the service[138].

One kind of waste that is a significant problem in the construction sector is **asbestos**, a hazardous waste with no economic value. Asbestos was used worldwide, including in all SIDS regions, particularly from the 1930s to the 1970s for its fire resistant and insulating properties. The level of awareness of the dangers of asbestos is generally low in SIDS. Waste materials containing asbestos are commonly buried onsite or taken to disposal sites[139]. Though there are some contractors in SIDS capable of undertaking asbestos clean up, it is uncertain what level of training is needed to ensure the work is accomplished safely. Estimates in the Pacific indicate that asbestos-contaminated materials affect more than 285,000 m^2 of building floor space spread across the Pacific in stockpiles and in abandoned infrastructure and occupied buildings, with 87% of this material contaminated at a high enough degree of asbestos concentration for it to be considered high risk. If disturbed, the asbestos can pose significant health risks[140] to building occupants. In addition, exposure to asbestos leads to an aggressive form of cancer that manifests differently in both genders. The cancer affects the lining of the lungs. In women, the major concern is peritoneal mesothelioma, which occurs twice as frequently in women as men. In men, the chief concern is pleural mesothelioma, which is harder to diagnose and occurs five times more frequently than peritoneal mesothelioma. Women also have a better prognosis than men, because treatment is more effective for women[141]. The spread of asbestos is shown for some Pacific Islands in **Figure 4.2**. Nauru accounts for 74% of the asbestos in the Pacific region.

Figure 4.2 Asbestos-containing material in 13 selected Pacific SIDS[142]



[138] Mauritius (2010)
[139] Secretariat of the Pacific Regional Environment Programme (2016)
[140] Asbestos is a known carcinogen causing cancer of the lungs, ovaries and larynx. The fibers can also cause scarring of the lungs (asbestosis), making breathing harder, and pleural disease, potentially causing lung membrane thickening and fluid buildup around the lungs. (https://www.atsdr.cdc.gov/asbestos/health_effects_asbestos.html). There are no safe levels of exposure to the airborne fibers (http://www.euro.who.int/___data/assets/pdf_file/0005/74732/E71922.pdf).
[141] Mesothelioma Center (2018)
[142] Secretariat of the Pacific Regional Environment Programme (2015)

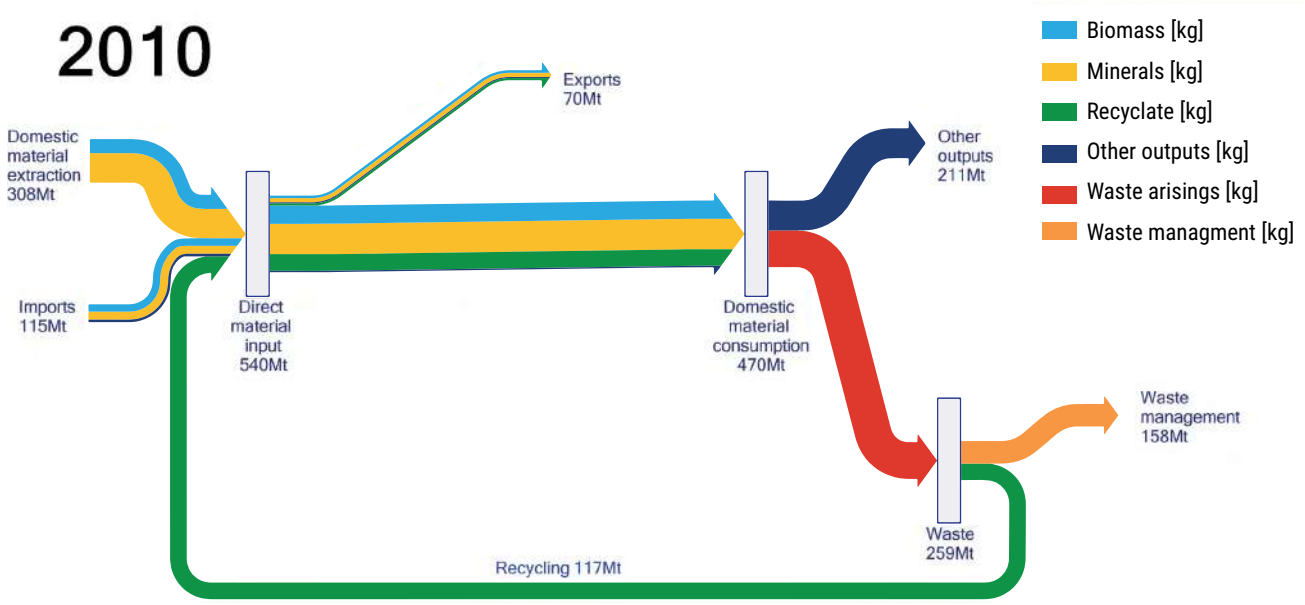
SIDS in other regions, including Bahrain, Mauritius, New Caledonia and the Seychelles, have responded to the harmful effects of asbestos by banning the import of asbestos[143]. But even though bans exist, they are not totally effective. In 2012, the Seychelles reported that asbestos cement board had been used in the construction of the Perseverance Housing Project on Mahé, which relied on imported prefabricated houses, assembled onsite[144].

Ways to reduce the amount of construction and demolition waste generated and better manage it can include simple measures such as:[145]

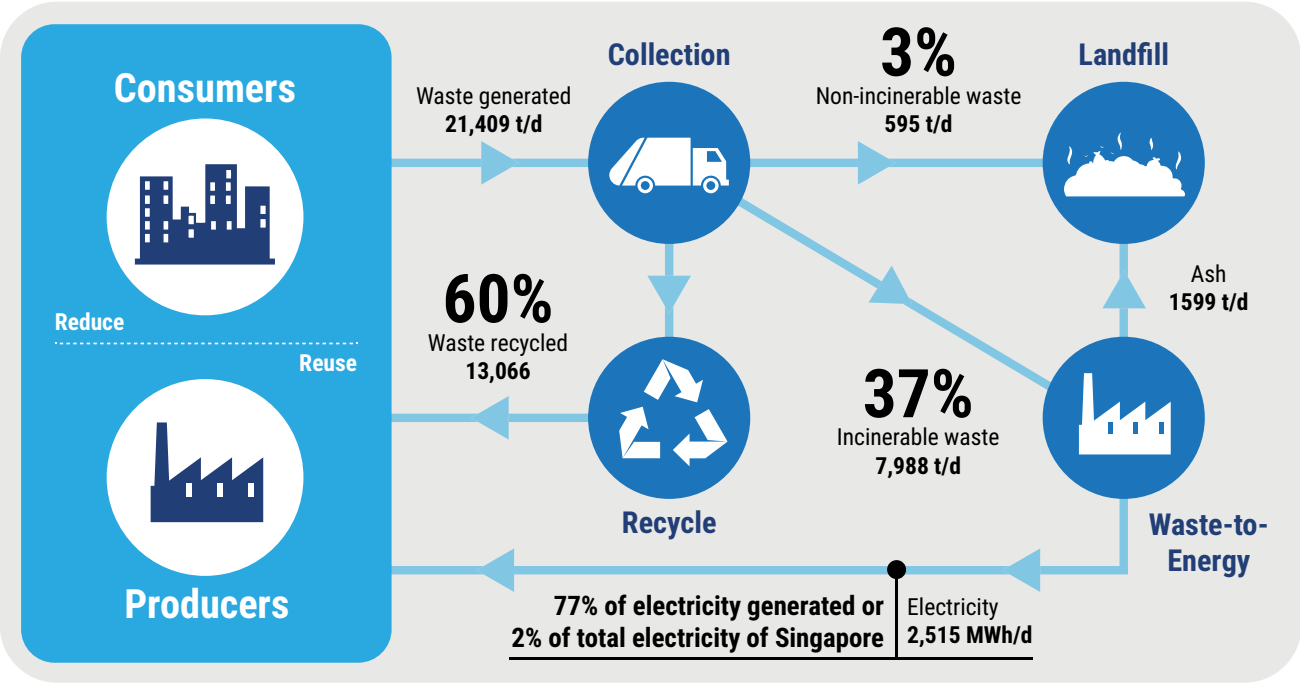
- opting for deconstruction rather than demolition, in order to preserve the integrity of the building elements;
- setting up separation containers on-site for different waste materials;
- using crushed stones and concrete as base material or roading;
- reusing rocks, bricks and concrete for land reclamation, shore erosion protection and building sea walls;
- reimbursement by suppliers for returned unused construction materials; and
- improving inventory control to ensure only amounts needed are ordered and goods arrive on site when they are needed.

Singapore provides an example of a high rate of diversion for a SIDS. There, diversion of waste from landfills has reached 97 percent. Wood, metal, paper, and plastics are recovered and made into aggregates which are then used in new construction. Dedicated recycling companies recover materials from the waste stream through manual or mechanical sorting. Undamaged materials are reused within the sector and others are crushed and screened for use as aggregates for making concrete blocks or road pavement[146].

Figure 4.3 Waste diversion in Singapore[147]



[143] Asbestos Global (n.d.)
[144] Kazan-Allen (2012)
[145] United Nations Environment Programme (2002)
[146] Singapore National Environment Agency (2016)
[147] ©WRAP



Source of the image: Adapted from the 2013 Singapore National Environment Agency report, with 2016 figures.

4.3 Plastics

Plastics represent a growing international problem due to their longevity. In SIDS, they represent about 8% of municipal solid waste. As high volume, low weight and non-degradable wastes, they are difficult to manage. Palau converts plastics to oil[148], a process that requires high skill levels and sophisticated infrastructure[149]. However, generally speaking, SIDS lack the technologies to adequately manage them onshore, and so several SIDS try to recycle in some form. Recycling plastics can reduce the environmental impacts arising from plastics waste. One benefit of recycling plastics is that greenhouse gas emissions are reduced by 70% because recycling displaces virgin materials. However, markets for recycled plastics are becoming more difficult to find as the world's leading importer of plastics waste by far, China, introduced new restrictions in 2017 on materials it would accept from January 2018[150]. In addition, plastics incorporated into other products, like electronic goods, compound the plastics waste issue.

Waterways are often dumping grounds for plastics waste generated through human undertakings, contributing to obstructing the water flow, which during periods of heavy rain can causes flooding. Plastic bags are a major problem in marine environments, and they also create a nuisance around landfills as they get blown away by the wind and then become trapped in surrounding vegetation or in the sea. Microbeads and marine plastics that break down into microplastics are of concern as they endanger the marine ecosystem, and are easily ingested by fish, entering the food chain and potentially producing organo-toxin contamination.

Ways to reduce the impact of plastics and better manage them can include[151]:

- Improving waste management systems;
- Promoting eco-friendly alternatives to phase out single-use plastics;
- Educating consumers to make environmentally friendly choices;
- Enabling voluntary reduction strategies; and
- Banning or introducing levies on the use and sale of single-use plastic items.

Some measures on islands, such as plastic bag bans (where environmentally responsible alternatives exist) have worked well when they have been introduced in cooperation with the key stakeholders who are charged with enforcement of the ban.

The Pacific islands are making a concerted effort to reduce plastic waste as shown in **Table 4.2**.

[148] Secretariat of the Pacific Regional Environment Programme (2016)
[149] United Nations (2015a)
[150] World Trade Organization (2017)
[151] United Nations Environment Programme (2018c)

Table 4.2 Plastic waste reduction in the Pacific islands

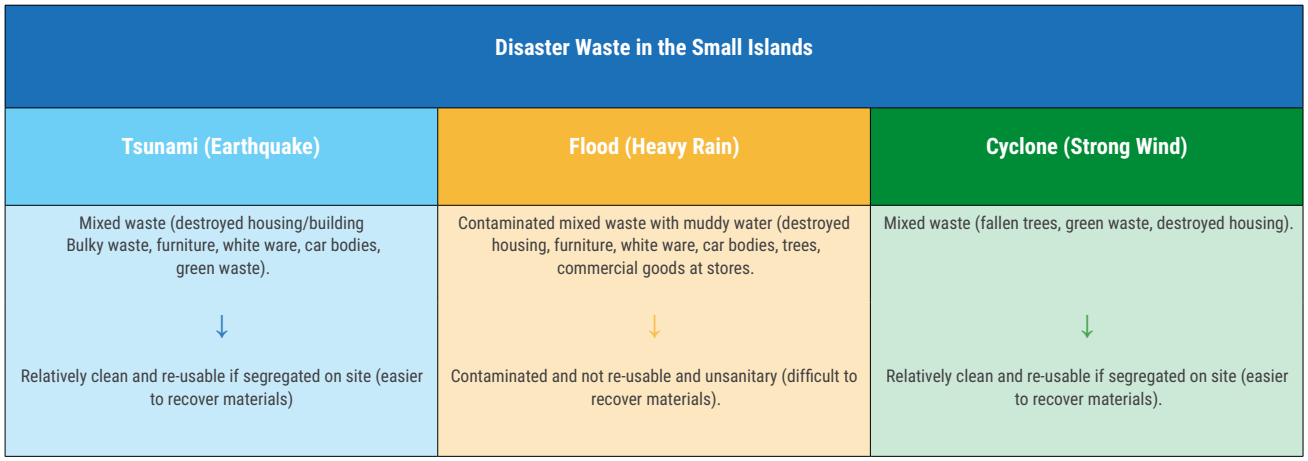
Action / Country	American Samoa[154]	Cook Islands	Federated States of Micronesia[155]	Fiji[156]	Guam[157]	Marshall Islands[158]	Niue[159]	Northern Mariana Islands[160]	Palau[161]	Papua New Guinea[162]	Samoa[163]	Solomon Islands[164]	Vanuatu[165]
Single-use plastic bag ban	✓				✓	✓	✓	✓	✓	✓			✓
Consulting on ban of single-use plastic bags[152]		✓									✓		
Consulting on ban of single-use polystyrene[153]		✓											
Single-use plastic bag ban in Pohnpei and Yap states			✓										
Levy on single-use plastic shopping bags				✓									
Consulting on ban for plastic straws											✓		
Single-use plastic bag ban in Western Province												✓	
Plastic straw ban													✓
Polystyrene takeaway box ban													✓

[152] Kumar (2018)
[153] Cook Islands (2018)
[154] Secretariat of the Pacific Regional Environmental Programme (2018)
[155] Secretariat of the Pacific Regional Environmental Programme (2018)
[156] Secretariat of the Pacific Regional Environmental Programme (2018)
[157] Secretariat of the Pacific Regional Environmental Programme (2018)
[158] Secretariat of the Pacific Regional Environmental Programme (2018)
[159] Niue joins growing Pacific movement (2018)
[160] Secretariat of the Pacific Regional Environmental Programme (2018)
[161] Secretariat of the Pacific Regional Environmental Programme (2018)
[162] Niue joins growing Pacific movement (2018)
[163] Secretariat of the Pacific Regional Environmental Programme (2018)
[164] Leroux (2017)
[165] Secretariat of the Pacific Regional Environmental Programme (2018)

4.4 Disaster Waste

Disasters such as storm surges, tropical cyclones, and earthquakes often result in an accumulation of debris and waste blocking shorelines and access routes. **Figure 4.4** illustrates the disaster waste in SIDS as a consequence of different forms of environmental hazards.

Figure 4.4 Disaster waste in SIDS[166]



In a matter of seconds, a disaster can generate the equivalent of decades of waste. Examples of the quantities of waste generated by some disasters is shown in **Table 4.3**.

Table 4.3 Waste generated by selected disasters in SIDS[167, 168]

Date	Country	Event	Estimated quantity of disaster waste (tonnes)	Time normally needed to generate an equivalent amount of waste in that country
Sep 2009	Samoa	Earthquake and tsunami	4,500	72 days
Jan 2010	Haiti	Earthquake	60,000,000	51 years[169]
Jan 2012	Fiji	Flood in Ba Town	4,091	6 days
Dec 2013	Samoa	Cyclone Evan	1,080	17 days
Jan 2014	Tonga	Cyclone Ian	>300	>4 days

Waste generated by disasters can threaten public health, hinder relief and reconstruction and also impact the environment. Disaster waste can be harder to manage than other waste because of the large amounts generated in a short time, much of which is mixed, contaminated waste.

[166] Japan International Cooperation Agency (JICA) (2016). Extracted from the presentation under the title "Disaster Waste Management for 'Build Back Better'.
[167] Secretariat of the Pacific Regional Environment Programme (2016)
[168] United Nations (2015)
[169] For this calculation, estimates of yearly municipal solid waste generation are sourced from the World Bank report, What a Waste, 2012.

The frequency of extreme events like **tropical cyclones** (hurricanes, typhoons) is increasing. Generally, disaster responses aim to address waste management needs in the post disaster period. Instead, **preparedness should be a key component of any disaster strategy**. The course of action to be taken following the immediate response is rehabilitation for waste management, which is often the responsibility of the government, in consultation with other key stakeholders, as for example prescribed in the Solomon Islands regulation[170]. **Innovative thinking can provide opportunities to utilize the waste a disaster leaves behind**.

For example, when cyclone Pam struck Vanuatu in 2015, it created a large quantity of vegetative waste. Trees were cut into 50 cm lengths and piled in convenient places in the community for use as firewood. Smaller green waste such as leaves and branches were taken by an organic farming company for compost. The municipality dealing with the disaster waste cleanup and separation took this opportunity to enhance public awareness regarding waste management concepts through interacting actively with communities[171].

Earthquakes, which have essentially no warning period, and **volcanic eruptions**, which can have warning periods up to several weeks, are significant disaster events that produce large quantities of waste. Some SIDS have very high susceptibility to these events, such as Papua New Guinea (ranked in the top six countries in the Asia-Pacific region for earthquake exposure) and Guadeloupe for earthquake risk and Vanuatu, Martinique and St. Lucia for volcanic risk. Planning for these events is not an easy task, as the aftereffects of the initial event can last for years, producing further waste management complications. Having a Disaster Waste Management Contingency Plan in place before an emergency occurs helps in identifying options for waste collection, recycling and disposal, thereby saving critical time and resources in the aftermath of a disaster. If such a plan is not developed in advance, it needs to be considered during the recovery phase or as preparedness for future disasters. **Typhoon** Haiyan, also known as Super Typhoon Yolanda, hit the Philippines in November 2013. **Typhoon** Haiyan is one of the strongest tropical cyclones ever recorded and some of the measures undertaken as part of the recovery phase in the Philippines can be applicable as best practices for disaster waste management in SIDS.

[170] Solomon Islands (2008)
[171] Secretariat of the Pacific Regional Environment Programme (2015)

These actions had significant impacts and include[172]:

- The allocation of **financial resources for debris clearing** and for the recovery phase. This helped in:
  - Boosting local economies through cash injections;
  - Developing ownership of the recovery process and speeding up accessibility;
  - Accelerating clean-up of areas inaccessible by heavy machinery; and
  - Enhancing worker safety by people acting as spotters and coordinators.

- Action to **demolish unstable buildings**. This:
  - Enhanced safety for residents living nearby; and
  - Strengthened leverage for future construction projects, boosting local construction-related companies and job opportunities.

- **Targeted** training for local government. This enabled:
  - Increased shared understandings of the situation, including of the needs and available resources in their districts; and
  - Increased cooperation and asset sharing (e.g. promoting regional thinking towards landfills).

As in previous cases in the Philippines, local agencies worked during the disaster response and recovery phases with international organizations to carry out the necessary actions[173].

In a more recent case in Dominica, two hurricanes, Maria and Irma in September 2017, devastated the island, as well as much of the Caribbean. A report to the government from the UN Environment/UN Office for the Coordination of Humanitarian Affairs Joint Unit made the following recommendations regarding disaster waste[174]:

- Inclusion of disaster waste management into future waste management and disaster preparedness plans;
- Development of natural and technological hazards maps at the national and community levels; and
- Construction and maintenance of hazardous material stores and waste sites to withstand disasters.

These recommendations would be relevant to many SIDS in hurricane, tropical cyclone and typhoon zones.

[172] United Nations (2015a)
[173] United Nations High Commissioner for Refugees (2013)
[174] United Nations Environment Programme/United Nations Office for the Coordination of Humanitarian Affairs Joint Unit (2017)

Hurricane debris, Dominica, 2017 (Photo by UNEP/Dan Stothart)

4.5 Tyre Waste

Tyre waste is generated during the life and at the end of life of vehicles. Generally, tyres are either dumped illegally or end up in landfills. For example, in Barbados, 90% of used tyres end up in landfills. Waste tyres are a bulky waste taking up large spaces in landfills – adding to the space concerns of SIDS – and also represent a fire hazard. Over time, if they trap methane gases, scrap tyres can surface in landfills. Waste tyres can fill up with water, harboring mosquitos and vermin. In an effort to divert tyres from landfills, research is underway to use them for rubberized asphalt or as a fuel source[175].

To increase diversion of waste tyres from landfills, specific environmentally sound technologies can be used to recover materials and energy from waste tyres. In terms of **materials recovery**, technologies including tyre-derived aggregates (TDA) could be used to recover ground rubber, metal and devulcanized rubber. For **energy recovery**, there are technologies that allow waste tyres to be directly used as **fuel** and others that help convert scrap tyres to conventional type fuels, or recycle waste tyres in steel production[176].

However, before proceeding to an investment, waste tyre quantification must be undertaken locally in order to prioritize and identify the most effective and economically sustainable solution. For example, in Dominica, the average waste tyre output has been estimated to be roughly 50,000 passenger tyre equivalents (PTEs) per year, equivalent to approximately 500 tonnes per year. Such an amount does not justify large investments in tyre shredding and processing equipment, but other tyre applications may be feasible as potential diversion options[177]. Niche markets might not be ideal, but are a possibility for utilizing used tyres. The Marshall Islands has identified innovative ways to deal with used tyres. Tyres destined for domestic landfills are first shredded into large chunks to prevent them from filling with methane gas and rising to the surface and also prevent them from accumulating water. Other tyres are sent to Vietnam, where they will be either retreaded or upcycled into flower pots[178].

4.6 Nanomaterials

Nanomaterials provide an emerging waste stream that can have potentially significant consequences for SIDS. They can enter the environment either through waste disposal or wastewater disposal. Some nanomaterials (e.g. nano-silver)[179] are toxic to organisms and their effect on ecosystems is, as yet, undetermined. Though small in concentration and size, their effects can be long-lived as they are unreactive. This presents a problem for SIDS as the islands rely heavily on life in the surrounding seas for their survival. With the lack of sanitary landfills on SIDS and with many dumps close to shorelines, there is no way of containing the nanomaterials after disposal and these materials can easily leach into the marine environment. It is desirable for SIDS to gradually incorporate waste management programmes for nanoparticles to avoid risks to human health in particular, and also environmental risks.

[175] Barbados (2010)
[176] Waste Tyre Compendium of Technologies, United Nations Environment Programme, 2017)
[177] Sarkar, Chamberlain and Miller (2011)
[178] Marshall Islands (2012)
[179] Kittler et al. (2010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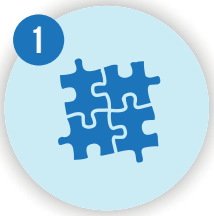
5. WASTE GOVERNANCE

Governance constitutes inter-related sets of norms (such as laws, regulations, frameworks, and standards), organizational and institutional arrangements and practices designed to enable implementation of measures that, in this case, effect waste minimization strategies. Governance plays a significant role in setting the agenda and motivating people to change their behaviours.

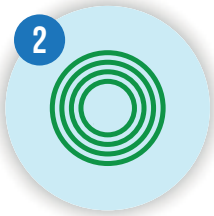
Ensuring broad stakeholder involvement is key in successful waste management governance. A broader consideration of stakeholders is taken up in Chapter 7.

This chapter considers global, regional and sub-regional policy initiatives, how they have been implemented in SIDS, and the challenges from a governance perspective.

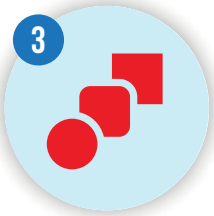
KEY MESSAGES



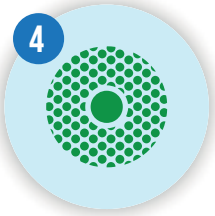
Integrated waste management requires extensive **coordination and cooperation** among all levels of government, private sector, community groups and other stakeholders



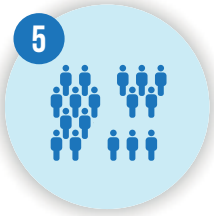
Most SIDS countries have **environmental and waste legislation** contextualized within international agreements and regional, sub-regional and national policy initiatives



Uptake and implementation of legislation **varies across countries** and **across sectors**



Regional initiatives have a higher uptake than global agreements



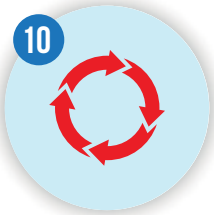
Waste specific **regional** and **sub-regional bodies** for critical mass would be beneficial

SIDS require **broader international cooperation** for transition to a circular economy

Legislation and regulations are mainly focused at the 'end of pipe' rather that at the top of the **Waste Management Hierarchy**

Governments need to **support investment** from the private sector by creating policy, regulatory and other enabling conditions and/or incentives

Having **clear responsibilities** and separating regulatory and operational functions with cross-government coordination is beneficial in delivering waste outcomes



Consideration should be given to other pricing mechanisms, in particular to **Extended Producer Responsibility**

5.1 GOVERNANCE IN SIDS

Few SIDS have adopted the key legislative measures needed to move towards a circular economy. In addition, while many of the present legislative instruments have enforcement provisions, they are generally poorly enforced. Part of the lack of enforcement is because of deficiencies in their capacity to supply services or manage stakeholders in the private and community sectors. Across SIDS there are different models of delivery from national or local government taking control, to industry stakeholders or community groups, churches and civil society organizations undertaking waste management activities. However, the lack of coordination and enforcement of existing provisions for the end of life of materials, the low levels of expertise of operators and the often competing priorities of government officials and departments hamper progress.

That said, the two prime enablers of governance change in waste management are: (1) **national government** (including relevant departments, agencies, entities, chief executives, and relevant ministers), and (2) **local government** (including state, province, region and municipality).

National governments set countrywide policy and define the regulatory framework for implementation of global and regional agreements and deal with transboundary movements of waste. Local governments are responsible for the local management of waste and related practical issues.

Typically, policy-makers have seven groups of **tools** available to them[180]:
1. Executive decision making;
2. Regulation and enforcement;
3. Economic instruments (development and application);
4. Voluntary agreements (with industry groups and the industrial sector);
5. Data and information collection for analysis and dissemination that can influence behaviours and decision making;
6. Education and training of the producers, consumers, the general public and others; and
7. Harnessing the commitment of the community and the non-government sector.

These seven tools are most effective when used in combinations that are suited to the culture, socio-economic circumstances and context of the country they are applied to. More detail on how these tools operate can be found in UN Environment's *Guidelines for National Waste Management Strategies: Moving from Challenges to Opportunities*[181].

For effective governance it is important that when developing legislation, risks of possible **conflicts of interest** are mitigated. Due to financial constraints, in many SIDS, regulatory and operational functions rest with a limited number of people, potentially creating conflicts of interest, as one department (often formed by one or few people) might be responsible for both functions. There are, however, some good cases in which the legislative instruments take this into account, and assign roles and responsibilities to different government departments for better quality assurance and monitoring.

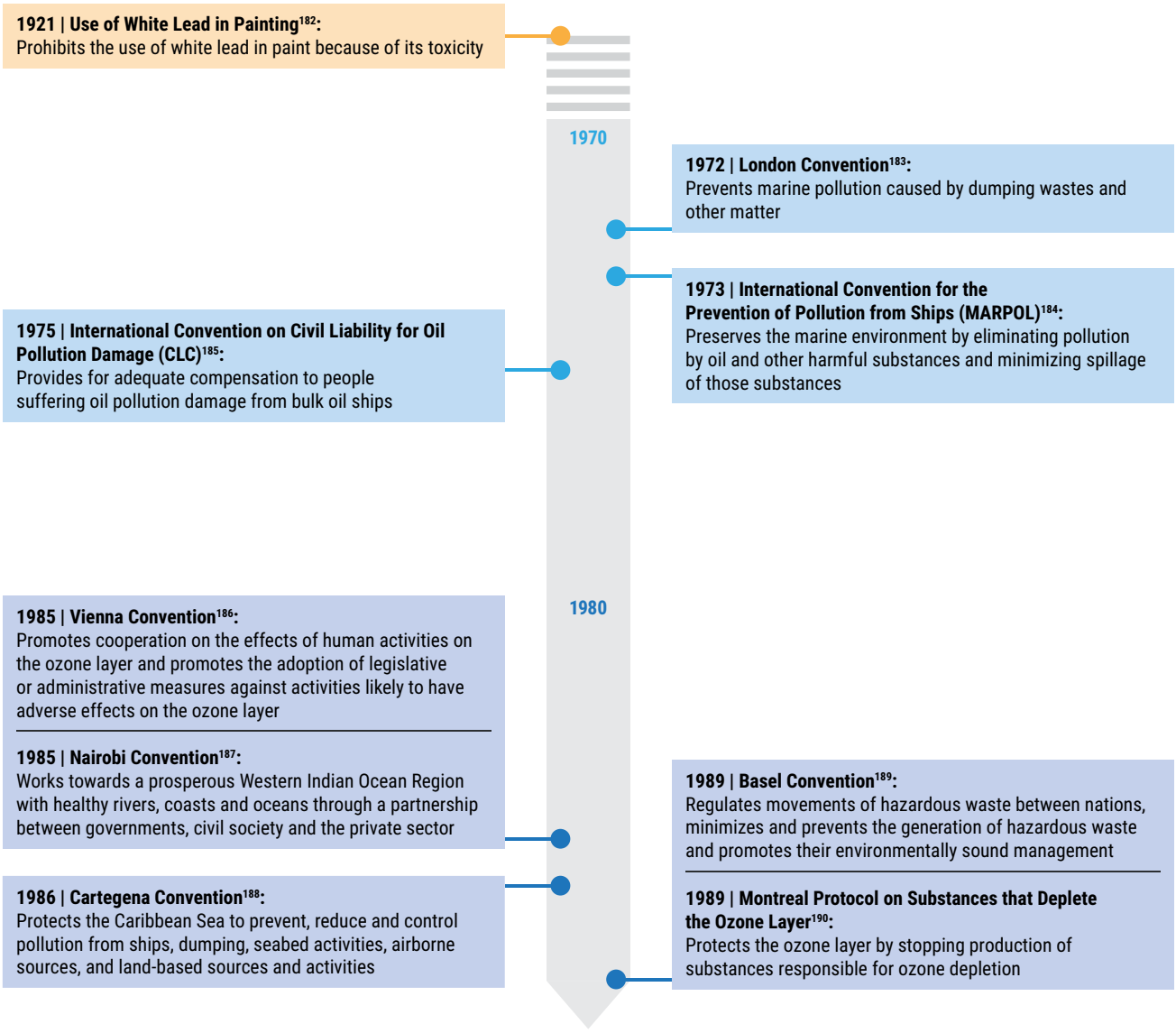
Governance issues also manifest themselves in departmental 'territorial' protection. The perception of encroachment is highly destructive. One mechanism to assist in overcoming this is to elevate the issue to the ministerial level and get agreement between ministers, which then filters down to the appropriate departments.

[180] United Nations Environment Programme and United Nations Institute for Training and Research (2013)
[181] United Nations Environment Programme and United Nations Institute for Training and Research (2013)

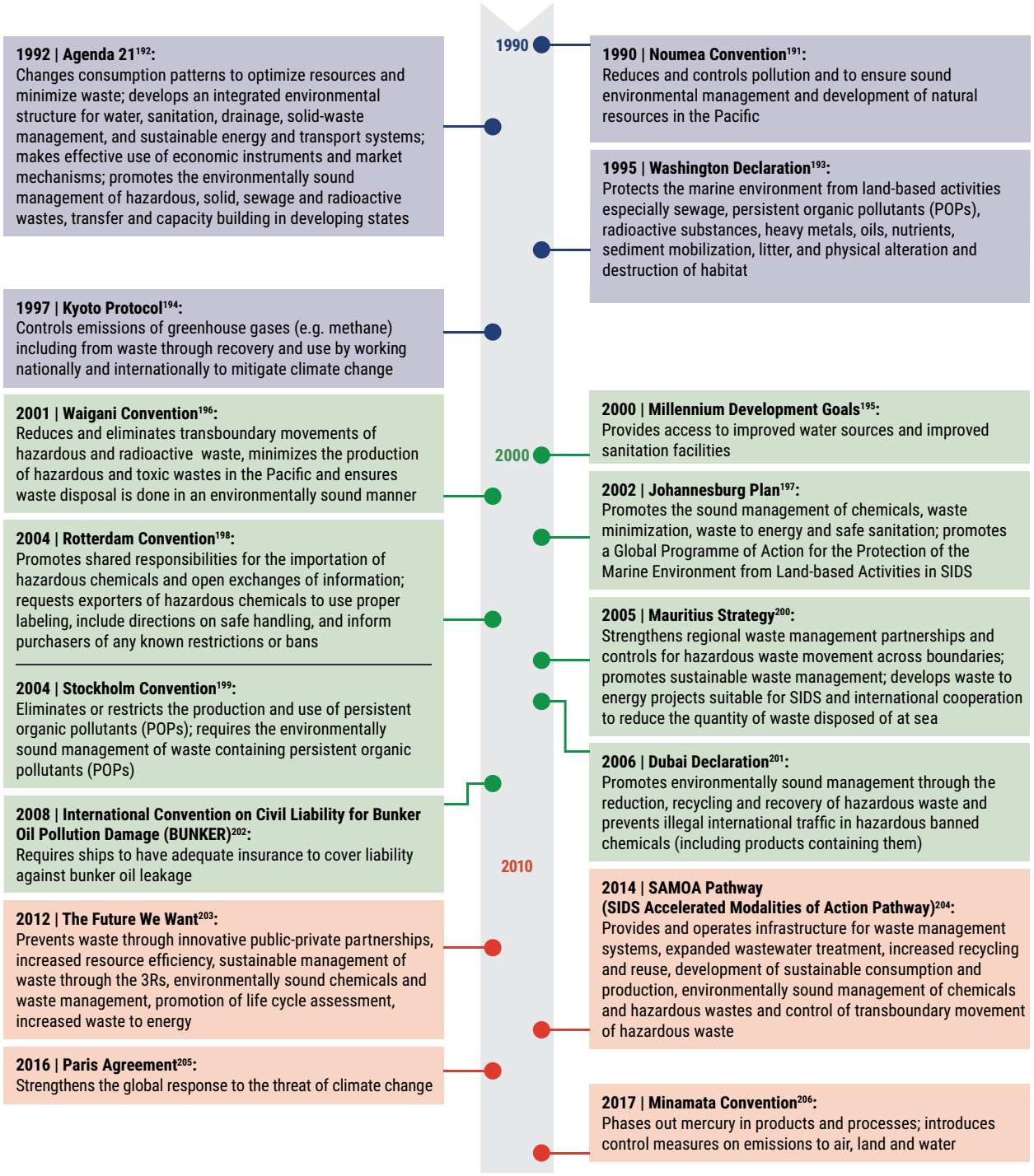
5.2 Global and Regional Environmental Agreements

Multilateral environmental agreements (MEAs) bind countries and regions together to enable them to, among other things, provide a coordinated response to waste management issues. Examples of these multilateral environmental agreements extend from the 1921 Convention concerning the Use of White Lead in Painting to, most recently, the 2017 Minamata Convention on Mercury. Some of the key agreements are shown in **Figure 5.1**.

Figure 5.1 Selected global and regional agreements in waste management



[182] International Labour Organization (1921)
[183] Convention on the Prevention of Marine Pollution by Dumpling of Wastes and Other Matter 1972 (London Convention) (1972)
[184] International Convention for the Prevention of Pollution from from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78) (1983)
[185] International Convention on Civil Liability for Oil Pollution Damage (CLC Convention) (1969)
[186] Vienna Convention for the Protection of the Ozone Layer (1985)
[187] Convention for the Development, Protection, Management and Development of the Marine and Coastal Environment of the Western Indian Ocean (Nairobi Convention) (1985)
[188] Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention) (1983)
[189] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989)
[190] Montreal Protocol (1987)



[191] Convention for the Protection of Natural Resources and Environment of the South Pacific Region (Noumea Convention) (1986)
[192] Agenda 21: Programme of Action (1993)
[193] Whashington Declaration on Protection of the Marine Environment from Land-based Activities (1995)
[194] Kyoto Protocol (1997)
[195] United Nations (2015a)
[196] Convention to Ban the Importation into Forum Island Countries of Hazardous and Radiocative Wastes (Waigani Convention) (1995)
[197] United Nations (2002)
[198] Rotterdam Convention (1998)
[199] Stockholm Convention on Persistent Organic Pollutants (2001)
[200] United Nations Educational, Scientific and Cultural Organization (2017)
[201] Strategic Approach to International Chemicals Management (2006)
[202] International Convention on Civil Liability for Bunker Oil Pollution Damage (2001)
[203] United Nations (2012a)
[204] United Nations (2014)
[205] Paris Agreement (2015)
[206] Minamata Convention on Mercury (2013)

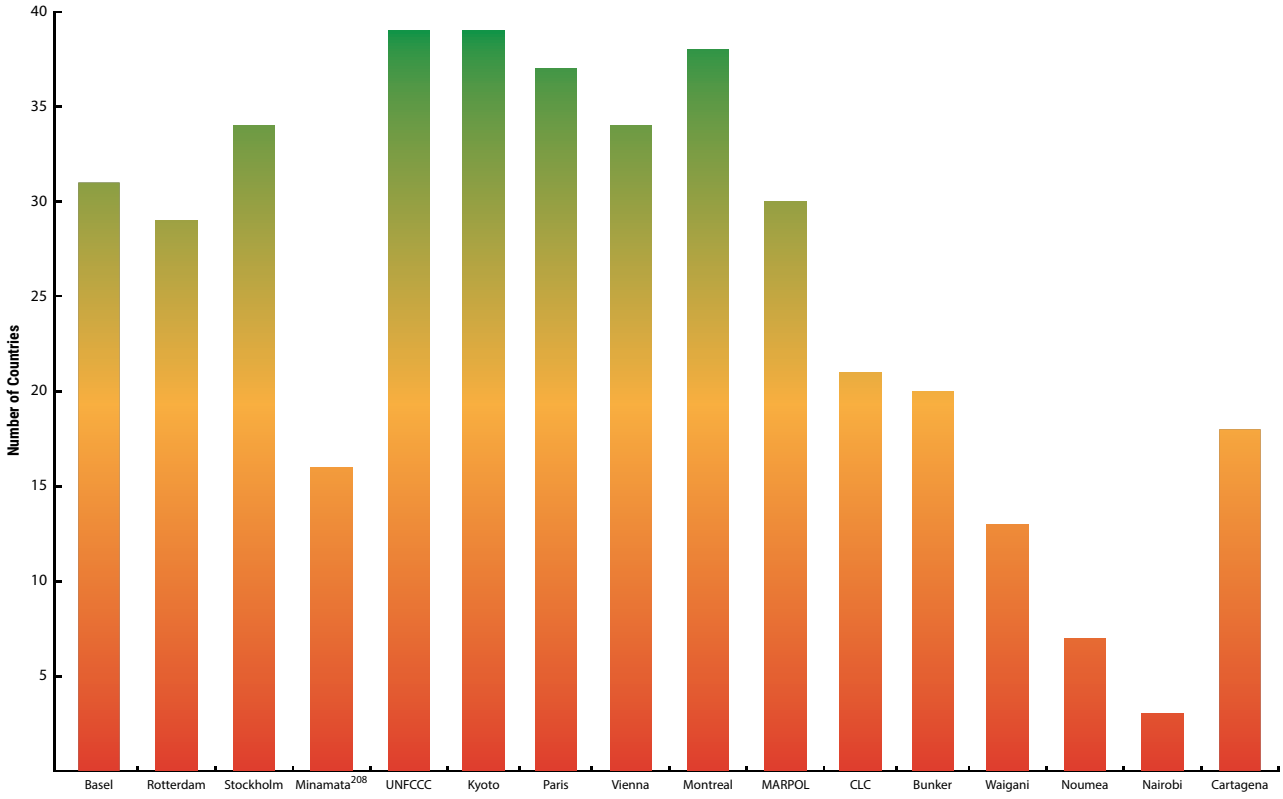
The **SIDS Accelerated Modalities of Action (SAMOA) Pathway** takes an overall approach to waste management across SIDS, and through it, marine litter issues became more visible. It recognizes the specific burdens experienced by SIDS, including the issue of management of waste and marine plastics, often emanating from faraway waters and lands.

Intersecting with the SIDS Accelerated Modalities of Action Pathway, regional cooperation is further enhanced by the **Regional Seas Conventions and Action Plans** Programme which performs a critical coordination role supporting the implementation at regional levels of UN Environment's Programme of Action for the Protection of the Marine Environment from Land-Based Activities.

5.2.1 Ratification of Waste-Related Multilateral Environmental Agreements by SIDS

National waste management initiatives are often influenced by international agreements. **Figure 5.2** presents an overview of multilateral environmental agreements (MEAs) concluded by SIDS.

Figure 5.2 Multilateral environmental agreements (MEAs) concluded by SIDS[207]



[207] United Nations Environment Programme (2016d)
[208] Some SIDS automatically adopted the Minamata Convention, as their protectors are signatories to it.

From **Figure 5.2** it can be seen that multilateral environmental agreements referring to global critical issues such as ozone depletion and global warming (the Montreal Protocol, UN Framework Convention on Climate Change, Kyoto Protocol and Paris Agreement) have the greatest uptake with 67% of SIDS ratifying them. The Vienna Protocol is only slightly behind with ratification by 55% of SIDS. The next most widely ratified group of multilateral environmental agreements is those concerning hazardous chemicals and wastes (the Basel, Rotterdam, Stockholm and Minamata Conventions) with a range from 64% of SIDS ratifying the Stockholm Convention to 21% for the Minamata Convention. It should be noted that the Minamata Convention only entered into force in 2017. The Paris Agreement, signed in 2015, has already an uptake by 67% of SIDS, indicating that climate change is high on political agendas.

Analysis from **Figure 5.2** of the regional spread of ratification shows that the Atlantic, Indian Ocean, Mediterranean, and South China Sea region SIDS have the highest overall multilateral environmental agreement ratification rate averaging at 83%, with Pacific SIDS at a 67% ratification rate and the Caribbean at a 61% rate as shown in **Figure 5.3**. Within the Atlantic, Indian Ocean, Mediterranean, and South China Sea region SIDS, the agreements having the highest rate of ratifications are for those conventions dealing with climate change, ozone (Montreal) and persistent organic pollutants (POPs) (Stockholm) at 100%. The lowest are the agreements on mercury (56%), one of the latest agreements, and oil (Bunker) at 22%. The Caribbean shows a similar pattern to the Atlantic, Indian Ocean, Mediterranean, and South China Sea region SIDS with the Minamata Convention still to gain much traction (25%) and the two oil conventions doing slightly better at 50% ratification.

Figure 5.3 Multilateral environmental agreement ratification rate

Regional initiatives have higher uptake, indicating that SIDS relate better to regional, rather than global agreements. In the Pacific, two regional agreements, the Waigani and Noumea Conventions, have higher than average rates of ratification than the global agreements (at 75% and 69% respectively) and in the Caribbean, the Cartagena Convention has an 86% ratification rate.

Acknowledgement of the importance SIDS attach to the marine environment is demonstrated by the high ratification rate of the **International Convention for the Prevention of Pollution from Ships (MARPOL)** focusing on the dumping of waste into marine waters. The 57% ratification rate is similar to climate change ratification by SIDS. The other two multilateral environmental agreements dealing with oil pollution, the International Convention on Civil Liability for Oil Pollution Damage and the Bunker Convention, both have a ratification rate of 34%.

Agreements that directly affect the economic lifeblood of SIDS can have compliance issues such as the International Convention for the Prevention of Pollution from Ships (MARPOL) that calls for port reception facilities for the collection of waste from ships. Long-term disposal opportunities for SIDS are limited. Waste reception facilities for shipping in the wider Caribbean region indicate that facilities to accept food waste are inadequate in number, aggravated by insufficient compliance and monitoring[209]. If the Caribbean countries moved to reduce oceanic discharge of food waste they would need to upgrade onshore infrastructure to cope with the change.

[209] Smith (2017)

5.2.2 Implementation of Multilateral Environmental Agreements in SIDS

With the increasing importance of sustainable development, SIDS are undertaking (and are encouraged to undertake) reviews of their legislative frameworks to ensure that government policies, development plans and investment decisions are up-to-date and align with the multilateral environmental agreements they have signed as well as their own sustainable development agenda, such as in the case of the Federated States of Micronesia,[210] with the expectation of having to report on progress. For instance, a long-due review undertaken in Barbados in 2010 of its 30-year-old zoning policy incorporated the protection of groundwater reserves and included provisions for adequate protection from modern industrial pollutants, such as oil and cleaning detergents[211].

Implementation of multilateral environmental agreements is a fundamental process after ratification of the agreements. For example, Barbados passed the Marine Pollution Control Act in 1998[212], which resulted from the country ratifying the Cartagena Convention. Under the Act, the Environmental Protection Department was charged with auditing waste on a sectoral basis. The process requires a review of practices and procedures, an assessment of waste streams and pollution control equipment, and the provision of recommendations to companies on ways to improve their environmental performance. This process has produced multiple benefits through local implementation of the Convention, including less waste, resulting in lower pollution; skilled employment for government officials; industry and public education on pollution avoidance; and a good news story for the public, including tourists who like pristine holiday spots.

The implementation of international agreements has been variable across SIDS. For example, implementation of the Stockholm Convention is reinforced vigorously in Sao Tome and Principe and Seychelles through provisions on motor vehicle disposal, plastic bags and beverage containers. On the other hand, uptake of measures to comply with the Basel Convention has been uneven across SIDS. The Basel Convention sought to protect developing countries from hazardous waste exported from developed countries to minimize waste disposal costs and for the environmentally sound management of hazardous wastes. Stronger implementation of the convention would reduce vulnerability to the harmful effects of hazardous wastes.

Governance issues feature strongly in the ability of SIDS to implement a waste legislative framework. Many SIDS have a lack of institutional, technical, and economic capacity, and limited technologies to appropriately manage the materials. A lack of monitoring and control skills results in mixed waste being dumped in areas such as riverbeds, where it readily pollutes the environment. Data in high-priority areas such as the quantities of hazardous waste generated, much less data for specific industry or business sectors, is sporadic for SIDS[213] and indeed for developing countries in general. For the situation to improve it would be beneficial for SIDS to develop a regional approach to achieve viability of the material recovery process[214].

[210] Yauvoli (2010)
[211] Barbados (2010)
[212] Barbados (2010)
[213] United Nations Environment Programme (n.d.)
[214] United Nations Environment Programme (n.d.)

5.3 Regional Policy Initiatives

Agreements that take a regional, or sub-regional approach, is shown in **Table 5.1**.

Table 5.1 Summary of SIDS regional waste policy initiatives

Year	Name	Comment
Caribbean[215]		
2001	Regional Latin American and Caribbean Platform for Electronic Waste	Amalgamates information in an online portal to raise awareness about regional e-waste issues
Pacific[216]		
2001	Pacific Wastewater Policy Statement	Guides future management of wastewater in Pacific island countries and territories
2001	Pacific Wastewater Framework for Action	Recommends actions at national and regional levels to realize the goals charted in the Pacific Wastewater Policy Statement
2003	Pacific Regional Action Plan on Sustainable Water Management	Promotes integrated water resources management for improving water supply and sanitation
2005	Pacific Regional Ocean Policy	Provides a framework for sustainable development, management and conservation of marine and coastal resources in the Pacific region including reducing the impact of pollution on the ocean environment
2005	Pacific Framework for Action on Drinking Water Quality and Health	Promotes investment in suitable wastewater technologies to reduce the impacts of wastewater on drinking water quality
2010	Pacific Oceanscape Framework	Builds on the Pacific Regional Ocean Policy by proposing coordination, resourcing and implementation provisions
2010	Pacific Regional Solid Waste Management Strategy 2010–2015	Adopts cost effective and self-sustaining solid waste management systems to protect the environment, to promote a healthy population and encourage economic growth
2011	An Asbestos-Free Pacific: A Regional Strategy and Action Plan 2011	Provides guidance on minimizing the adverse effects of asbestos on human health and the environment and guidance on the systematic replacement of asbestos materials with non-hazardous alternatives; maximizes coordination of asbestos management activities; builds the capacity of stakeholders to promote effective asbestos management; ensures national policy objectives are being met
2012	Pacific E-waste: A Regional Strategy and Action Plan 2012	Facilitates proper management and disposal of e-waste
2013	Ha Noi 3R Declaration	Develops and implements 3R policies and programmes to achieve defined goals
2014	Framework for Pacific Regionalism	Prescribes a robust process to identify regional priorities for implementation
2016	Draft Strategy for Disaster and Climate Resilient Development in the Pacific	Recognizes good waste management contributes to low carbon development; recommends improvement of waste management programmes through the 3Rs, and environmentally sound disposal for greenhouse gas emissions reduction
2016	Cleaner Pacific 2025	Promotes a strategic management framework to address waste, chemicals and pollution in the Pacific Region between 2016-2025, to reduce pressures on the region's sustainable development
Atlantic, Indian Ocean, Mediterranean, and South China Sea region (AIMS)[217]		
2004	Addressing Land-based Activities in the Western Indian Ocean	Reduces degradation of the marine and coastal environments due to land-based activities

[215] United Nations Environment Programme (n.d.)
[216] Secretariat of the Pacific Regional Environment Programme (2016)
[217] UN Department of Economic and Social Affairs (2010)

One of the more comprehensive regional initiatives noted in **Table 5.1** is Cleaner Pacific 2025[218], which aligns waste and pollution activities to other priority development areas that are common across many SIDS, such as climate change, biodiversity conservation, agricultural development and tourism development. This alignment is a proven way to advance waste management with the added benefits of cross-sector and multi-stakeholder engagement, increasing understanding and buy-in towards waste initiatives.

A successful regional initiative in Pacific SIDS is the Japanese funded project titled "Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries" (J-PRISM), which is overviewed in **Box 5.1**.

Box 5.1 Pacific Regional Success: The Japan-Funded Project "Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries" (J-PRISM) Programme

The first phase of the programme instituted good practices, such as:

- Community-based composting initiatives and community empowerment for collection services;
- Green waste management systems at disposal sites with associated improvements of the sites;
- Disposal site waste separation for disaster, bulky and recyclable waste;
- Recycling and return programs; and
- Financially sustainable practices like prepaid bags.

Following the success of the first phase of the programme, a second phase of the programme commenced in 2017 with a target of achieving sustainable cooperation among the participant SIDS through:

- Pacific to Pacific collaboration, including developing mechanisms for supporting collaboration;
- Promotion of regional and in-country 3R + return schemes; and
- Consolidation of the efforts of the Pacific community and inter-regional cooperation.

Further collective approaches in the Pacific region have been taken through programmes such as the Global Environment Facility Pacific Islands Ridge-to-Reef National Priorities Programme (ongoing); the Global Environment Facility Pacific Integrated Water Resources Management (IWRM) Project (completed); and the UN Development Programme/ Global Environment Facility International Waters Programme (completed)[219].

Marine litter has also been addressed at the regional level through the West Indian Ocean project and the SIDS Accelerated Modalities of Action (SAMOA) Pathway, as noted in Section 1.5.2. Additionally, several Regional Seas Conventions and Action Plans, which enable cooperation and coordination among countries sharing a common resource, have established, or are in the process of establishing, regional action plans on marine litter[220].

[218] Secretariat of the Pacific Regional Environment Programme (2016). It contains 14 guiding principles, four strategic goals and associated targets to be achieved between 2016 and 2025. https://sustainabledevelopment.un.org/content/documents/commitments/1326_7636_commitment_cleaner-pacific-strategy-2025.pdf

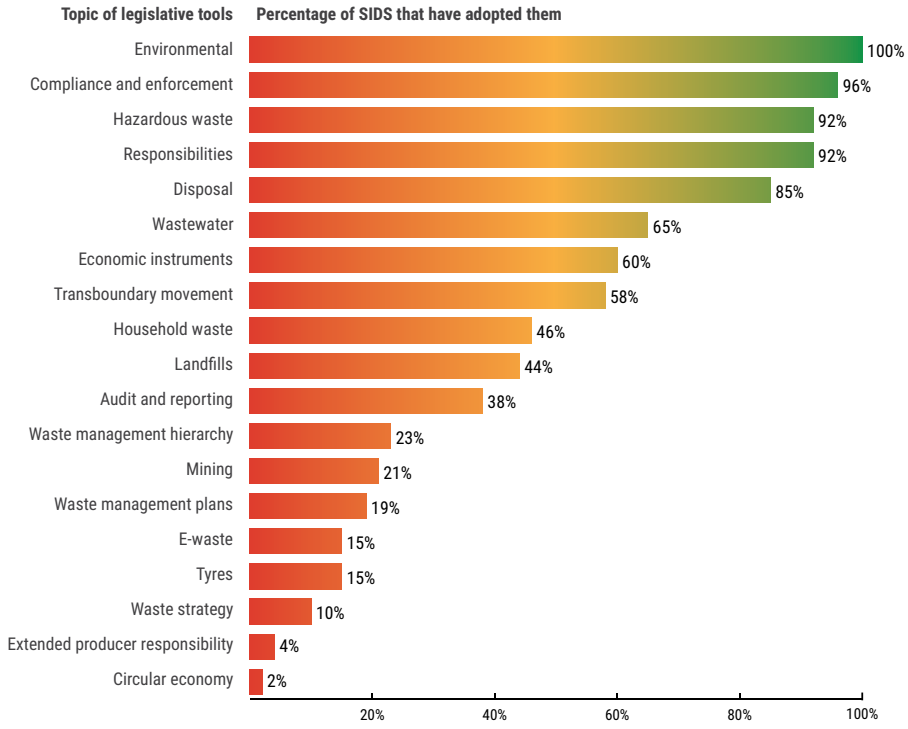
[219] Secretariat of the Pacific Regional Environment Programme (2016)

[220] United Nations Environment Programme (2016b)

5.4 National Legislation in SIDS

Critical national strategies link long-term visions to medium-term targets and short-term actions. An analysis of national level legislative tools[221] in SIDS shows that all have adopted national level environmental legislation and regulatory instruments (**Figure 5.4**). The environmental legislation normally contains environmental impact assessment provisions, useful in controlling waste emissions to the environment. It is useful to include in these environmental impact assessment provisions a requirement to assess the potential adverse impacts of the proposed new practices, as this can help to mitigate risks to the environment from the planning stage.

Figure 5.4 Categories of legislative tools and the percentage of SIDS adopting them[222]



Public health legislation commonly addresses hazardous waste (medical) and wastewater. In fact, 92% of SIDS have adopted at least some degree of legislation on hazardous waste. Wastewater legislation has been passed by 65% of SIDS. Wastewater is indeed mostly managed through networked systems, and as in the case of hazardous waste, has possible widespread public health concerns and implications.

Although compliance and enforcement provisions are found in 96% of SIDS, actual implementation of these provisions remains sporadic. Allocation of responsibilities for various waste-related activities is also very high, at 92%. Regardless, it is evident that in many SIDS accountability is not a high priority.

[168] ECOLEX database https://www.ecolex.org/
[169] Summarized from the ECOLEX database available at https://www.ecolex.org/

While national legislation on waste disposal exists in 85% of SIDS, landfill legislation has been adopted only in 44% of SIDS and household waste regulated only in 46%. This could be attributed to lower levels of political concern in relation to landfills and household waste because of what appear to be only localized impacts. Household wastes, for instance, can contain a mixture of wastes, from those that decompose readily (kitchen and garden waste) to hazardous wastes, and thus can cause significant problems if not segregated and handled properly.

The analysis shows that marine and port-related regulations generally deal with the dumping or discharge of waste in coastal areas (solid and wastewater) and transboundary waste issues; oil pollution and mining legislation address both marine and land pollution and discharge.

Legislation that deals with significant moves to a circular economy (categories from "waste management plans" to "circular economy" in **Figure 5.3**) is only found in a small portion of SIDS (between 2% and 19%), which indicates that many SIDS are not thinking along those lines yet. **Assistance will be needed for SIDS to develop the capacity to be able to transition to circular economies, beyond the simple passing of legislation**. A detailed analysis of national legislative initiatives by region (the Atlantic, Indian Ocean, Mediterranean, and South China Sea region [AIMS region]; the Caribbean region; and the Pacific region) is provided in **Annex 1**.

5.4.1 Extended Producer Responsibility

The advent of consumerism, particularly in relation to increased tourism on SIDS, brings along wastes that are not easily managed on the islands. Promoting and enforcing extended producer responsibility measures will assist in increasing the accountability of importers and retailers, creating a financially feasible circular approach. The extended producer responsibility tools include[223]:

- prohibiting sale;
- controlling or prohibiting disposal of products or waste;
- controlling or prohibiting the manufacture or sale of products that contain specified materials;
- requiring a takeback service for products;
- setting fees payable for the management of a product;
- establishing container deposit schemes;
- prescribing requirements for the labelling of a product; and
- defining standards to be met when reusing, recycling, or recovering the product or material.

So far, the most prominent use of extended producer responsibility tools in SIDS relates to the prohibition of manufacturing and selling plastic bags, although no comprehensive information is available on the impact achieved in individual SIDS. For example, by using one of the tools listed above, prohibiting sale, Mauritius banned the use of non-biodegradable plastic bags and instituted a levy on disposable bags. This resulted in significant reductions in single use plastic bags[224]. A similar ban on non-biodegradable bags was instituted in Samoa[225].

A successful extended producer responsibility tool is the establishment of container deposit schemes. The results can be seen, for instance, in Palau and in Yap State of the Federated States of Micronesia as shown in **Box 5.2**.

[223] United Nations Environment Programme (2016d)
[224] UN Department of Economic and Social Affairs (2010)
[225] Government of Samoa (2010)

Box 5.2 Container Deposit Schemes

Palau

Discarded beverage containers were a large and growing component of the waste problem in Palau. In 2006 the government of Palau, through a national act[226], created a recycling fund and established a fee-based incentive system to encourage the redemption and recycling of containers, called the Beverage Container Deposit Programme.

This programme, widely implemented in the urban state of Koror, which is home to about 70% of the country's population, contributes to the recycling fund, which is now self-sufficient to cover government expenditures associated with solid waste management, including the personnel and operating costs of the recycling centre and its facilities. The recycling centre no longer receives an extra budget allocation from the national government.

So far, of the 93 million imported beverage containers, about 81 million have been redeemed and compressed. This reflects an 87% success rate of redemption. An estimated 4,000 tonnes of used beverage containers have so far been processed for recycling and diverted from landfill in Palau. Of the containers redeemed, about 56 million aluminium and steel cans and 20 million plastic bottles have been shipped off island for recycling. About 2 million glass bottles have been recycled on the island.

Because of the successful Beverage Container Deposit Programme, beverage containers are now hardly ever found in the environment or in normal household waste. The successful implementation of the programme is a manifestation of the commitment of the government to address waste issues in the country and is a good example of sustainable financing with positive environmental impacts.

(Koror State Government and Bureau of Public Works, Palau)

Yap State, Federated States of Micronesia

The Yap State Environmental Protection Agency introduced, in 2009, a Container Deposit Programme. The state government charges a 6 cent deposit fee upon the purchase of each of the following containers: aluminium cans, polyethylene terephthalate (PET) beverage containers, polyethylene terephthalate (PET) cooking oil containers and glass beverage containers. Customers who bring back empty containers will be refunded 5 cents per container. The one cent difference goes to a private recycling centre to cover operating and shipping costs.

More than 14 million containers have been shipped out of Yap State for recycling, which helped to decrease the volume of plastic and aluminum waste that went to the landfill. From November 2014 to March 2015 alone, the recycling centre collected almost 1 million aluminium cans, 200,000 polyethylene terephthalate (PET) bottles, 5,000 polyethylene terephthalate (PET) cooking oil containers and 17,000 glass bottles. Over a five-year period from 2009 to 2014, the number of redeemed containers exceeded the number imported during the initial stages of the recycling programme, reflecting good public reception of the project. In 2014, more than 95% redemption was recorded.

For a small island state like Yap with very limited capacity, initiatives such as this, which reduce generation of wastes and increase diversion from the landfill, can have very big impacts.

(Yap State Environmental Protection Agency, Federated States of Micronesia)

[226] https://countrysafeguardsystems.net/sites/default/files/Palau%20Recycling%20Act%202006.pdf

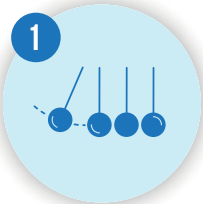
6. FINANCING

The financial challenges to institute and maintain integrated waste management programmes that lead to a circular economy are a major hindrance to progress. It is common for government departments to be adequately resourced to pass legislation, but there is often no ongoing finance to assist with implementation. Most of the legislative instruments are targeted at making waste disposal safer, but achieving that is a struggle for many SIDS from a financial perspective. SIDS have extra hurdles to overcome in that recyclable materials, such as plastic bottles, which are becoming more prevalent, are costly to export to markets where the economic value can be recognized. At the operational level, **a sustainable charging system for waste services remains a challenge for many SIDS communities**.

The success of waste development policies is underpinned by economic considerations ranging from effective budget allocations in the public sector to creating an enabling business environment for the private sector. While the costs of financing waste development policies can be high, the often invisible costs of inaction are considerably greater.

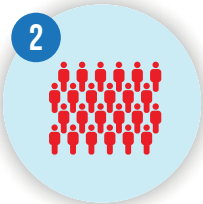
KEY MESSAGES

1



The **cost of substandard waste management practices** includes the loss of ecosystems, acceleration of climate change effects, the loss of national revenue (from tourism, for example), and the cost of healthcare for affected populations

2



Those costs are commonly borne **by society** as a whole, **rather than** the actual **polluters**

3

Governmental financial planning, including charging systems, deposit refund schemes, taxes and subsidies, to assist implementation of waste management legislation at the local level are crucial for effective and sustainable waste management

4

Waste **management programmes** need to be designed to effectively incorporate **waste** into **high priority** workstreams

5

Funding for waste management initiatives can come **from a variety of sources**, including international funding bodies, private sector and community contributions

6

Waste management programmes and projects have to **demonstrate clear win-win outcomes** for the recipients and the funding providers through the development of bankable projects

7

Public Private Partnerships in SIDS can be challenging to establish but might present **opportunities for infrastructure planning and improvements**

6.1 Cost of Inaction

When calculating the cost of inaction we must take into consideration things such as the loss of ecosystems and arable or residential land, increased air emissions, water and soil pollution, future remediation costs and possible legal action costs. Inaction also implies a possible acceleration of climate change and the resulting impacts on the economy and people's lives. These costs are generally not borne by those mismanaging the waste, but rather are spread across society as a whole, with impacts on future generations, and are often borne by different government departments not necessarily responsible for the offending sector. For example, air pollution is often generated as a by-product of economic development, but dealing with the aftereffects of air pollution involves costs that are borne by the health ministry. In practical terms this may mean that, if indoor pollution caused by economic development is reduced, there will be less income lost due to illness and there will be fewer medical costs borne by the health sector, so the savings to society are expected to be significant. In Timor-Leste these financial benefits have been estimated to be around USD 13 million per year. This equates to 1.4% of the gross national income or 3.5% of gross domestic product. Similarly, the cost of illness and premature death on the island (equivalent to 5% of gross domestic product) caused by poor sanitation and scarcity of access to clean water is borne by the health ministry but is caused by lack of action by local governments[227].

Inadequate attention to sewage can have disastrous consequences. Boracay, the Philippine island tourist haven, underwent rapid development followed by pollution from inadequate sewage treatment. In 2018, the Philippine president closed the island to tourists for six months to rectify the problem, resulting in significant job stress[228]. This is a reminder to SIDS governments about the high cost of inaction in terms of lost economic opportunities, and the need to plan for adequate waste management infrastructure as part of local economic development strategies and plans.

Further examples of the financial impacts of inaction are found in an extract from the Global Waste Management Outlook in **Table 6.1**.

Table 6.1 Financial effects of substandard waste management practices on selected SIDS[229]

SIDS	Impact	Financial implication	Cost (USD/capita/year)	Ministry to bear the cost
Palau	Health	Increased cost of pharmaceuticals, hospital time and lost labor productivity	36	Health Ministry
Palau	Fisheries	Land-sourced pollutants causing water pollution which cause loss of near shore fish catch	4.5	Economic Development Ministry
Palau	Beach pollution	Solid waste and marine litter requiring clean up	50	Health Ministry
St Lucia	Health	Increased cost of public health risks and damage to health	16	Health Ministry
St Lucia	Tourism	Loss of aesthetic value. Effects on tourism and residents, based on willingness to pay for preservation of the environment	156	Tourism Ministry, local governments
Trinidad and Tobago	Health	Increased cost of public health risks and damage	17	Health Ministry
Trinidad and Tobago	Tourism	Loss of aesthetic value. Effects on tourism and residents, based on willingness to pay for preservation of the environment	2	Tourism Ministry, local governments

[227] Timor-Leste (2012)
[228] Villamor (2018)
[229] United Nations (2015a)

The Global Waste Management Outlook demonstrates that action is cheaper than inaction, with an indication that action to achieve proper waste management is of the order of USD 5 to USD 7 per capita per year while inaction costs reach USD 20 to USD 50 per capita per year[230].

There are a variety of methods for calculating the economic impact of pollution including: abatement costs (the cost of cleaning up pollution); market price (the value of goods or services where they already exist); and willingness to pay (surveying people on how much they would be willing to pay for a cleaner environment). Understanding and publicizing the impacts of substandard waste management practices as well as coupling with tools that prohibit and/or make undesirable practices costlier can be powerful approaches in achieving both political and public buy-in for waste minimization strategies.

6.2 Financing Waste Management Initiatives

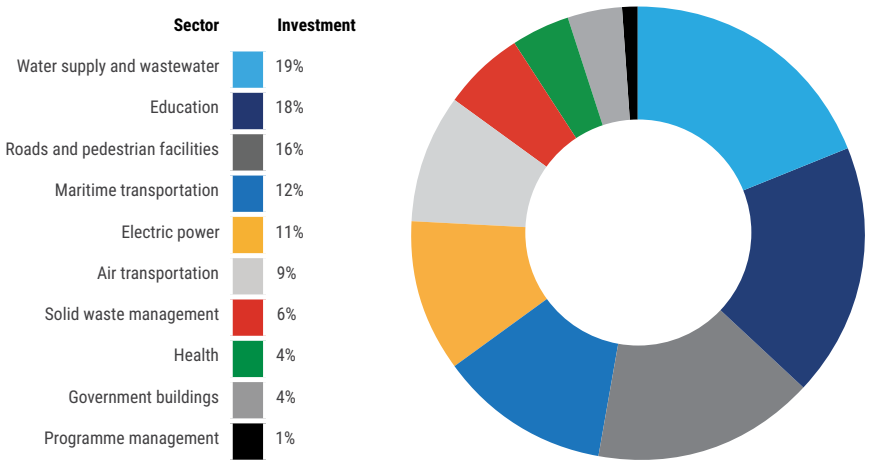
Waste management programmes compete with other government priorities, such as education and health projects, to receive financing. In addition, viable business models are needed to attract investment in waste management initiatives. Sound waste management will always be at a financial disadvantage compared to unregulated dumpsites. So in making waste management initiatives attractive to potential investors, there is a linkage here with government policies, strategy, and regulations, as well as with the ability to secure guaranteed fees and product take-off prices. Therefore, the decision to invest in waste management projects inevitably depends on those projects' rate of return, as well as societal and environmental benefits. A variety of sources can provide means to fund waste management programmes, including international finance, private sector participation and community contributions. In addition, incomes from pricing mechanisms (i.e. local fees from waste handling and/or landfilling) can be ring-fenced for investments in waste management improvement projects.

Ensuring adequate finance to sustain waste management activities is a significant issue for SIDS. For example, in Yap (Federated States of Micronesia), operational funding for its solid waste programmes, provided through the Compact Association Fund with the USA, will end in 2023. Thus major short-term issues for Yap are (1) deciding whether to pursue only a limited number of its current waste management initiatives beyond 2023, or whether to instead aim at continuing all its waste management programmes beyond 2023, and (2) identifying and mobilizing new funding sources to sustainably continue the chosen waste initiatives[231].

Countries typically operate with a medium- to long-term vision. For instance, the Federated States of Micronesia[232]determined that its overall country priorities until 2023 amount to USD 747 million, of which water supply, wastewater and solid waste will receive 25% of the total infrastructure budget until 2023 (**Figure 6.1**). This shows that the infrastructure to manage liquid and solid wastes has a prominent role in investment in the Federated States of Micronesia.

[230] United Nations (2015a)
[231] Marmar (2017)
[232] Federated States of Micronesia (2010b)

Figure 6.1 Planned infrastructure investment priorities for the Federated States of Micronesia until 2023[233]



Typically, countries will combine financing means to support waste management initiatives with a combination of government and international finance. For example, in its 2017–2018 budget, the Tongan government funded measures for promoting waste minimization in schools, community composting and coordinating persistent organic pollutants (POPs) through the use of international funding and use domestic funding for public awareness and education for its "Clean Green Tonga" campaign. Tonga is also a participant in the Pacific Hazardous Waste Management Project (PacWaste) and the second phase of the Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries (J-PRISM II) consortiums dealing with hazardous waste and capacity building[234].

6.2.1 Economic Instruments for Public Revenues

Improved resource recovery can be aided by the use of economic instruments for waste collection or transportation, or economic instruments that also promote the diversion of waste from landfills. A key component for successful implementation of economic instruments is collaboration between the regulators and those being regulated.

> ***For the waste sector this collaboration entails the engagement of national and local governments with local manufacturers, importers, retailers and waste managers to achieve an effective waste management system***

[233] Federated States of Micronesia (2010b)
[234] 'Akauola, Siale, Malakai Sika and Mafile'o Masi (2017)

Table 6.2 summarizes some of the more common market-based economic instruments and the key conditions for their successful implementation.

Table 6.2 Selected market-based economic instruments and key conditions for their success[235]

Instrument	Description	Example	Regulators' activities	Conditions for success	Strengths	Weaknesses
Charge system	• Fees set up for accessing waste activities	•Curbside collection fee • Drop off charge for waste at transfer stations	• Set up clear rules • Collect revenue	• Availability of pollutant monitoring data • Compliance enforcement • Very high institutional integrity	• Charges proportional to pollution	• Complex coordination needed for different pollution sources • Costly to monitor and enforce
Deposit refund schemes	• Monetary deposit, typically on containers when sold, that is refunded when containers are returned	• Container deposits	• Set up clear rules • Collect revenue • Set up simple and consumer-friendly system for refund	• Charging at point of sale and refunding at recycling point • Participation by community	• Low legal, institutional and political barriers • No monitoring need when voluntary	• Difficult to enforce when voluntary • High set-up cost • Lack of management transparency
Taxes	• Taxes and charges imposed on goods that cause pollution	• Waste levy (national or local)	• Set up clear rules • Collect revenue	• Compliance enforcement • Very high institutional integrity	•Can cover multiple sources of pollution • No need to identify abatement level • Works even without monitoring data • Easily managed • Generates revenue	• Does not always incentivize adoption of abatement technologies • May affect non-targeted activities • Political agreement difficult
Subsidies	• Given to non-polluting goods to encourage producers and consumers to choose goods that have more desirable environmental impacts	• Tax breaks and rebates	• Set up clear rules	• Monitoring data is vital • Compliance enforcement	• Incentive to drive a system change	• Taxpayer bears part of the pollution cost

Charging systems are normally imposed by national or local governments and often based on the weight or volume of waste. The advantage of a national system is that it is consistent for all players, whereas local charges can result in driving down charges, as industry stakeholders can threaten to move to areas charging less. A more successful charging system, from a waste management perspective, tends to be one that separates out the funds collected for reinvestment into the waste management system, rather than just being absorbed into the general funds.

Charging systems that have been introduced in the Pacific region include prepaid bag waste collection systems and tipping fees at local landfills. Financing through prepaid bags has been instituted in major centres in Vanuatu and Kiribati. However, a condition for a successful charging system is enforcement. Although Jamaica has tipping fees, they are not enforced so Jamaica funds its waste collection services from property taxes and national government grants[236].

[235] United Nations Environment Programme (2017)
[236] Riquelme, Mendez and Smith (2016)

Deposit refunds are most often for beverage containers and can be quite successful in increasing the diversion from landfill while providing income and jobs. The Kiribati container deposit scheme pays out to the consumer 80% of the deposit when the containers are returned, leaving 20% to run the system. Similar mechanisms operate in the states of Yap and Kosrae in the Federated States of Micronesia[237]. For the system to be successful, collection and storage need to be efficient and secure from vermin and potential thieves. Alongside the collection system, an efficient and simple accounting system needs to be incorporated. Deposit refund systems can provide side benefits. For example, Barbados' Returnable Containers Act (1987) resulted in the establishment of container deposits for all beverage containers with the fees collected generating high rates of return[238]. The community was engaged and directly benefitting and at the same time, the return scheme contributed to reduce the litter problem on the island.

Taxes can come in a variety of guises. A popular method of collecting funding for waste management activities is in the form of **flat fees**. One option is to collect the fee through local government rates, as in Samoa. An alternative is found in Tonga, where a flat waste fee is collected through the electricity bill[239]. In addition, women's community groups in Tonga gather waste collection fees in each village. The groups are given the flexibility to decide how to collect the fees and forward the fees (minus a 10% commission) to the Waste Management Authority[240]. This provides funding to run the waste management system.

A variation of the flat waste fee is found in Grenada which uses a **partial subsidy system** by adding a waste levy as a surcharge to the electricity bill based on electricity consumption bands. This allows the more wealthy consumers to subsidize the poorer ones. No fees are charged for those using up to 100 kWh. Fees are charged to those using 100 to 150 kWh and still higher fees are charged to those with electricity consumption greater than 150 kWh. These fees subsidize between 16% and 21% of the waste management costs. Another measure used in Grenada is to charge the importer of white goods[241] an environmental levy at 1% of the cost, insurance and freight value. This levy alone generates 39% of the waste authority's revenue[242].

However, in some countries where fees added to other utility bills have been introduced, people have taken a selective approach to paying their electricity bill by only paying the utility portion to ensure they keep their supply, while ignoring the waste management portion. The selective nature of the payments makes it difficult for the waste collection services to accurately target the non-payers.

Targeting **specific users** of waste management systems through taxation is a way to pay for services that locals cannot afford. This is particularly the case for SIDS that receive large numbers of tourists in comparison to the numbers of locals. Several Caribbean SIDS have instigated small environmental levies on tourists (USD 1.50), which generate between 12% and 40% of the operating revenue for waste management of those SIDS. This is seen as a circular action in which a properly managed waste management system attracts more visitors, which then generates extra revenue from the levy[243]. An alternative is to attach a levy on waste generation, based on volume or weight. This method operates as a behaviour control mechanism – the more waste a person (or company) generates, the more that party must pay to manage it. A decrease in the amount of waste means that there is less income, but also less to manage.

[237] Secretariat of the Pacific Regional Environment Programme (2006)
[238] Barbados (2010)
[239] Sagapolutele (n.d.)
[240] Secretariat of the Pacific Regional Environment Programme (2006)
[241] White goods" are large, heavy consumer goods such as air conditioners, refrigerators, stoves, etc. that used to be finished only in white enamel.
[242] Secretariat of the Pacific Regional Environment Programme (2009a)
[243] Decretariat of the Pacific Regional Environment Programme (2009a)

Taxes on cruise ship passengers to create funds to manage waste generated by cruise ships have been generally resisted by cruise ship operators in the Caribbean as SIDS compete to attract tourists. Cruise ship operators have significant influence since, if one island does not perform as expected, there is another nearby island that is ready to meet their demands[244]. A regional or SIDS-wide approach to address this issue might be beneficial.

Regulatory mechanisms are often used to send signals to the market place. For example, in Mauritius, a levy on plastic bags drastically reduced the number of waste plastic bags, and its Environmental Protection (Plastic Carry Bags) Regulations of 2004 stipulated these types of bags must be degradable within 12 months[245]. Fiji reduced its fiscal duty rate on paper bags, sacs and biodegradable bags while calling for a ban on imported plastic bags[246].

Subsidies are often used to present a new amenity or innovation, or for providing social or environmental benefits, but may not be economically sustainable. Subsidies are commonly provided for a short-term purpose until economic sustainability is reached. The aim of their introduction should be to facilitate the activity becoming self-supporting. Prior to introduction, a **survey of market conditions** should be undertaken to gauge the effects that the subsidy would have on the market and current operators. For example, the Cook Islands used a subsidized scheme provided by the New Zealand government in a tripartite arrangement in which the two governments and private industry were partners. New Zealand funded an excavator and truck and subsidized freight costs to remove legacy scrap metal (both ferrous and non-ferrous). Private industry provided training and funded the purchase and operation of a guillotine and a metal compactor. This enabled recycling of 12 container loads of scrap metal annually[247].

Another example of how subsidies work is given by Trinidad and Tobago. A local fund (the Trinidad and Tobago Green Fund, derived from a 0.3% tax on businesses' gross income)[248] provides 90% of the finance for developing a system for collecting, recycling and safely disposing of lubricating waste oils, with the other 10% coming from the Basel Convention Regional Centre for Training and Technology Transfer for the Caribbean[249].

Boosting jobs and exports through subsidies can be beneficial to SIDS. The Federated States of Micronesia provides a tax concession for income derived from the export of recyclable materials[250].

Some countries use a **combination of public revenue methods**. The Barbados Sanitation Service Authority generates revenue from equipment hire and dead animal collections. Additional funding comes from national government to bridge the fiscal gap. Other SIDS like the Bahamas, Trinidad and Tobago, Haiti, Suriname and Guyana use a mixture of national and local government funding obtained through the general taxation system. However, in most cases relying on generic national and local revenue sources does not guarantee sufficient funding flows to implement waste services or improvements programmes[251].

[244] United Nations Environment Programme (2016b)
[245] Mauritius (2010)
[246] Secretariat of the Pacific Regional Environment Programme (2009a)
[247] Secretariat of the Pacific Regional Environment Programme (2009b)
[248] PWC (2017)
[249] Khan (2017)
[250] Secretariat of the Pacific Regional Environment Programme (2009a)
[251] Riquelme, Mendez and Smith (2016)

6.2.2 International Finance

International funding agencies have played a crucial role in supporting waste management projects, which can be catalysts for other benefits in the community. For example, Jamaica has seen a targeted decrease in crime as a result of a World Bank results-based financing programme and waste management infrastructure investments in 18 communities. The reduced crime rate was due to job creation in those communities. The results-based component provided financial incentives for environmental wardens and community-based organizations, provided that the separated recyclables and organics met a specified weight and the communities met a cleanliness requirement[252].

A summary of the larger projects in the **Pacific region** is shown in **Table 6.3**.

Table 6.3 International funding sources in the Pacific region[253]

Funding source	Programme	Amount (USD)
European Development Fund	Pacific Hazardous Waste Management Project (PacWaste)	9.5 million
Global Environment Facility and UN Development Programme	Implementing Sustainable Water Resources and Wastewater Management in the Pacific Island Countries	10.7 million
Global Environment Facility and the Pacific Alliance for Sustainability	Pacific Persistent Organic Pollutant (POPs) Release Reduction through Improved Solid and Hazardous Wastes Management	9.5 million
French Development Agency (Agence Française de Développement)	Regional Solid Waste Management Initiative	1.4 million
International Maritime Organization	Integrated Technical Cooperation Programme	0.7 million (in 2016)
Japan International Cooperation Agency (JICA)	43 projects (see Annex 2)	124.9 million

One method of building capacity is utilizing inter-country expertise for projects. For example, the Naboro sanitary landfill in Fiji, an anaerobic system, was funded by the European Union, administered by the local Department of Environment and maintained by the New Zealand company H.G. Leach Ltd[254].

The **Caribbean region** has two development banks, the Caribbean Development Bank, concentrating on the eastern portion of the Caribbean, and the Inter-American Development Bank, covering most of the Caribbean as well as the rest of Latin America. The Inter-American Development Bank has funded 31 projects in solid waste management and wastewater projects that have been, or are, progressing since the start of this decade. Some of the wastewater projects also have water supply components. For simplicity, as they are dealing with water, they are counted under wastewater projects in **Table 6.4**.

[252] Burrowes (2017)
[253] Secretariat of the Pacific Regional Environment Programme (2016)
[254] Fiji (2010)

Table 6.4 Inter-American Development Bank-funded waste-related projects in the Caribbean[255]

Range	Medium	Contributions (million USD)		Total (million USD)
		Inter-American Development Bank	Local	
Regional	Solid waste	3.54	0.42	3.96
	Wastewater	18.11	17.5	35.61
Barbados	Wastewater	50	3	53
Belize	Solid waste	26.2	4.26	30.46
	Wastewater	5.5	5	10.5
Haiti	Solid waste	2.04	0.56	2.60
	Wastewater	19.9	21.7	41.6
Suriname	Solid waste	0.15	0.33	0.48
Trinidad and Tobago	Solid waste	0.18		0.18
	Wastewater	297.25	0.06	297.31
Total		**422.87**	**52.83**	**475.7**

In the period since 2010, it can be seen from **Table 6.4** that the Inter-American Development Bank has allocated almost USD 423 million to waste projects in the Caribbean, representing 89% of the funding for the projects. The funding has been a mixture of grants and loans. Most of the projects that have been 100% funded by the Inter-American Development Bank addressed human capacity building or scoping projects while the infrastructure-building projects have had contributions from the countries benefitting.

The Caribbean Development Bank engaged regional water and waste management specialists and partnered with the Caribbean Water and Wastewater Association in 2016 to build capacity in delivering clean water across the Caribbean[256]. The bank has also funded an integrated waste management project in Grenada to a value of USD 11 million to cover the supply of equipment, action plan development, an awareness building programme for appropriate waste management practices and further development of the Perseverance Landfill[257]. Other projects funded by the bank over the last few years covered a recycling project in Grenada, sanitation in Haiti and Antigua and sewage in Grenada.

Funding from the European Union through EuropeAid has benefitted waste management in several of the Atlantic, Indian Ocean, Mediterranean, and South China Sea region SIDS. Examples are shown in **Table 6.5**.

[255] Inter-American Development Bank (2017)
[256] Caribbean Development Bank (2016)
[257] Caribbean Development Bank (2015)

Table 6.5 EuropeAid-funded waste-related projects for Atlantic, Indian Ocean, Mediterranean, and South China Sea region SIDS[258]

SIDS	Year(s)	Programme	Amount (USD)
Comoros	2012-13	Municipal development projects improving services to the population with particular attention to solid waste management	466,000
Maldives	2007-13	Development of sustainable infrastructure and services including safe water, renewable and efficient energy, waste disposal, and the protection of coral reefs	9.3 million
Maldives	2014-18	Adaptation to climate change by funding "the introduction of waste management and recycling techniques also serving energy efficiency, while using local development mechanisms and taking social inclusion into account"	4.5 million
Mauritius	2013-14	Consultancy services for the elaboration of policies, strategies and action plan for electronic waste (e-waste) management	90,000

The 2014 project in the Maldives also touches on other elements of the SDGs. This suggests that the focus of significant funders like the European Commission are taking a more holistic perspective as a result of the adoption of SDGs.

6.2.3 Public-Private Sector Engagements

One of the most common ways for governments to interact with the private sector is through **contracting**. Most governments are familiar with purchasing goods or services through the process of procurement and tendering[259], where breaches of contracts are normally dealt with through set procedures.

Another form of private sector engagement is the so called **public-private partnership (PPP)** model, in which governments (local or national) share the risk and develop medium to long-term relationships with private entities for the delivery of a service. There are many possible variables, but public-private partnerships tend to require more active and collaborative relationships than traditional contracting. One of the significant issues with public-private partnerships is that of getting the appropriate governance structures in place. Guidance on this can be found in the Guidebook on Promoting Good Governance in Public-Private Partnerships[260]. Although research has concluded that this model may not be better than other traditional contracting models[261], public-private partnerships could still represent an opportunity for SIDS[262], particularly in relation to infrastructure planning and improvement.

[258] European Commission (2018)
[259] Public tendering entails awarding contracts based on a set of criteria, public announcement notice and monitoring of deliverables.
[260] United Nations Economic Commission for Europe (2008)
[261] Soos, Whiteman, Wilson et al. (2013)
[262] High-Level UN Conference for SIDS in Aruba (March 2016) http://www.sids2014.org/index.php?page=view&type=12&nr=266&menu=1601

7. TECHNOLOGY

Analysis has shown that reducing waste generation can save municipalities in SIDS between USD 35 and USD 400 per tonne, depending on the location of the waste prevention activity and the technologies used to handle the waste[263]. A key part in the identification of suitable technologies is assessing whether they can serve as sustainable, environmentally sound solutions. This chapter presents some useful tools to be used for the selection of the most appropriate environmentally sound technologies for waste management and considers the most common technologies used by, and suitable for, SIDS along the waste value chain.

KEY MESSAGES

The following are the key messages regarding issues and opportunities for waste management in SIDS:

1 Before technologies are purchased a thorough assessment process is needed including:

- Addressing government's key needs as well as local operational **requirements**
- The financial viability of technologies, their cost/benefit, and policy levers that can **facilitate deployment**
- An **assessment process** that includes screening, scoping and detailed assessment involving a wide range of stakeholders
- Quantitative procedures to consider **varying scenarios**
- Look at how the proposed technology **affects the waste system** rather than just the efficiency of the technology itself
- The ability of **local people** to maintain and operate the technology
- Placing importance on information **expertise** and **stakeholder participation**

2 Environmentally sound technologies may be applicable for:

- **Waste collection and transfer**
- **Composting and biogas**
- **Incineration**
- **Landfills**
- **Hazardous waste treatment**
- **Wastewater**

[263] United Nations Environment Programme (n.d.)

7.1 Selecting Environmentally Sound Technologies

The UN Environment International Environmental Technology Centre (IETC) has focused on assisting national and local governments, environmental organizations and other stakeholders, especially in developing countries, in assessing and selecting appropriate environmentally sound technologies (ESTs) for sustainable waste management processes.

It is critically important to conduct a careful assessment of the appropriateness of technologies within the local context before moving into implementation. In line with the Sustainability Assessment of Technology (SAT) methodology[264], considerations of appropriateness should include:

- An examination of whether or not the technology addresses the government's strategic needs as well as local operational requirements;
- A progressive process of criteria setting, screening, scoping and assessing in detail technologies, involving a wide range of stakeholders to provide a realistic analysis of implementation outcomes;
- Financial and economic modeling to allow for an objective and long-term impact assessment. Sensitivity analysis results should be studied for differing scenarios;
- An examination of how the technology works as part of the waste system, as opposed to an examination of the individual technology on its own, outside of the local context;
- An assessment of the ability of the local authorities and people to operate and maintain the technology;
- An assessment of potential risks and unintended consequences linked to the introduction of the technology, along with associated mitigation and remediation measures; and
- Emphasis on developing expertise and ensuring stakeholder participation.

The tools and resources in **Table 7.1** can be of assistance in evaluating different technological options and selecting the solution that is most suitable for each SIDS.

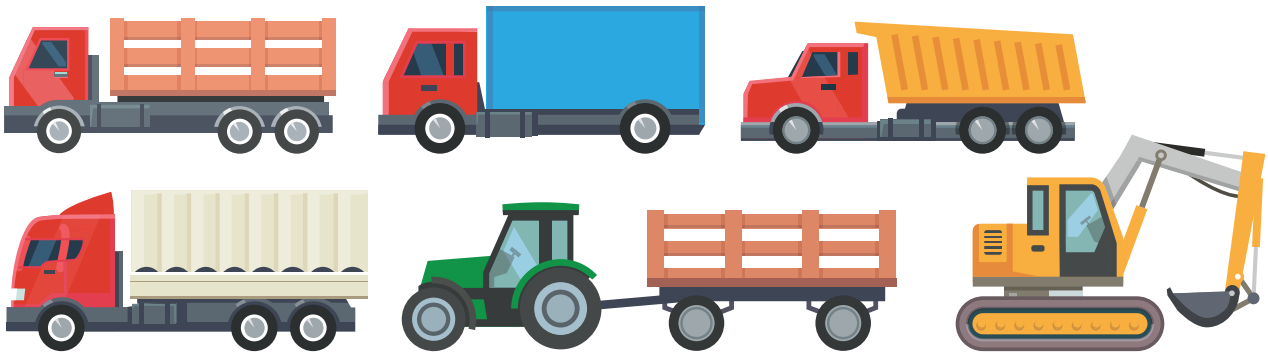
Table 7.1 Tools to assist in evaluating waste-related technologies

Name of resource	Short description
Application of the Sustainability Assessment of Technologies Methodology: Assessment Guidelines[265]	Methodology for the sustainable assessment of technologies
Environmentally Sound Technologies for the Integrated Management of Solid, Liquid and Hazardous Waste for Small Island Developing States(SIDS) in the Pacific Region[266]	Technologies for managing hazardous waste
Converting Plastic into a Resource[267]	Technologies for managing waste plastic
Recycling Used Tyres[268]	Technologies for managing waste tyres
Treatment and Disposal of Healthcare Waste[269]	Methodologies for managing healthcare waste
Converting Waste Agricultural Biomass into a Resource[270]	Technologies for managing waste biomass
Recycling and Destruction of Used Oils[271]	Technologies for managing waste oil
Assessment and Management of E-Waste[272, 273]	Methodologies for managing waste electronics

[264] United Nations Environment Programme (2012a)
[265] United Nations Environment Programme (2012a)
[266] United Nations Environment Programme (2002)
[267] United Nations Environment Programme (2009a)
[268] United Nations Environment Programme (1999)
[269] United Nations Environment Programme (2012b)
[270] United Nations Environment Programme (2009b)
[271] United Nations Environment Programme (2012c)
[272] United Nations Environment Programme (2007a)
[273] United Nations Environment Programme (2007b)

7.2 Collection and Transfer

Waste collection systems tend to be developed in an ad hoc fashion, with new routes being added as the necessity arises and vehicle availability allows. The vehicles most commonly used on SIDS for their versatility are tractor and trailer units, conventional trucks, and highside open-top trucks[274]. These vehicles often have to travel considerable distances over difficult roads to collect the small quantities of waste that are often widely dispersed as in, for example, Fiji[275]. Manual loading of vehicles is common due to trucks' lack of mechanical complexity.



Ideally **collection vehicles** should be chosen based on the minimum energy needed and the least technical complexity to enable efficient operations. Vehicles which rely on local expertise to maintain and readily available parts should be preferred. For small settlements and hilly countries, light vehicles provide the most practical means of collection. This could also be an opportunity to utilize informal sector collectors as a more integral part of the overall collection programme.

Systems for **waste bins** vary across SIDS. One common system is to use roadside bins. In Male (Maldives), 80% of the roadside bins have been removed due to odour and aesthetic issues[276]. In the Seychelles, although over 60% of the waste is biodegradable, it is mixed with other forms of waste and deposited in 240 L bins (provided by the waste contractor), located in public sites[277]. The Suva City Council (Fiji) provides about 28 skip bins at informal settlements and council facilities, which are then collected regularly[278]. An example of low cost efficiency improvement due to a combined system for waste bins and roadside collection is found in Chuuk State, Federated States of Micronesia, as shown in **Box 7.1**.

[274] United Nations Environment Programme (2002)
[275] Asian Development Bank (2014e)
[276] Maldives (2010)
[277] Martin (2010)
[278] Asian Development Bank (2017)

Box 7.1 Horn Collection System, Chuuk State, Federated States of Micronesiaa

The Horn Collection System in Chuuk, Federated States of Micronesia (so named because of the horns sounded by collection vehicles announcing their arrival) requires residents to bring their waste outside for collection. This system has greatly improved the efficiency of waste collection services around the island. From the pilot village of Mwan, the system has been extended to six other villages.

The Horn Collection System is supplemented by providing locally made metal bins in commercial areas. Through the combination of improved collection and the bins system, littering has diminished greatly. Chuuk's Horn Collection System is one of the components of the "Sia Numeti Chuuk" Project created to address the waste issues in the State of Chuuk. The project was made possible through collaboration among the Environment Protection Agency, the Department of Transportation and Public Works and the Chuuk Women's Council.

For small island states, a simple system such as this creates a huge impact considering the limited resources and capacity to address waste issues.

(Chuuk State Environmental Protection Agency, Federated States of Micronesia)

Bins for recycling materials are increasing in frequency. The Majuro-Atoll Waste Management Company (Marshall Islands) distributed to the village of Jenrok recycling bins which are collected regularly[279]. In a programme in Mauritius all 293 primary schools have labelled bins for collecting plastic bottles and paper waste, and compost bins for green wastes. In addition, the Curepipe Municipal Council has placed street litter bins at eight strategic sites and special container bins in all supermarkets within the town for the separate collection of plastic, paper and cans[280].

Scavenging animals can be a problem for municipal solid waste. In Fiji, Papua New Guinea, and Samoa, raised **waste storage** platforms seem effective in keeping scavenging animals away from municipal solid waste. The platforms range from flimsy wooden structures to properly manufactured steel structures on which bins are placed. Timor-Leste uses a system of brick storage facilities to store municipal solid waste, which has to be transferred to smaller containers for uploading to collection vehicles[281].

Separation of waste before sending it to a disposal site provides job opportunities as well as making downstream recycling and treatment technologies (e.g. biodigesting) more viable. Separation is most often done using a **tipping floor** which is quite efficient for small volumes of waste[282] and can achieve significant diversion. For instance, in Barbados, development of a combined transfer station and materials recovery facility that separated construction and demolition waste, green waste, wood pallets, plastics, glass and metals resulted in only 30% of the waste going to landfill[283]. An alternative is at-source separation, which requires significant buy-in from consumers to separate their waste before disposal.

[279] Marshall Islands (2014)
[280] Mauritius (2011)
[281] Asian Development Bank (2014e)
[282] United Nations Environment Programme (2002)
[283] Riquelme, Mendez and Smith (2016)

7.3 Composting and biogas Technologies

Separation of organic waste in SIDS can provide significant benefits. The most suitable composting technologies for SIDS are the **backyard composters** (family-based) and **windrow systems**[284] used to generate field fertilizer[285]. A few successful examples of awareness programmes are found in Mauritius[286]. Through a school programme, children learn how to compost and sustainably fertilize the school gardens. The programme is also used to train children in how to separate organics from other recyclables. More broadly, the local authority of Curepipe (Mauritius) set up a composting plant in the botanical garden, coupled with a visitor's centre to educate the public on the importance of sorting and composting[287].

An example of a successful home composting programme is found in Fiji, as shown in **Box 7.2**

Box 7.2 Fiji's Home Composting Programme

Organic waste in Fiji accounts for 60 to 70% of the nation's waste stream, and in some Councils like Lautoka, about 20% of the local budget is spent on waste management.

The Home Composting Programme in Fiji started in 2008 with the objective of separating and composting at the household level a minimum of 20% of the organic waste generated.

Separating and composting organic waste close to its source contributes to the reduction of waste collection services, prolongs the life of the landfill and reduces leachate generation, odour and flies.

The locally made composters (made of plastic and sold to families together with a user's manual) were sold to households at a subsidized rate of USD 15 to USD 20, depending on Council policy. The main challenge, even after extensive media campaigns, was to convince and motivate the community to segregate organic wastes from general wastes. Those who participated received technical advice and regular monitoring. Around 385 Lautoka households use compost bins and an average of 107 g per person per day of organic waste is composted. From the monitoring results it is noted that all composters sold are well-managed, the amount of kitchen waste collected considerably decreased and households in the community started backyard gardening using the compost. In addition, the practices of illegal dumping and backyard burning decreased.

The pilot home composting proved very effective and even exceeded the original target of a 20% reduction in household-generated organic wastes (currently 25%). Based on this success story, Nadi Town Council and Lautoka City Council have adopted the promotion of home composting as a core activity in their Solid Waste Management Master Plans and intend to maintain the promotion of the community-based programme.

The Home Composting Programme in Fiji is implemented through the Japan International Cooperation Agency (JICA)-funded Waste Minimization and Recycling Promotion Project.

(Nadi Town Council and Lautoka City Council, Fiji)

An alternative way to treat organic waste is by converting it into energy. **Biogas digesters** help transform bio waste into energy, reducing odours and allowing for methane emissions capture. Biogas digesters reduce the flow of nitrates to groundwater which, if in sufficient concentrations, can cause "blue baby" disease[288] as well as leachates that contain a high biochemical oxygen demand[289]. The breakdown of organic waste (agricultural waste, manure, kitchen waste, plant material, sewage, etc.) by anaerobic fermentation in a digester (air-tight tanks or drums) produces mostly methane gas that can be used in cooking or heating, run motor vehicles and generate electricity. The residues after the digestion process can even be used as fertilizer.

[284] Windrow systems: Compost is produced by piling Organic wastes or biodegradable waste in parallel rows. Temperature in the rows will rise due to biological activity and the piles are turned periodically to improve porosity and oxygen levels. The compost generated through windrow systems can be used to enrich soils.
[285] United Nations Environment Programme (2002)
[286] Mauritius (2011)
[287] Mauritius (2011)
[288] Casland, Trautmann, Porter and Wagenet (2012)
[289] Asian Development Bank (2014e)

Belize, in the Caribbean Region, is investigating biogas utilization as shown in **Box 7.3**

Box 7.3 The Potential Use of Biogas in Belize

The Belize Ministry of Energy, Science & Technology and Public Utilities is investigating the feasibility of establishing a biogas plant in the country.
In 2015, the Caribbean Community Climate Change Centre introduced a mobile biogas laboratory at the University of Belize. The facility conducts tests on locally supplied feedstock (consisting mostly of easy to harvest biomass, manure and organic waste) for potential biogas production.
Belize currently does not have a modern biogas industrial facility but on a smaller scale, some livestock farmers and rural households in Belize have small-scale domestic biogas plants.

(Michael F. Somerville, Environmental Scientist)

7.4 Incineration Technologies

Incineration is a method often carried out in SIDS by either human- or auto-ignition of family or community dumpsites. This type of waste burning at low temperatures and open burning waste releases carcinogens and other harmful substances into the atmosphere, affecting both human health and the environment, as well as contributing to climate change[290]. More formalized incineration, as an alternative to landfilling, tends to be carried out in densely populated countries such as Singapore where about 91% of waste is incinerated in high technology incinerators[291]. Small-scale **high-temperature incineration** for medical waste is gaining popularity in Pacific SIDS. For example, the PacWaste project has installed reliable healthcare waste incinerators in Kiribati, Tonga, Tuvalu and Vanuatu which are easy to operate and maintain[292].

The introduction of incineration technologies can require fundamental changes to municipal spending patterns. For example, in Bahrain, the introduction of a **waste-to-energy plant** was estimated to cost between 0.12% to 0.18% of gross domestic product if averaged over 25 or 10 years respectively. In addition, to make the waste-to-energy plant viable, waste management spending on diversion from landfill would need to more than double[293]. Waste incineration, even when producing energy, is a controversial issue. While (primarily) technology companies promote the virtues of waste-to-energy, the installation of a plant is a long-term commitment that requires sufficient quantities of high-calorific waste (e.g. paper and plastics – which also are the most economically viable recycled materials) to make the system economic. This need precludes the possibility of reducing waste over time, something which is contrary to circular economy thinking.

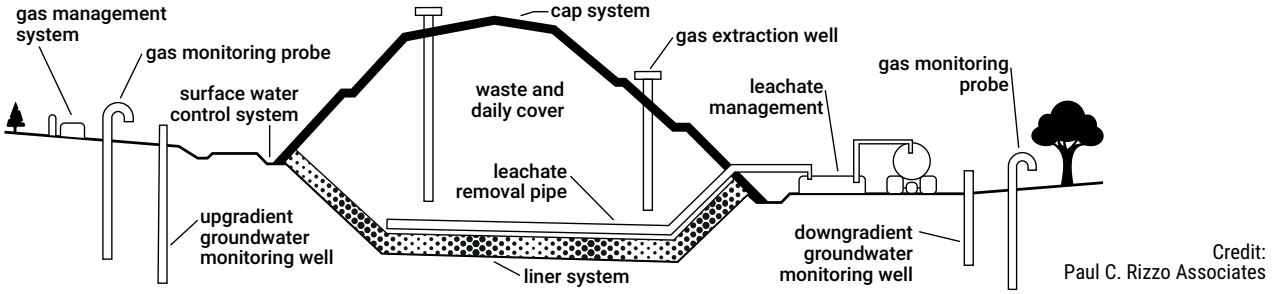
[290] Asian Development Bank (2014e)
[291] Singapore (2010)
[292] Inciner8 (2016)
[293] El-Karawy (2017)

7.5 LANDFILL TECHNOLOGIES

Solid waste disposal presents a continuing challenge for SIDS, with the most common option being dumping as noted in section 1.3.1. A slight improvement on such dumps is **controlled dumps** in which, among other measures, there is some degree of grading, draining and fencing in site preparation and partial leachate management[294]. Examples of operational controlled dumps can be found in Mauritius[295] and Fiji[296]. Belize has undertaken an active programme to upgrade its controlled dumps[297].

At the other end of the scale are **sanitary landfills** which have an impervious liner, leachate control systems, cover material and may have landfill gas capture. Sanitary landfills are costly operations to set up and require skilled people to operate and maintain them. Examples of this sort of landfill are found in all three SIDS regions in countries such as Barbados[298], Singapore [299] and Fiji[300]. An example is shown in **Figure 7.1**.

Figure 7.1 Typical schematic of a state-of-the-art landfill[301]



Landfill gas capture systems are among the most effective ways to mitigate climate change impacts from the waste sector. These systems in fact help reduce the amount of greenhouse gas and short-lived climate pollutants (especially methane) emissions generated by landfills. An example of landfill gas capture is demonstrated by Belize City as shown in **Box 7.4**.

Box 7.4 Belize Sanitary Landfill Gas Capture

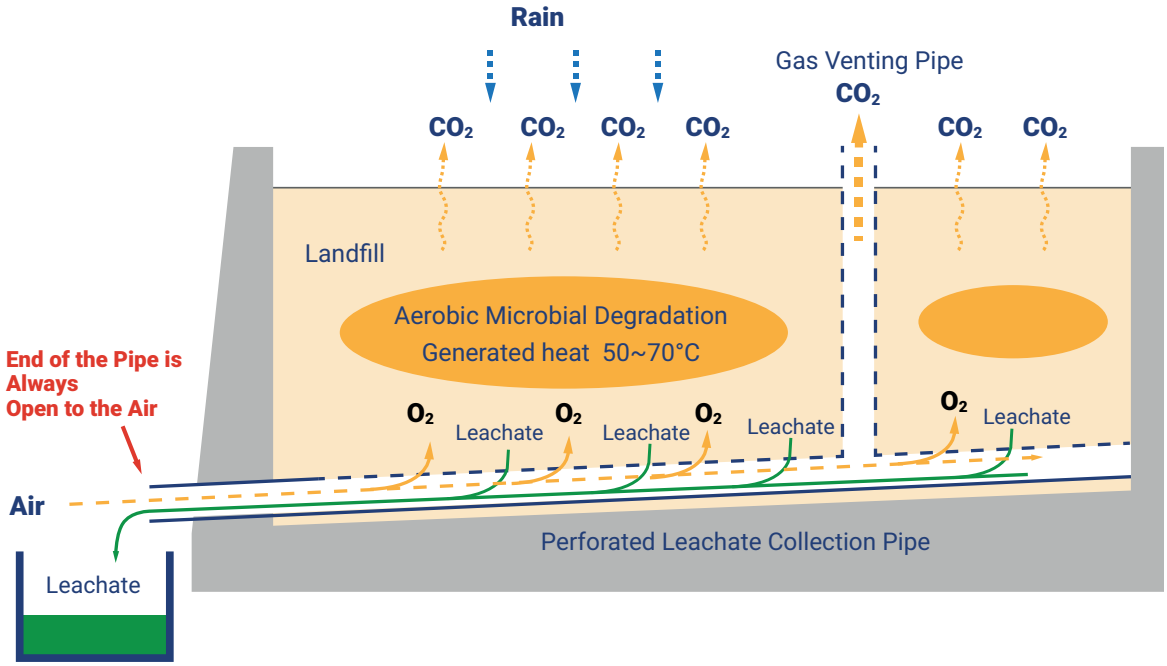
Methane gas, produced when anaerobic bacteria decompose organic waste from landfill sites, can be captured and used in cooking and heating, to run motor vehicles and to generate electricity. Although landfill gas is not considered a renewable energy source, projects that utilize it help to reduce methane emissions into the atmosphere. The Mile 24 Sanitary Landfill in Belize is a Clean Development Mechanism registered project that captures and eliminates landfill gas through flaring (burning off the flammable gases to avoid buildup and subsurface migration). By capturing and flaring landfill gas, the facility helps to reduce global greenhouse gas emissions, and in turn earns certified emission reduction units (or carbon credits) that can be sold to industrialized countries to meet part of these countries' emission reduction commitments. The landfill gas produced at the sanitary landfill will eventually be used to generate electricity once sufficient waste is in place.

(Michael F. Somerville, Environmental Scientist)

[294] Asian Development Bank (2014e)
[295] Mauritius (2010)
[296] Fiji (2010)
[297] Belize (2016)
[298] Riquelme, Mendez and Smith (2016)
[299] Singapore (2010)
[300] Asian Development Bank (2017)
[301] Asian Development Bank (2014e)

A technology that is midway between dumpsites and sanitary landfills is the **semi-aerobic landfill** (Fukuoka method) which the Japan International Cooperation Agency (JICA) has assisted in installing in several of the Pacific SIDS[302]. This system may prove to be a more affordable option for SIDS than sanitary landfills. A schematic of the semi-aerobic landfill is shown in **Figure 7.2.**

Figure 7.2 Typical schematic of a semi-aerobic landfill: The Fukuoka method[303]



The Fukuoka method removes leachate through a network of perforated pipes embedded in the landfill, allowing air inflow. The leachate collection pipes are supplemented by vertical gas venting pipes. The collection pipe allows the air to flow naturally into the landfill allowing for aerobic conditions to reduce methane production.

Leachate management is an ongoing issue for SIDS. Many SIDS have no leachate management systems while others have simple ones. For instance, leachate collection in Palau is confined to simple leachate collection pipes draining leachate under gravity to a primary holding pond near the landfill[304]. A greater level of treatment is found in the Mare Chicose landfill (Mauritius) where leachate is collected through a piped system. The leachate is stored in ponds before being transferred by licensed wastewater carriers to a pumping station where screening and degritting take place before discharge to the sea[305]. Monitoring and maintenance are key for successful operations. For instance, in the Bikenibeu and Nanikai landfills on Kiribati, even when leachate management systems were installed, the leachate pumping systems became inoperable due to lack of maintenance[306].

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[302] Secretariat of the Pacific Regional Environment Programme (2016)
[303] Tashiro (2011)
[304] Asian Development Bank (2014d)
[305] Mauritius (2011)
[306] Asian Development Bank (2014f)

7.6 Treatment of Hazardous Wastes

The small quantities of hazardous waste generated in most SIDS render individual investment in treatment technologies unfeasible. One potential method for gaining critical mass is to work on hazardous wastes as a regional or subregional issue and consider how current supply lines could be used to most effectively attain that critical mass.

Sound management of hazardous wastes is critical to reducing the wastes' human health and environmental effects. The first option should be to formulate strategies to minimize the generation of hazardous wastes. For those hazardous wastes that remain, low-tech practices that can be adopted nationally include[307]:

- Separation into hazard classes;
- Sound public training on the need to separate and how to handle these substances;
- Frequent recycling and collection opportunities;
- Identification at the point of purchase with labelling and instructions for end-of-life;
- Adoption of take-back systems; and
- Adequate training for those working in hazardous waste facilities to reduce the risk of an emergency occurring.

A more detailed analysis of hazardous waste is found in section 4.1

[307] United Nations Environment Programme (2002)

7.7 Wastewater Technologies

Technologies for treatment and disposal of sewage are highly relevant for SIDS as discharge without treatment can result in significant human health and environmental effects. Sewage systems are often poorly constructed and inadequate for the populations they have to service, resulting in coliform contamination of surface and ground waters[308]. While larger municipal systems are the norm (where such systems exist), the Caribbean Council for Science and Technology has called for research into small-scale alternative sewage treatment systems including **solar aquatic treatment systems** and **systems for composting sludge** resulting from sewage treatment[309]. Alternatives to centralized systems are starting to be considered. The United States Virgin Islands Department of Planning and Natural Resources developed a handbook for **onsite sewage disposal systems** and constructed wetlands that were utilized by the Coral Bay Community Council to provide recommendations for wastewater treatment[310].

A combination of technologies is often effective depending on the local circumstances. An example is found in **Box 7.5**.

Box 7.5 Combination of Technologies: Water Supply and Wastewater Treatment in Papua New Guinea[311]

Methane gas, produced when anaerobic bacteria decompose organic waste from landfill sites, can be captured and used in cooking and heating, to run motor vehicles and to generate electricity. Although landfill gas is not considered a renewable energy source, projects that utilize it help to reduce methane emissions into the atmosphere.

The Mile 24 Sanitary Landfill in Belize is a Clean Development Mechanism registered project that captures and eliminates landfill gas through flaring (burning off the flammable gases to avoid buildup and subsurface migration). By capturing and flaring landfill gas, the facility helps to reduce global greenhouse gas emissions, and in turn earns certified emission reduction units (or carbon credits) that can be sold to industrialized countries to meet part of these countries' emission reduction commitments. The landfill gas produced at the sanitary landfill will eventually be used to generate electricity once sufficient waste is in place.

[308] Federated States of Micronesia (2010b)
[309] Caribbean Council for Science and Technology (2007)
[310] United States Virgin Islands, Coral Bay Community Council (2015)
[311] Papua New Guinea (n.d.)

(Photos by EMEECY (US Virgin Islands)

8. STAKEHOLDER ROLES

A critical component for successful implementation of waste management legislations and initiatives is to ensure cooperation between national and local government while recognizing the crucial roles played by the private sector, communities and the informal sector. In many SIDS, because of financial constraints, regulatory and operational functions are concentrated in a limited number of people and the persons responsible for these regulatory and operational aspects are often in the same department, giving rise to potential conflicts of interest. Only a few of the existing legislative instruments take this into account and split the critical roles between different government departments and stakeholders. Governments often lack the capacity for action in waste issues and are under-resourced. By identifying the key stakeholders and ensuring their appropriate engagement in initiatives through the clear distribution of responsibilities, governments can share the load and achieve far greater and more sustainable results.

An extract from the integrated waste management system of Bahrain (**Table 8.1**), shows an example of division of roles and responsibilities among stakeholder's groups.

Table 8.1 Waste management responsibilities in Bahrain[312]

Type of Waste	Responsibility
Domestic Some commercial Street cleaning Construction and demolition Treatment plant Agricultural wastes Askar Dumpsite	Ministry of Municipalities and Urban Affairs and five municipalities
Hazardous wastes Hafira Landfill Licensing of hazardous waste collection contractors Industrial waste Monitoring and control	Supreme Council for Environment, Directory of the Waste Management Department
Clinical waste	Ministry of Health
Hazardous waste	Bapco hazardous waste landfill
Recovery of scrap metal Used oil Paper Plastics Waste electrical and electronic equipment exporting	Civil society organizations
Wastewater	Ministry of Public Works

[312] El-Karawy (2017)

KEY MESSAGES

1

Government agencies at national and local levels are usually **not well resourced to tackle waste minimisation** as it is perceived to be a low priority area

2

Strengthening waste management requires **cooperation between national and local government** to create an enabling environment for the private, civil society organizations and informal sectors

3

Best results are achieved when building local capacity using **locally acceptable solutions**

4

Stakeholder engagement is essential to gain community buy-in

5

Identification and engagement of key stakeholders is critical for success of waste management initiatives

6

Engaging and partnering with local communities involving **both men and women** is cost effective and **builds capacity at many levels**

7

Local government has a role to **mobilize** local resources and **implement** national interests and priorities

8

The **private sector**, which encompasses international and local entities, local community-based organizations, and the informal sector **often provide specialist services**

9

Clarity of roles and responsibilities is one of the key policy requirements for integrated waste management

10

Inclusion of traditional community leaders is important for the success of waste management initiatives

11

Awareness and education initiatives at all levels are important for implementation of integrated waste management and particularly to **promote waste reduction**

12

Awareness and education initiatives are best implemented in the **practical context** and/or in conjunction with other broader initiatives

8.1 National and Local Governments

National government has the role of ensuring that resources are utilized to reflect national interests and priorities. SIDS governments have limited capacity to operate waste management infrastructure works. This is further accentuated by the low priority politicians often put on the waste management agenda. Strong political commitment to waste management by national governments can achieve long-lasting results also in smaller SIDS, as happened in the case of Tuvalu, as seen in **Box 8.1**.

Box 8.1 Creation of a Dedicated Office for Waste Management in Tuvalu

As a result of Tuvalu's enactment of the Waste Operations and Services Act of 2009, the Solid Waste Agency of Tuvalu (SWAT) became a separate registered new department under the Ministry of Home Affairs and Rural Development. From a two-man waste management team[313] in 2010, the functions expanded and the agency has grown to 13 staff members, including field workers.

The growth of Solid Waste Agency of Tuvalu (SWAT) is indicative of the political commitment of Tuvalu to address waste issues specifically. For a small island state with very limited resources, this is a bold move and a realization that waste management should be given priority in the islands because of human health and environmental implications. This commitment attracted donor investment and Tuvalu, through the Solid Waste Agency of Tuvalu, will receive USD 8.4 million in funding to progress waste management in all the islands through the European Development Fund 11 bilateral programme with the European Union.

Apart from overseeing the delivery of waste management services, the department also deals with planning, financing, awareness programmes, enforcement of the new act and the overall management of all activities dealing with waste. The Solid Waste Agency of Tuvalu is now extending its waste operations to the outer islands and working directly with the island councils (Kaupule).

(Solid Waste Agency of Tuvalu, Tuvalu)

Approval of a national strategic plan/approach for waste management by government can encourage the **private sector** to engage as it provides longer term visibility and allows the private sector to plan for larger scale implementation programmes that are more economically viable and therefore more attractive.

While this is hardly ever considered in policy planning, implementation of legislation requires building institutional and technical capabilities. Having access to skilled practitioners within the national government structures is important to ensure sound implementation and sustainability of improvement measures. In SIDS, this is often enabled by international cooperation through training and networking opportunities provided on an international scale, such as those for people responsible for the implementation of multilateral environmental agreements. Mauritius, for example, successfully phased out chlorofluorocarbons (CFCs) five years ahead of the target set in the Montreal Protocol. One of reasons for the success is attributable to a comprehensive training targeting customs officers, who were then able to enforce the ban of equipment containing the undesired substances[314].

Reliance on external consultants for expertise can be effective but can also be counterproductive in some circumstances. For instance, Bahrain relies on external consultants for much of its expertise in various sectors, who often do not understand the local situation[315]. There is growing recognition that expertise should be developed onshore to provide appropriate advice to government and skilled employment opportunities for the local people.

[313] Tuvalu had initially created a project-based Waste Management Unit with limited functions under a department in response to recommendations by donor partners)
[314] Mauritius (2011)
[315] El-Karawy (2017)

It is critical that **national and local level decisions** be mutually reinforcing, and that coordination between national and local authorities be maintained on a regular basis. A clear assignment of responsibilities needs to be set and enforcement is key. An example is found in the Solomon Islands as shown in **Table 8.2** where each agency has clearly defined jurisdictions.

Table 8.2 Waste management responsibilities in the Solomon Islands[316]

Waste and pollution	Responsibility
Control issues	Ministry of Environment Climate Change Disaster Management & Meteorology
Health issues	Ministry of Health and Medical Services
Provincial centres	Provincial government
Capital city	Honiara City Council
Marine environment	Solomon Islands Maritime Safety Administration

The role of **local government**, where workers are given specialized responsibilities, is to mobilize local resources in a manner that reflects national interests and priorities. There is a need for local training and capacity building to support the implementation of initiatives and enforcement and monitoring of the outcomes. Local government's role is often as the main specialist provider of integrated waste management services, particularly on offshore islands. The services can be delivered by the public and/or private sector. The **private sector** can be a combination of entities operating locally or internationally, local community-based organizations and/or informal or micro-enterprises. An example of local government action is demonstrated by Lautoka City, Fiji, as shown in **Box 8.2**.

Box 8.2 Local Government's Market Composting Programme in Fiji

A Market Composting Programme is being implemented in Lautoka City by the City Council. The Japan International Cooperation Agency (JICA)-funded Waste Minimization and Recycling Promotion Project commenced in 2008 to enable diversion of organic wastes (currently 60% of the waste stream) from the landfill. More than 85% of market waste generated is organic in nature, resulting in an average of 1.1 tonnes/day of market organic waste being unloaded at the compost yard located at the Vunato disposal site. An estimated 250 tonnes of market green waste is separated and composted at the disposal site per year amounting to savings in landfill operation costs of USD 1,360/year.

Through a series of awareness activities run by the Council, market vendors started segregating organic wastes. The Council also modified the market cleaning contract which makes the contractor also responsible to separately store organic waste during collection and unloading at the compost yard. In the yard, the 3R workers also cut bigger organic materials into smaller pieces to hasten decomposition.

Wood chips shredded from green waste (partly decomposed) are used as base material and for covering. This assists in moisture control, elimination of flies and odours and in the introduction of microorganisms to catalyze the composting process. In addition wood chips, or browns, are an excellent source of carbon and when combined with fresh organics, with high nitrogen content, help maintain a desirable carbon to nitrogen ratio, which is very important for good quality compost. The matured compost is packaged in 10 kg bags for sale at subsidized price of USD 1.50. The Council has sold 52.8 tonnes of compost since 2011 and managed to establish a sustainable market for the compost.

(Lautoka City Council, Fiji)

Management of solid waste in the Caribbean is usually led by national governments except in Belize, Guyana, Trinidad and Tobago and Haiti where collection and disposal is the responsibility of local government. Belize, Jamaica, St Lucia, and Trinidad and Tobago have created separate bodies within government responsible for waste collection and disposal[317]. In Belize, the local government of Belize City initiated a significant upgrade of the infrastructure for waste management services, as shown in **Box 8.3**.

[316] Solomon Islands, Ministry of Environment (2017)
[317] Riquelme, Mendez and Smith (2016)

Box 8.3 Municipal Solid Waste Disposal in Belize: The Transformation of the Mile 3 Garbage Dump

Up until 2013, Belize City residents engaged in inadequate and unsafe municipal solid waste disposal practices (burning, burying, dumping on land, and throwing in water bodies). In addition their health and the environment were affected by hazardous air, land and water pollutants from the poorly managed city dumpsite located at Mile 3 on the George Price Highway.

In 2013, the Belize Solid Waste Management Authority officially closed the Belize City garbage dumpsite and replaced it with a modern Waste Transfer Station. The initiative was part of a Solid Waste Management Project intended to improve infrastructure for solid waste transfer and final disposal in Belize. Today, waste from Belize City is brought to the transfer station by collection vehicles for sorting and processing, and the residual waste is transferred to a first-of-its-kind-in-the-Caribbean Regional Sanitary Landfill at Mile 24 on the George Price Highway for environmentally sound disposal. The overall results have been a cleaner and healthier environment for Belize City residents.

Presently, four additional transfer stations have been put in place to service other municipalities in Belize, and the country continues to address its municipal solid waste disposal needs.

(Michael F. Somerville, Environmental Scientist)

Government can retain some degree of control on waste management activities by issuing **licenses**. Licensing can be very effective in improving the standard of waste management in the area, provided there are monitoring and enforcement procedures in place.

8.2 Civil Society Organizations and the Informal Sector

Civil society organizations in SIDS can build support, raise awareness through public campaign and education programmes and provide advice on community engagement through the government's committees. Civil society organizations in the waste sector are particularly aligned to supporting environmentally beneficial projects. The promotion of concepts such as the waste management hierarchy, in which waste prevention is the first objective, followed sequentially by reduction, reuse and recycling, forms the basis of any successful waste management initiative.

Many SIDS rely on the informal sector to collect, transport, separate and dispose of waste and, over the past couple of decades the visibility of the informal sector to government has increased. One of the strong drivers for waste management improvement by civil society organizations is through the formation of organizations representing the informal sector. For instance, the Latin American and Caribbean Recyclers Network was established to improve informal waste operators' working conditions, to exchange experiences, propose actions and carry them out[318]. The informal sector is largely invisible and often hard to reach. Raising the awareness of political decision-makers on the contributions of the informal sector to waste management can assist in the integration of the sector and encourage the inclusion of its valuable experiences as inputs for decision-making.

[318] United Nations Environment Programme (n.d.)

8.3 Communities

As a more diverse group, the general **community** has roles as consumers of goods, waste generators and users of waste-related services. The community culture plays a significant role in determining the responses of citizens to government-initiated actions. Hence, it is important for government to signal its intentions in culturally appropriate ways to their communities. The Marshall Islands Visitors Authority distributed educational materials, made radio announcements, and organized cleanups in different areas of Majuro. However, despite the government's effort, the success of the programme was hindered by the lack of **involvement of traditional leaders** and landowners in tackling Majuro's solid waste challenges. For instance, the influence that landowners have on their lessees could have been (and could be) leveraged to discourage illegal dumping and burning of waste. Individuals in communities naturally see as the most pressing needs those needs that, when addressed, will directly improve their wellbeing and quality of life[319].

At times, a community's expectation for a 'state of the art' waste sanitation system can provide a barrier to progress. In Papua New Guinea for instance, sanitation in urban areas is in fact a mixture of networked sewerage, septic tanks, sanitary buckets and pit latrines. Any expectation on the part of the Papua New Guinean people for a fully networked sewerage system would comprise a significant barrier to introducing alternative sewage disposal technologies that are perhaps less advanced but more economically viable and sustainable within the local context. The solution the government proposes is for better public awareness of the viable alternatives[320].

Often the negative impacts of improper waste management practices are not known to the public, reducing the community buy-in into improvement initiatives. This further reinforces the importance of increasing public awareness regarding the necessity and benefits of improved waste management in SIDS. Significant stakeholder buy-in is found in Fiji, where the annual Clean Up Fiji campaign, after government promotion, is now well supported by the entirety of the local and business communities[321].

8.4 Private Sector

The private sector is a major player in the waste sector. Business decisions on importation, product design and engineering, packaging through to the end-of-life processes, bear great impacts on the level of waste generated and its environmental footprint. Engagement with the private sector is of upmost importance to minimize waste generation upstream and identify environmentally sound alternatives. On the upstream side, governments could provide assistance at the design stage or pre-importation of goods to assist designers and importers to consider the downstream effects of introducing their products into the market place. For this to happen, governments need assistance with information to provide education programmes for the private sector.

Partnerships with the private sector often help to ensure the provision of more efficient waste management services and infrastructure development. For instance, the Mauritius government works closely with the private sector for their waste-to-energy facility, composting plant and an e-waste facility[322]. To balance the level of reliance on the private sector, however, local capacity building of government staff should always be considered a priority – particularly for offshore islands – as it can prove extremely valuable to have the necessary skills on-site to technically assess whether the proposed solutions by private businesses are indeed locally acceptable and sustainable.

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[319] Asian Development Bank (2014c)
[320] Papua New Guinea (n.d.)
[321] Fiji (2010)
[322] Mauritius (2010)

9. STRATEGIES TOWARDS A CIRCULAR ECONOMY

SIDS face many barriers and challenges in moving towards a circular economy. Practical challenges manifest themselves through the small and dispersed nature of the islands, which does not easily allow for economies of scale, at a time of increasing waste generation caused by population and economic growth. Coupled with illegal littering and dumping of wastes from all media, the resultant environmental impacts are significant. These trends are aggravated by the challenges brought about by climate change, natural disasters, and external factors such as marine litter.

While the barriers and challenges to achieve a circular economy are significant and have been discussed throughout the Outlook, there are strategies for working towards their resolution. Measures to overcome barriers need to fit into the culture of the population that they are targeting to have a chance of uptake. The measures need to consider the impacts on the receiving environment as well as look at the possibility of waste as a resource.

KEY MESSAGES

1. SIDS need to take a whole of life approach considering all **solid, liquid and gaseous wastes**

2. Developing environmentally sound National Integrated Waste Management Strategies and Action Plans based on Best Available Techniques, Best Environmental Practices can provide a consistent **policy framework to guide improvements**

3. Regional cooperation enables SIDS to **learn from each other's experiences**

4. Inter-generational long-term **education programs** and education as part of program delivery are vital elements for a circular economy

5. **Technologies** to assist waste reduction must be **appropriate for SIDS**; generally this means simple to operate, reliable, and easy to repair and maintain with local parts and skills

6. **Remediating dumpsites** can provide materials with value, jobs and reduced environmental impacts

7. Enforcement of current waste **legislative provisions** can provide a significant step towards better waste management

8. Waste data is very sparse resulting in **lack of knowledge** of the waste problem and evidence-based decision-making

9. **Monitoring and evaluation** are poorly carried out and need to be enhanced to stimulate further buy-in for changes in waste practices

9.1 Integrated Waste Management

SIDS need to adopt an integrated waste management approach. While the most cutting-edge concepts of each era have transitioned somewhat, from the cleaner production and industrial ecology concepts of the 1990s to the cradle-to-cradle movement of the early 2000s and then to the circular economy of the present day, each concept takes a whole-of-life consideration and acknowledges that waste can cross media boundaries (solid, liquid and gaseous states).

In many of the lower income SIDS, the first step in integrated waste management is to reduce the health impacts of waste by tackling its environmental impacts. This includes green procurement by SIDS governments, segregation of waste at source, organizing collection systems for solid, liquid and hazardous wastes and eliminating unrestrained dumping and burning. Developing environmentally sound **National Integrated Waste Management Strategies and Action Plans** based on best available techniques and best environmental practices can provide a coherent policy framework to guide improvements. Efforts to promote the 3Rs (reduce, reuse and recycle) can provide further means for addressing waste issues constructively. Programmes that include women can increase the reach and the impact of those projects.

Singapore has adopted a strategic and integrated approach to tackle difficult wastes by avoiding the generation of intractable waste; encouraging waste minimization, reuse, recycling and recovery; regulating collection, treatment and disposal; monitoring and auditing end-of-life processes; and promoting and supporting educational and training programmes[323].

9.2 Regional Cooperation

Working on a **regional or sub-regional** basis can enable SIDS to learn from each other's experiences, as, for example, explained in section 4.1 with a regional approach for hazardous waste handling. In the Pacific, after endorsing the **Regional Solid Waste Management Strategy**, the participant SIDS worked on developing national strategies to guide actions, training courses and pilot initiatives[324]. International funding and support was provided by the French Development Agency (l'Agence Française de Développement) and Japan International Cooperation Agency (JICA), in cooperation with the Secretariat of the Pacific Regional Environment Programme (SPREP). The Caribbean SIDS organized the first Regional Waste Management Conference in July 2017, with the objective of starting to shape the design of a regional waste management action plan. Financial and technical assistance for the Caribbean regional conference has been provided by the Dutch government and UN Environment.

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[323] Singapore (2010)
[324] Asian Development Bank (2014f)

9.3 Education and Public Awareness

Many smaller, less developed SIDS struggle to move beyond the traditional methods of waste management that were adequate for pre-industrial societies but are no match for modern long-lasting materials. A major long-term action to overcome the barriers associated with moving towards a circular economy is awareness raising and education. **Public awareness** campaigns and education require the involvement of several stakeholders and are key initiatives for the success of any long-term programme that aims at behavioural change. Public awareness of both upstream and downstream stages of waste management is not often viewed as a priority by policy makers and in practice, it is very limited in SIDS. Consequently, the importance of environmentally sound waste management in solid, liquid and gaseous media is not well understood and people are not aware of the costs of inaction. Singapore, with a high level of public awareness, has developed significant capacity among the population which is now better able to segregate and manage their own wastes.

Programmes to raise awareness of waste and waste management should be **targeted and appropriate for the audience**, whether it be an audience of policy makers, business executives, communities, or technical waste management operators for efficiency improvements in the value chain. Timor-Leste developed formal and informal education programmes targeted at sectors such as construction, equipment maintenance and repair, renewable energy sources, recycling, waste reduction, disposal and rainwater harvesting. These programmes were aimed at construction workers, farmers, fishermen, rural communities, students, tourist operators, staff in the tourism sector and women's groups. Government officials worked closely with community leaders to preserve the environment and local employment while strengthening local customary law. Formal education programmes can be enhanced by outreach programmes to local and national government departments, community groups, civil society organizations and religious groups[325].

Waste collection and recycling decisions and awareness campaigns should be targeted at those who are most likely to participate in them. How households participate in waste management is influenced by the societal customs of how to divide up work and other duties, often based around gender. Hence, the role of women needs to be carefully considered when setting up these programmes[326].

Awareness raising conducted in relation to a specific initiative (with concrete outcomes) has generally greater success since people relate better to concrete applications, rather than abstract concepts. Climate change is one of the largest issues affecting SIDS, thus it could be a vehicle for larger awareness raising initiatives. For example, in the Solomon Islands, the school syllabus covers climate change in the social science and science curriculum and through that, children are introduced to topics like weather, pollution, and earth sciences[327].

Inter-generational education programmes through schools and tertiary education, whereby young children are taught to practice the 3R (reduce, reuse and recycle) concept at school and at home, have proven successful and could be considered in more SIDS as they build capacity and ensure continued improvements, as leadership changes occur. Examples are found in Fiji and in Dominica as shown in **Box 9.1**.

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[325] Timor-Leste, Ministry of Economy and Development (2012)
[326] Swedish International Development Cooperation Agency (1998)
[327] Solomon Islands (2008)

Box 9.1 3R (Reduce, Reuse and Recycle) School Programmes

Fiji Clean School Programme

The **Fiji Clean School Programme** has been using a 3R-centric system in all schools within a boundary area since February 2010. The programme focuses on resolving solid waste management issues and practices in the schools by enhancing the students' potential to be agents of change and extend what they have learned to their homes and communities. This initiative began in 11 schools (within the boundary area) with three sets of 3R activities: environmental awareness activities; school composting; and recycling. The programme is now implemented in 30 schools.

Participating schools attended workshops and had to submit action plans to the Nadi Town Council for their planned 3R activities. A Guidebook capturing lessons for the period 2010-2012 was developed. The activities are monitored and competitions are held with high performing schools presented with prizes and certificates and given the opportunity to demonstrate their good activities to other schools. Ongoing training and professional development sessions for the teachers and children are underway. Because of the success of the programme, more schools outside the boundary zone have shown interest and joined the programme.

The initial challenges of getting the interest of teachers and students and changing their mindset have been addressed but the greater challenge is sustaining the good practices. Continuous awareness activities and regular monitoring are conducted by the Nadi Town Council.

The success of the Clean School Programme and the good practices demonstrated in the programme are now being shared and disseminated to the other towns/cities of the western division in Fiji as well as to other Pacific island countries like Kiribati, the Solomon Islands, Tonga and the Marshall Islands. The **Fiji Clean School Programme** is implemented through a partnership among the Nadi Town Council, Japan International Cooperation Agency (JICA) and the Ministry of Education.

(Nadi Town Council, Fiji)

Dominica 3Rs Awareness for Schools

The 3R Awareness Programme for schools in Dominica is a modular training course meant to change the mindset of young minds towards proper waste management in the country. By doing so, it is hoped that there will be a spillover effect, where students will share experiences learnt at home and in their communities. The involvement of parents in the process is important in ensuring support and understanding of the need to reduce, reuse and recycle the waste generated at home for a cleaner and healthier environment.

The 3Rs Awareness Programme for Schools is an initiative of the Dominica Solid Waste Management Corporation. Although the Corporation wishes to further strengthen the impact of the programme by regularly delivering training to new students, developing outreach materials to distribute to children and families, and by airing TV and radio messages, lack of funding is restricting these plans.

(Dominica Solid Waste Management Corporation)

Although often forgotten, **monitoring and evaluating public awareness campaigns** are also key in verifying efficacy and in introducing improvements to the campaign strategy. By periodically monitoring and evaluating a campaign, it would also be easier to generate timely data to be presented in a user-friendly fashion to the community or to government, to stimulate further buy-in and support.

9.4 Technology and Innovation

Technologies play an important part of waste management from the collection of waste materials to processing and end-of-life options. Most national waste management strategies focus on end-of-life solutions that often amount to dumping (more details are included in Chapter 7). To achieve change SIDS must think of solutions higher up the waste management hierarchy, use appropriate innovative technologies and explore regional cooperation options[328].

[328] United Nations Environment Programme (2014b)

A life cycle-thinking approach is necessary in order to minimize waste generation: new product designs, alternative and reduced packaging, improvements in product efficiency, and improvements in a product's life expectancy. A key driver for **turning waste into a resource** is recognizing the value of waste and creating markets for recycling and reusing the diverted materials. It is evident that some of the barriers to SIDS embarking on this route are economies of scale and the identification of the appropriate technologies to use[329].

9.5 Remediation and Dumpsites

Another strategic action to overcome the barriers associated with waste is **the remediation of dumpsites**, particularly with a view to separating out materials that may have economic value. It is a longer term vision that may be more viable after market and supply chains are organized. The informal sector operators are important stakeholders in collection and processing, and integrating them into the formal sector will be key to achieving success. More on the role of the informal sector is found in Section 2.4.

9.6 enforcement

Enforcement can be a significant barrier. Mauritius has successfully implemented container deposits on PET bottles and enforced a levy on hazardous substances to finance the cost of managing wastes and obsolete stocks[330]. They have done so by adopting an approach that uses environmental police working in combination with enforcing agencies (local government and the Department of Environment) providing a coordinating role. A prosecution division within the Department ensures that environmental offences are prosecuted[331].

9.7 Waste data and Monitoring

Environmental monitoring has so far been inadequate in SIDS. Simple measures like monitoring waste going into a disposal site or emissions to air would provide information for authorities to recognize the actual state of waste in their areas and evidence for action. For instance, improvements have been achieved in Mauritius, where since 2001 ambient air quality in residential and industrial zones has been monitored to capture data for an air quality index for the island[332].

Waste-related statistics facilitate **evidence-based decision-making** and an ability to then design systems, select appropriate technologies, budget for investment needs, and assess policy performance. Statistics also deliver a useful guide on compliance adherence and the effectiveness of the approaches used throughout the waste management system.

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[329] United Nations Environment Programme (2014b)
[330] Mauritius (2010)
[331] Mauritius (2011)
[332] Mauritius (2011)

10. CONCLUSIONS

This Outlook is relevant to all 58 SIDS as well as all countries that have inhabited off-shore islands, numbering approximately 11,000 worldwide, as these islands often have similarities to SIDS. The focus on waste management in this Outlook takes an integrated approach covering emissions to air, water and land. For SIDS to move from a dumping society to a circular economy, it will require a different type of thinking and targeted assistance.

Appropriate waste management is integral to sustainable development in SIDS and helps them to fulfil all 17 Sustainable Development Goals. Inadequate waste management impacts negatively on public health as well as atmospheric, terrestrial, coastal, freshwater and marine environments, and SIDS' primary economic sectors like tourism, fishing and agriculture. The promotion of resource efficiency, sustainable infrastructure, delivery of basic services to all, and green and suitable jobs will provide a better quality of life for residents.

SIDS have many waste management related issues in common with global trends. However, their unique geography and environmental sensitivity often exacerbate the impacts, creating more comple*x situ*ations that require innovation, collaboration and regional, community-based solutions.

KEY MESSAGES

1. **Regional cooperation** on hazardous waste, recycling, marine litter, greenhouse gas emission reduction and wastewater is necessary for SIDS to move towards a circular economy

2. **Regional coordination** of data is needed to enable data-led decision making for SIDS and provide a common measurement system

3. **Individual SIDS** need to take a whole-of-life integrated **waste management approach**

4. **Governments** need to engage with all **stakeholders** in meaningful ways to get progress in waste management

5. **Waste management programmes need to be designed** to add value to high priority government workstreams like job creation, skills development and economic development

6. **Key wastes to focus on** are hazardous, construction and demolition, and marine litter

7. Governments need to **support investment from the private sector** by creating policy, regulatory and other enabling conditions

8. Implementation of current **legislative and regulatory provisions** would assist waste management greatly

10.1 Regional Initiatives

Regional cooperation between SIDS is vital for them to progress on their path towards a circular economy. Regions can learn from each other through shared experiences like the development of this Outlook, hazardous waste programmes in the Pacific and wastewater programmes in the Caribbean. From a regional perspective, the Pacific region has a long-standing regional waste programme, while the Caribbean has some coordinated activities, but the disparate spread of Atlantic, Indian Ocean, Mediterranean, and South China Sea region countries means that there is little that enables them to take a regional approach. Atlantic, Indian Ocean, Mediterranean, and South China Sea region programmes seem better aligned to the predominate region they are associated with (e.g. Africa or Asia). However, there are some initiatives that transcend the regional focus and take a global SIDS focus (e.g. the SIDS Accelerated Modalities of Action [SAMOA] Pathway).

Regional cooperation and management models that utilize synergies between countries are required. Difficult end-of-life materials that are hard to manage on a country basis (e.g. hazardous waste and packaging) can be better coordinated through regional approaches. **Hazardous waste** should be considered a top priority requiring coordination between SIDS. The return or re-export of these wastes is vital for those SIDS which will never be able to afford environmentally sound disposal of hazardous wastes on-island. This need is specifically recognized under the Basel Convention, which permits SIDS to export hazardous waste for the purpose of environmentally sound disposal. The model developed for the Pacific (see section 4.1) can be replicated in other regions to enable suitable management of hazardous wastes, and could be transferred to other waste streams like **recyclable packaging**.

Marine litter is another type of waste that needs a regional approach to be properly managed. SIDS are minute producers of this waste but oceanic drift means that the major effects of this waste stream exhibit themselves on the SIDS' coastlines, which are very dependent on tourism and on marine harvests for food. A regional programme that can be implemented on an island basis is needed.

Following the theme of SIDS being severely impacted by other countries' actions, SIDS are among the least sizable global contributors of **greenhouse gases (GHGs)**, averaging only 47% of the global average emissions. However, the impact of the gas emissions on them is significant, including sea level rise and increasingly severe weather events. While the actions of SIDS to reduce greenhouse gas emissions may not yield huge results in absolute terms, their beneficial side effects can be significant for the countries concerned. For example, replacing fossil fuels with renewable energy sources saves substantial foreign currency and the diversion of organic matter from dumpsites (which can cause the release of, and exposure to, hazardous and biological pollutants) can enhance the soil quality for crop production.

Another waste that requires a regional initiative, **wastewater**, presents a serious public health and environmental problem in many SIDS, both on island waterways and coastal outlet areas. Regional action that supports local implementation is necessary to address this widespread issue. Action to get piped water supply and water treatment networks installed are the first steps towards adopting more sustainable practices.

For any initiative to be funded, it is necessary to make a business case for the funding. **Data** is a vital aspect of the business case. Good waste data, and associated monitoring to generate the data, is quite rare for SIDS. Fundamental periodic data such as quantity and characteristics are also absent in many instances. There is even little agreement on terms and data collection methods among regions. Acquisition of data is made more difficult given that some SIDS don't even have basic weighbridges, or volume-to-weight conversions, or even vehicle movements to and from sites. They also do not have full cost accounting systems and information management systems. Regional cooperation to establish these necessities could go a long way to provide data-led decision making.

10.2 Country Initiatives

While regional programmes are necessary, country-based programmes are key to moving up the waste management hierarchy. Governments should consider the waste implications of products entering the marketplace, at the design stage or pre-importation of goods. For this to happen, governments will need to gather information on the baseline situation and provide education programmes for the public and private sectors.

For waste reduction efficiency and effectiveness, governments need to bring together industry stakeholders, the public health sector, oil and other industries, international action, as well as local community involvement. Identification and **engagement of key stakeholders** is critical for the success of waste management initiatives. The informal sector is crucial to waste diversion and job opportunities, particularly for women who are often left out of the decision-making process.

Strengthening waste management requires cooperation between national and local governments to create an enabling environment for the private and informal sectors. Government agencies at the national and local levels need to **prioritize waste-related issues** as an important first step to effective waste management. To raise the profile and importance of waste management programmes, they need to be designed to effectively incorporate 'waste' into high priority government workstreams (e.g. job creation, skills development and economic development).

Particular waste areas for SIDS to focus on are:

- **Hazardous waste** (including **medical waste** and **wastewater**), which has significant health effects for all living organisms;
- **Construction and demolition** waste, which has a high potential for diversion from the waste stream and is often a massive component of disaster waste;
- **Marine litter**, which can severely impact tourism and marine species; and
- Other wastes including **plastics**, **disaster waste**, **tyres** and **nanomaterials**.

Securing financing for programmes in SIDS is an ongoing issue. Governments should investigate opportunities for funding waste management initiatives, including international funding bodies, the private sector and community contributions. Governments need to support investment from the private sector by creating policy, regulatory and other enabling conditions and/or incentives. Consideration should be given to pricing mechanisms, in particular **extended producer responsibility** to drive **behaviour change**.

Government resources need to be for **enforcement** of current waste legislative provisions. Better **monitoring** and **evaluation** functions are needed to enable changes in waste practices.

Circular economy thinking emphasizes closed material flows, efficient natural resources use, low energy consumption and low emissions. When SIDS adopt this sort of thinking, they will not only start to solve their waste issues, but they will be contributing to all 17 UN Sustainable Development Goals.

11. Annexes

Annex 1: Breakdown of SIDS National Legislation by Region

The Atlantic, Indian Ocean, Mediterranean and South China Sea Region

Waste-related legislation at the national level in the Atlantic, Indian Ocean, Mediterranean and South China Sea region can be found across a wide variety of legislative areas, such as public health, environment, hazardous substances management, renewable energy, maritime and ports, tourism and mining. Some countries have specific waste regulations, such as Mauritius, which has a CO_2 levy and rebate, and the Seychelles, which provides economic incentives for recycling. Renewable energy legislation and programmes have been a common way for reducing dependence on fossil fuels in the SIDS in this region. A summary of the number of national legislative instruments found in this region is shown in **Table A.1**.

Table A.1 Summary of national legislative tools in the Atlantic, Indian Ocean, Mediterranean and South China Sea region SIDS[333]

Legislative tool	Number of occurrences in AIMS region
Wastes, all media	21
Economic instruments	15
Solid waste	13
Disposal	13
Liquid waste	12
Environmental aspects	12
Responsibility	12
Hazardous waste	10
Gaseous waste	8
Wastewater	8
Air and water quality standards	5
Audits	4
Household waste	4
Reporting	4
Landfills	4
Transboundary	1
Tyres	1
Mining	1

An analysis of the Atlantic, Indian Ocean, Mediterranean and South China Sea region SIDS shows that waste legislation there commonly addresses all waste streams, with more emphasis on solid waste and wastewater. Public health legislation commonly addresses hazardous waste (medical) and wastewater. Maritime and port regulations deal with the dumping or discharge of waste (both solid and wastewater) in coastal areas and transboundary waste, while oil pollution and mining legislation addresses both marine and land pollution and discharge.

Although waste management strategies are not specifically mentioned within waste-related legislation, the waste management hierarchy is obliquely referred to in legislation in São Tomé and Principe, and the Seychelles. Waste management plans, extended producer responsibility and the circular economy are not addressed directly or indirectly by any Atlantic, Indian Ocean, Mediterranean and South China Sea region SIDS.

[333] Summarized from the ECOLEX database available at https://www.ecolex.org/

The Caribbean Region

Like the Atlantic, Indian Ocean, Mediterranean and South China Sea region group, waste-related legislation in the Caribbean can be found across a wide spectrum of legislative areas, with some countries having specific waste legislation and regulations, focused mainly on solid waste. For example, Grenada imposes levies on ships and tyres. As another example, in response to the Montreal Convention, legislation to prevent ozone depletion also exists, as reflected in **Table A.2**.

Table A.2 Summary of national legislative tools in Caribbean SIDS[334]

Legislative tool	Frequency in the Caribbean region
Disposal	28
Wastes, all media	21
Solid waste	21
Economic instruments	15
Environmental aspects	20
Compliance and enforcement	20
Responsibility	20
Hazardous waste	18
Liquid waste	15
Wastewater	15
Landfills	13
Household waste	11
Gaseous wastes	10
Audits	9
Reporting	9
Transboundary	6
Tyres	5
Waste management plans	5
E-waste	4
Mining	3
Ozone layer protection	3
Waste management hierarchy	3
Waste management strategies	2
Carbon trading	1

The legislation covers all waste mediums in all countries. Most environmental legislation and regulations contain provisions for environmental impact assessments. Public health legislation commonly addresses hazardous waste (medical) and wastewater. Maritime and port regulations deal with the dumping or discharge of waste (both solid and wastewater) in coastal areas and transboundary waste, while oil pollution and mining legislation addresses both marine and land pollution and discharge. Standards and indicators of success are not specifically addressed.

Whereas Caribbean countries are not major emitters of greenhouse gases, their dependence on fossil fuels for energy is seen as a major environmental and economic issue and the region has embarked on a number of renewable energy initiatives.

Legislation that has a stronger focus on the circular economy, such as legislation on extended producer responsibility, is not addressed within national legislation.

[334] Summarized from the ECOLEX database available at https://www.ecolex.org/

The Pacific Region

The Pacific region can be divided into three subregions, Melanesia, Micronesia and Polynesia, which are discussed individually below.

The Subregion of Melanesia

In this analysis, the subregion of Melanesia includes five sovereign nations – Fiji, Papua New Guinea, the Solomon Islands, Timor-Leste and Vanuatu – and the French territory of New Caledonia. In the Melanesia subregion, waste-related legislation can be found in areas similar to those of the regions discussed earlier, as shown in **Table A.3**.

Table A.3 Summary of national legislative tools in the Melanesian SIDS[335]

Legislative tool	Frequency in the Melanesia subregion
Wastes, all media	14
Solid waste	14
Liquid waste	13
Environmental aspects	11
Disposal	9
Wastewater	7
Gaseous wastes	7
Landfills	6
Hazardous waste	3
Transboundary	2
Economic instruments	2
Audits	2
Reporting	2
Household waste	2
Mining	1
Waste management hierarchy	1
Waste management plans	1

Environmental legislation commonly addresses all waste streams in general terms, with more emphasis on solid waste and wastewater. Most environmental legislation and regulations contain provisions for environmental impact assessments. Public health legislation commonly addresses hazardous waste (medical) and wastewater. Maritime and port regulations deal with the dumping or discharge of waste (both solid and wastewater) in coastal areas and transboundary waste, while oil pollution and mining legislation address both marine and land pollution and discharge.

Countries in the region have a marked focus on the sea and the dumping of waste, including hazardous waste, in coastal waters. New Caledonia places emphasis on composting.

Waste legislation with drivers towards a circular economy like waste management strategies, the waste management hierarchy, waste management plans and extended producer responsibility are not directly mentioned across the subregion.

[335] Summarized from the ECOLEX database available at https://www.ecolex.org/

The Subregion of Micronesia

In this analysis, the subregion of Micronesia includes five sovereign nations – the Federated States of Micronesia, Kiribati, the Marshall Islands, Nauru and Palau – and two US territories, Guam and the Northern Mariana Islands. Data on 14 pieces of legislation from the subregion are summarized in **Table A.4**.

Table A.4 Summary of national legislative tools in the Micronesian SIDS[336]

Legislative tool	Frequency in the Micronesia subregion
Wastes, all media	14
Solid waste	14
Liquid waste	13
Environmental aspects	11
Disposal	9
Wastewater	7
Gaseous wastes	7
Landfills	6
Hazardous waste	3
Transboundary	2
Economic instruments	2
Audits	2
Reporting	2
Household waste	2
Mining	1
Waste management hierarchy	1
Waste management plans	1

The legislation covers all waste mediums. This subregion shows similar patterns to the others though standards and indicators of success are not specifically addressed. There are some unique provisions in this subregion. The Environment Act in the Marianas addresses waste disposal in emergencies and renewable energy; Guam has specific regulations for beverage cans and Kiribati has a special fund for waste recovery. The circular economy is implied in legislation in the Marianas, but not by this name.

[336] Summarized from the ECOLEX database available at https://www.ecolex.org/

The Subregion of Polynesia

The subregion of Polynesia includes American Samoa, the Cook Islands, French Polynesia, Niue, Samoa, Tokelau, Tonga, and Tuvalu. Some countries and territories have specific waste-related regulations, focused on solid waste (municipal solid waste and plastic bags in particular), public and environmental health, ecosystem protection, wastewater utilities and air emission standards. In response to the Montreal Convention, legislation to prevent ozone depletion also exists.

Table A.5 Summary of national legislative tools in Polynesian SIDS[337]

Legislative tool	Frequency in the Polynesia subregion
Wastes, all media	27
Responsibility	27
Compliance and enforcement	27
Environmental aspects	27
Hazardous waste	24
Disposal	23
Solid waste	21
Economic instruments	13
Liquid waste	13
Gaseous wastes	10
Household waste	10
Wastewater	9
Audits	8
Reporting	8
Transboundary	7
Success indicators	4
Waste management plans	3
Tyres	2
Mining	2
Waste management hierarchy	2
Waste management strategy	2
E-waste	1
Extended producer responsibility	1
Circular Economy	1

Environmental legislation commonly addresses all waste streams in general terms, with more emphasis on solid waste and wastewater. Extended producer responsibility and the circular economy are indirectly referred to in Tuvaluan and Samoan legislation respectively, albeit not under those specific names.

[337] Summarized from the ECOLEX database available at https://www.ecolex.org/

Annex 2: Japan International Cooperation Agency (JICA) International Financing in the Pacific Region

The Japan International Cooperation Agency (JICA) has funded many projects in the Pacific region covering solid waste, wastewater, water supply and general environmental projects. An account of most of the projects is found in **Table A.6**.

Table A.6 Japan International Cooperation Agency (JICA)-funded waste-related projects in the Pacific region[338]

Targeted area	Number of projects		Individual SIDS	Value (USD)
	Country-based	Regional		
Solid waste	12	3 in Oceania, 2 in Micronesia subregion	Fiji, Federated States of Micronesia, Palau, Samoa, Solomon Islands, Tonga, Vanuatu	27.9 million
Wastewater	7	0	Fiji, Papua New Guinea, Samoa	79.9 million (including a 72.7 million loan to Papua New Guinea)
Water supply	14	3 in Oceania	Fiji, Palau, Papua New Guinea, Samoa, Solomon Islands	7.5 million
Environmental	10	3 in Oceania	Palau, Papua New Guinea, Samoa	9.6 million

[338] Amano (2017b)

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