



**National Waste Management
Strategy and Master Plan
for Myanmar
(2018-2030)**

August 2018

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Acknowledgement

Myanmar's National Waste Management Strategy and Master Plan (NWMSMP) is the result of the concerted and dedicated efforts of team led by the Hon. Union Minister and the Director General (DG) of the Environmental Conservation Department (ECD) of the Ministry of Natural Resources and Environmental Conservation (MONREC) with the participation of the Director of ECD's Pollution Control Division, staff of the ECD, representatives of other Ministries, including the Ministry of Foreign Affairs, Ministry of Home Affairs, Ministry of Defence, Ministry of Border Affairs, Ministry of Information, Ministry of Religious Affairs and Culture, Ministry of Agriculture, Livestock and Irrigation, Ministry of Transport and Communication (Directorate of Water Resources and Improvement of River System and Department of Meteorology and Hydrology), Ministry of Labour, Immigration and Population, Ministry of Commerce, Ministry of Planning and Finance, Ministry of Health and Sports, Ministry of Construction, Ministry of Industry, Ministry of Education, Ministry of Electricity and Energy, Ministry of Social Welfare, Relief and Resettlement, Ministry of Hotels and Tourism, Ministry of Ethnic Affairs, Union Attorney General's Office, and other key public, private, academic and civil society stakeholders, as well as national and international consultants. Designed through a participatory and consultative process, the ideas, suggestions and contributions of these key members proved indispensable for drafting and refining the strategy in a timely, practical and quality manner.

Myanmar's National Waste Management Strategy and Master Plan is the Government's first national initiative aimed at institutionalising waste and as such offers a visionary document and strategic guide for addressing key issues, opportunities and challenges associated with achieving a resource efficient and zero waste society. MONREC expresses its sincere gratitude to all public, private, academic and civil society stakeholders who participated in consultations at the township, regional/state and national levels, and provided valuable feedback during meetings and working group discussions. MONREC also wishes to thank all the 14 State and Region Development Affairs Committees, Yangon City Development Committee, Mandalay City Development Committee, Nay Pyi Taw Development Committee, and all other Township and City Development Committees that participated in the development of the National Waste Management Strategy and Master Plan, which greatly contributed towards ensuring the strategy remained practical, implementable and relevant to the country's needs.

The National Waste Management Strategy and Master Plan benefitted from the generous financial support of the Ministry of Environment Japan (MOEJ) in partnership with UN Environment, and was developed based on agreement of the ECD of the MONREC and the Institute for Global Environmental Strategies' Centre Collaborating with UNEP on Environmental Technologies (CCET). MONREC also recognises the important coordinating role played by the Institute for Global Environmental Strategies (IGES) and Environmental Quality Management Co., Ltd. (EQM), both with regard to their technical support and project facilitation throughout the strategy formulation process.

Foreword

In the past decade, Myanmar, the largest country in mainland Southeast Asia, has witnessed rapid urban and economic growth, becoming one of the world's fastest growing economies. This is expected to further accelerate with the recent government approval of the Myanmar Sustainable Development Plan (2018-2030). Rapid economic growth accompanied by urbanisation and industrialisation has led to significant challenges with the management of waste. Due to the absence of proper waste management systems by townships and city development committees (CDCs), uncollected waste is often dumped on the streets and waterbodies or burned openly, polluting the air, soil, and in-land and marine water bodies. In addition to environmental pollution, insufficient waste management also impacts public health, social systems and economic activities such as tourism in the country.

In this regard, I do believe that Myanmar's National Waste Management Strategy and Master Plan (2018-2030) will aim to provide a conducive national policy framework and strategic direction moving from conventional waste management to sustainable waste management based on the 3Rs (reduce, reuse and recycling). It includes a series of strategies and practical actions towards achieving the goal of a zero waste, circular and sustainable society by 2030. The National Waste Management Strategy and Master Plan links with other national policies, strategies and development plans as well as contributes to achievement of the country's commitments under the Sustainable Development Goals (SDGs) and Paris Climate Agreement.

To achieve the objectives of strategies, the most important factors for success are implementation, monitoring and enforcement. Therefore, I would like to encourage all the relevant ministries, government departments, state and regional governments, CDCs, townships, private sector actors, local and international nongovernmental organisations (NGOs), civil society and international agencies to work together, in order to carry out Myanmar's first National Waste Management Strategy and Master Plan to the fullest extent possible.

Myint Swe
Vice President
Patron,
National Environmental Conservation and
Climate Change Central Committee (NECCCC)

In Myanmar, the Ministry of Natural Resources and Environmental Conservation (MONREC) formulated the country's Environmental Conservation Law in 2012, which sets long-term policy, establishes political leadership and provides directions for government to work towards achieving sustainable development. In so doing, it also serves as an umbrella law aimed at instituting basic principles and guidance for the systematic integration of environmental concerns into the sustainable development process. According to the Environmental Conservation Law (2012), MONREC is responsible for formulating national or regional strategies and action plans relating to environmental conservation and management. In this context, development of the country's National Waste Management Strategy and Master Plan represents an important and timely step for addressing waste management issues, given the scale and scope of the challenge in Myanmar.

Myanmar's National Waste Management Strategy and Master Plan is the country's first guiding document that seeks to address waste management in a more holistic and integrated manner, covering waste in all its forms (solid waste, liquid waste/ wastewater, and gaseous emissions). Accordingly, the Strategy and Master Plan identifies an overall vision, requisite programmes as well as short, medium and long-term goals and key actions for delivering environmentally sound waste management. However, ensuring these measures are successful will require the active involvement and participation of all stakeholders, complemented by a supportive institutional framework and a sound budgeting process to guide the implementation and monitoring of each of the respective goals. For this reason, I hope that the relevant government ministries, departments and local authorities, states and region development committees, development agencies, as well as international and local Non-Governmental Organisations (NGOs) will play an active role in the implementation of the strategy at all levels, and I would like to encourage all stakeholders to consider making the institutionalisation of the National Waste Management Strategy and Master Plan a priority consideration.

Lastly, I would like to specifically thank the UN Environment and IGES Centre Collaborating with UNEP on Environmental Technologies (CCET) for their continued technical support and contributions towards making the Strategy a reality. I also give my thanks to all of those who have driven this process forward, most especially those individuals who have actively contributed to the drafting and formulation of this document and who are committed to its success.

U Ohnn Win
Hon. Union Minister,
Ministry of Natural Resources and Environmental Conservation (MONREC), Myanmar

This National Waste Management Strategy and Master Plan for Myanmar has been prepared to provide the strategic vision, guiding principles, long-term goals and key activities for addressing waste management in Myanmar in a more holistic and integrated manner. Based on this document, the Ministry of Natural Resources and Environmental Conservation (MONREC) will continue to focus on promoting zero waste, zero emissions and an overall circular economy aimed at achieving a greener, cleaner and healthier environment in the country.

The Strategy is designed to respond to the needs and priorities of different actors at various levels. At the policy level, the strategy proposes necessary policy interventions to the national government, taking national and city development plans into account and suggesting options for waste management to align with long-term development efforts. At the stakeholder level, it establishes a supportive institutional framework. At the operational level, it addresses the awareness and training needs of relevant stakeholders involved in waste management. The strategy also includes basic technology specifications for addressing a range of considerations associated with the waste management chain. Similarly, the master plan complements the strategy by outlining a way forward in terms of different activities that can be undertaken taken in order to achieve the objectives set out by the Strategy. The master plan also includes a number of project concepts on concrete pilot actions that might be applied towards implementing the Strategy. Monitoring and feedback mechanisms should be put in place on this basis with a view to reviewing the Strategy and master plan on a periodical basis and to accommodate adjustments as necessary.

Waste management is a crosscutting issue affecting many aspects of society such as health, poverty, food and resource security, as well as sustainable production and consumption. Given that sound waste management offers numerous benefits both to society and the general economy, carefully implemented waste management policy and strategy has the potential to contribute to all three pillars of sustainable development (environmental, economic and social). Accordingly, addressing waste management issues by way of the National Strategy and Master Plan demonstrates Myanmar's commitment to achieving the Sustainable Development Goals (SDGs), particularly Goals 11 (Sustainable Cities and Communities) and Goals 12 (Sustainable Consumption and Production).

U Hla Maung Thein,
Director General (DG)
Environmental Conservation Department (ECD), Ministry of Natural Resources and
Environmental Conservation (MONREC), Myanmar

Environmentally sound management of waste underpins sustainable development. Waste management opens new employment and business opportunities while improving people's health and the health of our environment. UN Environment began assisting in the development of national and city level waste policies, strategies and action plans in response to a resolution adopted by the UN Environment General Assembly at its second session in 2015. In this context, the International Environmental Technology Centre of the UN Environment has been happy to work with numerous stakeholders around the world, including in Myanmar. This National Waste Management Strategy and Master Plan for Myanmar (2018-2030) is the first document that has been developed with and for Myanmar as a roadmap towards sound management of waste. The plans build on existing waste management practices and take account of national and local socioeconomic development goals and a range of public and private stakeholders. UN Environment very much looks forward to Myanmar achieving the short, medium and long-term targets for sound management of waste outlined in this plan.

Keith Alverson

Director of International Environmental Technology Centre, UN Environment

Poor waste management practices contribute to a number of significant environmental and public health impacts in Myanmar. For instance, due to a lack of proper collection, transportation and disposal systems, much of Myanmar's generated waste ultimately becomes pollution, negatively affecting the country's open lands, channels and rivers. Leachate from unmanaged disposal sites has been linked with soil and water contamination; open burning of waste directly leads to a reduction in air quality and, more broadly speaking, climate change. Moreover, failing to utilise recycled materials from waste represents a missed opportunity for resource recovery, accelerating the depletion of raw materials as well as increasing costs. These issues, together with gaps in institutional capacity and associated financial constraints, underline the Government of Myanmar's decision to emphasise waste management as an important planning and policy priority. In this context, Myanmar's National Waste Management Strategy — a joint effort of the Ministry of Natural Resources and Environmental Conservation (MONREC), the IGES Centre Collaborating with UNEP on Environmental Technologies (CCET), with the support of UN Environment and the Ministry of Environment of Japan (MOEJ) — highlights the main issues, needs and challenges associated with efforts to improve the country's waste management system, aimed at raising awareness among key stakeholders towards achieving a resource efficient and zero waste society in Myanmar. It intends to identify strategic programs and approaches to improve waste collection, diversion, final treatment and disposal of solid, liquid and gaseous waste including, among others, industrial, medical and other hazardous waste, waste water from the domestic and commercial sector, and air pollution generated from poor management practices, whilst ensuring waste services are made sustainable over the long term through supportive financial mechanisms, sound policies, and robust institutional and monitoring frameworks. Accordingly, targets and actions have been identified and proposed, with a view towards encouraging strengthened political commitment, participation and collaboration of key public, private and civil society actors (citizens, businesses, academia and other stakeholders) for guiding efficient and effective waste management practices in Myanmar.

Kazunobu Onogawa

Director, the IGES Centre Collaborating with UNEP on Environmental Technologies (CCET)

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List of Abbreviations

3R	Reduce, Reuse, Recycle
ADB	Asian Development Bank
BORDA	Berman Overseas Research and Development Association
CBD	Central Business District
CCET	IGES Centre Collaborating with UN Environment on Environmental Technologies
CDCs	City Development Committees
CSOs	Civil Society Organisations
ECD	Environmental Conservation Department
EQM	Environmental Quality Management Co. Ltd.,
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse Gases
IETC	International Environmental Technology Centre
IGES	Institute for Global Environmental Strategies
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency
KOICA	Korean International Cooperation Agency
MCDC	Mandalay City Development Committee
MONREC	Ministry of Natural Resources and Environmental Conservation
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
NCDP	National Comprehensive Development Plan
NGO	Non-Governmental Organisation
NPTDC	Nay Pyi Taw City Development Committee
NSDS	National Sustainable Development Strategy
NWMSMP	National Waste Management Strategy and Master Plan
PCCD	Pollution Control and Cleansing Department
PPP	Public-Private Partnership
PRC	People's Republic of China
SEZ	Special Economic Zone
SWM	Solid Waste Management
TDCs	Township Development Committee
UN-Habitat	United Nations Human Settlements Programme
UN Environment	United Nations Environment Programme
UN Environment-IETC	United Nations Environment Programme - International Environmental Technology Centre
UNDP	United Nations Development Programme
WHO	World Health Organization
WWF	World Wide Fund for Nature
YCDC	Yangon City Development Committee

Executive Summary

Myanmar has had to face tremendous challenges in waste management in the recent past, due to a number of factors – its growing population and economy, increasing complexity of waste streams, and lack of effective waste management systems, proper infrastructure, capital investment, financial and human resources, as well as effective policy and regulatory environment. As a cross-cutting issue, waste management touches on all aspects of sustainable development, including the environment, society and economy, and as such is widely associated with a range of global challenges, including public health, climate change, poverty, food security, resource efficacy, sustainable cities and production and consumption.

To address these issues, the National Waste Management Strategy and Master Plan (2018-2030) was developed by the Ministry of Natural Resources and Environmental Conservation (MONREC) with the assistance of the International Environmental Technology Centre (IETC) of the United Nations Environment Programme (UN Environment) and the IGES Centre Collaborating with UNEP on Environmental Technologies (CCET). It aims to build capacity for sustainable waste management and promote development of a conducive policy framework and strategies that transit from a conventional waste management paradigm to sustainable waste management based on waste hierarchy and the 3Rs (reduce, reuse and recycle), in linkage with other national environmental policies.

The National Waste Management Strategy and Master Plan is the first national initiative aimed at institutionalising waste management and offers a vision and strategy to address key issues, needs and challenges, whilst also raising awareness amongst key stakeholders towards achieving a resource-efficient and zero-waste society. Its holistic nature means it addresses waste in all its forms (solid waste, liquid waste/wastewater, and gaseous emissions) for pollution control and environmental management, although at present prioritises solid waste management.

The National Waste Management Strategy and Master Plan is also intended to identify strategic policy directions, programmes and actions for sustainable development in waste management, ensuring that wastes generated are managed in a more environmentally-friendly manner to both limit short-term environmental impacts caused by the waste management system, as well as, over the medium and long term, be socially acceptable and economically feasible. The waste management hierarchy and 3Rs together provide a conceptual framework that will lead to the most desirable waste management options in order to improve solid waste collection, intermediate treatment and disposal. It is structured around a framework of six goals and identified priority actions to maximise proper collection and disposal of all solid waste including municipal, industrial, medical, plastic, hazardous and emerging waste, proper disposal and treatment of liquid waste (waste water from domestic sector and industry), whilst ensuring waste management services are sustainable over the long term. The latter would be achieved through establishing an enabling framework including supportive financial mechanisms, sound policies, and institutional and monitoring frameworks.

Implementation of the National Waste Management Strategy and Master Plan (2018-2030) is a priority of the ECD, MONREC, and relies on strong participation and collaboration from all other key stakeholders (citizens, industries, academia, city development committees, townships, other line ministries and departments, and actors) in order to provide guidance on efficient and effective waste management services. It is subject to periodic reviews and evaluations according to targets, in order to monitor progress and identify any actions that need to be taken in the face of new obstacles.

1. INTRODUCTION TO THE STRATEGY

1.1. Presentation of the strategy

After decades of isolation, Myanmar is roaring ahead with the fast growing economy in Asia. Its economy has experienced strong growth, exceeding 6% GDP expansion every year, since a series of political and economic reforms in 2011 (ADB, 2016; World Bank, 2018).

This rapid economic growth with urbanisation and industrialisation has led to significant challenges with the management of waste. Daily waste generation, especially in three of the largest cities in the country (Yangon, Mandalay and Nay Pyi Taw), have increased dramatically, which in turn is leading to a number of public health and environmental pollutions. Typically, between one to two-thirds of generated waste in many townships is not properly collected, and uncollected waste is often dumped on open land, in the streets and in waterbodies, or burned in the open, causing pollution to both surface and ground water. In addition, the volume of industrial and other hazardous waste is also growing rapidly in Myanmar, emphasising the importance of an integrated approach to manage all waste.

In this regard, the ECD of the MONREC has been actively working with the International Environmental Technology Centre of the UN Environment and other relevant ministries, departments, institutions, state/regional governments, townships and all other relevant stakeholders to develop a National Waste Management Strategy and Master Plan for Myanmar. It aims to build capacity for sustainable waste management and promote

the development of conducive policy framework and strategies, moving from conventional waste management (collect, transport and disposal) thinking and practice to sustainable waste management based on waste hierarchy and 3Rs.

The National Waste Management Strategy and Master Plan is the first national initiative aimed at institutionalising waste management and offers a visionary document and strategic guide to address key issues, needs and challenges whilst raising awareness amongst key stakeholders towards achieving a resource efficient and zero waste society. It respects the holistic nature of waste management, which needs to address waste in all its forms (solid waste, liquid waste/wastewater, and gaseous emissions) for pollution control and environmental management. However, considering the current priority, this strategy and master plan gives more focus to solid waste management at present.

The National Waste Management Strategy and Master Plan also intended to identify strategic directions, programmes and actions to improve solid waste collection, reduction through 3Rs, intermediate treatment and disposal. In addition, it identifies priority actions to maximise proper collection and disposal of industrial, medical and other hazardous waste, proper disposal and treatment of liquid waste (waste water from domestic and industries) whilst ensuring waste management services are made sustainable over the long term through establishing an enabling framework including supportive financial mechanisms, sound policies,

institutional and monitoring frameworks. Accordingly, targets and actions have been identified and proposed, aimed at encouraging the strong participation and collaboration of key actors (citizens, industries, academic and other stakeholders) for guiding efficient and effective waste management services.

1.2. Vision statement

In light of the vision, statements outlined both in Myanmar's National Sustainable Development Strategy (NSDS, 2009) and the National Environment Policy (2018): The vision *"Sustainable, Green, Clean and Healthy Environment towards a Brighter Future for*

Myanmar" was identified as a common declaration for the National Waste Management Strategy and Master Plan.

1.3. Mission statement

Accordingly, the National Waste Management Strategy and Master Plan's Mission Statement is as follows:

"To develop and implement the holistic and integrated waste management strategy based on principles of inclusiveness, zero waste, zero emissions and circular economy to achieve a greener, cleaner and healthier environment in Myanmar".

2. STRATEGY DEVELOPMENT – THE PROCESS

The National Waste Management Strategy and Master Plan for Myanmar was developed by the ECD of the MONREC with technical assistance from the CCET. It was developed with the participation of relevant governmental agencies at national, regional/states and township levels, the private sector, industries, academic and civil society groups through organising a series of consultative workshops and focus group discussions during the period of 2016-2018 (Figure 1).

As a first step, a quick study/baseline report was prepared based on a literature review, focus group meetings, personal interviews and site visits to respective waste management facilities to understand the current state of waste management in major cities, including Yangon,

Mandalay and Nay Pyi Taw and to identify major gaps to be addressed in the national strategy.

Accordingly, a multi-stakeholder consultation workshop, entitled “*First Workshop on the Development of National Waste Management Strategy and Master Plan for Myanmar*” was organised on 13-15 June 2016 in the capital city of Nay Pyi Taw to solicit inputs and views of key stakeholders on the drafting of the National Waste Management Strategy and Master Plan. The workshop was attended by about 50 participants representing a range of government ministries and departments, the private sector, industries, academic institutions, NGOs, CSOs, community groups and international agencies, and featured interactive discussions on the process of identifying key goals, targets,



Figure 1: A Participatory Consultation Process in Preparing the National Waste Management Strategy and Master Plan in Myanmar

objectives and actions to move towards resource efficiency and a zero waste society.

The editorial team then prepared the first draft of the National Waste Management Strategy and Master Plan based on the major findings of the first multi-stakeholder workshop and quick study during the period of June – August 2016. Following that, a roundtable meeting was held on 12 September 2016 at the office of the ECD in Nay Pyi Taw, inviting key national institutions and other relevant members from private, academic and civil society groups to present the draft strategy and action plan, discuss its contents and technical feasibility, and to reach a consensus on the final format and content. Based on the results of this roundtable meeting, the draft strategy and master plan was further improved and made ready for a subsequent multi-stakeholder workshop by the editorial team.

The updated draft of the National Waste Management Strategy and Master Plan was thereafter shared in a subsequent multi-stakeholder workshop held on the office premises of the YCDC on 5-6 December 2016 to discuss any further revisions and updates to the strategy and master plan. About 80 participants attended the workshop, representing relevant ministries, departments, regional/states and townships, the private sector, academia, education, citizen groups, NGOs as well as international development partners. Notably, and further to MONREC's request for ensuring close alignment between the national, regional/ state and townships, regional MONREC representatives from Myanmar's one Union Territory (Nay Pyi Taw), seven states (Kayin, Mon, Chin, Kachin, Rakhine, Shan, Kayah) and seven

regions (Yangon, Mandalay, Magwe, Ayeyarwady, Thanintharyi, Bago, Sagaing) also took part in the workshop in person to input their ideas and feedback into the draft strategy.

The final draft of the National Waste Management Strategy and Master Plan was then prepared based on the outcomes of this multistakeholder workshop. The final report was later presented and discussed at the final national workshop in Nay Pyi Taw on 7 August 2017 for final endorsement of the strategy and expression of commitment to its implementation by the relevant stakeholders.

In addition, the National Waste Management Strategy and Master Plan was also shared and discussed within a number of other events organised by MONREC and relevant agencies to raise awareness of and receive feedback to the strategy from a wider audience. These events included: (i) Industries, Urban and Rural Waste Management Working Group Committee meeting, Environmental Conservation Department, Nay Pyi Taw, 3 November, 2016; (ii) Workshop for Myanmar's Green Growth Potential Assessment (GGPA), 9 February 2017, Thingaha Hotel (Nay Pyi Taw); (iii) Waste management seminar organised by the Golden Dowa, 5 April, 2017, Rose Garden Hotel, Yangon; (iv) Workshop for Solid Waste Management in Myanmar at Mandalay City hosted by the Embassy of France; (v) Myanmar Waste Management Workshop, 16 January 2018, Park Royal hotel, Nay Pyi Taw during the Environmental Week between Japan and Myanmar, (vi) a series of waste management awareness programmes organised at ECD Head Office and the NPTDC.

3. WASTE MANAGEMENT- WHERE ARE WE NOW

3.1. Overview

Myanmar is the largest country in mainland Southeast Asia, with a total land area of 677,000 sq. km. It is strategically located as a land bridge between South and Southeast Asia and shares borders with Bangladesh, the People’s Republic of China (PRC), India, the Lao People’s Democratic Republic, and Thailand (Figure 2). In addition to its strategic location, Myanmar has been famous for its wealth in natural resources of all kinds, including oil and gas, various minerals, precious stones and gems, timber and forest products, hydropower potential, etc. According to the Myanmar Population and Housing Census (2014), the total population was about 51.48 million in 2014. However, a recent estimate puts it at about 54 million as of 2017, with an annual increase of 0.71% (Worldometers, 2017). Approximately one-third of Myanmar’s population is classified as living in urban areas, while the remainder resides in rural areas and depends largely on subsistence farming. The capital of the country is Nay Pyi Taw, located midway between Myanmar’s two largest cities of Yangon, with a population of about 5.2 million, and Mandalay, with a population of about 1.3 million (Ministry of Immigration and Population, 2015).

The country is divided into one union territory (Nay Pyi Taw), seven states (Chin, Kachin, Kayah, Kayin, Mon, Rakhine, and Shan) that mainly encompass hilly and mountainous areas, and

are predominantly populated by ethnic communities of the seven regions or divisions (Ayeyarwady, Bago, Magway, Mandalay, Sagaing, Tanintharyi, and Yangon). Similarly, Myanmar’s plains region is predominantly populated by people of Bamar ethnic origin. Myanmar, a lower-middle income economy with a GNI per capita of 1,455 USD in 2017, is one of the fastest growing economies in the East Asia and Pacific region and globally. The GDP growth rate for 2016/2017 was 6.4% and is expected to remain the same in 2017/18, growing to 6.7% in 2018/19 and 7% in 2019/2020, mainly driven by services, industry and agriculture (World Bank, 2018). Myanmar is an agricultural country, and



Figure 2: A Location of the Myanmar in the Southeast Asia context

the agriculture sector is the backbone of its economy, contributing to 37.8% of GDP, 25% to 30% of total export earnings, and which employs 70% of the labour force (FAO, 2018).

In contrast, the share of GDP accounted for by the industrial sector more than doubled during the recent past, to 25%. Liberalisation of the economy and opening up to foreign direct investment (FDI) has prompted rapid growth in this sector, notably through exports of natural gas. In addition, the services sector has been expanding strongly in recent years, and the opening of the economy offers great potential for the development of tourism and related services.

However, underinvestment in urban infrastructure and services including water supply, sanitation, drainage, wastewater, and solid waste management has resulted in significantly deficient urban services throughout Myanmar, especially in the large urban areas of Yangon and Mandalay. Inadequate water, drainage and sanitation services, coupled with insufficient investment in preventative health care, have resulted in significant health challenges at many levels. The incidence of diarrhoea among children under 5 years of age is considerably higher than elsewhere in Southeast Asia, contributing to a high child mortality rate. Out of every 100 children, 6.2 die before their first birthday and 7.2 before their fifth (Population and Housing Census, 2014). The high prevalence of debilitating water-related vector borne diseases, such as malaria, dengue, and Chikungunya fever are also directly related to the poor state of critical urban services (ADB, 2013). Myanmar is one of the world's most disaster-prone countries and is exposed to

multiple hazards, including floods, cyclones, earthquakes, landslides, and droughts, ranking 2nd out of 187 countries in the 2016 Global Climate Risk Index and 9th out of 191 countries in the INFORM Index for Risk Management.

3.2. Current status of waste management

Waste in Myanmar is generated from a number of sources, such as households, commercial and business establishments, institutions, public areas, hospitals and industries. Myanmar's rapid industrialisation and urbanisation, which have accompanied economic growth, together with gradual shifts in consumption and production patterns have precipitated immense challenges in managing waste generation from all of these various sectors. Currently, there exists no accurate and reliable data on the total waste generation in the country. According to 2012 estimations by the World Bank, solid waste generation in Myanmar was 5,616 tonnes/day, with per capita waste generation totalling 0.44 kg/capita/day. This figure was expected to reach about 21,012 tonnes/day with 0.85 kg/capita/day by 2025 (World Bank, 2015).

However, recent estimations show that Myanmar already produced approximately 20,000 tonnes of solid waste per day as of 2017 (Netherland Enterprise Agency, 2017). This report also highlights that the current average production of waste in two major cities, Yangon and Mandalay is about 0.8 kg per capita per day, which is assumed will grow to 1.0 kg per capita per day in 2025.

Traditionally, waste collection and disposal in Myanmar was the responsibility of respective townships. In Yangon, Mandalay and Nay Pyi

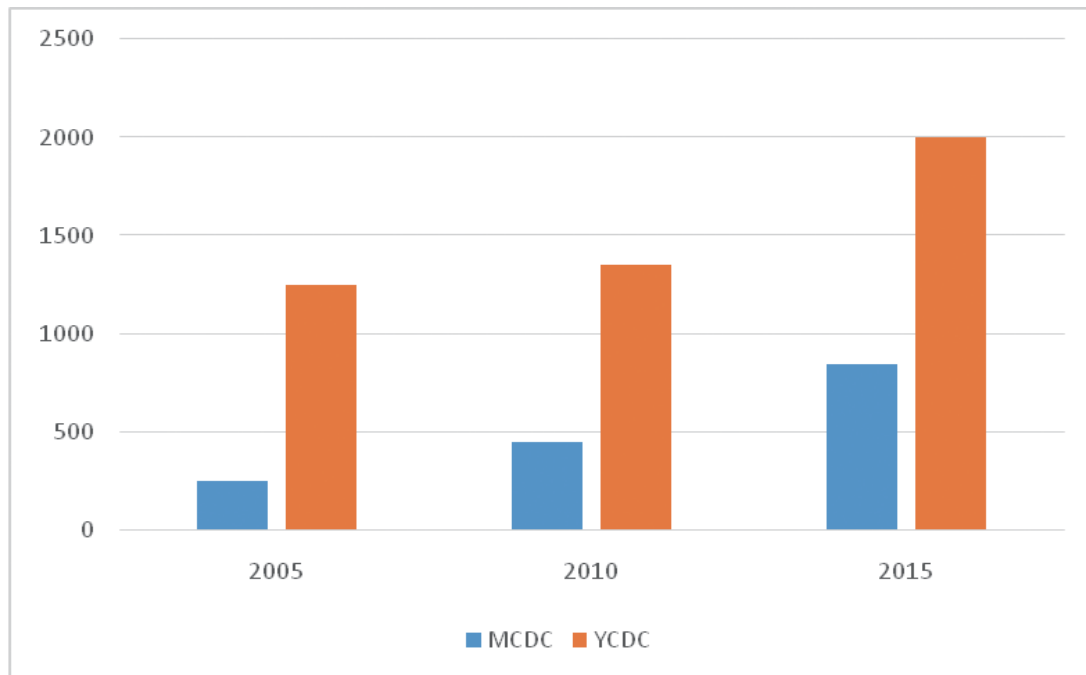


Figure 3: Waste generation in two largest cities in Myanmar. Source: MCDC and YCDC, 2016

Taw, autonomous CDCs with their respective administrative departments and sub-units are tasked with waste management within their boundaries. In other parts of the country, including 285 townships, respective TDCs are responsible for managing waste collection and disposal.

Out of the total waste generation in the country, at least half is generated by three major cities: Yangon (2,000 tonnes/day), Mandalay (955 tonnes/day) and Nay Pyi Taw (200 tonnes/day). However, these figures only reflect the volume of waste reaching city dump sites and do not include waste not collected, burned, dumped elsewhere or recycled/reused. It should be assumed that the real figures are higher. Due to the escalating state of waste generation in most of these larger cities (Figure 3), all of them have prioritised waste management as issues of immediate concern, both in terms of the environmental pollution and in terms of public health.

Municipal Solid Waste (MSW):

Although there are no set specifications at both national and regional and/or township levels, MSW is generally defined as the “non-gaseous and non-liquid waste” that results from the daily activities of residential, commercial and public operations (public markets, street sweepings, etc.) within a given administrative area. Myanmar’s MSW is generated from households (60%), markets (15%), commercial producers (10%), hotels (2%), gardens (5%) and other institutions (8%). MSW also contains mainly organic materials (77%) with the balance comprising plastic (13%), paper (7%), and other residuals (3%). This has been largely confirmed by observation and evaluation of the waste composition of Yangon and Mandalay cities (Figure 4).

The existing methods of waste collection by the cities consist of primary collection, secondary collection and final disposal. Primary waste collection methods include door-to-door

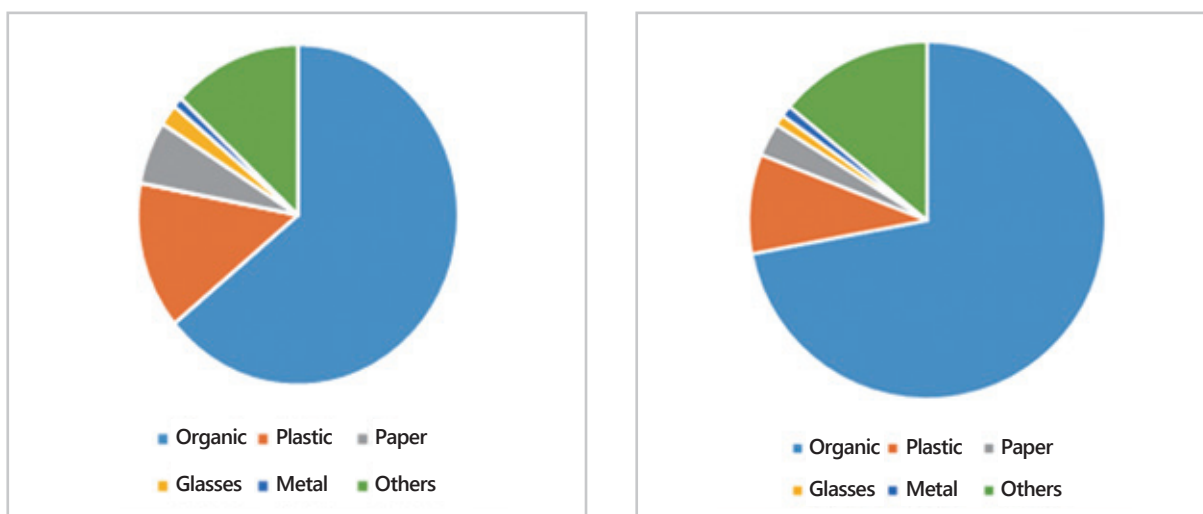


Figure 4: Waste composition in Mandalay (left) and Yangon (right). Source: MCDC and YCDC, 2016

collection, kerb side, bin container collection, and open or communal waste collection points. Door-to-door collection is a particularly labour intensive activity making use of various announcement methods such as bell ringing and loudspeakers. Accordingly, door-to-door collection is carried out using either or a combination of pushcarts, tri-bikes and tipper trucks based on the physical conditions of the respective areas (Figure 5).

Some cities in Myanmar conduct public awareness-raising campaigns and environmental education programs for local residents to mobilise support for 3Rs (waste reduction, reuse and recycling activities). For example, the Mandalay City Development Committee has prohibited the production, trading and use of thin plastic bags in its administrative area, and since 2009 promotion of alternative bags such as string bags, leaf boxes and baskets. The Mandalay City Development Committee aims to promote more sustainable lifestyles and has implemented public awareness programmes.

Similarly, recycling activities are carried out in many cities in Myanmar mostly by the informal sector, which includes scavengers, waste collectors, and waste dealers. These scavengers and waste collectors collect recyclable materials such as newspapers, metal, plastic bottles, tin and glass from households, communal depots, streets, commercial areas and final disposal sites and in turn sell them to waste dealers who subsequently clean, sort, store and sell them in bulk to the recycling industry both locally and for export (Figure 6). Currently there is a lack of accurate and reliable data on recycling volumes, ratios and the number of recycling factories present in Myanmar cities. However, a sample survey carried out in Yangon City identified that 86 tonnes of recyclable materials are directed to the waste dealers per day. Out of this total, 57% was glass; cardboard and paper accounted for 15% and 13%, respectively. Plastic (7%), tin cans (7%) and other materials such as metal, iron and steel, (1%) were observed to also be collected.

At present, waste collected by townships is transported to designated disposal sites located



Figure 5: A view of typical waste management system in Myanmar's cities



Figure 6: A typical recycling system in Myanmar cities

within their city boundaries. A number of disposal sites that are used for waste dumping were identified in Yangon City and Mandalay City. These are often located about 10 to 25 km away from the city's CBD (central business district) area and are found to have an area of approximately one hectare or so. The typical period of time dumping can be conducted in line with onsite capacity was observed to be one or two years to a maximum of five years. Most disposal sites face challenges in terms of operations and management. Transported waste is unloaded on the ground or onto existing waste. Waste pickers subsequently sort waste by hand and manual tools, such as rakes. Following manual sorting, unsorted waste is moved further inside the dumpsite by using mechanical equipment, such as bulldozers. Sorted waste is thereafter packed, stored and transported back to the city for resale. Landfill fires are common and these generate dense smoke and noxious fumes. In addition to offensive odours, uncontrolled dumps pose a number of health hazards including from pathogenic organisms, insects, rodents as well as air pollution from dust, accidental burning, and ground and surface water pollution from issues of unaddressed leachate.

In order to improve environmental and sanitation conditions aiming at proper MSW treatment and disposal, the government of Myanmar and Japan jointly built a waste to energy model plant in Yangon city with funding of 16 million USD, 8 million of which came from the Yangon City Development Committee and 8 million from the Japanese Government under its financial support scheme, the Joint Credit Mechanisms (JCM), which assists developing countries through transfer of Japanese low-

carbon technologies. The model plant is designed and constructed by JFE Engineering Corporation (JFE), one of Japan's leading companies using state-of-the-art technology to achieve higher power generation and waste volume reduction efficiency. The model plant, which has a capacity of 60 tonnes/day (1 unit), started operations from April 2017 on a trial basis, jointly with the YCDC and JFE. The plant is estimated to contribute to the reduction of 4,800 tonnes of Carbon Dioxide (CO₂) a year. It also aims to generate 700 KW and use 300 KW for its own operations, with the rest being sent to the national grid. The plant is still in its infancy, but lessons learned and applicability as well as sustainability should be studied and well documented before upscaling within Yangon city and other cities. In addition, another private company, Organic Asia Group from Thailand, had planned to generate energy from municipal solid waste in Mandalay. However, this project was not successful due challenges including difficulty in selling the generated electricity.

Industrial waste:

Although Myanmar's economy is largely based on agricultural production, the government is placing increasing emphasis on industrialisation. In this regard, the government has made efforts to enhance the country's basic infrastructure, including bridges and communication systems to accelerate economic activities. Accordingly, Myanmar's Ministry of Industry is responsible for managing state-owned industries, including 18 industrial zones and three special economic zones as well as coordinating with private industries to engage with the industrial sector. Moreover, seven industrial zones are planned to be extended further.

Industrial waste varies enormously. Some waste is consistent in composition and therefore more easily recovered, but may require management because it is hazardous, or contaminated with materials that require special management. Other waste may be heterogeneous in amount and composition, which will affect the economics of reuse, materials recovery, and recycling as well as disposal options. Mining industries and mineral refining generate very large volumes of waste material, although accurate data is not available. Some of this waste may lend itself to reprocessing and recovery. Other waste will need to be managed by landfilling or long-term storage, in some cases. Additionally, changes in raw materials can reduce waste volumes.

Notably, the government has made some efforts to encourage the industrial sector to minimise impacts on the environment. For instance, in order to avoid unnecessary pollution and damage to the natural environment caused by industrial waste, Myanmar's Water and Air Pollution Control Plan (Standing Order No.3) was issued in 1995. In this order, actions to control, reduce and eliminate waste must be progressively developed and carried out.

However, it was found that all major cities (Yangon, Mandalay and Nay Pyi Taw) are facing tremendous challenges with regard to managing industrial waste. Accordingly, all cities are responsible for collecting industrial waste from respective factories but only on an on-call basis. Consequently, collected waste is often transported to landfill sites without prior treatment. There is currently no reliable data on the generation and collection of industrial waste by the cities. According to the Yangon City

Development Committee, approximately 150 tonnes of industrial waste is collected by the city daily. In Yangon, Dowa Eco-System Co., Ltd., a subsidiary of Dowa Holdings Co., Ltd. in Japan, has established and begun operating Myanmar's first controlled landfill facility at the Thilawa Special Economic Zone. This area is jointly developed by Myanmar and Japan, with the development of Phase One Area (211ha) completed in June 2015. It is planned that this site will receive industrial waste not only from the Thilawa Special Economic Zone but also from across the country in due course. In addition to tackling different discharge sources, and managing the controlled landfill, the new company will provide comprehensive waste management services to cover the collection, transportation, intermediate treatment and recycling of waste according to their different characteristics. In so doing, the company will work to address the waste management needs of different industries whilst helping to contribute towards sustainable industrial development in Myanmar.

Medical waste:

Overall, medical waste management practices in Myanmar are substandard although there is basic awareness at all levels about the importance of protecting health workers, as well as visitors to health care facilities and communities living within the vicinity of health care waste. Cities are responsible for collecting medical waste. Both Yangon City Development Committee and Mandalay City Development Committee collect medical waste from large hospitals and special clinics on a daily basis, while a collection service is provided to smaller facilities once a week or on an on-call basis. Three different coloured bags are used for



Figure 7: A typical medical waste treatment system in Myanmar's cities

separating the waste: (i) blue or green (YCDC)/ black (MCDC) for non-hazardous health care waste or domestic waste uncontaminated with infectious or pathogenic agents (food residues, paper, cardboard and plastic wrapping); (ii) yellow for pathological waste, infectious waste as well as items that have been used for medical care; and (iii) red for sharps, and mainly, but not exclusively, auto-disable or disposal syringes with needles and pharmaceutical waste that consists of outdated drugs or expired unfinished medical solvents. Infectious waste is incinerated or burned in the dig made at the cemetery while sharp wastes are buried underground in landfills (Figure 7). Other waste is treated as domestic waste. Data on the current levels of medical waste generation in the country is incomplete, but Yangon City Development Committee and Mandalay City Development Committee estimate that on average medical waste

amounts to 1,825 and 730 tonnes per year, for each city respectively. A significant portion of this (over 70%) is infectious waste.

Plastic waste:

The issue of plastic waste is receiving increased attention these days due to its negative impacts on the environment, public health and wellbeing. According to Earth Day Network (2018), about 300 million tonnes of plastic is produced annually, half of which is destined for Single-use products. The World Economic Forum (2016) reported that only 14% of plastic packaging is collected for recycling with just 10% actually recycled. The rest, End-of-Life Plastic, is landfilled (40%), incinerated (14%), or alarmingly, leaks into the environment (32%), where it may take up to 1,000 years to decompose, leaching potentially toxic substances into soil and water. The impact of

terrestrial microplastic pollution in soils, sediments and freshwater could have long-term negative effects on ecosystems. The report also points out that in excess of 8 million tonnes of plastic enters the oceans each year (World Economic Forum, 2016), and Myanmar, a country within the top 20 (as ranked by mismanaged plastic waste according to global data; Jambeck et al., 2015) is no exception. The data shows that the total volume of mismanaged plastic is about 0.46 million tonnes per year, of which about 0.1 million tonnes is plastic marine debris.

Against this background, several different stakeholders in Myanmar have started to address this issue with various initiatives. YCDC officially announced a ban on businesses manufacturing, importing, trading and distribution of high-density polyethylene (HDPE) plastic bags for environmental reasons in 2009, which was followed, two years later, by a ban on polyethylene bags by the MCDC as well as attempts, by Yangon authorities, to stem the production, storage and sales of nonbiodegradable waste such as polyethylene bags in 2011. A number of important initiatives have also taken place to raise awareness of the importance of ridding the world of plastic pollution and man-made waste, as one of Myanmar's national environmental priorities. In one such initiative, a community of food and beverage services in Yangon launched a campaign titled "Straws Suck", which was aimed at ceasing the practice of serving customers single-use plastic straws. The activity, started in 2017 by a group of restaurants and bars, generated much interest and was soon adopted by others too, and involves providing reusable, biodegradable alternatives. To highlight the

impact of plastic waste on rivers and oceans, an art studio and gallery, "Wired 39" is currently collaborating with a group called "Beat Plastic Pollution in Myanmar" in an art installation created by collecting plastic bags and bottles. Further, signs have been placed on some roads announcing 'Plastic Bag Free Zone' (MYANMORE 2018, Mar, W. W, 2018).

On an industrial scale, considerable private activities are underway for wholesale trading of bulk plastic waste with foreign countries, such as China. Another interesting initiative was the so-called "Chu Chu Store" (Chu Chu is Burmese for small plastic bag), found in Dala, a suburb of Yangon. Indeed, plastics recycling is starting to take hold as a regular industry within Myanmar, as both larger plastic factories and various small factories have sprung up in Yangon and Mandalay cities. Despite such initiatives, however, the country still has a long way to go before plastics collection and recycling reach such a scale as to impact on waste reduction, which is due to poor waste management policies and regulations, as well as the lack of financial schemes and appropriate technologies (MYANMORE 2018, Mar, W. W, 2018, Netherland Enterprise Agency, 2017).

Emerging and other special waste:

In addition to the above waste categories, there are some emerging and special waste streams, which present specific challenges and warrant particular management systems. For example, electronic waste (E-waste), chemical and mercury-containing waste (mercury waste includes fluorescent lamps, thermometers, and dental amalgam). These types of waste cannot be sold or processed as valuable materials without proper separation and careful

management. In addition, some materials cannot be destroyed, and therefore must be immobilised, permanently encapsulated, or managed in perpetuity — all costly processes that illustrate the importance of changing product composition, industrial processes or the sources of raw materials.

E-waste is one of the fastest-growing waste streams in Myanmar due to increased consumer demand, rapid changes in technology, inventions of new electronic devices and availability of cheap import products. The situation is compounded by the short lifespans of certain products and products not being designed with recycling in mind. E-waste comes from a broad range of electronic products such as computers, televisions, and video games, as well as all kinds of electrical equipment, often divided into large equipment (washing machines, air-conditioners, freezers, etc.) and small equipment (hairdryers, electric toothbrushes, vacuum cleaners, etc.).

A 2015 report by the United Nations University (UNU) estimated that 29,000 tonnes of e-waste was generated in 2014 with 0.4 kg per capita. However, as no national data or information currently exists about these waste types and their operation, it can only be inferred that the volume has been increasing, and that the existing informal treatment and recycling practices result in major environmental pollution and public health impacts. Examples of operations include backyard dismantling into various parts (metal frames, power supplies, circuit boards, plastics), often by hand, but increasingly by automated shredding equipment; open burning for segregating organic and inorganic compounds (for example,

burning cables to recover copper); and using acids to recover gold, silver, palladium and copper, largely from printed circuit boards (Figure 8).

Considering the importance of handling hazardous waste, ECD has been working with the Norwegian Environmental Agency and SINTEF in developing the Hazardous Waste Management Master Plan for Myanmar. This aims to assist in developing a regulatory framework for HWM in Myanmar, including implementation of the Basel Convention. In addition, the Department of Marine Administration under the Ministry of Transport and Communication has implemented a port reception facility for systematic management of wastes from international shipping.

Wastewater:

Inadequate wastewater and sanitation services, combined with underinvestment in preventative health care, have resulted in significant environmental and human health challenges. Research on solid waste management identified that large resettlement areas in Yangon, Mandalay and Nay Pyi Taw have urban sanitation services that are well below acceptable levels, with the situation worse in other poor regions and areas of the country. With the exception of central business districts, there are no conventional central wastewater and sewerage collection and treatment systems in any of Myanmar's three major cities. Domestic wastewater is usually released into the storm water drainage and natural waterways. In Yangon, only six areas of the city (home to 7% of the total population) were observed to have wastewater and sewage wastes managed in connection with treatment plant drainage



Figure 8: Parts of electronic waste is showcased for selling on the pavements

facilities whereby activated sludge is used as fertiliser and treated water is disposed of into the Yangon River. For other parts of the city, septic tank waste is transported by vacuum trucks to designated treatment ponds. In Mandalay, septic tank sewage waste is collected with a vacuum truck and disposed into an oxidation pond in the grounds of Ayeyatneyin cemetery, Kyar Ni Kan village, Patheingyi Township (old) and Patheingyi Township (new). The remaining sludge after evaporation is utilised as fertiliser. Further, all industries generating wastewater have constructed individual temporary treatment systems to connect and dispose of liquid waste via a 10-inch drainage pipeline which is subsequently connected to the Dohthe Hta Waddy River without any prior treatment. In Nay Pyi Taw,

there is a centralised wastewater and sewerage treatment facility, which is connected to the premises in Wannatheikdeed Quarter comprising 110 units and a population of 10,000. The treatment plant makes use of an anaerobic microorganism system and chlorination processing before discharging treated water to Bukwe Creek.

There are some initiatives supported by the international community for wastewater management in Myanmar, especially in areas such as sanitation, drainage and wastewater. With funding assistance from the Asian Development Bank (ADB) and World Bank (WB), investment in improving water supply, wastewater treatment and sanitation is expected to increase. The German government is

supporting technical cooperation for clean air in small cities. Moreover, the ADB is working on developing a wastewater quality standard in Myanmar. JICA is also involved with monitoring sampling points of Hlaing River in Yangon and Dothtawady River in Mandalay for pollution. Japan's Kubota Group is set to build a 108 million USD wastewater treatment facility over the next five years in Thilawa Special Economic Zone. JICA has provided assistance worth 20 million USD for a water supply system in Pyigy Tagon Township. In addition to international loans and assistance, MCDC has partnered with Hydrotek Public Company, a Thai based company, to build a central wastewater treatment plant and collection system.

3.3. Existing policy and regulations

The importance of environmental protection in Myanmar is recognised in national and local policy, which is in part due to the country being a signatory to various multilateral environmental treaties and agreements, including the Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel) 1989, the 2030 Agenda for Sustainable Development (SDGs) 2015 and the Paris Agreement on Climate Change 2016.

Myanmar's National Environmental Policy of 1994 instituted environmental regulations on the utilisation, conservation, and prevention of environmental degradation including water, land, forest, mineral, marine resources, and other natural resources. Following the development of this national policy, the country prepared its Agenda 21 commitment (1997) to implement integrated management of natural resources, which provides a blueprint for achieving specific targets on environmentally

sustainable development. In 2009, the country's NSDS was prepared, marking an important step for Myanmar, as this guiding document aims to ensure development remains in harmony with the three main pillars of sustainability: environment, economy and society. The National Environmental Conservation Law and the ECD were established in 2012 as an enforcement mechanism to implement the country's National Environmental Policy; to introduce basic principles and guidelines for sustainable development and systematic integration of environmental conservation; to maintain a clean environment, preserving Myanmar's natural and cultural heritage for present and future generations, to prevent degradation and promote the sustainable use of natural resources; and to cultivate public awareness on environmental issues. Myanmar's Environmental Conservation Rules (2014), the Procedure for Environmental Impact Assessment and Environmental Quality (Emission) Guidelines (2015) were instituted with a view to ensuring project developers implement appropriate measures for reducing pollution and promoting environmental conservation. In addition, City and Township Development Committees have promulgated a number of local policies and bylaws establishing a legal basis for action at the local level. However, in practice, actual implementation and proper enforcement of these environmental regulations has lagged behind general policy proclamations.

3.4. Institutional framework

The MONREC is the focal and coordinating agency for overall environmental management in Myanmar. The ECD, one of the 11 departments under MONREC, is responsible for implementing the country's National

Environmental Policy, overseeing the management and protection of natural resources and regulating pollution associated with water, air and land. The Environmental Conservation Department's main responsibilities are development of legislation related to environmental regulations, guidelines and procedures, coordination of environmental conservation activities, development of climate change mitigation and adaptation, desertification control and ozone layer protection, and preparation of national reports in relation to international agreements.

The Environmental Conservation Department has presently 255 officers and 321 staff under the supervision of the Director General at the Head Office in Nay Pyi Taw, one union territory (Nay Pyi Taw) and in 14 states and regions. According to the Union Government Meeting No (18/2016) dated 22 December 2016, the constitution of Environmental Conservation Department has been expanding its staff, which now numbers 19,229. In addition, within the budget years between 2017/2018 – 2025/2026, it has been planning further staff increases in relation to the nine year plan. A number of different ministries with mandates relevant to environmental matters also maintain their own respective policies, processes, legislations, and budgets for addressing these issues.

Waste management, however, is a principal function of City Development Committees and Township Development Committees designated within Myanmar cities. Each committee maintains a PCCD, which is responsible for overseeing household solid waste, industrial, medical and hazardous waste management. On the other hand, the Department of Water and

Sanitation is directly responsible for managing wastewater and sewerage waste. In addition, other departments such as Playground and Garden, City Planning, Inspection and Agriculture offices also play an important role in the planning and implementation of waste management activities. It was noted that the largest proportion of budget expenditures related to waste management was associated with labour and waste handling. A total of 4,220 workers were employed by Yangon City Development Committee for waste collection and disposal in 2015. In point of contrast, 1700 workers were employed for these tasks in the year 1983. This is very similar to the situation in Mandalay City Development Committee where 2,000 workers were responsible for conducting waste management activities in 2016 compared to 900 workers in 2005. There has been a general increase in the allocation of capital expenditure for waste collection over time, including for purchasing new waste collection trucks and developing appropriate waste treatment infrastructure such as establishment of final disposal sites. This reflects the commitment and determination of Myanmar cities to enhance waste management systems and processes. However, collection and disposal are currently the main priorities of the municipalities and intermediate waste treatment such as recycling plays a minimal role at present.

Direct revenues are also generated through the collection of user charges for waste management services. Waste collection charges for household or domestic waste are based on the volume of waste disposed (MCDC) or location (YCDC), and the fee ranges from 300-900 kyats/month. Other types of waste are charged based on the waste volume and price

for one truck (3 tonne capacity) comprising about 35,000 kyats (25.5 USD) per trip. This cost recovery policy helps to reduce waste disposal subsidies provided by the city and thus encourages more sound fiscal planning. In addition, cities have entered into partnerships with both local and international partners aimed at improving waste collection in their respective cities. Local NGOs support community awareness activities and implement initiatives to promote the 3Rs. Similarly, the private sector (both formal and informal) is involved in waste collection and recycling activities. Lastly, all three major cities (Yangon, Mandalay and Nay Pyi Taw) have received technical and financial support from international agencies (JICA, KOICA, ADB, EU, BORDA) and engaged with foreign partners' cities to establish new waste collection, recycling, treatment and final disposal facilities.

3.5. Challenges in the future

Myanmar faces significant waste management challenges at the national and city levels resulting from a range of social, economic and institutional constraints, which together contribute to soil and water contamination, air pollution, climate change and impacts on biodiversity and ecological health (Figure 9). Addressing these bottlenecks is a crucial first step towards achieving environmentally sustainable waste management practices across the country.

At the national level, MONREC reports that increasing consumption of resources is leading to growing waste generation and pollution, particularly of new and emerging types, such as industrial and hazardous waste. An attendant issue is the lack of effective financing for treatment technologies and infrastructure, and



Figure 9: A group of waste scavengers are busy in the final disposal site of Mandalay

the low capacity of the government to mobilise resources towards this end. Similarly, the Myanmar government is experiencing challenges with promoting the institutional coordination necessary for managing waste related issues, as well as monitoring, evaluation, and enforcement of existing laws and regulations governing the waste sector. Overall, these obstacles reflect an absence of a long-term waste management strategy at the national level.

Accordingly, the cities of Mandalay, Yangon and Nay Pyi Taw have also identified a number of waste management issues and are making efforts to tackle them at the municipal level. In addition to increasing waste generation levels, these cities describe data gaps, low levels of public awareness about waste management and willingness to pay for waste services, a general lack of compliance with existing waste rules/regulations, and poor cooperation with local authorities. At the same time, Myanmar cities also recognise that waste segregation practices are not being effectively implemented, nor is waste collection and transportation being

carried out efficiently. This is resulting in the poor treatment of domestic, industrial and hazardous waste, as well as creating health and safety risks for waste collectors and operators.

Following similar observations made by their national counterparts, another concern highlighted by cities is a deficiency of resources for waste technologies and procurement of land for the establishment of waste treatment facilities, as well as inadequate budget for operation, maintenance and upgrading of waste infrastructure. All of these issues point to a need for modifying municipal laws and regulations, and enhancing the enforcement of relevant rules and standards on waste management. In this regard, Mandalay is actively working to address waste gaps by expanding the number of waste collection workers and vehicles; likewise, Yangon reports increasing rates of waste collection, having nearly doubled its collection percentage between the years of 2007 and 2016. Nay Pyi Taw is currently exploring the potential of implementing an awards system to incentivise appropriate waste management practices.

4. HOW TO MOVE FORWARD

4.1. Scope and period covered by the strategy

The National Waste Management Strategy and Master Plan for Myanmar aims to make a transformation from conventional waste management towards achieving a goal of a zero waste, resource-efficient and sustainable society by 2030. This recognises that waste is to be regarded as resources. Thus, waste management needs to be environmentally effective, economically affordable and socially acceptable. To this end, it sets a strategic plan with short-term targets (2018-2020), mid-term targets (2021-2025) and long-term targets (2025-2030) to be achieved. It also includes a comprehensive list of strategies and actions that are based on the findings of a quick study and feedback from a range of city-level stakeholders. The National Waste Management Strategy and Master Plan thus reflects the stated goals and directives of public authorities with a view towards efficient and effective implementation of waste management.

4.2. Strategic context for waste management

Waste management is a crosscutting issue affecting many aspects of society and its economy. It has strong linkages to a range of other local and global challenges such as health, poverty, food and resource security, sustainable consumption and production (SCP) and climate change. The IPCC estimates that solid waste management accounted for around 3% of GHG emissions in 2010, with most being attributable to methane emissions from landfill sites.

According to the World Resources Institute Climate Analysis Indicators Tool (WRI CAIT), total GHG emissions in Myanmar were 201.5 MtCO₂e in 2013 (WRI CAIT 2.0, 2017). This was 0.48% of total global emissions. Out of this figure, 11.7 (5.8%) was from the waste management sector. Myanmar's Initial National Communication (INC) under the UNFCCC also identified that dumping of solid wastes contributes to emitting about 2,799.51 Gg of CO₂e into the atmosphere (MOECA, 2012).

In addition, a clean city with effective waste management services ensures a healthy and safe environment for residents, increases its attraction for tourists, and also provides a conducive location to conduct business and invite inward investment. Proper waste and resource management also brings many positive benefits to society and the economy, resulting from reduced resource consumption, improved resource efficiency and reduced costs of waste management. A properly designed and carefully implemented waste management policy and strategy thus contributes to all three pillars of sustainable development (environmental, economic and social). Addressing waste management issues is therefore a priority for achieving the country's commitment for the Sustainable Development Goals (SDGs) as well as the Paris Climate Agreement.

Therefore, the National Waste Management Strategy and Master Plan makes efforts to link with other existing and proposed national environmental policies, laws/regulations, development plans and strategies (Figure 10).

The NCDP 2015 and the Myanmar Sustainable Development Plan (MSDP) 2018 identify the importance of managing the environment and natural resources in a sustainable manner, promoting sustainable and transparent investments in ways that sustain the resource base and benefit the local and national population as a whole; reducing environmental health risks from air and water pollution with improved access to those services, and reducing vulnerability to climate change related disasters and impacts.

Further, the proposed National Environmental Policy aims to provide long-term guidance for government, civil society, the private sector and development partners in Myanmar regarding environmentally sustainable development objectives, including but not limited to the introduction of detailed strategic frameworks

and action plans targeting the environment sector, such as green economic development, climate change and waste management strategies, and other relevant plans and policies. Similarly, both Myanmar Climate Change Policy, Strategy and Master Plan and National Green Economy Policy Framework (currently being drafted) are also aimed at achieving green growth, climate resilient, inclusive and sustainable development in Myanmar.

4.3. Guiding principles - waste management hierarchy and principles

The following guiding principles are used as the foundation on which to build the actions that will be used to shift current solid waste management practices in Myanmar.

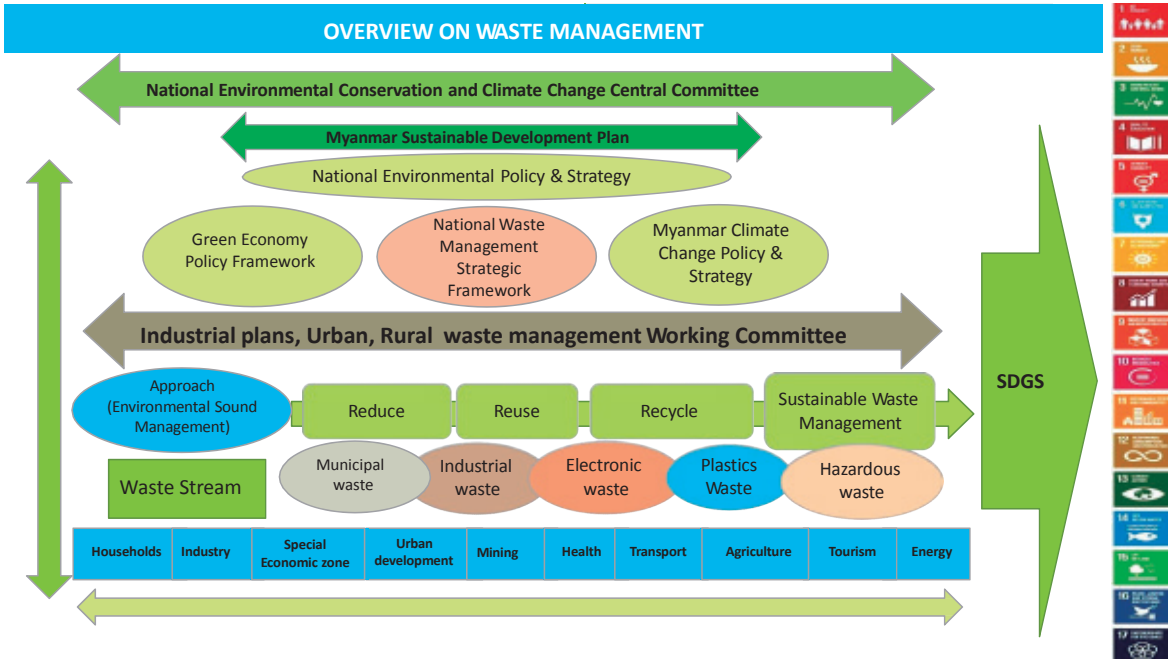


Figure 10: Strategic link with other national policies and strategies

Zero Waste: Zero Waste refers to waste management and planning approaches, which emphasise waste prevention as opposed to end-of-pipe waste management. It is a whole-systems approach that aims to totally overhaul the way materials flow through society, resulting in no waste. Zero waste encompasses more than eliminating waste through recycling and reuse; it focuses on restructuring production and distribution systems to reduce waste generation. Zero Waste is therefore more of a goal or ideal rather than a hard target. Zero Waste provides guiding principles for continually working towards eliminating waste.

Waste Hierarchy: The Waste Hierarchy is a strategic tool, which prioritizes actions for waste management. This consists of the 3Rs: Reduce - reducing waste that is generated and which is directed to the landfill (including composting); Reuse - repairing products that can be repaired, or finding alternative uses for waste; and Recycle - returning waste with recoverable value for re-processing (Figure 11).

Resource conservation: Entails promoting the most efficient use of resources, including resource recovery and waste avoidance.

Polluter-pays Principle: A principle that holds that those responsible for causing pollution or generating solid waste should pay the cost for dealing with the pollution, or managing the solid waste (collection and disposal) in order to maintain ecological health and diversity.

Precautionary Principle: A principle that dictates that a lack of scientific data/information certainty should not be used as a reason for not acting to prevent serious or

irreversible environmental damage or degradation.

Proximity Principle: A principle that maintains that waste should be dealt with as close to the source of generation as possible. This reduces transportation costs, as well as risks of contamination of the environment during transport.

Consultation Principle: A principle that conveys the importance of all levels of Government consulting and working with people and organisations throughout the development and implementation of waste management strategies and action plans.

Shared responsibility: In this context, Zero Waste is a shared responsibility and requires partnerships and collaborations between all sectors of government, industry, research institutions, NGOs, and the general community.

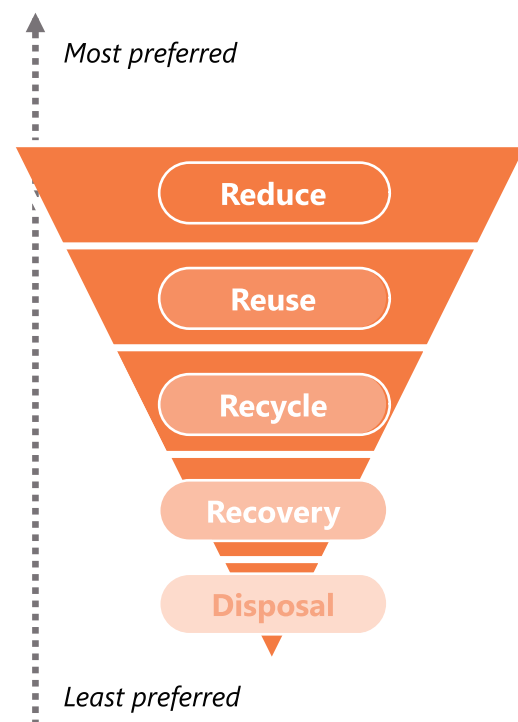


Figure 11: Waste management hierarchy

5. SETTING NATIONAL GOALS, OBJECTIVES AND TARGETS

The National Waste Management Strategy and Master Plan for Myanmar has identified the following strategic goals, each of which is then

briefly discussed with some key targets and proposed activities.



5.1. Goal A: Extending sound waste collection service to all citizens and eliminating uncontrolled disposal and open burning as a first step towards environmentally sound waste management

Targets

	Short-term (2018-2020)	Mid-term (2021-2025)	Long-term (2026-2030)
(i) Achieve sound waste collection service for all citizens	70%	85%	100%
(ii) Eliminate the uncontrolled dumping and burning in the cities and mandate the operation of environmentally sound disposal facilities	Major City Development Committees (Yangon, Mandalay and Nay Pyi Taw)	50% of all other Township Development Committees in the country	100% of all other Township Development Committees in the country

Overview

The provision of waste collection services is the legal responsibility of the City Development Committees and Township Development Committees in Myanmar, which act as the primary interface between citizens and the government on waste management. The quality and coverage of the current waste collection service in the townships is poor and varies widely between major and smaller townships as well as within urban and peri-urban or rural neighbourhoods. Due to the absence of regular and reliable waste collection services, national waste regulations, and their implementation and enforcement, waste generators dump waste in the street, on vacant ground, into drains, streams or waterbodies (inland and marines), or burn it to reduce the perceived nuisance of accumulated piles of waste.

At the same time, collected waste is also disposed in open dumpsites, which pose a high risk to public health and the environment. Uncontrolled burning of waste creates emissions containing fine particulates (including black

carbon) and complex organic compounds (including both carcinogenic and persistent organic pollutants [POPs]), which are highly damaging locally and globally. Uncontrolled waste disposal also encourages disease vectors to breed, leading to increases in infectious diseases such as cholera and dengue fever. They are also a major cause of flooding. Uncontrolled dumpsites, and in particular hazardous waste mixed with other waste, cause disease in neighbouring settlements, as well as among waste workers. Such dumpsites on land can also cause pollution of both surface and groundwater. Sites are often alongside rivers or the sea, so can directly contribute to river and marine pollution.

It is now evident that the cost of inaction in improving the waste collection service is much higher than the cost of providing a proper waste collection service. Thus, there is an urgent need to expand access in order to ensure a minimum level of waste collection services in townships and certify that waste incapable of being reused, recycled or recovered is treated or disposed of

safely in properly permitted landfill sites. This goal therefore seeks to address current bottlenecks in waste management and disparities in access to waste services, and improve the quality of life for all citizens by providing a cleaner environment to live and work, noting that expanded waste services would also support the creation of green jobs and climate-resilient cities. It also requires new regulatory, planning and fiscal instruments support the programme for effective and efficient delivery of waste services over the long term, including villages which are not being served by townships.

Proposed Activities

This section presents the key activities that are identified to improve the municipal solid waste collection, and eliminate uncontrolled waste disposal and open burning.

A.1: Expand access to municipal waste management service in order to ensure a minimum level of services for all citizens, irrespective of income levels

- A.1.1: Develop, implement and monitor national waste management standards and guidelines to ensure that townships will meet minimum-level standards for providing waste management services to all citizens. These standards should determine service provision levels, selection of options for waste collection, separation at source, supply of receptacles, collection vehicles, and health and safety measures, with a view to redressing prior disparities in waste collection services.
- A.1.2: Mandate regional officials of ECD, state/region governments and townships to prepare regional and township level waste management strategies and action plans to achieve appropriate waste reduction targets, separation, collection and treatment standards with each of them setting targets and formulating action plans including allocation of budget, monitoring and evaluation mechanisms, and measurement of progress.
- A.1.3: Set service standards at township levels based on national standards and guidelines for separating, transferring, and storing solid waste, managing and directing solid waste disposal, and controlling litter.
- A.1.4: Establish proper fiscal mechanisms to assist in the funding of expanded waste services, such as appropriate tariff setting and full-cost accounting for waste services.
- A.1.5: Coordinate action among different government ministries to address fiscal and capacity gaps faced with waste service provision, including the establishment of an inter-ministerial committee comprised of MONREC and other relevant national agencies to address waste service delivery issues and support townships with expanding waste service provision. .
- A.1.6: Formulate a policy that provides impoverished households access to essential waste removal services, specifying appropriate service levels based on neighbourhood densities, composition and volume of waste generated, and appropriate subsidy mechanisms for targeting services especially among households that cannot afford to pay for services.
- A.1.7: Establish national environmental education and awareness programme and support curriculum development by reviewing existing policies and programs for including SWM in school curricula and university course offerings collaborating with the agencies

involved in preparing the National Education Plans to strengthened public awareness on bad impacts of uncontrolled waste management.

A.2: Safe treatment and disposal of waste in permitted/ officially approved landfill sites to protect uncontrolled dumping and open burning

- A.2.1: Introduce a waste disposal standard at landfills, including regulations on standard engineering design, and receipt/disposal requirements for different classes of landfills, restrictions on certain types of waste, and guidelines for thermal waste treatment.
- A.2.2: Develop standards and compliance mechanisms for managing hazardous wastes, as determined by established waste classification and management system to achieve safe disposal of such waste.
- A.2.3: Conduct a nation-wide assessment of the necessary actions required to standardise management and licensing of existing

disposal sites, providing the basis for the design and implementation of a national landfill licencing programme.

- A.2.4: Conduct a feasibility study on the costs and benefits of establishing regional disposal facilities in partnership with private companies.
- A.2.5: Guide townships on registration processes for waste transporters in accordance with the rules and regulations at the national, provincial or local level, mandating that registered transporters prevent any spillage of waste/littering from waste transport vehicles and that the disposal of waste is conducted in officially designated areas.
- A.2.6: Perform a feasibility study on options for introducing waste-to-energy technologies to treat residual waste before landfill.
- A.2.7: Review current practices and promote awareness raising among townships on good practices with regard to liquid waste treatment.

5.2. Goal B: Extending sustainable and environmentally sound management of industrial and other hazardous wastes

Targets

	Short-term (2018-2020)	Mid-term (2021-2025)	Long-term (2026-2030)
(i) Mandate separate collection and sound treatment of hazardous waste including infectious medical waste, agro-chemical waste from non-hazardous waste	Major City Development Committees (Yangon, Mandalay and Nay Pyi Taw)	50% of all other Township Development Committees in the country	100% of all other Township Development Committees in the country
(ii) Mandate sound collection and environmentally friendly treatment of all industrial waste and agro-chemical waste	Major City Development Committees (Yangon, Mandalay and Nay Pyi Taw)	50% of all other Township Development Committees in the country	100% of all other Township Development Committees in the country

Overview

Currently, the City Development Committees and Township Development Committees collect industrial waste along with the municipal waste and this often ends up being mixed up in open dumpsites. The first and only controlled landfill facility to be established in Myanmar can be found in the Thilawa Special Economic Zone. Operated by Dowa Eco-System Co., Ltd., (subsidiary of Dowa Holdings Co., Ltd.), it handles collection and treatment of industrial waste separately. However, the company has experienced certain challenges with conducting operations due to lack of national policy and guidelines for industrial waste management.

The same situation exists for other special/hazardous waste (i.e., medical waste, electronic waste, mining waste, mercury waste, construction and disaster waste). At present, almost all townships in Myanmar lack proper systems and methods with which to deal with such waste separately, with much of it ultimately sent to landfill sites or open burning. In addition, no proper collection and treatment systems are

available for either domestic or industrial liquid waste and sludge.

Thus, this National Waste Management Strategy and Master Plan identified the importance of basic frameworks, regulations and systems concerning industrial waste and other waste managed separately from municipal waste, classifying waste into industrial/hazardous waste and municipal waste and establishing a system to manage each type appropriately on their own, setting standards concerning the collection, transport and disposal.

Industrial waste varies enormously and requires special management. Some types of waste are consistent in composition and therefore more easily recovered, but may require management because they are hazardous, or contaminated with materials that require special management. Others may be heterogeneous in amount and composition, which will affect the economics of reuse, materials recovery, and recycling as well as disposal options. Some waste streams are made up of materials not easily separated, or

components not easily dismantled, such as e-waste. These can nevertheless be sold or processed as a source of valuable materials if separated and carefully managed. Mining industries and mineral refining can generate very large volumes of waste material. Some of this waste may lend itself to reprocessing and recovery. Other waste will need to be managed by landfilling or long-term storage. In some cases, changes in raw materials can reduce the generation of industrial and hazardous waste volumes.

Sewage sludge is a high-volume waste that may be contaminated, for example, with heavy metals, depending on sewage treatment methods. Contamination can limit its application in uses such as a soil ameliorant. Management of the sewerage system (e.g., strict criteria for industrial discharges) can help minimise contamination. Waste consisting of, containing or contaminated with, the above hazardous materials (and other hazardous materials such as asbestos, arsenic, or cadmium) requires special treatment. Policies should minimise the extent of these problems by avoiding production of goods containing these and other hazardous materials, eliminating or reducing their presence in industrial waste, preventing them from contaminating other waste, and providing for the safe and environmentally sound management of waste that cannot currently be avoided.

Some waste streams contain elements for which there are currently few or no uses, while they pose a high level of risk to human health and the environment. Examples include waste containing arsenic and mercury (mercury waste includes fluorescent lamps, thermometers, and dental amalgam). These types of waste cannot be destroyed, and therefore must be immobilised, permanently encapsulated, or managed in perpetuity – all costly processes that illustrate

the importance of changing product composition, industrial processes or the sources of raw materials. This goal therefore aims to address the above challenges in managing industrial and other hazardous waste in a more environmentally friendly and resource efficient manner.

Proposed Activities

B.1: Establishing sound legal and regulated structure addressing industrial and hazardous waste

- B.1.1: Introduce a clear definition and classification of waste, such as municipal/domestic waste and industrial/other special or hazardous waste. This separate classification enables MONREC to regulate waste more effectively. According to the classification, municipal waste management can be a responsibility of the respective townships, and industrial and hazardous waste management should be a producer responsibility.
- B.1.2: Establish relevant regulations concerning industrial and other hazardous waste management, a legal structure of waste policies, legal system governing waste providing the basic principles underlying not only waste policies but also environmental policies in general, intended to protect the environment and public health through reductions in waste generation and through proper waste disposal. Even though these regulations and legal systems will be stipulated by the national government, most of them need to be implemented and enforced by regional/state and townships at the local level.
- B.1.3: Introduce Polluter Pay Principle and Extended Producer Responsibility (EPR) strengthening the responsibilities of business operators for proper management of industrial and other hazardous waste. To make such provisions more concrete, specific regulations will be set clarifying that the responsibility for

managing and disposing of industrial waste and hazardous waste is to be undertaken by the waste generators. It should be noted that such responsibility might be carried out by commissioning the waste properly to third parties.

- B.1.4: Introduce proper recycling laws and cleaner production practices to reduce waste at source. The recycling laws designate target industries and products. Within these voluntary efforts, the law states that 3R measures should be used during the stages of product design and manufacturing that companies should use identification labelling to enable the classification of waste for collection, and those business operators should voluntarily formulate collection and recycling systems. They were designed in a way that promotes recycling according to the properties or state of waste generation inherent to articles. The details of these systems vary with the individual laws. These laws clarify the role sharing, obligations, and cost burdens of relevant parties, such as the manufacturers, retailers, consumers, waste generators, disposers and local governments. They also set targets for recycling. The laws include special exceptions for those who dispose of wastes in accordance with the law. The enactment and enforcement of these laws has significantly increased the rate of recycling of the articles they target.
- B.1.5: Licensing for industrial waste handling businesses, which provide industrial waste handling (collection, transport and disposal) as a new business. This license can be issued by the ECD, MONREC in coordination with other relevant agencies, including the Ministry of Industries (MOI) after obtaining business approval from the respective region/state or townships to conduct such business. There are different types of licenses, categorised by waste classification, i.e., industrial waste or industrial waste subject to special control, and

by the type of services to be provided, either collection and transport services or disposal services. This license also needs to be renewed at regular intervals. In addition, the license designates the scope of services that can be performed, and specifies the disposal processes and the types of industrial wastes that can be handled. This designation is determined based on the contents of the application submitted and the results of a screening. In addition, MONREC needs to obtain commitments from these businesses to comply with other laws and regulations along with laws and regulations set by the Ministry of Labor, Immigration and Population for labor employing, labor rights, occupational health and safety.

- B.1.6: Set disposal standards for industrial waste management. Whether waste generators dispose of their industrial wastes on their own or commission third parties for such, disposal must be in accordance with the standards established by MONREC. During the stages of collection and transport, intermediate processing, and landfill, the disposal standards require prevention of scattering and spills, strong odours, noise or vibration and the labelling of the vehicles used in collection and transport and of the storage facilities. They also stipulate the processes to be used when incinerating or landfilling the waste.
- B.1.7: Permission for industrial waste disposal facilities. Facilities requiring this prior permission include incineration facilities and landfills. This provision is applicable regardless of what entity is conducting the disposal (the waste generator or a commissioned entity). To apply for this permission, the entity seeking to establish such a facility must conduct a survey on the impacts on the surrounding living environment and attach the results to the application form. In addition, for some facilities requiring permission, the procedure is

designed to ensure transparency in the permission process. The process includes giving public notice and allowing public inspection of the application. After permission is granted for a facility, the entity establishing the facility must perform maintenance in accordance with the maintenance standards and a maintenance plan should be submitted as part of the application. In addition, final disposal sites for waste are designated as sites having underground waste even after removal of the facility. If earthworks or other changes are to be made to the configuration of a site, the facility must confirm that these changes will not negatively affect the living environment.

B.2. Effective monitoring and incentive mechanisms

- B.2.1: Introduce a Manifest System for properly monitoring the operation of industrial and other hazardous waste management. The manifest is a collection of slips containing information such as the names of the waste generator, collector and the disposal company, the mode of packing the industrial waste and the addresses of the waste generator, as well as the sites for intermediate processing and final disposal. The waste generators provide this manifest while handing over their industrial wastes to collectors, transporters or disposers. The contractors receiving the waste send one slip of the manifest back to the waste generator upon completion of disposal. In this way, the waste generators can understand how the disposal progresses. In addition, when waste generators commission industrial waste disposal, they are obliged to make efforts to take required measures for proper disposal after checking the status of disposal, by conducting site investigations or utilising information disclosed by the disposer.
- B.2.2: Collection of reports, on-site inspection, orders to improve operations, administrative orders and penalties. In order to ensure the effectiveness of regulations based on the Waste Management Law, provisions for collecting reports, on-site inspections, orders to improve operations, administrative orders and penalties have been established. These provisions stipulate that waste generators be also subject to administrative orders as mentioned above in specific cases. With regard to penalties, rules on corporate exposure were also established.
- B.2.3: Support for technology development. Since disposal of industrial waste must be done either by the waste generators themselves or by commissioned licensed disposers, in principle, private businesses should maintain disposal facilities on their own. However, MONREC in coordination with other relevant line ministries, such as Industrial, Financial, Energy, National Policy and Planning, and Higher Education can provide some incentives and support mechanisms. These include subsidising a portion of such corporations' expenses for constructing and maintaining disposal facilities, and subsidising part of the expense of waste disposers that construct or maintain facilities recovering electric or thermal energy (generation through waste incineration) in the course of waste disposal. In addition, some other measures to promote the maintenance of such facilities have been introduced, including a low-interest loan system and a debt guarantee system. There is also a system for providing assistance for the research and development of waste disposal technologies. MONREC can create a competitive research fund for environmental research that can be used by selected research institutions and private companies for research and development topics.

5.3. Goal C: Substantively prevent waste through 3Rs and thereby establish a resource circular society

Targets

	Short-term (2018-2020)	Mid-term (2021-2025)	Long-term (2026-2030)
(i) Mandate the development of city waste management strategies and action plans with actual waste reduction targets by all CDCs and TDCs	25%	50%	80%
(ii) Mandate the introduction of targets for diverting the food waste from landfills	15%	35%	60%
(iii) Mandate the separate collection and set waste recycling targets for industrial, medical and other wastes	15%	35%	60%

Overview

Waste needs to be properly managed in order to protect public health and the environment. However, that does not imply an exclusive focus on treatment and disposal: the best way to manage waste is as a resource, and by avoiding materials becoming waste in the first place. This approach suggests that the focus should shift upstream, aiming to tackle the problem at the source through the options at the top of the waste hierarchy and through sustainable consumption and production practices (SCP) and Sustainable Lifestyles. The idea is to move from waste disposal to waste management and from waste to resource management as part of the circular society. Therefore, the efficient use of resources and waste prevention are not only good for the economy, but also essential for continued growth and prosperity. The scope of waste prevention and resource efficiency covers the whole economy – all material flows and all products used by a nation, from the mining

sector and productive industries, designers and service providers, and public and private consumers in addition to the waste management sector. Consequently, all economic sectors need to be stakeholders in waste prevention, and a systematic approach to waste prevention can yield substantial greenhouse gas reductions, not just in the waste sector but right across the economy. An important component of resource management is waste reduction and reuse, including the repair and refurbishment of products, which has been traditional for millennia and is still an active economic sector in many low- and middle-income countries. Building on such traditional repair and reuse practices makes good sense.

Thus, one of the primary intentions of the National Waste Management Strategy and Master Plan is to follow the waste management hierarchy, which includes waste reduction, reuse, recycling and recovery (such as energy from

waste) before the final disposal of residual waste that cannot be converted into resources. Although some cities in Myanmar conduct public awareness and environmental education programmes for local residents and businesses to mobilise their support for waste reduction and recycling, the successful implementation of these activities remains limited and ad-hoc. There is no waste separation system in place and recycling activities are mainly carried out by the informal sector which collects recyclable materials from households, communal collection points and landfill sites.

Thus, this National Waste Management Strategy and Master Plan creates an enabling framework for waste producers to avoid generating waste and, failing that, to minimise the amount and toxicity of the waste generated. Thereafter, waste generators are expected to reduce, reuse, recycle or recover waste to their highest potential before disposing of them as necessary in designated landfill sites. Effective implementation of waste management in line with the waste hierarchy entails the consideration of various tools and instruments, including national norms and standards, appropriate incentives and disincentives, integrated management plans for domestic wastes, industrial waste management plans, extended producer responsibility, and prioritising certain types of waste, among others. Promoting waste minimisation goes beyond the remit of environmental policy and depends in part on industrial policy and supporting economic instruments. Government and industry should coordinate their actions in a waste minimisation programme in such a way that knits together different policy strands and identifies the goods and services to which the

provisions on waste can feasibly apply.

Further, increasing the waste reduction, reuse, recycling or recovery of goods and waste materials requires encouraging coordinated efforts among waste generators, including households, businesses and organisations. A fundamental change in waste disposal practices should be supported by the development of national awareness and education programmes for waste generators and recycling infrastructure founded on partnerships among these various role-players. The infrastructure should enable separation at source of organic waste, hazardous waste and general recyclable waste, as well as prioritise the collection of particular waste types that contaminate general household waste with appropriate infrastructure. The various functions and responsibilities of different role-players and their involvement in efforts to promote recycling infrastructure for management of the selected waste streams will also be set up accordingly (Figure 12).

Proposed Activities

Relying just on developing more and more environmentally sound disposal facilities and increasing recycling to cope with this rapidly increasing waste mountain will put a severe strain on institutions and budgets which Township Development Committees are already struggling to cope with. This section therefore identifies a list of proposed activities for developing effective policies and practices for waste prevention at source.

C.1: Promote waste reduction upstream through introduction of sustainable production (in the design, fabrication and manufacturing of products) and consumption

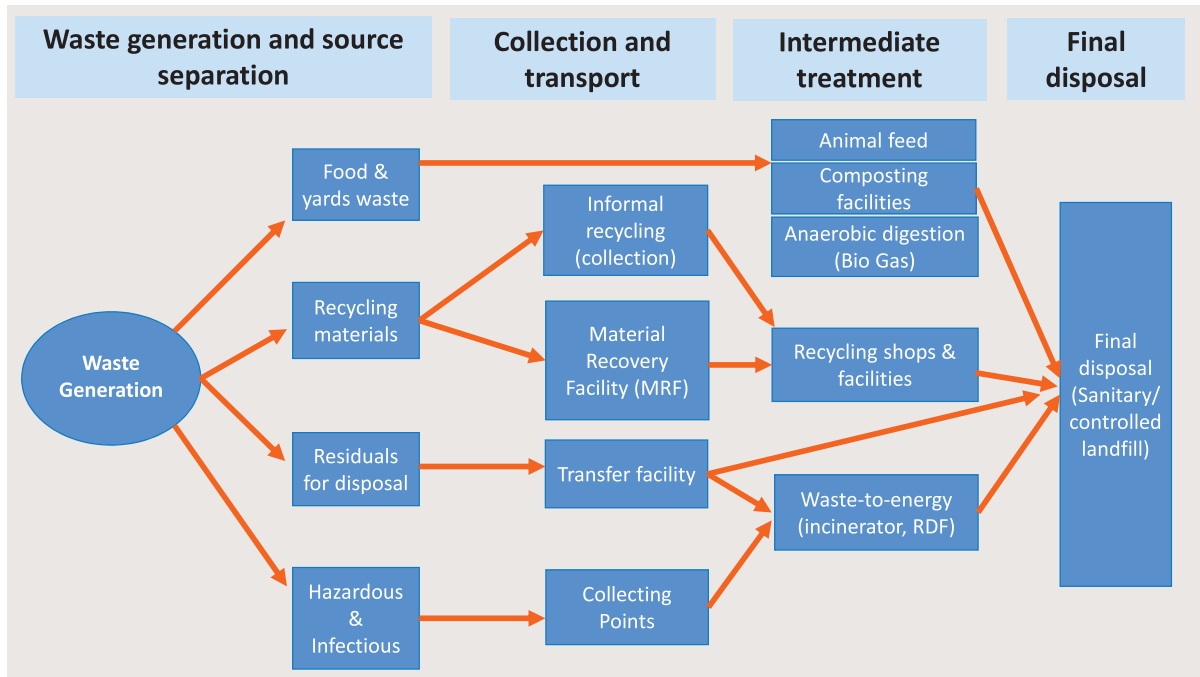


Figure 12: A proposed flow of waste management encouraging 3Rs

(traditional repair and reuse)

- C.1.1: Introduce design principles that incorporate the reuse of goods or their dismantling into components for reuse.
- C.1.2: Mandate Extended Producer Responsibility (EPR) with a view to enforce industries to take responsibility for the lifecycle of products that they produce, including establishing methods and funding mechanisms to manage the products once they become waste, and setting targets for reuse, recycling or recovery.
- C.1.3: Implement a Cleaner Production Strategy that aims to minimise the quantity and toxicity of waste produced during the manufacturing processes.
- C.1.4: Allocate investment for research and development of technology innovations in design to minimise waste generation
- C.1.5: Introduce national policies, programmes and awareness campaigns to promote green businesses, sustainable

consumption and production, and ecolabelling, etc.

C.2: Promote reduce, reuse, recycle and recovery of waste materials before final disposal

- C.2.1: Mandate CDCs and TDCs to develop waste management plans with measurable targets for waste reduction, reuse separation and recycling.
- C.2.2: Direct industries in industrial zones to develop waste management plans with targets for waste reduction and for reuse, recycling and proper recovery.
- C.2.3: Develop national standards for cities with a view to promote waste reduction, reuse, recycle, and recovery of waste materials.
- C.2.4: Develop strategies and guidelines on waste separation, collection and sorting of general recyclable waste materials, supported by appropriate recycling infrastructure.

- C.2.5: Develop standards and incentives for the establishment of MRF and buy-back centres in different CDCs and TDCs, with space provided for sorting reuseable and recyclable waste.
- C.2.6: Combine recyclable waste collection systems with existing waste collection services and transform disposal sites into integrated waste management sites.
- C.2.7: Promote nationally coordinated awareness campaigns, which support separation at source of recyclables from the domestic waste stream among all households, businesses and organisations.
- C.2.8: Build on existing small-scale entrepreneurial recycling by integrating the informal recycling within the mainstream waste management sector.
- C.2.9: Develop strategies, standards and incentives for diversion of specific waste streams such as food waste, green waste, hazardous waste (industrial and medical waste) from landfills.
- C.2.10: Study and develop strategies/ standards for various waste treatment/ recovery options for waste that cannot be reused or recycled, including biogas projects and methane gas from landfills, as well as thermal treatment; by introducing financial incentives such as tipping fees and renewable energy feed-in tariff and sound empirical standards for air emissions/water effluents aimed at mitigating the impact on human health and the environment.
- C.2.11: Establish a proper mechanism for data gathering, monitoring, enforcement and incentives for waste management strategies at the city level and in industrial zones.
- C.2.12: Include sustainable lifestyle practices into formal and non-formal education.

5.4. Goal D: Ensure sustainable financing mechanisms

Targets

	Short-term (2018-2020)	Mid-term (2021-2025)	Long-term (2026-2030)
(i) All City and Township Development Committees conduct full cost accounting for waste service	50%	75%	100%
(ii) All City and Township Development Committees establish cost reflective tariffs for waste management services	50%	75%	100%

Overview

Sound financing is essential in the provision of sustainable waste services. In most cities, waste management services are underfunded and outfitted with aging and deficient capital infrastructure, face irregular or unsuitable budget allocation, in part due to the absence of an Environmental Management Fund (EMF), are defined by infrequent public-private partnerships; low level of willingness to pay SWM fees among households, as well as private sector actors due to the high cost of investing in waste technologies and processes; and absence of full cost accounting at the local level, leading to a shortage of resources impeding the successful implementation of waste management services. For CDCs and TDCs, high capitalisation of waste services entails knowledge of available finance windows, capacities for undertaking cost-benefit analysis, capabilities for entering public-private partnerships and clustering options to enhance economies of scale.

Proposed Activities

D.1: Enhanced financing options for waste management

- D.1.1: Identify existing and potential funding availability for waste management, including reviewing, documenting and updating information on concessional windows available within and outside of the CDCs and TDCs to finance waste management projects. Conduct

consultative discussions with other concerned institutions with a view to gather inputs on options for streamlining accounting processes and requirements to avail such funds, and establishing a database for local governments to monitor funding availability.

- D.1.2: One approach to extending primary waste collection and recycling services in CDCs and TDCs is through community-based initiatives, providing livelihoods for local people, generating income from reuse, and recycling.
- D.1.3: Support Public-Private Partnership (PPP) schemes for waste management, including compiling a directory of private enterprises involved in the market of waste management services; reviewing and proposing enabling policies or systems for the promotion of public-private partnerships; clarifying legal and institutional support mechanisms for undertaking such partnerships, e.g., BOT, DBO; compiling a compendium of all possible PPP modalities, including advantages, trade-offs and examples of good practices for assisting CDCs and TDCs in implementing waste management projects and programmes; disseminating relevant fact sheets to CDCs and TDCs via various channels; collaborating with international donor/development agencies and relevant government institutions in capacitating CDCs and TDCs on entering

public-private partnerships, such as conducting feasibility studies and tender processes; and facilitating business matching with private enterprises involved in marketing waste management services.

- D.1.4: Consider extended producer responsibility (EPR) as a means to transfer the costs of managing end-of-life products in municipal solid waste from the municipality to the producer and other appropriate stakeholders along the supply chain.
- D.1.5: Establish a national waste management fund (NWMF) for supporting cities, based on discussions with the Ministry of Planning and Finance on opportunities to develop such a funding mechanism as well as consultations with relevant agencies on possible funding sources, including but not limited to environmental taxes, tobacco excise taxes, special shares and others earmarked from the proceeds from national taxes, fines and penalties, as well as private sector/domestic and foreign sources.

D.2: Sustainably financed waste management at the CDCs and TDCs

- D.2.1: Enhance cost recovery mechanisms at the city level, including by reviewing existing local waste management ordinances and related national policies on cost-recovery features and strategies, such as sticker systems, integrated utilities billing system, pay-as-you-throw systems, business licensing, income generation, charges for special waste management, etc.; compiling local waste management statutes with cost-recovery mechanisms and developing pro forma ordinances as a guide for CDCs and TDCs; capacitating all CDCs and TDCs in replicating or customising their own ordinances, reviewing and recommending waste fees and tariffs, as well as fines and penalties; full-cost accounting of waste management services; conducting public perception, demand analysis, capacity- and willingness-to-pay surveys following a

generic format; establishing a separate waste management account under general funds to ensure the optimal management of collected waste fees; formulating protocols on how to access funds for CDCs and TDCs projects; developing ordinances with localised cost recovery mechanisms, and ensuring that such ordinances are adopted and strictly implemented by local governments.

- D.2.2: Establish a database monitoring system to evaluate performance levels among cities in implementing cost recovery mechanisms with a view towards the identification of good practices, including but not limited to the integration of financial data as parameter(s) in the waste management compliance/performance criteria, documenting the financial/full-cost accounting data, analysing relevant policies, guidelines or recommendations, as needed, and documenting and disseminating case studies as needed.
- D.2.3: Support economies of scale in the design of waste management facilities and programmes, including reviewing and documenting examples of successful CDCs and TDCs alliances and clustered waste management facilities, assessing the advantages and trade-offs vis-a-vis technical and financial requirements for materials recovery facilities, composting and sanitary landfills; developing guidelines and/or pro forma memoranda of understanding/agreement (MOU/MOA) formats for intercities, regional government-led and private sector-led clustering approaches, including incentive options for host governments; strengthening the capacity of CDCs and TDCs for replicating or customising clustered approaches; and monitoring the performance of CDCs and TDCs clusters with a view to document best practices.
- D.2.4: disposal is priced, to provide an incentive to the waste generator to reduce waste quantities at source.

5.5. Goal E: Awareness raising, advocacy and capacity building

Targets

	Short-term (2018-2020)	Mid-term (2021-2025)	Long-term (2026-2030)
(i) Increase in the number of townships that have implemented standard awareness-raising programmes for their residents	25%	50%	100%
(ii) Increase in the number of schools in the townships that have established environmental education programmes for their students	25%	50%	100%

Overview

The Ministry of Natural Resources and Environmental Conservation, Ministry of Education, NGOs, media partners, and CDCs/TDCs play central roles in raising public awareness about the importance of waste management and effectively motivating communities to engage in waste avoidance and the 3Rs, which are key to achieving the goals set out by national and municipal waste management strategies.

However, lack of awareness about proper waste practices such as source segregation as well as low motivation of the general public impedes efficient integration of waste management systems with knock-on effects for information, education and communication (IEC) programmes in local government budgets. This coupled with a general lack of political will to enforce regulations on waste segregation, littering, open burning, and promote incentives on good practices all contribute to the low motivation of the public to participate in sustainable waste management. This consequently results in weak promotion of waste avoidance, eco-labelling measures, sustainable production and consumption initiatives, etc. especially among public education institutions. In order to effectively implement social marketing, IEC and advocacy campaigns on environmental protection, educational centres need to be capacitated in

the various aspects of value formation, ecoliteracy and the functional elements of solid waste management.

Proposed Activities

E.1: Mainstream environmental education and sustainable waste management in school curricula and programmes at all levels

- E.1.1: Support curriculum development by reviewing existing policies and programmes for including environmental education and waste management in school curricula and university course offerings; collaborating with the agencies involved in preparing National Education Plans to strengthen environmental education, sustainable lifestyles and waste management; collaborating with the relevant agencies to standardise waste management modules or course offerings, teachers' instructional guides and competency-based learning materials, in coordination with interagency bodies, and formalised through memorandum circulars, administrative orders or any appropriate legal instruments; assisting educational institutions in integrating waste management into pre-, elementary, secondary, tertiary, and technical, vocational, education and training (TVET) school curricula, the Community Service Program (CSP) for high schools and National Service Training Program (NSTP) for colleges and universities; and continuously monitoring, evaluating, improving and replicating in relevant

educational institutions.

- E.1.2: Select and disseminate best practices for integrating environmental education and waste management in the school curricula, including by reviewing and upgrading criteria for evaluating best practices associated with waste management for curriculum integration; establish an incentives/award system aimed at incentivising best practices in waste management curriculum integration through national, regional and local awards (e.g., Annual Search for Sustainable and EcoFriendly Schools) or private sector initiatives; review criteria for selecting examples of good practices and case studies; record best practices/lessons learned using a common documentation format; identify channels of communication for dissemination of case studies; assess and document successful practices and case studies.
- E.1.3: Collaborate with concerned agencies towards encouraging schools and universities to implement environmental education and waste management programmes, including by reviewing and consolidating existing policies and programmes, e.g., school MRF, composting facilities, segregation systems, demo-gardens; identifying, reviewing and promoting model waste management plans and projects in schools and universities; reviewing, adopting and proposing guidebooks and guidelines for establishing, financing, evaluating and monitoring school-based environmental waste management programmes, identifying institutional and financial support mechanisms for promoting environmental waste management in schools; implementing capacity building or mentoring programmes for educational institutions.

E.2: Mobilise the support of all stakeholders by increasing awareness and participation in sustainable waste management practices

- E.2.1: Conduct training needs assessments based on identified core competencies in waste management at the national, regional

and city levels, and develop appropriate tools and instruments (e.g. survey forms, gap analysis) with a view to establishing a formal training and development needs assessment system, used to analyse data and inform training development.

- E.2.2: Develop standardised training modules for waste management capacity development following a training-of-trainers approach, including by developing an inventory of knowledge products associated with all aspects and functional elements of waste management; designing, consolidating, or piloting communication and technical skills/waste management training-of-trainers training modules and relevant workshop courses; making use of visual aids and instructional manuals; finalising the training materials/workshops by pilot-testing them at national and regional levels; evaluating the standardised training modules, packaging and delivering them for different audiences; and continuously updating and improving waste management training materials and courses.
- E.2.3: Deliver regular waste management trainings on value formation, communication, technical skills and financial management for trainers, organisations, waste management focal persons and advocates, including by identifying potential information channels, venues and funding sources for waste management capacity building, values formation, communication facilitation and technical skills trainings for selected targets, including education professionals, local government stakeholders, etc.; customising the training modules for different audiences, conducting trainer-training sessions and accrediting trainers; conducting annual regional waste management summits, capacity development activities and other awareness-building campaigns together with partners for selected target groups; and monitoring/tweaking social marketing and advocacy campaigns strategies as necessary.

5.6. Goal F: Compliance, monitoring, enforcement and recognition

Targets

	Short-term (2017-2020)	Mid-term (2021-2025)	Long-term (2026-2030)
(i) City and Township Development Committees establish benchmark performance indicators	50%	75%	100%
(ii) Increase in the number of successful enforcement actions filed against non-compliant entities by City and Township Development Committees	50%	75%	100%

Overview

In order to enhance the participation of different stakeholders in monitoring and enforcement of waste management laws and regulations, the following interventions are both critical and necessary: establishing monitoring and enforcement schemes to encourage waste avoidance and diversion (e.g., promoting the 3Rs in the context of sustainable production and consumption, supporting green public procurement, developing a database on waste reduction, diversion rates, etc.); assisting local governments to institute systems for monitoring and enforcement, including defining prohibited acts, supporting segregation at source and segregated collection, educating haulers and service providers on proper waste management practices, promoting the use of weighbridges, and separating hazardous materials from municipal solid waste streams; providing technical support for the upgrading of monitoring and enforcement systems among local governments, including clarifying overlapping functions, designating responsible authorities for filing litigation against noncomplying local governments, securing contracts with waste haulers and service

providers, promoting the use of material recovery facilities to address the lack of communal storage areas, and ensuring safeguards when siting facilities at critical sites; ensuring financial requirements are met at the local level (e.g., deputised enforcers, monitoring operations and equipment to ensure financial viability).

The above actions can be considered prerequisites for the development of an enforcement mechanism, which effectively imposes sanctions on violators of environmental rules and regulations. Without a mechanism for monitoring and enforcement, sectors that do not comply are not penalised; while those that comply are not recognised. In addition, encouraging the participation of different sectors is important, as this helps to promote checks and balances in monitoring and enforcement. Defining how monitoring and enforcement roles can be complementary and supportive is necessary to leverage capacities, stretch available resources, and improve coverage of the regulating community, whereas uncoordinated enforcement can lead to cost inefficiencies and duplication in efforts,

restricting the scope of the programme.

Perceived biases and inconsistencies could also lead to potential conflicts. To effectively address these pressing issues and concerns, the National Waste Management Strategy and Master Plan shall implement the actions presented below with a view to achieve the following objectives:

Proposed Activities

F.1: Institutionalise mechanisms for monitoring, enforcement and recognition

- F.1.1: Establish and regularly update an interactive database for monitoring the compliance of local governments and other stakeholders with relevant waste laws and regulations, including establishing standard process flows in data gathering and agreeing on the parameters for local level compliance; inputting existing local government information with a view towards monitoring, developing and pilot-testing the national online database; strengthening the capacity of local governments by assisting in data gathering, completing official compliance monitoring forms, and establishing internal monitoring systems to manage the online database; circulating a memorandum to all regional offices aimed at consolidating, validating and updating the database on or before the end of every quarter; and evaluating local government compliance monitoring data using results-based monitoring schemes whilst ensuring the availability of such information to the general public.
- F.1.2: Strengthen the capacities of local authorities, including by deputising waste management enforcers at all levels, by developing guidelines on the deputation of national and local SWM enforcers following competitive examination or evaluation with corresponding provisions for qualifications; setting terms on honoraria/allowances, developing training modules and standardised operations manuals for SWM enforcement officers/task forces at the national and local levels; pool trainers for would-be enforcers; conduct legal training and practicum on SWM enforcement at all levels, including directives with regard to apprehension of violators, setting terms of engagement and issuance of citation tickets, with parameters for enforcing violations, among others.
- F.1.3: Document best practices of recognised local governments and other stakeholders with regard to waste management, including by forging partnerships with institutions and networks that support the promotion of awards and recognitions; review, and revise if necessary, existing criteria and assessment forms for recognising SWM best practices and developing standardised evaluation schemes applicable for each sector or category, i.e., provinces, cities/municipalities, private sector, schools, etc.; and continually enhance and institutionalise existing rewards and incentive systems, including a monitoring period for sustainability of waste management programmes.

6. IMPLEMENTATION PRIORITIES AND MECHANISMS

A range of policy measures, instruments and incentives will be required to ensure effective implementation of Myanmar's NWMSMP. Key priorities and mechanisms that were identified through national-level consultations are briefly described below:

6.1. Adoption and mainstreaming

The process of implementation begins with the formal adoption and launch of the strategy and master plan. High-level political endorsement and commitment should be obtained from designated authorities at appropriate stages, subject to legislative review and approval. The launch of the strategy should be supported and accompanied by public consultation, whereby citizens are sensitised and informed about the strategy, and invited to provide comments and feedback.

6.2. Mobilising resources

The continued development and implementation of the national strategy and master plan will require allocating sufficient resources including utilising funding, from both within and outside government. Securing adequate finances, including necessary technical and human resources will ensure that the strategy development process proceeds in a timely and effective manner. Similarly, mobilising financial instruments will be essential for improving the efficiency of waste systems, by way of internalising the costs of waste management operations. Shifting the costs of waste management to waste producers would ease some of the cost pressure faced by the city

and township development committees resulting from annual increases in budget for waste management, as well as providing supplementary funding for enhancing waste collection and transport systems, establishing new treatment facilities and procuring new technologies. Moreover, such instruments can serve as a strong incentive for reducing waste generation and encouraging source separation, in turn maximising opportunities for re-use and recycling. This will involve providing incentives for private sector investment as well as public-private partnerships, which further underlines the importance of earmarking supplementary budget from government sources. Accordingly, national authorities should possess the capability and capacity to negotiate terms and arrangements with relevant private sector actors, to identify and deliver any necessary legislative and regulatory changes for addressing structural, policy and market barriers, as well as to design and implement action plans for priority waste streams in a participatory and demand-driven way. Given current constraints both with regard to skills and capital, Myanmar may choose to initially limit the reach of the national strategy, perhaps with the intention of expanding the scope as internal capacities are successively strengthened and enhanced.

6.3. Legislation and regulation

Appropriate legislation and associated regulatory requirements need to be set by MONREC with the cooperation of relevant line ministries, regional development committees, and city and township development committees

to guide the execution of the National Waste Management Strategy and Master Plan. Key priorities are listed as follows:

- (i) Setting necessary standards and tools for the management of isolated waste streams, such as municipal solid waste, industrial waste, other special waste (hazardous, medical, e-waste, mining and wastewater etc.)
- (ii) Establishing the legal basis for directing mandatory extended producer responsibility practices,
- (iii) Defining the basic parameters and infrastructural guidelines for implementing a waste management system, including separation classifications, intermediate treatment options, and final disposal,
- (iv) Issuing requirements for licensing and conditions for legal liability associated with addressing environmental concerns such as air and water issues associated with waste management facilities, landfill construction and incinerator operations,
- (v) Developing a supportive legal and regulatory framework that, among others, stipulates the amount and collection frequency of waste charges; delegates powers to concerned authorities with regard to supervising the implementation of regular waste audits; mandates the collection and submission of relevant information and data on a timely basis; and outlines specific waste management performance targets for government bodies and agencies,
- (vi) Instituting a compliance and enforcement programme will be critical to the successful execution of the strategy and master plan. MONREC thus requires an independent and robust team of inspectorates or environmental regulators in both Nay Pyi

Taw and its regional offices tasked with ensuring that the public behaves in accordance with the legislation and regulations. Establishing and equipping this inspectorate team with sufficient resources will be equally as important as all other efforts involved with the design and promotion of a functioning waste management system.

6.4. Monitoring and performance assessment

Another prerequisite for effective implementation of the National Waste Management Strategy and Master Plan is the establishment of an operational monitoring and evaluation system designed to both track progress and identify the emergence of new obstacles. This system should be prioritized assessing the strategy and action plan to ensure that stated objectives and priorities are being carried out; that important waste streams and issues are being addressed; that data is being collected and disseminated to support informed decision-making; and that there is visible and measurable progress made towards the targets. Should the main committee involved in developing the strategy be retained, it is advised that this body be assigned the ongoing role of collecting and evaluating progress reports aimed at the identification and analysis of barriers, to inform the modification of policies and budget for addressing observed failures, shortcomings and challenges accordingly.

Ensuring that there is sufficient political will, commitment and consensus on the intended direction of the national strategy and master plan will be fundamental to achieving these ambitions. MONREC-ECD, the leading ministry

whose remit includes legislating on waste management and related environmental issues, may be tasked with the implementation of the strategy; however, successful monitoring and performance assessment should be built on inter-ministerial coordination and cooperation through a representative body or mechanism, endowed with adequate legislative authority and resources, to guide the development of the strategy and master plan over the long term.

6.5. Responsibilities and partnership

Promoting the transparent and credible commitment of all involved stakeholders—members of the public, city staff, political decision makers, informal and formal business sectors, among others—will be paramount for ensuring the National Waste Management Strategy and Master Plan is fit for purpose and implementable over time. In this way, the strategy and master plan, together with its attendant rules, standards, and regulations can help to coordinate the actions of different actors based on a level of shared expectations. Resolving future commitment-related challenges rests on designing the strategy and master plan in a consultative and participatory manner, providing all stakeholders the opportunity to contribute to the decision-making process and reflecting these inputs in the city’s legal and political system, even in the face of changing circumstances and incentives. The starting point for facilitating these objectives includes establishing a national waste management coordinating committee tasked with convening concerned institutional actors and stakeholders. As outlined below, such a committee may be organised into various sub-committees, working groups and/or stakeholder task forces in order to effectively manage related work:

National government will by definition have a leading role in developing, coordinating, implementing and reviewing the national waste management strategy. Government agencies with particular sectoral responsibilities (e.g., environment, industry policy, infrastructure and planning, education, health) will be important for policy coordination, coherency and integration, as well as potentially taking the lead in their sector.

Regional and local governments are the main actors involved with delivering waste management in most countries, including carrying out MSW treatment and disposal as well as associated waste reduction, reuse recovery and recycling initiatives. Understanding the way in which regional and local governments engage both with each other as well as with national government is critical to the successful development and implementation of the national strategy.

The private sector plays a major role in waste management, especially with regard to business decisions on the viability of different approaches, technologies and processes. Private sector involvement can also be instrumental in obtaining data on the amount and types of waste generated. The private sector thus serves a key function in delivering waste management solutions to various issues and challenges, as well as suppliers of facilities and equipment, and as service providers.

The informal sector contributes necessary labour towards the reuse, sorting, recovery and recycling of useful materials and products found across different waste streams, although its contribution is not always given due recognition,

measured or documented. The sector includes waste pickers and collectors, operators of collection facilities and wholesale vendor operations, small mills and factories that make use of recovered materials, delivery operations and retail of recovered, remanufactured and/or recycled products.

Members of the greater public, as national citizens, may have rights that the waste management strategy needs to recognise: for instance, they may have rights conferred by law to access waste services, to participate in waste management-related decisions, and to have their voice heard on matters where their interests are affected. Accordingly, community members should be afforded involvement in the design of the strategy as well as in the development of local action plans. A structured and inclusive initial consultation process on strategy development can facilitate a more responsive design whilst contributing to higher rates of participation over the long term. In much the same way, community members should be extended an active role in monitoring the implementation of the strategy and its corresponding programmes within their local areas. Determining how, where, and to what extent efforts can best engage communities and encourage participation in decision-making is therefore vital to the successful promotion of waste management.

CSOs and NGOs are important sources of support, including with regard to raising awareness, disseminating information and providing technical guidance. CSOs and NGOs may also sometimes provide relevant organised services, such as cooperatives that serve to reduce waste generation. CSOs and NGOs often

play a critical role in terms of shaping and influencing the political acceptability of waste management policies, and therefore can be considered a valuable ally.

Waste experts and academics, such as university lecturers and researchers contribute to knowledge sharing and exchange, including by engaging in research and development on the technical and social dimensions of waste management, such as technologies, interactions between different stakeholders and the use of different decision-making and monitoring tools..

Teachers and other educators contribute to generating skilled human resources responsible for the management, regulation and continuation of waste management operations as well as assist in fostering community engagement and influencing consumer behaviour, both at the individual and household levels.

International partners, such as development agencies and public interest groups including UN bodies, industry associations, NGOs, academic networks, and others, can offer financial and technical assistance and a range of other services with regard to the promotion of sound waste management practices, reflected by the numerous examples of successful strategies, assistance and guidance materials, case studies, surveys and analysis on the topic. Such materials offer a wealth of ideas and relevant templates that can be used in fashioning a national waste management strategy. Further, these partners can bring financial and technical support.

6.6. Choice of technology

National-level decision-makers should decide on introducing specific waste management technologies that are best suited to local circumstances. Taking this into account, continuous research and development is necessary in terms of both identifying waste solutions and improving existing service provision; careful decision-making and evaluation of waste management options thus is an important part of implementing the National Waste Management Strategy and Master Plan over the long run. In addition to the selection of appropriate technologies, coordinating the transfer of technologies with different partners and deciding on the most effective deployment of such solutions are also key considerations in guiding a successful policy approach to waste management.

6.7. Awareness raising and public education

Awareness raising and education of different actors on proper waste practices are imperative for achieving waste management policy objectives. On the one hand, producers need to rethink the range, composition and design of their products and the design and structure of their processes; shop owners, office staff, the construction and demolition industry and its workers also need to rethink their attitudes towards the generation of waste. On the other hand, consumers should be encouraged to play a role in waste management, other than simply discarding goods and materials which no longer have a use.

Many actions taken at the level of industry, and by extension, the company or individual office, site, or facility can contribute to revenue

generation by avoiding costs associated with the production of waste producers, and businesses should be sensitised or encouraged to examine existing operations and adopt changes in product or process design as well as overall business practices. Improvements can result from a variety of motives: some actions will be justified for purely financial reasons, others will enable the producer to gain a marketing advantage, for example by building brand reputation. Some initiatives may be undertaken to avoid encouraging regulatory action, whilst others – probably most – may result from a combination of reasons and motives.

Downstream consumers can be guided and educated on ways to minimise or avoid waste including by: reducing their purchases of products that contribute to the waste stream, for example by buying unpackaged or more lightly packaged goods, or greener products in general; reusing, recovering or recycling goods, where possible, rather than discarding them; composting food wastes at home, where possible, separating waste at source for contribution to recovery and recycling programmes; and keeping hazardous materials out of MSW, in accordance with product or government guidance, among others.

One instrument for heightened consumer awareness is eco-labelling whereby products are required to be labelled with information about their impacts on health and the environment. In the present context, this signifies potential waste impacts, or recycling options at the end of the product's use phase. Another option is providing public education to help people play their part in elements of waste management

such as source separation.

Ensuring high levels of awareness and building motivation can be especially important at periods of transition. If, for example, major changes in practice are to be introduced, or waste charges are to be levied for the first time, having waste generators aware of the impending change can be vital in securing high levels of compliance. Certain audiences are

particularly susceptible to educational programmes or delivery of targeted information. Educating children early and building an awareness of the importance of managing waste properly at an individual and family level, and then reinforcing that message throughout the course of schooling, will yield returns over many years and contribute to responsible waste behaviour.

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Glossary of Terms

There are many different terms agreed and used to introduce waste management policy, system, theory and practices in the different parts of this National Waste Management Strategy and Master Plan and draws extensively from the *Guidelines for National Waste Management Strategies* (UNEP, 2013) and the *International Source Book on Environmental Sound Technologies for Municipal Solid Waste Management* (UNEP, 1996).

Anaerobic digestion (AD) - The biological conversion of processed organic waste to methane and carbon dioxide under anaerobic conditions.

Biodegradable material - any organic material that can be broken down by microorganisms into simpler, more stable compounds. Most organic wastes (e.g., food, paper) are biodegradable.

Bulky waste - large wastes such as appliances, furniture, and trees and branches that cannot be handled by normal MSW processing methods.

Circular economy - an economic model based inter alia on sharing, leasing, reuse, repair, refurbishment and recycling, in an (almost) closed loop, which aims to retain the highest utility and value of products, components and materials at all times.

Cleaner production - the continuous application of an integrated environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment". It aims at resource efficiency but also explicitly addresses and strives to reduce the use of hazardous substances in products and their production processes, and generation of emissions and wastes.

Collection - the process of picking up wastes from residences, businesses, or a collection point, loading them into a vehicle, and transporting them to a processing, transfer, or disposal site.

Commercial solid waste - wastes generated by commercial establishments including wholesale, retail, or service establishments such as stores, offices, markets, hotels, restaurants and warehouses, etc.

Communal collection - a system of collection in which individuals bring their waste directly to a central point, from which it is collected by the city or private sector.

Compost - the material resulting from composting. Compost, also called humus, is a soil conditioner and in some instances is used as a fertilizer.

Composting - the controlled, biological decomposition of organic solid waste materials under aerobic conditions

Construction and demolition debris (C&D) - waste generated by construction and demolition of buildings, such as bricks, concrete, drywall, lumber, miscellaneous metal parts and sheets, packaging materials, etc.

Controlled dumpsite - dumpsite that has been upgraded to incorporate some of the practices associated with sanitary landfills such as siting with respect to hydroge-ological suitability, grading, compaction in some cases, leachate control, partial gas management, regular (not usually daily) cover, access control, basic recordkeeping and controlled scavenging.

Cost Recovery Mechanisms - A simple definition of cost recovery for waste management services might read: to recover all of the costs associated with a waste management system, programme or service to ensure long-term sustainability.

Curb side collection - collection of compostable, recyclables, or trash at the edge of a sidewalk in front of a residence or shop.

Disposal - the final handling of solid waste, following collection, processing, or incineration. Disposal most often means placement of wastes in a dump or a landfill.

Disposal site - a site or location where solid waste is finally discharged and deposited.

Diversion rate - the proportion of waste material diverted for recycling, composting, or reuse and away from landfilling or incineration.

Eco-design - it is an approach, which includes the considerations of resource efficiency and reduction of risks, in addition to focusing on design features, which incorporate: extension of the product use period, design for disassembly, repair or upgrading (thus phasing out components that prevent reuse or recycling) and constructing a product from materials that can serve as inputs to another process.

Eco-labelling - whereby products are required to be labelled with information about their impacts on health and the environment.

Economic instruments - A monetary incentive or disincentive to act in a manner supportive of policy objectives

Electronic waste/E-waste/Waste Electrical and Electronic Equipment (WEEE) - generic term encompassing various forms of electrical and electronic equipment that have ceased to be of value and are disposed of. A practical definition of e-waste is "any electrically empowered appliance that fails to satisfy the current owner for its originally intended purpose

Energy recovery - the process of extracting useful energy from waste, typically from the heat produced by incineration or via methane gas from landfills

Environmentally sound waste management - waste management which must go beyond the mere safe disposal or recovery of wastes that are generated and seek to address the root cause of the problem by attempting to change unsustainable patterns of production and consumption. This implies the application of the integrated life cycle management concept, which presents a unique opportunity to reconcile development with environmental protection.

Extended producer responsibility - making producers responsible for their products at the end of the use phase in their life-cycle

Food waste - animal and vegetable waste resulting from the handling, storage, sale, preparation, cooking and serving of waste

Governance - the way government is understood has changed in response to social, economic and technological changes over recent decades. There is a corresponding shift from government defined strictly by the nation-state to a more inclusive concept of governance, recognizing the contributions of various levels of government (global, international, regional, local) and the roles of the private sector, of non-governmental actors and of civil society

Green economy - UNEP defines a green economy as one that results in "improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities".

Green waste - vegetable matter resulting from the tending, maintenance or creation of public or private gardens, and green areas and organic waste generated by professional or municipal horticultural activities.

Hazardous waste - waste that is reactive, toxic, corrosive, or otherwise dangerous to living things and/or the environment. Many industrial by-products are hazardous.

Health-care waste (medical waste) - waste generated by health care activities includes a broad range of materials, from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices and radioactive materials

Incineration - the process of burning solid waste under controlled conditions to reduce its weight and volume, and often to produce energy.

Industrial waste - solid waste that results from industrial processes and manufacturing

Informal sector - the part of an economy that is characterized by private, usually small-scale, labor-intensive, largely unregulated, and unregistered manufacturing or provision of services.

Landfilling - the final disposal of solid waste by placing it in a controlled fashion in a place intended to be permanent. The Source Book uses this term for both controlled dumps and sanitary landfills.

Leachate - liquid that has percolated through solid waste or another medium and has extracted, dissolved or suspended materials from it. Because leachate may include potentially harmful materials, leachate collection and treatment are crucial at municipal waste landfills

Life-cycle approach - examines a product and its passage through distinct stages of a life-cycle from the very beginning: extraction of raw materials, manufacture, packaging, transport, distribution, sale, use and end-of-life, when it enters into the waste management system and the later phases of the waste hierarchy

Market waste - primarily organic waste, such as leaves, skins, and unsold food, discarded at or near food markets.

Materials recovery facility (MRF) - a facility for separating commingled recyclables by manual or mechanical means. Some MRFs are designed to separate recyclables from mixed MSW. MRFs then bale and market the recovered materials.

Municipal solid waste (MSW) - all solid waste generated in an area except industrial and agricultural wastes. Sometimes includes construction and demolition debris and other special wastes that may enter the municipal waste stream. Generally excludes hazardous wastes except to the extent that they enter the municipal waste stream. Sometimes defined to mean all solid wastes that a city authority accepts responsibility for managing in some way.

NIMBY (Not In My Back Yard) - An expression of resident opposition to the siting of a solid waste facility based on the particular location proposed.

Open dumping - an unplanned "landfill" that incorporates few if any of the characteristics of a controlled landfill. There is typically no leachate control, no access control, no cover, no management, and many waste pickers.

Persistent Organic Pollutants (POPs) - chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms and are toxic to people and wildlife. POPs circulate globally and can cause damage wherever they travel

Polluter pays principle - states that those who cause or generate pollution should bear the cost of it. In the waste management context, the principle means that those who generate waste should bear the cost of managing it so that it does not pose risks to human health and the environment.

Producer responsibility - a system in which a producer of products or services takes responsibility for the waste that results from the products or services marketed, by reducing materials used in production, making repairable or recyclable goods, and/ or reducing packaging.

Recycle - the use of waste itself as resources including the process of transforming materials into raw materials for manufacturing new products, which may or may not be similar to the original product.

Reduce - choosing to use things with care to reduce the amount of waste generated

Reduce-reuse-recycle (3Rs) - the 3R Initiative aims to promote the "3 Rs" (reduce, reuse and recycle) globally so as to build a sound-material-cycle society through the effective use of resources and materials. Agreed upon at the G8 Sea Island Summit in June 2004, it was formally launched at a ministerial meeting in Japan in the spring of 2005.

Refuse-derived fuel (RDF) - fuel produced from MSW that has undergone processing. Processing can include separation of recyclables and noncombustible materials, shredding, size reduction, and pelletizing.

Resource efficiency - rethink the life-cycle of a product from the perspective of the resources that go into each stage, since losing resources as waste is inefficient. That may include rethinking the entire design and asking whether the functions that the product provides to the consumer can be delivered in some other way

Resource recovery - the extraction and utilization of materials and energy from wastes.

Reuse - involves the repeated use of items or parts of items which still have usable aspects.

Sanitary landfill - an engineered method of disposing of solid waste on land, in a manner that meets most of the standard specifications, including sound siting, extensive site preparation, proper leachate and gas management and monitoring, compaction, daily and final cover, complete access control, and record-keeping.

Sludge - a semisolid residue from air or water treatment processes

Source reduction - the design, manufacture, acquisition, and reuse of materials so as to minimize the quantity and/or toxicity of waste produced.

Source separation - setting aside of compostable and recyclable materials from the waste stream before they are collected with other MSW, to facilitate reuse, recycling, and composting.

Stakeholder - a person or an organisation that has a legitimate interest in a project or entity, or would be affected by a particular action or policy

Subsidy - direct or indirect payment from government to businesses, citizens, or institutions to encourage a desired activity.

Tipping fee - a fee for unloading or dumping waste at a landfill, transfer station, incinerator, or recycling facility

Transfer station - a major facility at which MSW from collection vehicles is consolidated into loads that are transported by larger trucks or other means to more distant final disposal facilities, typically landfills.

Waste - unwanted or unusable materials. Waste is any substance which is discarded after primary use, or is worthless, defective and of no use or is required to discard.

Waste-to-energy (WTE) plant - a facility that uses solid waste materials (processed or raw) to produce energy. WTE plants include incinerators that produce steam for district heating or industrial use, or that generate electricity; they also include facilities that convert landfill gas to electricity

Waste management hierarchy - the hierarchy indicates an order of preference for action to reduce and manage waste. The waste hierarchy is presented as a pyramid that specifies that preventing the generation of waste is the preferred action, followed by reduction (e.g. through re-use), recycling, recovery and as the least preferred action, disposal. Different versions of the hierarchy have been adopted by different countries.

Waste picker - a person or family who salvages recyclable materials from streets, public places or disposal sites

Waste reduction - all means of reducing the amount of waste that is produced initially and that must be collected by solid waste authorities. This ranges from legislation and product design to local programs designed to keep recyclables and compostables out of the final waste stream.

Waste sources - agricultural, residential, commercial and industrial facilities, open areas and treatment plants where solid waste are generated

Waste stream - the total flow of waste from a community, region or facility



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