Waste Management Strategy and Action Plan for Mandalay City (2017-2030)

December 2017

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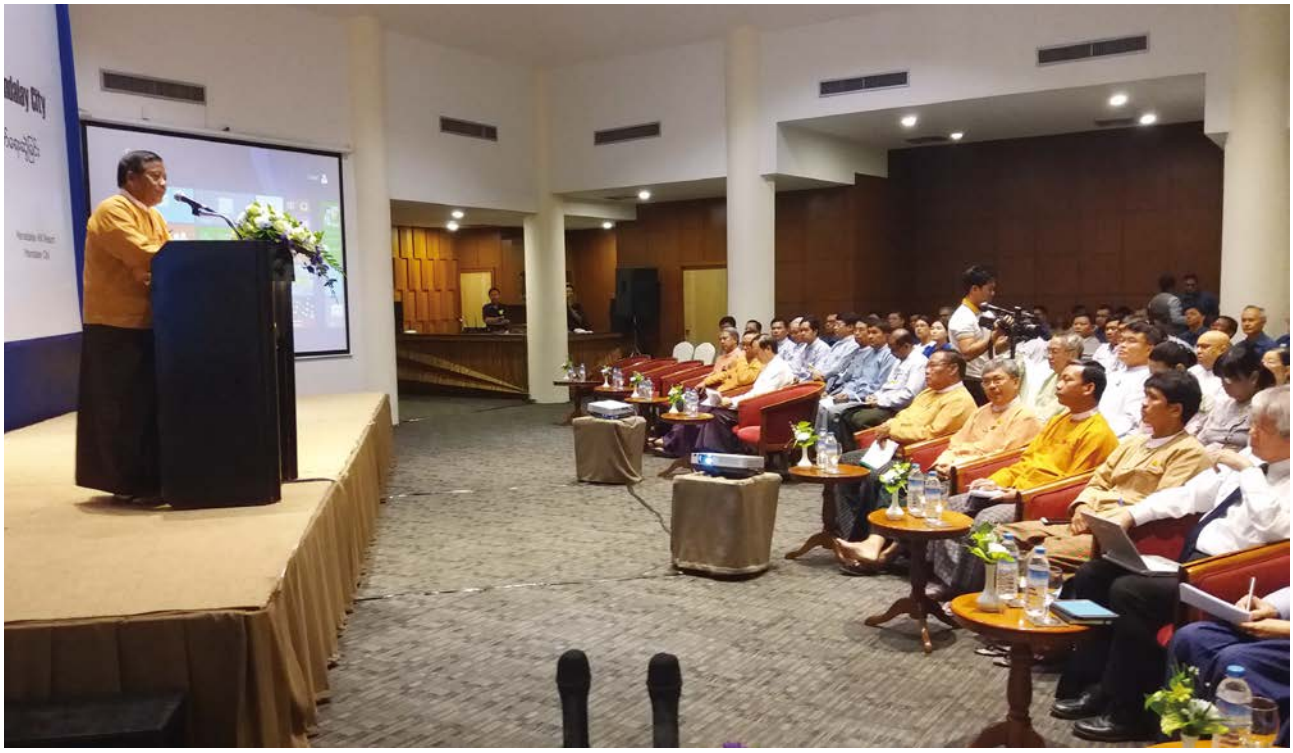

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UN environment

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Acknowledgement

Mandalay's City Waste Management Strategy and Action Plan is the result of concerted and dedicated team efforts led by the Mayor of Mandalay City and the Mandalay City Development Committee (MCDC), comprised of the Vice Mayor, Secretary, Joint Secretary, affiliated Committee Members, and the Heads of relevant departments, namely the Cleansing Department, Water and Sanitation Department, Motor and Transport Department, Administrative Department, Market and Slaughterhouse Department, Finance Department, Revenue Department, City Planning Department, Public Relations and Information Department, and Inspection Department. The strategy also benefited from inputs provided by key public, private, education, 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 stakeholders proved indispensable for drafting and refining the strategy in a timely, more practical and quality manner.

Mandalay's City Waste Management Strategy and Action Plan is the first ever initiative aimed at improving the city's waste in a holistic and integrated manner and as such offers a visionary document and strategic guide for addressing key issues, opportunities and challenges associated with transitioning towards a resource-efficient and zero waste management system. In this regard, Mandalay City Development Committee expresses its sincere gratitude to all public, private, academic and civil society stakeholders who actively participated in consultations at the ward, township and city levels and provided valuable feedback during specific meetings and working group discussions. Mandalay City Development Committee wishes also to thank the Environmental Conservation Department (ECD) of the Ministry of Natural Resources and Environmental Conservation (MONREC) and the Mandalay Regional Government for their continuous support in the development of the City Waste Management Strategy and Action Plan, which greatly contributed towards ensuring the strategy remained practical, implementable and relevant to the city's needs as well as national priorities, strategies and policy directions.

The Mandalay City Development Committee benefitted from the generous financial support of the Ministry of the Environment Japan (MOEJ) in partnership with the United Nations Environment Programme (UN Environment), and was developed based on agreement by the Ministry of Natural Resources and Environmental Conservation and the Institute for Global Environmental Strategies (IGES) Centre Collaborating with UNEP on Environmental Technologies (CCET). Mandalay City Development Committee also recognises the important coordinating role played by the CCET and the Environmental Quality Management Co., Ltd. (EQM), both with regard to their technical support and project facilitation throughout the strategy formulation process.

Foreword

Mandalay Regional Government is carrying out tasks with the objective of making Mandalay into a clean, green and smart city. Mandalay, the former capital city of Myanmar, is widely recognised for its numerous opportunities for economic development and its rich cultural background. Known for its royal palace where the last monarchy of Myanmar resided and where the ancient cities of Amayapuya and Inn Wa were located, Mandalay is now also considered a city that is making progress in ecotourism. Furthermore, it is located in the heart of Myanmar, with convenient connections to neighbouring countries such as China and India. Mandalay is developing as a trading hub in Myanmar with an increasing number of small and medium-sized enterprises as well as industrial sectors. Thus, the Mandalay Regional Government needs to execute action plans along with the development of strategies and policy frameworks. The governments also need cooperation from citizens and other stakeholders to keep the city unconditionally clean. In conjunction with fast growth in Mandalay, waste management is a significantly important issue and needs to be addressed in strategic manner. Improving waste management is certainly not a short-term matter that can be overcome within a day, a month or a year, but a matter that requires a long-term vision along with implementation of practical actions to introduce a sustainable waste management system. Therefore, a waste management strategy and action plans should be developed and implemented systematically so that Mandalay can achieve improved sustainable development for the benefit of future generations and for the city itself. However, it is impossible for the Mandalay City Development Committee (MCDC) to carry out this task alone. It is essential for the government and public to work together to maintain a clean, modern and attractive city. Therefore, I would very much encourage elected parliament representatives, civil society organisations, nongovernmental and governmental organisations and citizens to work together in implementing this City Waste Management Strategy and Action Plan towards achieving sustainable development in Mandalay City.

Dr. Zaw Myint Maung,

Hon. Chief Minister of Mandalay Regional Government

I can state with confidence that Mandalay City Development Committee aims to keep Mandalay City clean, beautiful and liveable for its people. Hence, in order to achieve the objectives, it is imperative to manage activities including waste generation, collection, transportation and proper waste disposal in a vigilant manner. Rather than to carry out conventional waste management, the city needs to conduct it in a more efficient and effective manner leading to sustainable waste management which can ensure that a clean, green and healthy city is passed on to future generations. Thus, I welcome that Mandalay City has taken its first step in developing this City Waste Management Strategy and Action Plan aiming to accelerate the transformation from a traditional way of waste management to sustainable waste management. I would also like to guarantee the commitment of the Mandalay City Development Committee to the successful implementation of the waste management strategy and action plan, strengthening the partnership between the public and private sectors.

Dr. Ye Lwin,

Hon. Mayor of the Mandalay City Development Committee (MCDC)

While Myanmar is one of the fastest growing economic nations, the country needs to put more attention on sustainable development in harmony with social, economic and environmental aspects. Along with rapid urbanisation, accelerated development of industries and economic growth, Myanmar is witnessing s a growth in population, resulting in significant waste generation year by year along with pollution of air, water and soil. This situation can ultimately lead not only to environmental impacts but also to public health issues. Hence, it is urgently required to take some proactive measures to solve this problem by a developing waste management strategy at national and city levels. Currently, waste management strategy and action plans drawn up by the city of Mandalay are planned to be implemented in other regions/ states of Myanmar. I believe that such strategies can also be utilised in other respective sectors to implement proper waste management.

U Hla Maung Thein,

Director General (DG) of the Environmental Conservation Department,

Ministry of Natural Resources and Environmental Conservation, Myanmar

Rapid urbanisation in the developing world is leading to massive waste management challenges. City governments are expected to provide environmentally sound municipal solid waste services for fast-growing populations in the context of increasing consumption, and hence refuse, often despite flat-lined municipal budgets, and increasingly overburdened infrastructure. In order meet this challenge, a locally tailored waste management action plan is a necessary component of any municipal level development planning. This waste management strategy and action plan for Mandalay, Myanmar was developed to tackle precisely such local challenges. The plan is an inclusive one, involving a range of stakeholders including in particular the informal sector in its envisioned future waste management practices. Though focused at the city level, it is linked to the National Comprehensive Development Plan and sets out a series of clear objectives with achievable targets over three periods, from short to long term. I am very pleased that UN Environment has had the opportunity to work with the Mandalay City Development Committee in cooperation with the Institute for Global Environmental Strategies and its Collaborating Centre to develop this plan, and thereby helped contribute to a healthier future for the growing population and the environment in Mandalay.

Keith Alverson,

Director of International Environmental Technology Centre, UN Environment

Like many other fast-growing cities in the country, Mandalay City faces a tremendous challenge in managing its waste. In this regard, Mandalay is one of the first cities to receive technical assistance from the IGES – Centre Collaborating with UNEP on Environmental Technologies (CCET), aimed at supporting the development of a waste management strategy and action plan based on a holistic waste management approach. Thanks to the strong leadership, commitment and encouragement of Hon. Mayor and the Committee Members, the City Waste Management Strategy and Action Plan (CWMSAP) for Mandalay City was successfully developed with close coordination and supervision of the concerned Departments and representatives from local communities. This City Waste Management Strategy and Action Plan highlights the main issues, needs and challenges associated with efforts to improve the city's waste management system, aimed at raising awareness among key stakeholders towards achieving a resource efficient and zero waste society in Mandalay. It also identifies strategic programmes 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 the city.

Kazunobu Onogawa,

Director, CCET

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List of abbreviations

ADB	Asian Development Bank
BORDA	Bremen Overseas Development & Research Association
CBD	Central Business District
CCET	IGES Centre Collaborating with UN Environment on Environmental Technologies
CDCs	City Development Committees
ECD	Environmental Conservation Department
EU	European Union
EQM	Environmental Quality Management Co. Ltd.,
GDP	Gross Domestic Product
GHGs	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
MSW	Municipal Solid Waste
MRF	Material Recovery Facility
NWMSAP	National Waste Management Strategy and Action Plan
NCDC	Nay Pyi Taw City Development Committee
NGO	Non-Governmental Organisation
NSDS	National Sustainable Development Strategy
NCDP	National Comprehensive Development Plan
PCCD	Pollution Control and Cleansing Department
PRC	People's Republic of China
PPP	Public-Private Partnership
3R	Reduce, Reuse, Recycle
SEZ	Special Economic Zone
SWM	Solid Waste Management
TDCs	Township Development Committee
UNDP	United Nations Development Programme

UN Environment	United Nations Environment Programme
UN Environment-IETC	United Nations Environmental Programme International Environmental Technology Centre
UN-Habitat	United Nations Human Settlements Programme
WHO	World Health Organization
WWF	World Wide Fund for Nature
YCDC	Yangon City Development Committee

1. INTRODUCTION TO THE STRATEGY

1.1. Presentation of the strategy

Mandalay, the second largest city and last royal capital of Myanmar, currently faces a tremendous challenge in managing its waste, much like many other fast growing cities in the country. Further to a request from Myanmar's Ministry of Natural Resources and Environmental Conservation (MONREC), the International Environmental Technology Centre (IETC) of the United Nations Environment Programme (UN Environment) has been supporting both national and local governments to build capacity for waste management and promote the development of conducive policy framework, strategies and their implementation through pilot demonstration. In this regard, Mandalay is one of the first cities to have received technical assistance from the IGES Centre Collaborating with UNEP on Environmental Technologies (CCET) for the development of a City Waste Management Strategy and Action Plan based on the National Waste Management Strategy and Action Plan of the Government of Myanmar.

The City Waste Management Strategy and Action Plan for Mandalay (CWMSAP) gives a long-term vision and guide to Mandalay City Development Committee (MCDC) for its efforts towards transforming from the traditional waste management practices (waste collection and disposal) to more sustainable waste management practices including 3Rs (Reduce, Reuse and Recycle) to achieve a resource efficient and zero waste society. It focuses on the ongoing work undertaken by MCDC to improve the level and quality of waste management, taking into consideration past actions and present socioeconomic constraints. It also reflects discussions on best practices from around the world as well as the expressed views of national and local stakeholders, though remains specific to Mandalay as it has been developed in context of its particular social, economic, cultural and political environment.

The City Waste Management Strategy and Action Plan is also intended to identify programmes, approaches and local policies to enhance municipal solid waste (MSW) collection and diversion, improve final treatment and disposal, maximise proper collection and treatment of industrial, medical and other types of waste, an effective treatment of liquid waste (waste water), whilst ensuring that waste management services remain sustainable through institutional strengthening, capacity building, awareness raising, advocacy and continuous review, monitoring, innovation and improvement.

Specific targets and actions have also been developed for each strategy via a consultative process with key stakeholders to ensure efficient operation of waste management and recycling activities in the city. However, the specific processing or disposal technologies identified in this strategy and action plan need to be finalised after reviewing their practical applicability to the local financial, environmental, social and cultural context.

1.2. Summary of the city waste management strategy and action plan of Mandalay city

Vision Statement	Mission Statement
Mandalay will be a Clean, Green, and Healthy City in Myanmar, where culture and environment are preserved for future generations.	To reduce waste generation and manage residual waste materials in a way which maximises opportunities for resource recovery, while protecting public health and the environment to achieve a zero waste society.

Goals					
A Provide adequate and affordable municipal waste collection service for all and waste reduction through prevention and the 3Rs	**B** Stop uncontrolled dumping, open burning and improve the final treatment and disposal	**C** Maximise proper waste collection and treatment of industrial and other special types of waste (hazardous, medical, mining, e-waste, construction and demolition waste etc.)	**D** Maximise proper disposal and treatment of liquid waste	**E** Capacity development, awareness raising and advocacy	**F** Ensure sustainable services through regular review, monitoring, innovation and improvement
Targets					
(i) Increased (%) municipal waste collection coverage in the whole city (ii) Progress (%) of waste separation at source and collection system will be operated (iii) Increased (%)	(i) Reduction (%) of illegal dumping in the city (ii) Improvement of landfill site operation (iii) Reduction (%) of food waste, market waste and green waste to be landfilled	(i) Increased (%) of recycling of industrial and other special types of waste (ii) Reduction (%) of industrial and other waste sent to landfill without pre-treatment	(i) Increased (%) of coverage of liquid waste collection and proper treatment in domestic sector (ii) Increased (%) of coverage of liquid waste collection and proper treatment in industrial	(i) Increased (%) number of townships have implemented standard awareness-raising programmes for their residents and the (%) of population reached (ii) Increased (%) number of	(i) Establishment and monitoring of data collection and benchmark performance indicators (ii) Decreased (%) number of enforcement actions filed against non-compliant entities

material recovery and recycling	(iv) Introduction of appropriate technologies for intermediate treatment		sector (iii) Increased (%) of coverage of liquid waste collection and proper treatment in public places (public markets, central bus and train terminals)	schools have established environmental education programmes and the (%) of students reached (iii) Increased (%) the degree of cooperation of other stakeholders for ensuring the sustainable waste management service	(iii) Increased degree of public/ customer satisfaction (%) about the waste management service
Objectives/ Actions					
A.1: Provide effective and efficient municipal waste collection services A.2: Introduce waste separation at source A.3: Integrate private and informal sectors as partners in the delivery of sustainable waste management A.4: Improve infrastructure for waste collection, storage, transfer and transport	B.1: Reduce organic (food) waste sent to landfill B.2: Increase recovery of additional material at landfill for RDF B.3: Examine potential of waste to energy (W2E) technologies such as incinerators and landfill gas capture B.4: Establish a new sanitary landfill meeting engineering standards for final disposal B.5: Establish mechanisms to discontinue the operation of illegal dumping sites in the city	C.1: Reduce industrial and hazardous waste generation C.2: Implement source segregation and collection systems C.3: Promote effective recycling, treatment and final disposal	D.1: Improve the collection and treatment of liquid waste in domestic areas D.2: Improve the collection and treatment of liquid waste in industrial areas D.3: Improve the collection and treatment of liquid waste in public areas (public markets and central bus/train terminals)	E.1: Mainstream environmental education and waste management in school curricula and programmes E.2: Mobilise the support of local stakeholders by increasing awareness and participation in environmental education and waste management	F.1: Establish a data collection mechanism F.2: Establish a reporting mechanism F.3: Establish a communication mechanism to ensure regular consultation among key stakeholders

2. STRATEGY DEVELOPMENT – THE PROCESS

As shown in Figure 1, the following key steps were taken in preparing Mandalay's City Waste Management Strategy and Action Plan with active involvement from all key stakeholders in the city between January 2016 and August 2017.

First, a quick study was conducted based on a literature review, technical discussions and personal interviews with relevant staff and other key stakeholders. This was combined with more details field observations and study of the respective waste management systems and facilities. These actions helped to clarify the current state of waste management systems in Mandalay and identify major gaps to be addressed in future strategies.

After that, a series of stakeholder consultation workshops were organised by MCDC with the Environmental Conservation Department of the MONREC and CCET to solicit first-hand inputs and reviews of key stakeholders. A two-day multi-stakeholder consultation workshop was held on 16-17 June 2016 attended by about 100 participants representing national and regional ministries, relevant departments of MCDC, private sector, academic institutions, NGOs, and community groups. The workshop involved active discussions on the current waste management system, key challenges and identification of practical goals, targets, objectives and actions to overcome those challenges moving towards resource efficiency and a zero waste society.

Major findings were then documented and used to develop the first draft of the city's waste management strategy and action plan during the period of June – August 2016. Subsequently, a roundtable meeting was organised by MCDC in September 2016 where key stakeholders were invited to present the draft strategy and action plan for their comments, discuss its contents and agree on the final text which will be shared and reviewed further with a wider range of stakeholders in follow-up citizen forums and

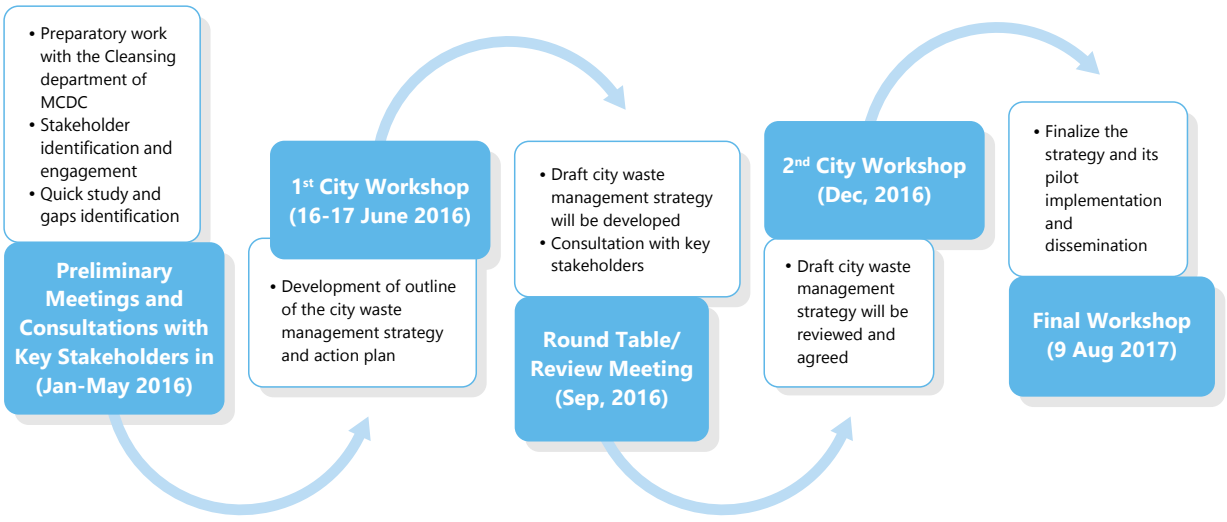

Figure 1: Process flow of strategy development in Mandalay. Source, IGES 2017

focused group discussions.

MCDC followed this up by organising another one-day multi-stakeholder workshop inviting over 100 representatives from public institutions, private sector, community organisations and academic institutions in December 2016 to present the final version of the draft strategy and action plan for their comments and discuss any further revisions to the strategy and action plan. The final draft of the city waste management strategy and action plan was further improved based on the outcomes of this multi-stakeholder workshop.

The final report of the Mandalay City Waste Management Strategy and Action Plan was then presented at the final city workshop in Mandalay on 9 August 2017 inviting Honourable Chief Minister of the Mandalay Regional Government and about 120 participants including the Mayor of Mandalay city, regional ministers, the members of MCDC, senior officials of relevant national government institutions, heads of departments, academic institutions, civil society, the private sector and media, for final endorsement of the strategy and expression of commitment to its implementation.

Figure 2: Snapshots of the multi-stakeholder workshops held in Mandalay. Source, IGES 2017

3. WASTE MANAGEMENT-WHERE WE ARE NOW

3.1. Overview

With approximately one million inhabitants, Mandalay is the second most populated city and the last royal capital (Konbaung Dynasty) of Myanmar. Mandalay is also the economic hub of the Upper and Central part of Myanmar, and a cultural and religious centre of Buddhism in the country. The city is located 716 km north of Yangon, bound by the Ayeyarwaddy River to the west and the Doehtawaddy to the south. Mandalay is composed of six townships with a total land area of 314.7 sq.km. These townships are further divided into 97 wards for the effective administrative and public services management. MCDC is responsible for local administration, planning and implementation of urban services. The Mayor who is also the Minister for Development Affairs in Mandalay Regional Government heads the MCDC. A team including the Deputy Mayor, Secretary, Joint Secretary and nine Committee members assist the Mayor.

3.2. Current status of waste management

According to the Cleansing Department of the MCDC, current municipal solid waste (MSW) generation in the city stands about 940 tonnes per day with the per capita waste generation of 0.64kg/person/day. However, a sample survey carried out by the FASEP/French Grant Urban Services Improvement Project identified that the solid waste generation per capita reached approximately 0.74 in 2015. This indicates that Mandalay's increasing economic growth is contributing to rising levels of waste that must be managed appropriately. MSW in Mandalay is primarily generated from households (75%), and

Figure 3: Mandalay City Development Committee (MCDC). Source: MCDC, 2015

the commercial (24%) and tourism (1%) sectors. As shown in Figure 4, the physical composition of MSW includes organic waste (64%), plastic waste (14%), and paper and cardboard (6%), wood (3%), textile (4%), glass (2%), metal (1%) and other waste (6%).

Mandalay's existing waste management system comprises primary collection, secondary collection and final disposal. Primary waste collection methods include door-to-door collection, container collection from kerbside bins, and open collection points. Door-to-door collection is a highly labour intensive activity involving various announcement methods such as bell ringing and loudspeaker announcement, and is carried out using either a combination of pushcarts, tri-bikes and tipper trucks based on the location and conditions of specific areas in the city.

In addition to the door-to-door collection, the MCDC has disseminated containers (approximately 7m^3) at 72 locations, including markets, business centres and neighbourhoods for local residents to dispose of the waste generated in their vicinity. When containers reach their maximum capacity, they are transported directly to respective landfill sites. However, unauthorised, non-designated collection points continue to operate due to inefficiencies in the collection system, as well as poor infrastructure and low levels of public awareness. In this case, waste is frequently disposed in open areas without any environmental safeguards, with MCDC staff manually collecting waste into vehicles and transporting it to the landfill sites. According to the MCDC, an average waste collection ratio in the city is about 80%. However, the sample survey of the FASEP/French Grant Urban Services Improvement Project found that this figure differs between urban and peripheral areas, where the ratio of waste collection has

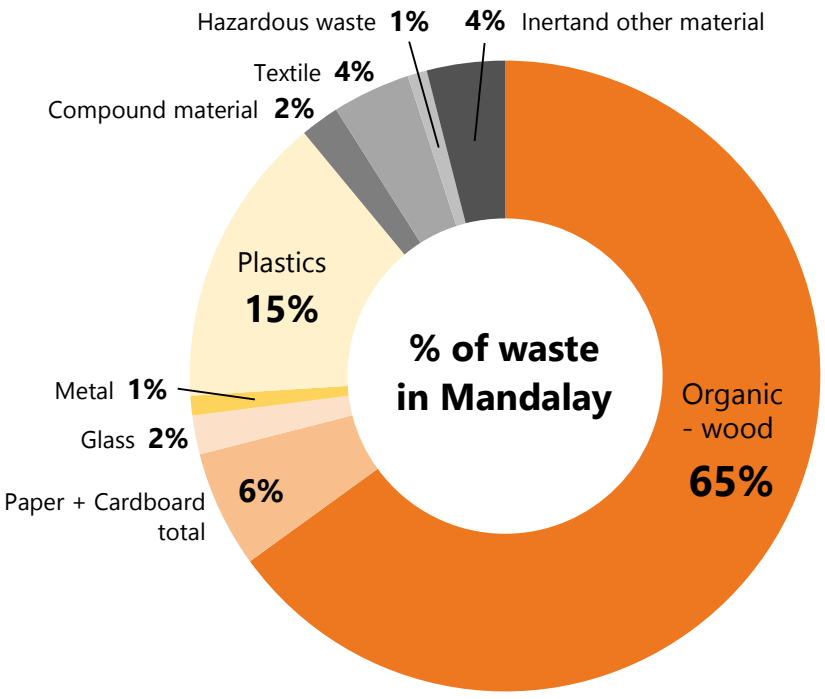

Figure 4: Waste characteristics of Mandalay. Source: MCDC, 2016

Figure 5: Landfill site at Kyar Ni Kan. Source: IGES, 2016

been found to be less than 50%.

Currently, there is no official waste separation system being implemented in the city. The informal sector plays a significant role in managing waste in Mandalay, with more than 1,000 waste collectors operating throughout the city involved in door-to-door collection of recyclable materials, transfer stations and final disposal sites. Collected recyclable materials are then resold to designated waste buyers who further separate, clean and process them for reuse or recycle markets. It was estimated that roughly 400 small and medium-size recycling enterprises are operated in the city for managing the sorting and resale of paper, plastic, metal, plastic bottles, and reuse glass bottles. The estimated recycle rate in Mandalay at present is about 5%.

According to the staff of the Cleansing Department of MCDC currently manages three treatment facilities for waste processing, including two landfill sites— one at Kyar Ni Kan (northern part of Mandalay, 500 tonnes /day) and at Thaung Inn Myout Inn (southern part of Mandalay, 400 tonnes /day), an incinerator (discontinued) (30 tonnes /day at Thaung Inn Myout Inn, southern part of Mandalay). However, it was identified that the incinerator in Thaung Inn has temporarily terminated operations due to some technical issues (its low treatment capacity, high fuel consumption and poor maintenance). Consequently, the city presently utilises the two previously mentioned landfill sites for final waste disposal. The

collected waste is unloaded onto the soil or existing layers of waste in the landfill site. Thereafter, waste pickers collect available recyclable materials using racks and baskets. Following that, heavy machinery such as bulldozers push the waste into the centre of the landfill. From these observations, it is apparent that the landfill sites do not maintain sufficient soil coverage or practice effective leachate management. However, there is currently no existing data on the level of air and water pollution being generated by Mandalay's existing landfill sites. It is apparent however that the risk is much higher for those informal labourers working at the landfill site.

Furthermore, Mandalay hosts three industrial zones located in Pyigyitagun Township (southern part of the city) which were established in 1991-1992. Approximately 1,500 different industries are operating in these zones. Currently, MCDC manages industrial waste collectively with municipal waste. There is no accurate data on the volume of generated industrial waste, separate collection practices, number of staff, vehicles or final treatment methods used to address industrial waste.

According to the Cleansing Department, only medical/ hospital waste is currently managed separately from municipal solid waste. The medical waste generation makes up approximately two tonnes /day and it is divided into several types: infectious waste (1,780 kg/ day), sharps (46 kg/day) and miscellaneous waste (309 kg/day). Collected medical waste is

Figure 6: Waste water treatment plant in a factory. Source: IGES, 2016

treated at the incineration pit located at Kyar Ni Kan landfill, in the northern part of Mandalay city.

In terms of the waste water, domestic waste water (residential/ commercial) generation is found to comprise 15,000 m^3 / year. Gray water treatment process (only aeration) is conducted at Thingazar creek (3 places). Domestic gray water is directly released into creeks (Thingazar creek, Shwe Ta Chaung creek, Ngwe Ta Chaung creek etc.). Current industrial waste water volume capacity is 2,000 m^3/day and there is no proper treatment of sewage and industrial waste water. Hospital waste water is treated by small-scale chlorination treatment.

3.3. Existing policy and regulations

There are some national and local policies, laws and regulations associated with waste management. Myanmar's National Environmental Policy of 1994 instituted environmental regulations concerning the utilisation, conservation, and prevention of environmental degradation including water, land, forest, mineral, marine resources, and other natural resources. In addition, Myanmar's Agenda 21 commitment (1997) on implementing the integrated management of natural resources provides a blueprint for achieving specific targets on environmentally sustainable development.

In 2009, the country's National Sustainable Development Strategy (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 Environmental Conservation Department (ECD) were also established in 2012 as mechanisms to enforce environmental conservation and protection. The Environmental Quality (Emission) Guidelines and the Procedures for Environmental Impact Assessment were also established at the national level with a view to prevent potentially adverse environmental and social impacts resulting from development projects.

In addition to these national policies and laws, MCDC has also established its own laws, regulations and rules for waste management and environmental conservation, such as the Environmental Conservation and Cleansing bylaws, Public Health Regulation and the Business Administration and Lichening Regulation dated May 14, 2015.

3.4. Institutional and financial framework

MCDC is the city government responsible for financing, planning and delivering urban services including waste management in all six townships of Mandalay city. The Mayor who is also the Minister for Development Affairs in Mandalay Regional Government heads the governing body of the MCDC. The Deputy Mayor, Secretary, Joint-Secretary and nine Committee members for the daily operation, assist the Mayor. Currently, MCDC is divided into 14 departments made up of over 6,000 staff. Among all these departments, the Cleansing Department (overall waste management), Water and Sanitation Department (water supply, waste water and sanitation management), Motor Transport and Workshop Department (waste collection), and Playgrounds, Parkes and Gardens Department (city greening and

landscaping), Administration Department/ Finance Department (administration and city finance), Revenues Department (collection of waste collection fees), Agriculture and Livestock Breeding Department (agricultural waste), Public Relation and Information Department (information gathering and sharing), and Inspection Department (inspection and monitoring) are focused on waste management activities in their respective areas.

It was noted that the highest percentage of budget expenditures related to waste management are associated with labour and waste handling. Accordingly, over 2,000 workers were employed for conducting waste management services including waste collection and disposal activities in 2015.

According to city staff, 55% of total staff were recruited for primary waste collection; 20% workers were involved in secondary waste collection; another 25% served as drivers of collection vehicles. In addition, it was observed that MCDC works closely with different stakeholders for improving waste collection in the city, such as District and Townships' Development Committee and Organizations, Region Health Departments, Wards Committees, the Environmental Conservation Department, Region Irrigation and Public Works Departments, Non-Governmental Organisations (NGOs), various political parties and the greater public.

According to the Cleansing Department, the annual operation and maintenance costs of the department was 4,946 Million Kyat (3.6 Million USD) in the year of 2015/2016. However the total income earned from providing the waste management service during the same period was only 651 Million Kyats (0.5 Million USD) including (i) public cleansing tax (320 Million Kyats), Tax from public, commercial, and institutional building cleansing (32 Million Kyats), waste collection fees from medical waste collection (29 Million Kyats), hotels (120 Million Kyats), and commercial wastes (150 Million Kyats). The balance cost (3.1 Million USD) was subsidised by the MCDC from its annual operation budget.

3.5. Challenges in the future

The key challenges associated with waste management in the Mandalay city are briefly described below.

Waste generation and composition:

There is a rapid increase in waste generation in the city. The data shows that the waste generation and collection has increased from 259 tonnes/day in 2005 to 896 in 2015. This is due to the gradual expansion of administrative boundaries of the city and the integration of adjacent neighbouring areas. In 1993, Mandalay city comprised only four townships with 54 wards. However, this number had increased to 6 townships and 97 wards by 2015. A rapid increase in the population of the city brings a major increase in the volume of waste generation and collection. In addition, economic development and changes in lifestyles have resulted in an increasing variety of types of waste requiring proper treatment, such as e-waste.

With the establishment of industrial zones, an increase in the amount of industrial and hazardous waste has also occurred. However, due to lack of an effective management system,

hazardous wastes are collected together with household wastes and disposed of in landfill sites. MCDC thus faces a tremendous challenge in identifying and implementing the appropriate waste disposal methods.

MCDC estimates that current landfill sites are set to reach the end of their lifecycle in another 2-4 years and the city administration is having trouble in locating suitable replacement land sites within city limits. Mounting waste generation results in a need for more waste collection staff and equipment, which ultimately leads to an increase in the cost of waste management services.

Policies, regulations and institutional arrangements:

As highlighted above, there are currently a range of national and local policies, laws and rules on environmental conservation in Myanmar. However, there is no direct regulations and policies for addressing waste management issues at both national and the city level. Similarly, weak enforcement of existing laws and regulations is also identified as one of the main obstacles to introducing proper waste management practices. In addition, a lack of knowledge and capacity at the national and local levels and the absence of coordination between different administrative units and stakeholders have also been identified as major challenges for guiding proper waste management.

Public participation (education, promotion of 3Rs through awareness campaign & awareness raising):

The MCDC has introduced a number of programmes in cooperation with local Non-Governmental Organisations (NGOs) and volunteer groups to increase public awareness and participation in the promotion of 3R (Reduce, Reuse, Recycle) activities. For instance, volunteer groups, youth groups, health and social service associations have been involved in public awareness and environmental cleaning campaigns.

In addition, MCDC has organised regular meetings with ward leaders and community members to educate the public on sustainable waste management activities. MCDC has also established an environmental education programme in local schools to raise the awareness of students on waste separation and recycling. However, due to the lack of an existing waste management strategy, road map and infrastructure for proper waste separation, collection and 3R activities, public participation in these activities remains limited and ad-hoc.

Economic aspects:

Public revenue for waste management is 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 and the fee ranges from 300-900 kyats/month. Other waste such as industrial and hazardous materials is charged based on the waste volume and price for one truck (3 tonnes capacity) comprising about 35,000 kyats per trip. This cost recovery policy helps to reduce waste disposal subsidies provided by the city and thus encourages sounder fiscal planning.

However, revenue captured from the collection of waste remains very low, and as such cannot maintain a balance with total waste management

expenditures, especially for the capital costs required for new waste management infrastructure. It was also identified that there is a lack of financial support from the national government for waste management at local level as service provision is considered the responsibility of municipalities. Correspondingly, there is no useful examples of private sector involvement in waste management due to lack of policy measures and capacity for establishing Public-Private Partnerships (PPP). The informal sector is involved in managing roughly 5% of waste collection and recycling in the city affording job opportunities for a significant number of urban poor. However, integrating the informal sector into the city's waste management system has proven a challenge.

Technological aspects:

The MCDC needs to upgrade existing infrastructure to improve its waste management system. This requires suitable technologies for waste collection, transport, biological treatment (composting/biogas), recycling, waste-to-energy and the establishment of sanitary landfills. However, limited expertise and capacity for identifying appropriate technologies adopted to local conditions, inadequate resources such as finance and technical capabilities to identify and invest in new technologies, and limited research and practical application of new technologies are some of critical barriers obstructing progress.

Figure 7: Waste separation at secondary collection points. Source: IGES, 2016

4. HOW TO MOVE FORWARD

4.1. Scope and period covered by the strategy

The MCDC recognises the need to increase waste diversion from landfill and it is actively pursuing the objective of developing Mandalay City into an environmentally sustainable city. Mandalay's City Waste Management Strategy and Action Plan therefore seeks to achieve the goal of zero waste by 2030. To this end, it sets a short-term target to be achieved during the period of 2017-2020, middle-term targets by 2021-2025 and long-term targets by 2026-2030. In addition, the City Waste Management Strategy and Action Plan includes a comprehensive list of actions that are based on the findings of the quick study and feedback from a range of municipal stakeholders. It also reflects the goals and implementation directives of the city. The strategy covers solid waste from residential, commercial, institutional, public areas (public markets and central bus/train stations) and industrial sources, as well as hazardous and liquid (waste water) waste.

4.2. Strategic context for waste management

This City Waste Management Strategy and Action Plan is prepared in line with the strategic outline of the National Waste Management Strategy and Action Plan of the Government of Myanmar and some other existing and proposed national and local environmental and development plans and strategies. The National Comprehensive Development Plan (NCDP) 2015 of Myanmar identifies 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; this includes 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.

In addition, on-going preparation of the country's National Environmental Policy (UNDP), Myanmar Climate Change Study and Action Plan (UN-Habitat), and the Green Economy Policy Framework (WWF) also take into consideration the importance of effective waste management to achieve government commitments relating to the Sustainable Development Goals (SDGs) and the Paris Agreement on Climate Change in 2015.

Further, the Strategic Plan also notes the City of Mandalay Development Law (2002) which delegates responsibility to the MCDC for the provision of effective urban services to its residents; it also makes reference to the findings of the Asian Development Bank (ADB) funded FASEP/French Grant Urban Services Improvement Project which aims to improve environmental and public health conditions to support Mandalay's vision of creating a clean and prosperous green city.

4.3. Guiding principles - waste management hierarchy and principles

The following guiding principles provide the foundation from which Mandalay City Development Committee will implement

concrete actions aimed at transforming current solid waste management practices.

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 for a massive change in 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. Zero Waste is more of a goal or ideal rather than a hard target, and provides guiding principles for continually working towards eliminating waste.

Waste hierarchy: The Waste Hierarchy is a strategic tool, which prioritises actions for waste management. This consists of the 3Rs: *Reduce* - reduce waste that must be generated and which goes to the landfill (this includes composting); *Reuse* - repair goods that can be repaired, or find alternative uses for wastes; and *Recycle* - return wastes with recoverable value for re-processing.

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

Polluter-pays principle: 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: 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: Waste should be dealt with as close to the source of generation as possible. This reduces transportation costs, and reduces risks of contamination of the environment during transport.

Consultation principle: All levels of Government should consult and work with people and organisations throughout the development and implementation of waste management strategies and action plans.

Shared responsibility: Zero Waste is a shared responsibility and requires partnerships and collaborations between all sectors of government, industry, research institutions, NGO's, and the general community.

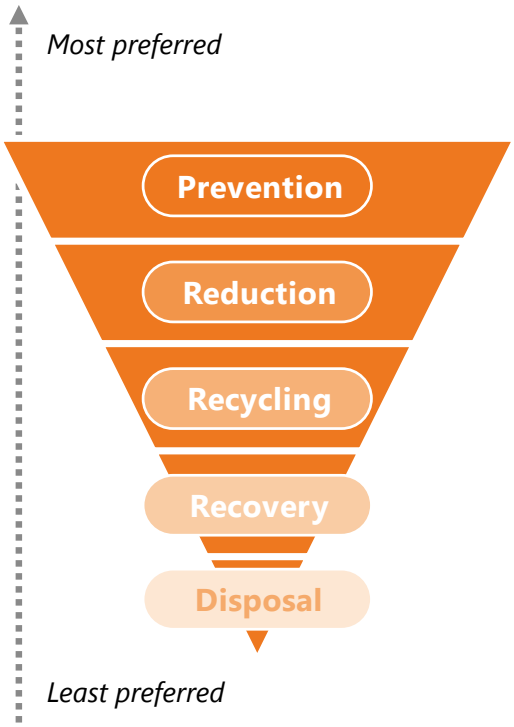

Figure 8: Waste hierarchy. Source: UNEP/IETC, 2013

5. SETTING CITY STRATEGIC GOALS, OBJECTIVES AND TARGETS

The Mandalay City Waste Management Strategy and Action Plan has identified the following overarching strategic goals: each of these strategic goals is briefly discussed together with key targets and objectives.

5.1. Strategic Goal A: Provide adequate and affordable municipal waste collection service for all and waste reduction through prevention and the 3Rs

Targets

	Short-term (2017-2020)	Mid-term (2021-2025)	Long-term (2026-2030)
(i) Increased (%) municipal waste collection coverage in the whole city	80%	90%	100%
(ii) Progress (%) of waste separation at source and collection system will be operated	1 or 2 pilot townships	Half of the townships	All townships of the city
(iii) Increased (%) material recovery and recycling	25% (10% recyclable materials and 15% food waste)	50% (15% recyclables and 35% food waste)	80% (20% recyclables, and 60% food waste)

Overview

MCDC is responsible for providing its residents with effective municipal solid waste management services. The current waste management system includes waste collection, transport and final disposal activities. Present staff and equipment for waste collection in the city includes over 2,000 staff, 350 pushcarts, 150 tri-bikes, 160 tippers, 20 hook-lift trucks, 138 roll containers and 3 dumpers.

However, MCDC has faced a number of implementation challenges. Mandalay's waste collection ratio ranges from about 50% for rural/ peripheral residents to 80% for urban residents. The remainder of the city's waste is not collected and ultimately results in clogging municipal drains, canals, creeks or contributing to illegal dumping in various sites throughout the city. Currently there is no waste separation and efficient material recovery system operating in the city. The informal sector is involved in collecting recyclable materials from households, secondary collection points and final disposal sites. Thus, the maximisation of waste collection services and recycling activities is identified as one of the priority goals under this strategy.

It was also established that the technical and financial assistance provided by ADB/FASEP under the MUSIP1 for establishing a waste collection or material recovery facility (MRF) in pilot townships and the on-going and anticipated support from Kitakyushu city for establishing separated waste collection and supporting the 3Rs and environmental education programmes, can contribute to achieving this goal.

Proposed activities

This section presents the key activities that are identified to improve the municipal solid waste collection and 3R activities in the city.

A.1: Provide effective and efficient municipal waste collection services

- Conduct a survey to understand the existing waste collection system, costs and challenges
- Identify the most suitable waste collection system and frequency for each residential area (door-to-door collection for urban residents and communal collection for peri-urban/ rural residents).
- Encourage micro-collection (rickshaws and tricycles) for primary waste collection.
- Encourage the involvement of informal sector/ community groups in primary waste collection.
- Eradicate open disposal and open burning waste (illegal dumpsites and illegal waste burning)
- Convert secondary collection points into MRF and drop-off centres
- Promote the use of appropriate types of vehicles in sufficient numbers for secondary collection and transport to the landfill site
- Establish functional financial mechanism for vehicle maintenance to increase productivity
- Establish proper waste collection fee system proportionate to the costs of waste collection

A.2: Introduce waste separation at source

- Conduct a study to identify an effective waste separation programme (number of types) based on the current market for recycling materials, vehicles and informal sector involvement
- Encourage both pickup (highly recyclable) and drop-off (bulk) systems for the collection of recyclable materials
- Conduct a comprehensive public awareness and education campaign about waste separation prior to implementation
- Integrate waste separation and 3R promotion activities into the school education system to influence behaviour with regard to the new waste management system
- Integrate small recycling enterprises and informal sector for separated waste collection and recycling

A.3: Integrate the private and informal sectors as partners in the delivery of sustainable waste management

- Conduct a study to understand the current operation and challenges to involving the private and informal sectors in operating waste management businesses
- Assist informal waste sector in the creation of a formal organisation (cooperative, association) and facilitate its involvement in the city waste management system
- Engage informal waste pickers through education and training on waste handling procedures to reduce vulnerability and strengthen skills
- Deliver information and training on health and safety issues
- Provide community empowerment and capacity building, such as access to loans, low-rent or fee space for storage
- Establish necessary supporting rules, regulations and policies to encourage participation of private and informal sectors in waste businesses.

A.4: Improve infrastructure for waste collection, storage, transfer and transport

- Examine and identify suitable technology and equipment for waste collection, storage and transport appropriate to local capacity
- Establish proper operation and maintenance system
- Establish training and capacity building for waste staff to ensure proper operation and

maintenance of the equipment

- Convert secondary collection points into MRF and drop-off locations
- Secure sufficient funds for investment and maintenance of equipment

Figure 9: Door-to-door waste collection in Mandalay. Source: IGES, 2016

5.2. Strategic Goal B: Stop uncontrolled dumping, open burning and improve the final treatment and disposal

Targets

	Short-term (2017-2020)	Mid-term (2021-2025)	Long-term (2026-2030)
(i) Reduction (%) of illegal dumping and open burning in the city	50%	75%	100%
(ii) Improvement of the landfill site operation	Immediate improvements to the operation of existing landfills (open dumping to control landfill)	Establishment of sanitary landfill site with minimum requirements in place to protect the environment	Full operation of the sanitary landfill
(iii) Reduction (%) of food waste, market waste and green waste to be landfilled	15%	35%	60% and take legislation to ban the food waste and market waste to be landfilled
(iv) Introduction of appropriate technologies for intermediate treatment	Feasibility study and pilot application of composting, anaerobic digester (bio-gas) and other options such as animal feeding to treat organic waste	Operation of composting, anaerobic digester (bio-gas) and animal feeding for organic waste Feasibility study on refuse derived fuel (RDF) and waste to energy (W2E) technologies aimed at minimising waste disposal.	Any application of refuse derived fuel (RDF) and waste to energy (W2E) technologies aimed at minimising waste disposal.

Overview

Mandalay city currently operates two disposal sites: one located in the north and the other in the south, managing approximately 450 tonnes/day and 300 tonnes/day of waste respectively. In addition, an incinerator is used in a cemetery near the northern landfill site for medical waste treatment. There is also a 30 tonnes/day incinerator established in the southern landfill site for treating municipal waste but this is not currently utilised due to high operation costs. Both landfill sites are managed as open dumpsites, posing a high risk to environment and public health. For instance, because the dumpsites do not make use of leachate protection barriers, the sites pose a potential risk of groundwater contamination. Moreover, as mentioned above, the lifespan of these dumpsites are estimated to elapse in roughly 2-4 years under the existing scenario; locating

suitable lands within city limits remains a difficult challenge. MCDC and a private company called Organic Asia Group were in negotiations to sign a contract to establish a biogas plant aiming to turn waste into energy at the landfill site in 2013. However, this negotiation was not successful due to some challenges including difficulties in selling the generated electricity. In this situation, immediate actions must be undertaken to implement the strategy.

Proposed activities

This section presents the key activities that are identified to stop uncontrolled dumping, open burning and improving the final treatment and disposal in the city.

B.1: Reduce organic (food) waste sent to landfill

- B.1.1: Assess organic waste (food waste) reduction potential from households, markets, shopping malls and other enterprises.
- B.1.2: Establish separated organic waste collection and treatment systems in public markets and shopping malls
- B.1.3: Implement a separated organic and green waste collection programme in residential areas
- B.1.4: Evaluate the technical feasibility of composting and bio-digester methods at decentralised and centralised levels
- B.1.5: Establish awareness-raising programme on source separation of organic waste
- B.1.6: Initiate programme to encourage use of compost products for urban farming and city

Figure 10: Temporary disposal site in Mandalay. Source: IGES, 2016

greening

- B.1.7: Establish local regulations, policies, rules and incentives in order to ban the landfilling of food waste

B.2: Increase recovery of additional material at landfill for RDF

- B.2.1: Assess the potential for additional recovery of high calorific value materials at the landfill site for RDF
- B.2.2: Utilise existing materials and new materials found at the landfill site as raw materials for RDF for cement industries

B.3: Examine potential of waste to energy (W2E) technologies such as incinerators and landfill gas capture

- B.3.1: Conduct feasibility study on the potential of W2E options for final treatment (incinerators and landfill gas)
- B.3.2: Categorise waste materials for potential feedstock of W2E technologies

B.4: Establish a new sanitary landfill meeting engineering standards for final disposal

- B.4.1: Rehabilitate existing landfills in the short-term
- B.4.2: Establish a sanitary landfill site with minimum requirements, including landfill liner system, leachate collection and treatment, ground water monitoring wells, cover for operations, final cap over retired landfill and plans for maintenance and closure in the middle-term
- B.4.3: Establish operational landfill site in the long-term to treat the residual waste that cannot be addressed by any other methods.

B.5: Establish mechanisms to discontinue the operation of illegal dumping sites in the city

- B.5.1: Conduct a quick study to identify the location of illegal dumping sites and the relevant factors contributing to for their operation
- B.5.2: Provide proper waste collection services to the residents in the area
- B.5.3: Conduct awareness programmes aimed at educating residents on the negative impacts of the open dumping and burning
- B.5.4: Establish a proper monitoring system that emphasises community participation aimed at preventing illegal dumping

5.3. Strategic Goal C: Maximise proper waste collection and treatment of industrial and other special types of waste (hazardous, medical, mining, e-waste, construction and demolition waste etc.)

Targets

	Short-term (2017-2020)	Mid-term (2021-2025)	Long-term (2026-2030)
(i) Increased (%) of recycling of industrial and other special types of waste	25%	50%	80%
(i) Reduction (%) of industrial and other waste sent to landfill without pre-treatment	25%	50%	Ban on industrial waste to be landfilled (100%) Established proper waste treatment methods and technologies for industrial waste

Overview

MCDC has three major industrial zones with over 1,400 manufacturing industries. Currently, all industrial and hazardous waste generated in these zones is not treated separately and is sent to landfills together with municipal solid waste. An incinerator with a capacity of 30 tonnes/day is located onsite at Mandalay's southern landfill for treating industrial and hazardous waste; however, this incinerator is currently not being utilised due to the high cost of operation and lack of safety controls on air pollution (no air filters). Similarly, medical waste collected from city hospitals and private clinics is burned directly in a ground pit dug in a cemetery neighbouring the city's northern landfill. Therefore, managing industrial and hazardous (medical) waste separately from municipal waste has been identified as one of the goals of the strategy. According to MCDC, the Korean International Cooperation Agency (KOICA) has agreed to provide technical and financial support towards the establishment of a two tonnes/day capacity incinerator to treat the city's medical waste. In addition, the Foundation for Scientific and Industrial Research (SINTEF) of Norway has been providing technical expertise and capacity building to develop a city master plan for hazardous waste management. MCDC and the Ministry of Industries have also worked with the United Nations Industrial Development Organisation (UNIDO) in delivering training for selected industries on cleaner production and resource efficiency. All of these types of external support can be utilised to improve industrial and hazardous (medical) waste management in the city.

Proposed activities

This section presents the key activities that are identified to maximise proper management of industrial and other types of waste in the city.

C.1: Reduce industrial and hazardous waste generation

- C.1.1: Assess current industrial and hazardous waste generation and volume
- C.1.2: Promote cleaner production systems and practices to reduce industrial waste at source

C.2: Implement source segregation and collection systems

- C.2.1: Introduce proper waste separation and collection system
- C.2.2: Introduce user pay system
- C.2.3: Introduce monitoring and evaluation mechanism for collection and treatment processes

C.3: Promote effective recycling, treatment and final disposal

- C.3.1: Institute incentives for recycling
- C.3.2: Institute incentives for final disposal
- C.3.3: Establish technical standard and guidelines for waste activities and develop permit system for concerned industries

Figure 11: Incinerator stopped in operation. Source: IGES, 2016

5.4. Strategic Goal D: Maximise proper disposal and treatment of liquid waste

Targets

	Short-term (2017-2020)	Mid-term (2021-2025)	Long-term (2026-2030)
(i) Increased (%) coverage of liquid waste collection and proper treatment in domestic sector	25%	50%	100%
(ii) Increased (%) coverage of liquid waste collection and proper treatment in industrial sector	25%	50%	100%
(iii) Increased (%) coverage of liquid waste collection and proper treatment in public places (public markets, central bus and train terminals)	25%	50%	100%

Overview

Mandalay currently lacks an effective collection and treatment system for liquid waste (both grey water and sewage effluent) in domestic, public areas (markets and bus/train terminals) and industrial sites. Currently the city lacks a piped sewerage system and does not possess an operational centralised waste water treatment plant. As such, liquid waste generated from both domestic and industrial sources is disposed directly into small bodies of water (Thingazar creek, Shwe Ta Chaung creek, and Ngwe Ta Chaung creek) throughout the city. Considering the environmental and public health issues this practice presents, the strategy places priority on identifying necessary actions to improve liquid waste management in Mandalay. According to MCDC, there are some examples of external technical and financial assistance currently being provided such as JICA/Nippon Koei Co. Ltd., (development of data base and standardisation of industrial waste water regulation), ADB/FASEP (establishment of waste water collection and treatment system with improved sewage management for residents, and Chinese Government support for the improvement of sludge treatment in the Taung Thaman Pond): these technical activities can also be utilised to guide the implementation of several key strategic actions listed under this goal.

Proposed activities

This section presents the key activities that are identified to maximise proper disposal and treatment of liquid waste in the city.

D.1: Improve the collection and treatment of liquid waste in domestic areas

- D.1.1: Assess existing waste water discharge and treatment system and develop plans for improvement
- D.1.2: Conduct feasibility study on suitable waste water and sewage treatment technologies at decentralised and centralised levels to treat the (septic tanks, johkasou, and treatment plants)
- D.1.3: Establish standards for proper liquid waste treatment
- D.1.4: Institute effective tariff and enforcement system
- D.1.5: Conduct training and capacity building for MCDC staff on selected technologies

D.2: Improve the collection and treatment of liquid waste in industrial areas

- D.2.1: Assess existing waste water discharge and treatment system and develop plans for improvement
- D.2.2: Conduct feasibility study on potential technology for industrial waste water treatment (biological treatment, chemical treatment and physical treatment)
- D.2.3: Establish standards for proper liquid waste treatment (both environmental quality standards and effluent standards)
- D.2.4: Institute effective tariff and enforcement system

Figure 12: Newly built waste water treatment plant in Mandalay. Source: IGES, 2016

- D.2.5: Designate pollution control manager and build their capacity through training in order to effectively supervise workers at industrial facilities and ensure environmental standards are met

D.3: Improve the collection and treatment of liquid waste in public areas (public markets and central bus/train terminals)

- D.3.1: Assess existing waste water discharge and treatment system and develop plans for improvement
- D.3.2: Conduct feasibility study on potential technology for waste water treatment (biological treatment, chemical treatment and physical treatment)
- D.3.3: Institute effective tariff and enforcement system
- D.3.4: Develop proper monitoring mechanism

5.5. Strategic Goal E: Capacity development, awareness raising and advocacy

Targets

	Short-term (2017-2020)	Mid-term (2021-2025)	Long-term (2026-2030)
(i) Increased (%) number of townships have implemented standard awareness-raising programmes for their residents and the (%) of population reached	25%	50%	100%
(ii) Increased (%) number of schools have established environmental education programmes and the (%) of students reached	25%	50%	100%
(iii) Increased (%) the degree of cooperation of other stakeholders for ensuring the sustainable waste management service	50%	75%	100%

Overview

Environmental education and information campaigns are critical in raising public awareness about the importance of waste management and effectively motivating communities to engage in waste avoidance and the 3Rs, both fundamental to achieving the goals set out in city 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 solid waste management systems with knock-on effects for information, education and communication (IEC) programmes in local government budgets. 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 different aspects of values formation, eco-literacy and the functional elements of solid waste management. In addition, local policymakers, practitioners and stakeholders require capacity building on good waste management practice and planning. Empowered local actors, particularly SWM Boards, can translate in enhanced organisation and implementation of a municipal waste management strategy in line with specific needs and challenges. Therefore, in order to capacitate local governments more effectively, knowledge and information sharing should be widely promoted, in addition to supporting education and training of public, private and civil society partners. Accordingly, this strategy seeks to implement the following with a view to achieve the objectives below. MCDC can further leverage the experience and assistance of Kitakyushu city and IGES in developing environmental education and training modules to support the successful implementation of this goal.

Proposed activities

This section presents the key activities that are identified to improve capacity development, awareness raising and advocacy in the city.

E.1: Mainstream environmental education and waste management in school curricula and programmes

- E.1.1: Support curriculum development or integration of environmental education and waste management topics as required
- E.1.2: Collaborate with other actors involved in promoting environmental education in schools to strengthen waste management and 3R activities in organisational policies and to enhance collaboration between schools and local stakeholders;
- E.1.3: Develop standardised training modules or course offerings, and instructional guide and competency-based learning materials for teachers in coordination with inter-agency bodies;
- E.1.4: Assist educational institutions in integrating environmental education and waste management into pre-, elementary, secondary, tertiary, and technical, vocational, education and training (TVET) school curricula, and Community Service Programmes.
- E.1.5: Select and disseminate best practices of integrating environmental education and waste management in the school curricula
- E.1.6: Establish incentives/award system aimed at incentivising best practices in environmental education and waste management curriculum integration; 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
- E.1.7: Monitor and evaluate environmental education and waste management practices with a view towards continuous improvement and replication, especially among educational institutions

E.2: Mobilise the support of local stakeholders by increasing awareness and participation in environmental education and waste management

- E.2.1: Conduct training needs assessments based on identified core competencies in waste management at the local level to

establish 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
- E.2.3: Deliver regular waste management training sessions on values formation, communication, technical skills and financial management for trainers, organisations, focal persons and advocates
- E.2.4: Conduct annual regional Waste Management Summits, capacity development activities and other awareness-building campaigns together with partners for selected target groups; monitor impacts and adjust social marketing and advocacy campaigns strategies as necessary
- E.2.5: Use multimedia (radio, television, newspaper and others) for raising public awareness on environmental and proper waste management practices

Figure 13: Environmental education in the schools. Source: IGES, 2016

5.6. Strategic Goal F: Ensure sustainable services through regular review, monitoring, innovation and improvement

Targets

	Short-term (2017-2020)	Mid-term (2021-2025)	Long-term (2026-2030)
(i) Establishment and monitoring of data collection and benchmark performance indicators	50%	75%	100%
(ii) Decreased (%) number of enforcement actions filed against non-compliant entities	50%	75%	100%
(iii) Increased degree of public/customer satisfaction (%) about the waste management service	50%	75%	100%

Overview

Monitoring system performance is fundamental for ensuring proper functioning of the overall waste management system and ensuring strategy goals are achieved. Key system performance indicators should be reviewed, monitored and/or measured on a regular basis to track system performance and the effectiveness of identified initiatives.

Objectives and key activities

This section presents the key activities that are identified to ensure sustainable service through regular review, monitoring and improvement in the city.

F.1: Establish a data collection mechanism

- F.1.1: Institute a coordinating committee comprised of key departments and stakeholders to review the progress
- F.1.2: Establish procedures for collection of relevant data on a daily, monthly and/or annual basis from the concerned stakeholders
- F.1.3: Designate a data management team for tracking progress associated with implementing the strategic plan

F.2: Establish a reporting mechanisms

- F.2.1: Present reporting of monitoring activities as an annual MCDC report
- F.2.2: Prepare an overview of each proposed objectives, targets and activities and their achievements, challenges and how these challenges are addressed

F.3: Establish a communication mechanism to ensure regular consultation among key stakeholders

- F.3.1: Disseminate information to Mandalay residents including via print media, hotlines, website, radio and television, presentations, and other products and tools, to be communicated in various public fora
- F.3.2: Allocate sufficient budget for monitoring communication activities

Figure 14: Citizen awareness activities in Mandalay. Source: IGES, 2016

6. IMPLEMENTATION TOOLS AND MECHANISMS

A range of policy measures, instruments and incentives will be required to ensure effective implementation of Mandalay city's waste management strategy and action plan. Several relevant tools and mechanisms identified through consultations with MCDC and its partners are briefly described below:

6.1. Legislation and regulation

Appropriate legislation and associated regulatory requirements set by MCDC and the Ministry of Natural Resources and Environmental Conservation will be essential for guiding the execution of the city's waste management strategy and action plan. Relevant provisions include: (i) practical standards and guidelines for managing discharges to air and water from waste management facilities, as well as standards for landfill construction and incinerator operations; (ii) proper licensing of facilities that produce, pro¬cess or dispose of hazardous waste (including ensuring a chain of custody for the waste); (iii) key parameters on how specific waste streams are managed; (iv) outlined criteria on waste man¬agement system infrastructure (i.e. stipulating features of MSW collection systems such as bin sizes, separation classifications, time and frequency of collection, etc.); (v) actions addressing greenhouse emissions that have a bearing on the management and operations of landfills and incinerators; and (vi) land use policies which specify the designation of available land for landfills and other waste treatment facilities.

However, noting that many well designed legislation and regulations remain ineffective because of poor public compliance, monitoring and enforcement of these rules will be crucial. Because the basis for all successful waste management operations lies in the willingness of citizens to follow good practices and maintain the discipline to do so consistently, actions that discourage departures from the law are also a critical element. MCDC's Cleansing Department thus requires an independent and robust team of inspectorates or environmental regulators tasked with ensuring that the public behaves in accordance with the legislation and regulations, which govern the operation of the city's waste management system. Accordingly, 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.

6.2. Financial instruments

The use of financial instruments is 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 MCDC resulting from annual increases in its budget for waste management, as well as providing supplementary funding for enhancing its waste collection and transport system, 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. Setting

the right rate for fees and user charges is therefore also important for the successful implementation of Mandalay's waste management strategy and action plan. At the same time, determining correct pricing for waste management services is not a simple matter. Any adopted approach must be agreed upon both by regulators and service providers as well as accepted by the wider public. A hastily planned or improvised rollout can backfire by ultimately discouraging the public from paying for waste management services. While current fees imposed by the MCDC focus on waste collection, waste disposal costs should also be included in the charging system to help cover the costs of waste recovery, recycling and other upstream management options. However, because some low-income communities or neighbourhoods may be unable to meet even modest charges for waste management services, arrangements may need to be made to exempt these groups from such fees or alternatively repay them as subsidies. Similarly, subsidies can be issued by the MCDC when key business actors, such as domestic recycling firms, face barriers to market entry. Such outlays can be directly disbursed, as well as take other forms including organisational assistance, tax holidays and the establishment of industrial recycling parks. Financial incentives can also be offered to promote preferred behaviour, such as applying lower fees and charges to households that separate waste at source or limit the generation of non-recyclable waste.

6.3. Choice of technology

MCDC should decide on introducing specific technologies that are best suited to local circumstances. Given its current capacity and level of resources, MCDC may wish to utilise technologies that are low-cost and low maintenance, for example handcarts for primary collection, and composting facilities for organic waste, as opposed to capital-intensive equipment such as large waste collection vehicles— which may create gaps in services when requiring maintenance— and waste incineration. Taking this into account, continuous research and development is necessary in terms of both identifying waste solutions and improving existing service provision. Therefore, careful decision-making and evaluation of waste management options are important parts of implementing Mandalay's waste strategy and action plan over the long run.

6.4. Awareness raising and public education

Influencing behaviours, attitudes and practices of concerned stakeholders is also fundamental to the successful implementation of the city's waste management strategy and action plan. Members of the public should be educated and encouraged to practice more sustainable lifestyles such as minimising or avoiding the purchase of products that generate large quantities of waste. This includes buying unpackaged or less packaged goods, or environmentally-friendly products in general; whenever possible, reusing, recovering or recycling goods, rather than discarding them; composting food wastes at home; carrying out source separation of waste as a part of the city's waste recovery and recycling programmes; and ensuring hazardous materials are not discarded with household waste, in accordance with product or government guidance.

Awareness raising and motivating the public to take action is imperative prior to the introduction of a new initiative or intervention. If, for example, MCDC were looking to encourage a

change in behaviour or practice, such as by levying waste charges for the first time, ensuring that waste generators are aware of this action in advance would be necessary for securing compliance. In addition, certain audiences are more receptive than others are when it comes to educational programmes or the delivery of targeted information. Educating children early about the importance of managing waste properly at the individual and household level, and subsequently reinforcing that message throughout the course of schooling, will yield returns over many years by instilling awareness about responsible waste behaviour.

6.5. Monitoring and performance assessment

Implementation of Mandalay's strategy and action plan should be monitored on a continuous basis, with progress and performance assessed against its specified goals and targets Monitoring and evaluation in this way works to identify a known starting point, providing the possibility of establishing whether or not anticipated milestones have been reached as time goes on. However, locating sound waste related data and information is often difficult to access and stands as one of the most challenging aspects of carrying out a waste management strategy. Data collection and information sharing is therefore a key element of strategy implementation. Information is not only an essential element of effective policy; it also can comprise a policy tool in itself. For instance, a decree or statute may mandate that entities of various kinds— mostly but not exclusively private companies— to publicly report on their discharge of hazardous chemicals to the environment. In such a case, the law might also include a requirement that offsite transfers of hazardous wastes for treatment or disposal be registered with the appropriate authorities. This reporting process serves several purposes: informing the public of polluting activities; providing required information to governments; and imposing a discipline on reporting entities themselves. However, such programmes also rely on the nature of the reported in¬formation in order to influence specific behaviour. Likewise, public sustainability reporting undertaken by companies, often on a voluntary basis, typically provides information on a wide range of parameters, including waste generation.

6.6. Commitment and partnership building

Lastly, establishing a transparent and credible commitment of all involved stakeholders— members of the public, city staff, political decision makers, informal and formal business sectors, among others— is paramount for ensuring the waste management strategy and action plan is fit for purpose and implementable over time. In this way, the strategy and action 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 action 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. This includes ensuring the continued involvement of political authorities throughout the strategy design process, as well as launch and implementation. In much the same way, cooperation and partnership can be sustained over the long term by limiting opportunistic behaviour, including through mechanisms such as rewards or penalties.

REFERENCES

Bingham Centre for the Rule of Law (2013): Constitutional Awareness Myanmar http://binghamcentre.biicl.org/binghamcentre/projects/burmamyanmar (accessed on 25 October 2016)

Government of Myanmar and UNFPA (2014): Population and Housing Census of Myanmar – Data Sheet. http://myanmar.unfpa.org/sites/asiapacific/files/pub-pdf/Census%20Data%20Sheet%20-%20ENGLISH_0.pdf (accessed on 25 November 2016)

Government of Myanmar (2014): National Comprehensive Development Plan, Ministry of National Planning and Economic Development, Nay Pyi Taw

Government of Myanmar (2015): The 2014 Myanmar Population and Housing Census, the Department of Population, Ministry of Immigration and Population, Nay Pyi Taw

Hoornweg, D and Bhada-Tata, P (2012): Waste a Waste: A Global Review of Solid Waste Management, World Bank, Washington, DC. http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/What_a_Waste2012_Final.pdf (accessed on 25 November 2016)

Hotta, Y (edited) (2014): Discussion Paper – 3R Policy Indicator Factsheets, IGES, Japan

Hotta, Y (edited) (2014): Co-benefits of the 3Rs (reduce, reuse and recycle) of municipal solid waste on climate change mitigation, IGES, Japan

Memon, M. A (2016): Holistic Waste Management Approach for Eco Towns, a presentation made at the First National/ City Workshops for Developing National/ City Waste Management Strategies in Myanmar, 13-17 June 2016 in Myanmar. http://www.iges.or.jp/files/research/scp/PDF/20160613/1_introtohwm_unep.pdf (accessed on 25 November 2016)

Nick Baker (2016): Myanmar's air pollution among the worst in the world: WHO, Sunday, October 16, 2016 http://www.mmtimes.com/index.php/national-news/22840-myanmar-s-air-pollution-among-the-worst-in-the-world-who.html (accessed 20 October 2016)

Nixon, H; Joelene, K.C; Chit Saw,P; Aung Lynn, T; and Arnold, M (2013): State and Region Governments in Myanmar, MDRI-CESD and the Asia Foundation, Yangon

Premakumara, D.G.J, Maeda, T (2015): Municipal Solid Waste – The Burgeoning Environmental Threat, Routledge Handbook of Environment and Society in Asia, edited by Paul G. Harris and Graeme Lang, Routledge, NY. 176-196

Premakumara, D.G.J, Simon Gilby and Yatsuka Kataoka (2016): Barriers for Implementation of the Philippine National Solid Waste Management Framework in Cities, IGES, Japan

Premakumara D.G.J (2016): Development of E-waste Management Policy at the Local Level: A Case of Cebu City, IGES, Japan

Premakumara, D.G.J; Yatsuka Kataoka; and Masako Chowdhury (2016): Development of Environmental Learning Programme for Establishing a Sustainable Solid Waste Management System in Mandalay City, Myanmar, The HDCA 2016 Conference: Capability and Diversity in a Global Society, 1-3 September 2016, IGES, Japan

Premakumara, D.G.J, Canete, A.M.L, Nagaishi, M., Kurniawan, T.A., (2014): Policy implementation of the Republic Act (RA) No. 9003 in the Philippines: A case study of Cebu city. Waste Management 34 (2014), p. 971–979.

Premakumara, D.G.J and Hengesbaugh, M (2016): Quick Study on Waste Management in Myanmar: Current Situation and Key Challenges, IGES, Japan.

UN Environment and ISWA (2015): The Global Waste Management Outlook, UN Environment-IETC, Osaka

Van de Klundert A and Anschütz J (2001): Integrated sustainable waste man¬agement – the concept. In: Scheinberg A (ed.) Integrated Sustainable Waste Management: Tools for Decision-makers, Set of Five Tools for Decision-makers – Experiences from the Urban Waste Expertise Programme (1995–2001). Gouda, the Netherlands: WASTE. http://www.waste.nl/page/513 (accessed 15 September 2016).

Wilson, D.C; Rodic, L; Scheinberg, A; Velis, C.A; Alabaster, G (2012): Comparative analysis of solid waste management in 20 cities, Waste Management & Research, 30 (3), 237-254, Sage Publication

http://www.iges.or.jp/files/research/scp/PDF/20160613/17_Quick_study_Web.pdf (accessed on 10 October 2016)

WHO (2016): Ambient air pollution: A global assessment of exposure and burden of disease. World Health Organisation, Geneva

World Resource Institute (2011): Climate Analysis Indicators Tool (CAIT) Version 9.0, WRI, Washington, DC.

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