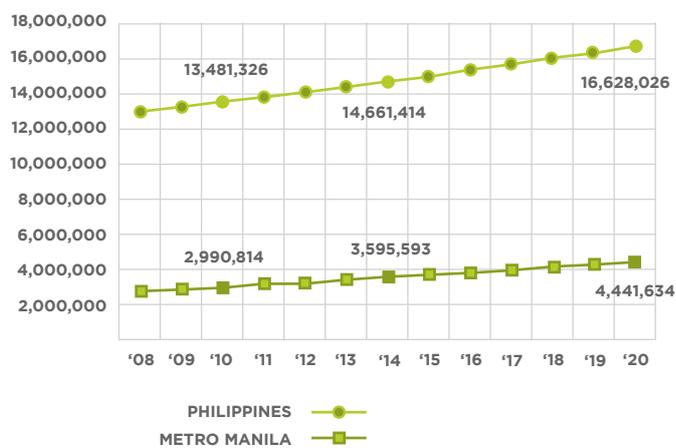




# SOLID WASTE AND CLIMATE CHANGE

## OVERVIEW OF THE WASTE SECTOR

FIGURE 1. PROJECTED WASTE GENERATION RATES (TONS PER YEAR) FROM 2008 TO 2020 (SOURCE: DENR, 2014)



Rapid urbanization influences production and consumption patterns in developing countries, which subsequently leads to an increase in the volume of waste generated by the residential, commercial, and industrial sectors. Aside from environmental and health risks associated with poor waste management practices such as open burning, dumping in water bodies, and non-segregation, greenhouse gases (GHG) are also released into the atmosphere and interfere with the earth's climate systems.

The Philippines' National Solid Waste Management Status Report (DENR, 2014) compiled all the available information from Regional State-of-the-Brown Environment (RSOBE) Reports from 2008 to 2013 as well as waste analysis and characterization study (WACS) data that were lifted from various references. The reported waste generation rates in 2010 vary widely from as low as 0.10 to as high as 0.79 kg/

capita/day with a weighted average value of 0.40 for the entire Philippines. Figure 1 shows the historical and projected waste generation rates in Metro Manila and in the entire country.

Figures 2 and 3 show the sources and composition of these municipal solid wastes (MSW), respectively. Bulk of the waste is generated from residential or household sources and more than half is classified as biodegradables. The mixed disposal of waste usually enables the biodegradable fractions to decompose anaerobically and produce methane.

FIGURE 2. SOURCES OF MUNICIPAL SOLID WASTE IN THE PHILIPPINES (SOURCE: DENR, 2014)

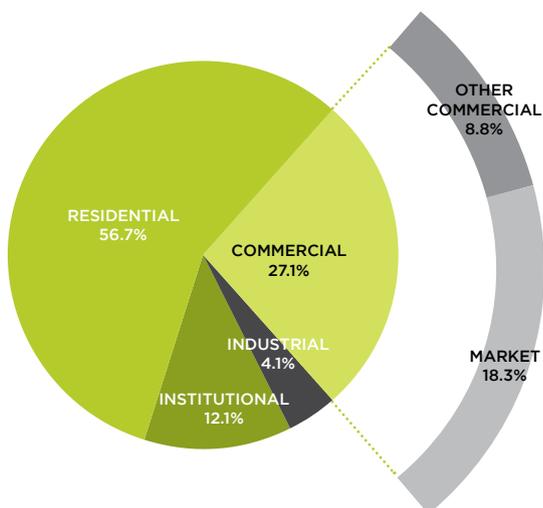
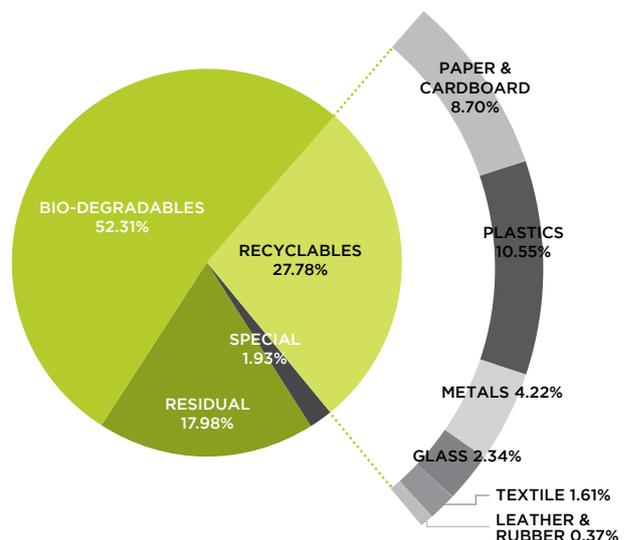


FIGURE 3. COMPOSITION OF MUNICIPAL SOLID WASTE IN THE PHILIPPINES (SOURCE: DENR, 2014)



Republic Act (RA) 9003 or the Philippine Ecological Solid Waste Management Act of 2000 has fully decentralized solid waste management implementation. RA 9003 mandates cities and municipalities to cease using dumpsites as a mode of disposal and encourages the establishment of properly designed sanitary landfills. The legislation also puts particular emphasis on the 3R policy of waste avoidance: reduce, reuse, recycling as well as resource recovery, and sets a target of at least 25% diversion rate among local governments.<sup>1</sup>

## CLIMATE CHANGE AND THE WASTE SECTOR

The Waste Sector contributes to climate change as one of the sources of greenhouse gases (GHGs).

### WHERE DO THESE EMISSIONS COME FROM?

Developing and newly industrializing countries, like the Philippines, commonly dispose of mixed municipal solid waste in dumpsites and/or through open burning. Biodegradable wastes comprise a significant proportion of these disposed solid wastes. The decomposition and open burning of this type of waste lead to methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>) emissions. Biomass burning also results in nitrous oxide (N<sub>2</sub>O) emission.

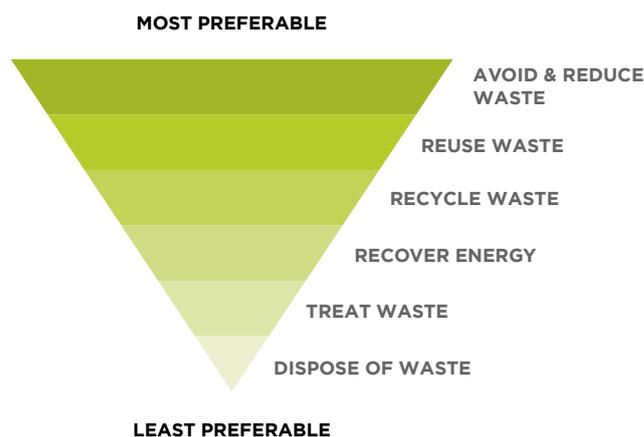
Aside from contributing to GHG emissions, uncontrolled disposal (open dumping & burning) have detrimental effects on health as warmer temperature promote pathogen growth and disease vectors (IPCC 4th Assessment Report, Working Group III).

The sector “Waste and wastewater” or Scope 3 in UNFCCC and IPCC terminology is the third largest emitter in the Philippines. Based on 2000 estimates, 11.6 million tCO<sub>2</sub>e per year is emitted from waste management, which translates to a 9.1% share. Most of these emissions are from methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O). A GIZ-supported study estimated a further 5 to 6% contribution of waste management in enabling other sectors, e.g., industrial processes, energy generation and agriculture, to avoid emissions. The capacity of national authorities, local government units (LGUs) and the private and informal waste sectors to catch up with population and economic growth as well as technological and financial drivers influences GHGs emissions from wastes.

Key findings from the IPCC 5th Assessment Report show that waste reduction, followed by re-using, recycling and energy recovery are important mitigation options that can significantly reduce emissions (robust evidence, high agreement). Figure 4 shows the waste hierarchy, with prevention being most favored, and disposal least favored. In the 4th IPCC Assessment Report, the Working Group III on Mitigation presented an array of mitigation options and their benefits on the social, economic and sustainable development dimensions.<sup>2</sup>

The highly preferred waste practices are dependent on the consumption and production patterns of the society. Waste avoidance enables the sector to mitigate GHG emissions indirectly, by lessening the demand for GHG-intensive production processes. Scenarios in Figure 5 illustrate that by recycling half of the paper used in the office, net emissions from the life cycle of the paper becomes negative.

FIGURE 4. WASTE HIERARCHY  
(SOURCE: [HTTP://WWW.EPA.NSW.GOV.AU/WASTE/STRATEGY/WASTE-HIERARCHY.HTM](http://www.epa.nsw.gov.au/wastestrategy/waste-hierarchy.htm))



Nevertheless, there remain opportunities to further mitigate GHG emissions at the disposal stage. Options include the installation of gas recovery and/or eco-efficient soil cover during closure and rehabilitation of existing dumpsites and in the development of sanitary landfills. These options also have positive impacts on socio and economic dimensions and the environment, if properly designed and managed.

**THE PHILIPPINE NSWM STRATEGY PUTS EMPHASIS ON THE 3RS RATHER THAN ON MITIGATING EMISSIONS AT END-OF-PIPE.**

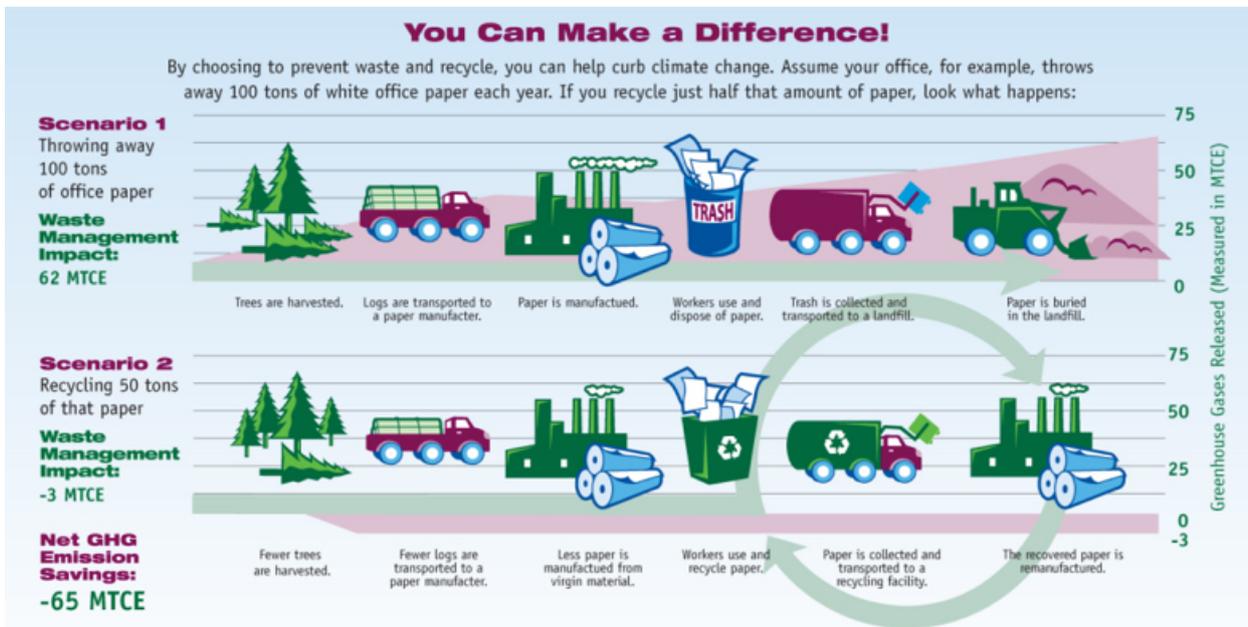


FIGURE 5. MAKING A DIFFERENCE THROUGH RECYCLING  
(SOURCE: [HTTPS://TORINOBYVEG.WORDPRESS.COM/2012/11/19/SUSTAINABLE-WASTE-WASTE-AND-CLIMATE-CHANGE/](https://torinobyveg.wordpress.com/2012/11/19/sustainable-waste-waste-and-climate-change/))

Figure 6 shows a life cycle analysis of goods in general. While waste disposal comes at the end, waste management practices embedded in the cycle offer mitigating opportunities as well.

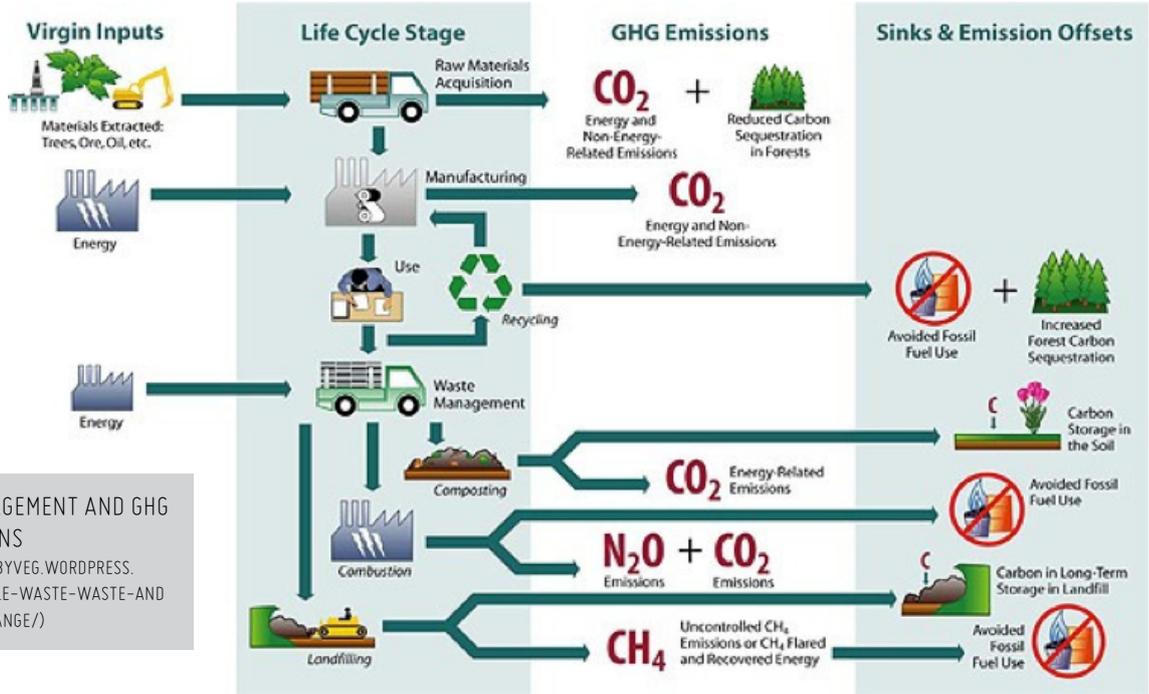


FIGURE 6. WASTE MANAGEMENT AND GHG EMISSIONS  
(SOURCE: [HTTPS://TORINOBYVEG.WORDPRESS.COM/2012/11/19/SUSTAINABLE-WASTE-WASTE-AND-CLIMATE-CHANGE/](https://torinobyveg.wordpress.com/2012/11/19/sustainable-waste-waste-and-climate-change/))

## VULNERABILITY AND ADAPTIVE CAPACITY OF THE WASTE SECTOR

The Waste Sector is also vulnerable to climate change. The process of waste management and disposal are also threatened and disrupted by damages to facilities of extreme events, flooding or storm surges. The table below summarizes some of the potential impacts on the sector:

TABLE 1. POTENTIAL IMPACTS ON THE WASTE SECTOR  
(SOURCE: [HTTP://WWW-ESD.WORLDBANK.ORG/CITIESCCADAPTATION/SOLIDWASTE.HTML](http://www-esd.worldbank.org/CITIESCCADAPTATION/SOLIDWASTE.HTML))

CLIMATE VARIABLE	POTENTIAL CHANGE	POTENTIAL IMPACTS ON SOLID WASTE MANAGEMENT
 <b>TEMPERATURE</b>	Annual warming	Increased risk of combustion at open sites and composting.
	Thawing permafrost or soils	Over time, may disrupt drainage and surface water flow around landfill sites.
	Increase in mean sea level	Flooding of facilities and basement/underground-level equipment Floating waste may wash up with high precipitation or storm surges.

CLIMATE VARIABLE	POTENTIAL CHANGE	POTENTIAL IMPACTS ON SOLID WASTE MANAGEMENT
 <b>PRECIPITATION</b>	Increased rainfall	Saturated soils and decreased stability of slopes and landfill linings (if clay or soil based) at waste management sites.
	More intense rainfall events	Flooding in areas with untreated, dumped waste carries the risk of groundwater contamination. Disruptions in the removal and transportation of solid waste.

From the table above, it is important to note that waste, when not properly managed, not only poses health and sanitary problems or emits potent GHGs, but also contribute to the overall vulnerability of the community. Waste management facilities can be vulnerable to extreme weather events especially when constructed in unsuitable areas or when standard construction procedures are not properly observed. The “trash slide“ in the Payatas Dump Site in 2000 and the flooding during Typhoon Ondoy in 2009 are tragic events where poor waste management and practices have directly brought or aggravated the risks and damages to the people and the community (NSWM Strategy 2012-2016).

Another cause of accidents is the spontaneous combustion of methane gas, which is highly combustible and can spark deep-seated fires. In some cases, fires are produced when a heat source of some type has contacted the surface of the waste body, e.g., deposited hot waste, lightning, extreme sunshine or deliberate burning. The burning of halogenated compounds produces persistent organic pollutants (POPs).

The waste sector also caters to the so-called informal waste sector who are engaged in waste picking as primary source of income (GIZ). Being highly dependent on these ‘resources’, these groups and their livelihood are also vulnerable. At the same time, members of this informal sector are also important stakeholders in diverting waste from disposal. A study by GIZ entitled, The Economics of the Informal Sector in Solid Waste Management which included Quezon City as one of the study areas, showed that 23% of the total waste generated are recovered by the informal sector while only 2% are recovered by the formal sector. Majority of the informal sector are street pickers and dump pickers.

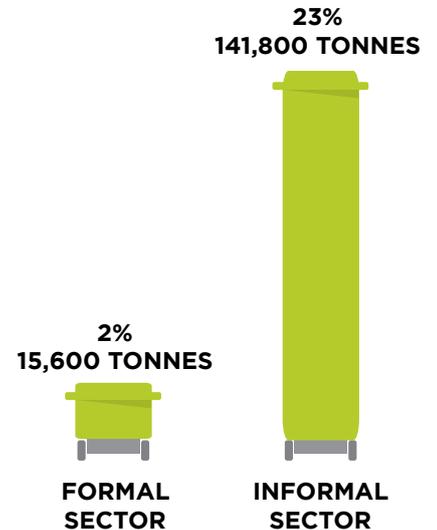


FIGURE 7. MATERIAL RECOVERED BY THE FORMAL AND INFORMAL SECTOR IN QC  
(SOURCE: [HTTPS://WWW.GIZ.DE/EN/DOWNLOADS/GIZ2011-CWG-BOOKLET-ECONOMICASPECTS.PDF](https://www.giz.de/en/downloads/giz2011-cwg-booklet-economic-aspects.pdf))

## NATIONAL POLICY RESPONSES AND ACTIONS

### RA 9003 OR THE ECOLOGICAL SOLID WASTE MANAGEMENT ACT OF 2000

Republic Act No. 9003 or the “Ecological Solid Waste Management Act” provides the legal framework for the country’s systematic, comprehensive and ecological solid waste management program that shall ensure protection of public health and the environment.

### WHAT ARE THE SALIENT FEATURES OF RA 9003?<sup>4</sup>

- i. Establishment of the National Solid Waste Management Commission mandated to oversee the implementation of SWM plans and prescribe policies to achieve the objectives of RA 9003. The NSWMC is tasked to undertake the following activities, among others: (a) prepare the National SWM Framework; (b) approve, review and monitor implementation of local SWM plans; (c) provide technical and other capability building assistance and support to LGUs; (d) develop a mechanism for the imposition of sanctions; (e) review the incentives scheme for effective SWM.
- ii. Formulation of the National Solid Waste Management Framework; 10-year solid management plans by local government units consistent with the National Solid Waste Management Framework;
- iii. Mandatory segregation of solid waste to be conducted primarily at the source such as household, institutional, industrial, commercial and agricultural sources;
- iv. Setting of minimum requirements to ensure systematic collection and transport of wastes and the proper protection of the health of garbage collectors;
- v. Establishment of reclamation programs and buy-back centers for recyclable and toxic materials;
- vi. Promotion of eco-labeling in local products and services;
- vii. Prohibition on non-environmentally acceptable products and packaging;
- viii. Establishment of Materials Recovery Facility in every barangay or cluster of barangays;
- ix. Prohibition against the use of open dumps;
- x. Setting of guidelines/criteria for the establishment of controlled dumps and sanitary landfills;
- xi. Provision of rewards, incentives both fiscal and non-fiscal, financial assistance, grants and the like to encourage LGUs and the general public to undertake effective solid waste management; and
- xii. Promotion of research on solid waste management and environmental education in the formal and non-formal sectors.

## KEY INITIATIVES UNDER THE SOLID WASTE MANAGEMENT STRATEGY

- i. Bridging Policy Gaps and Harmonizing Policies
- ii. Capacity Development, Social Marketing and Advocacy
- iii. Sustainable Solid Waste Management Financing
- iv. Creating Economic Opportunities
- v. Support Knowledge Management on Technology, Innovation and Research
- vi. Organizational Development and Enhancing Inter-Agency Collaboration
- vii. Compliance Monitoring, Enforcement and Recognition
- viii. Crosscutting Issues: Good Governance
- ix. Crosscutting Issue: Caring for Vulnerable Groups
- x. Crosscutting Issue: Reducing Disaster and Climate Risks

## GAPS / AREAS OF IMPROVEMENTS

Quick Facts on the Status of compliance to the ESWM Act since 2008-2014, as of 2014 :



## SUCCESS STORY/INTERVENTION

Often, the challenge to LGUs are the lack of funds to establish their SLFs and expertise, only a few cities have SWM units with technically capable staff. Finding and selecting a suitable site for the SLFs are also among the challenges faced by LGUs.

### ECO CENTERS

An Eco-Center is an integrated waste management facility that is equipped with appropriate technologies to recover as much materials as possible prior to final disposal. It allows the development and operation of centralized waste processing systems and a sanitary landfill in a single site.

### RECYCLABLES COLLECTION EVENTS

Recyclables are typically sold to junk dealers, consolidators and recyclers. The accumulated recyclables from MRFs are delivered to junkshops. In many cases, either the semi-formal or informal waste collectors or even the generators themselves bring the sellable materials to junkshops or at designated areas during national, regional and local recyclables collection events.

### AEROBIC AND ANAEROBIC COMPOSTING

Typical small-scale composting in the Philippines is done in compost pits, tire towers, coconut shell stack, bottomless bins, clay pots and plastic sacks. Meanwhile, large-scale composting is done in windrows (by turning, passive aeration, active aeration and static piles), in-vessel (e.g., agitated beds, composting silos and rotating drum bioreactors), and through vermi- or worm composting.

### PAYATAS LANDFILL GAS CAPTURE UTILIZATION

Upon closure and rehabilitation of the dumpsite sections of the Payatas facility in Quezon City, a landfill gas capture and utilization system was installed. Initially, 95% of the captured gas used to be flared while some were converted into electricity to provide power to field offices and extend social services such as the 'Plantsahan ng Bayan' or the community ironing program. By merely flaring, the facility used to earn certified emissions reduction (CERs). A few years ago, the management had to look for other viable financing options and had successfully negotiated for electricity supply to the grid with an agreed feed-in tariff rate.

### ECO-EFFICIENT SOIL COVER

The principle behind the bio- or eco-efficient soil cover is that specific soil bacteria are capable to consume methane by natural microbial processes while passing through eco-efficient cover strata. Such conditions develop naturally where both CH<sub>4</sub> and O<sub>2</sub> are available at the same time, for example at the boundary of aerobic and anaerobic regions of GHG sources. The experiences of Ormoc and Bais City in climate-proofing its waste disposal facilities and in establishing the cost-effectiveness of eco-efficient soil cover demonstrate the applicability of the reactive barrier concept in the Philippine setting while encouraging more LGUs to comply by offering better and more doable alternatives.

## ADOPT-AN-ESTERO PROGRAM

With a continuous need to clean up, declog and dredge waterways, one major response is the implementation of the 'Adopt an Estero' Program, which was spearheaded by the DENR in 2010. Stakeholders and beneficiaries of have already reported several results and impacts of this initiative, which includes:

Quicker flooding subsidence.	Less floating debris on esteros.
Improved waste collection efficiency.	Additional employment generation.
Increased frequency of declogging/dredging activities.	Complementary local policies and programs.

Taking on the original goal to clean up canals and creeks of wastes, debris and silt via community mobilization and information, education and communication (IEC) programs, the public-private partnerships were enhanced to increase the program's coverage. In fact, barely a year since it was launched, 208 Memoranda of Agreement were already inked with corporate entities expressing its commitment and resources to serve as guardians of flood-prone waterways all over the country.

## END NOTES AND REFERENCES

<sup>1</sup>Eco-Center Integrated Solid Waste Management Facility with Sanitary Landfill and Resource Recovery Technologies

<sup>2</sup>IPCC. Summary of adaptation, mitigation and sustainable development issues for the waste sector. May be accessed through this link: [https://www.ipcc.ch/publications\\_and\\_data/ar4/wg3/en/ch10s10-6-3.html](https://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch10s10-6-3.html)

<sup>3</sup>GIZ, 2011. The Economics of the Informal Sector in Solid Waste Management. Accessed from: <https://www.giz.de/en/downloads/giz2011-cwg-booklet-economicspects.pdf>

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<sup>5</sup>DENR, 2015. PHILIPPINES: National Solid Waste Management Status Report 2008 – 2014. Accessed from: <http://119.92.161.2/portal/Portals/38/Solid%20Wastefinaldraft%2012.29.15.pdf>

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## IMPRINT

The development of this sector factsheet on climate change is a joint undertaking of the projects under Deutsche Gesellschaft für Internationale Zusammenarbeit's (GIZ) GmbH Green Sector Forum envisioned to raise awareness on climate change in the Philippines in support to the Philippine Government.

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On behalf of



Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

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Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety under its International Climate Initiative.

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Support to the Philippines in Shaping and Implementing the International Climate Regime (SupportCCC II) Project

## Date

November 2016