The 8th Workshop on GHG Inventories in Asia (WGIA8)
-Capacity building for measurability, reportability and verifiability –
13-16 July 2010, Vientiane, Lao PDR

Indonesia's progress in Waste inventory

WG 4: Waste Sector
Information Exchange on the Current Status of the Inventory
Preparation for Waste Sector in each Asian Country

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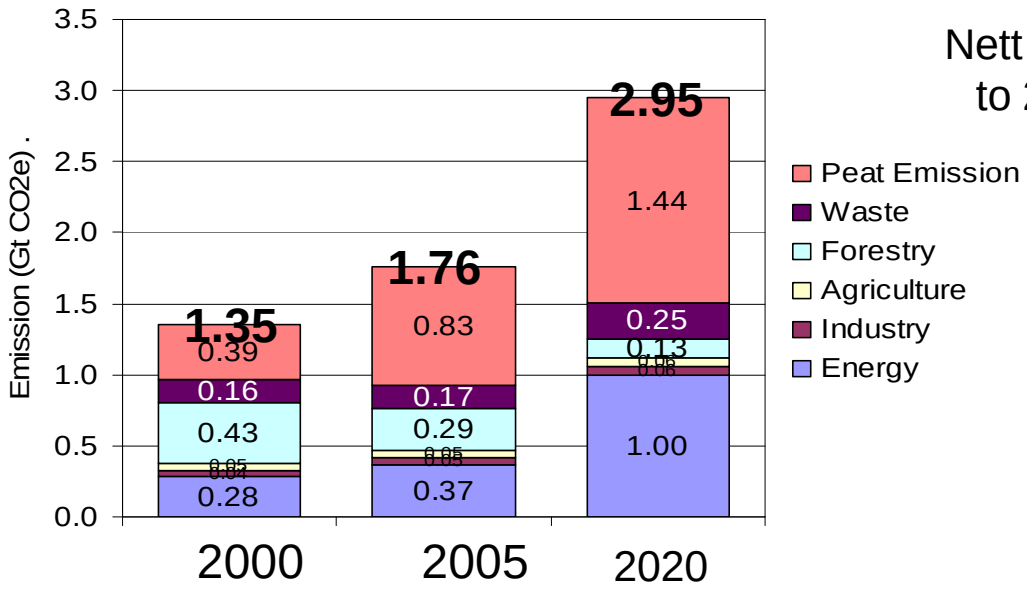
Presentation Outline

- Background : GHGs from Waste Sector Among Indonesian GHGs
- Methodology for Estimating of GHG Emissions from Waste Sector
  - Key Sources Activity and Emission Factors
  - Comparability
  - Compilation System
  - Transparancy
  - Completeness
- Estimation and Projections
- Main Problems and Mitigation

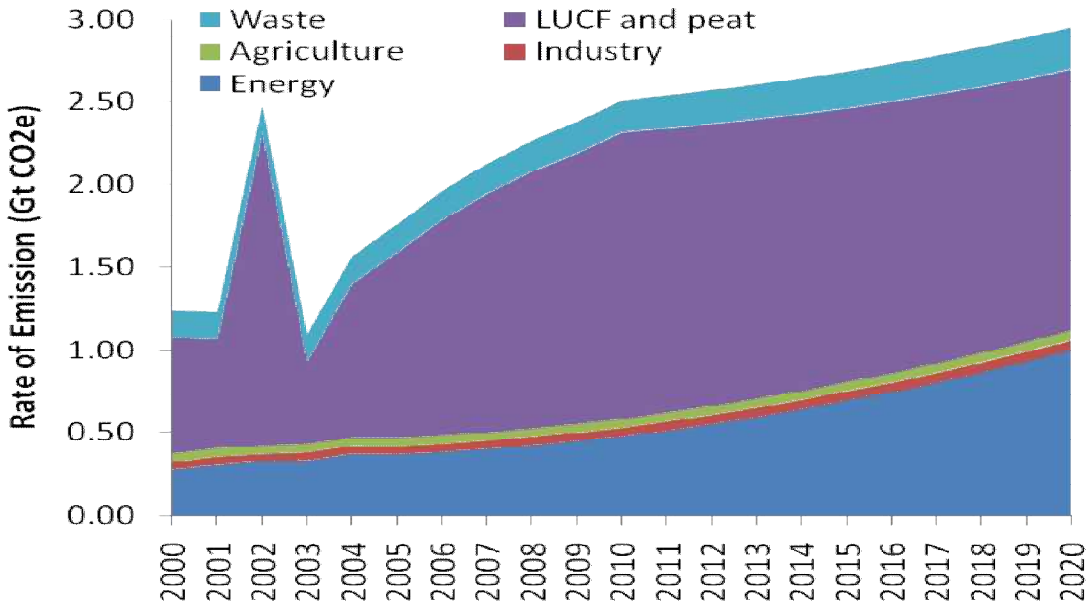
Background

- Indonesia is among the world's 10 largest emitters of GHGs. According to the Second National Communication, Indonesia's GHGs is 1,377 MTon CO2eq in 2000 and is increased to 1,991 MTon CO2-eq in 2005. The major sources are LUCF and peat fire (56-60%), energy (18-20%), **waste (8-11%)**, agriculture (4-5.5%), and industrial processes (2-3%).
- It is projected that GHG emissions will reach 2,614 MTons CO2eq in 2020 and 3,078 MTons COeq in 2025. Total GHG emissions removal potential will reach 753 MTons CO2 eq in 2020 and 830 MTons CO2 eq in 2025. Therefore, net GHG emissions of Indonesia in 2020 will reach 1,861 MTons CO2eq in 2020 and 2,248 MTons CO2eq in 2025.

Sector	2000	2001	2002	2003	2004	2005	Growth ,% per yr
Energy	280,938	306,774	327,911	333,950	372,123	369,800	5.7
Industry	42,814	49,810	43,716	46,118	47,971	48,733	2.6
Agriculture	75,420	77,501	77,030	79,829	77,863	80,179	1.1
Waste	157,328	160,818	162,800	164,074	165,799	166,831	1.2
LUCF	649,254	560,546	1,287,495	345,489	617,423	674,828*	Fluctuated
Peat Fire[1]	172,000	194,000	678,000	246,000	440,000	451,000	Fluctuated
Total with LUCF	1,377,753	1,349,449	2,576,952	1,215,460	1,721,179	1,991,371	Fluctuated
Total w/o LUCF	556,499	594,903	611,457	623,971	663,756	665,544	3.2



Nett emission will increase 1.35 to 2.95 $GtCO_2e$ (2000-2020)



Historcal and future projection of emission from all sectors in Indonesia

Institutional Arrangement in Developing GHG Inventory of Waste Sector

Management of national GHG inventory of Indonesia is developed based on consensus among sectors relevant to GHG emission and climate change through a series of intensive Focus Group Discussion (FGD) and Working Group Discussion (WGD).

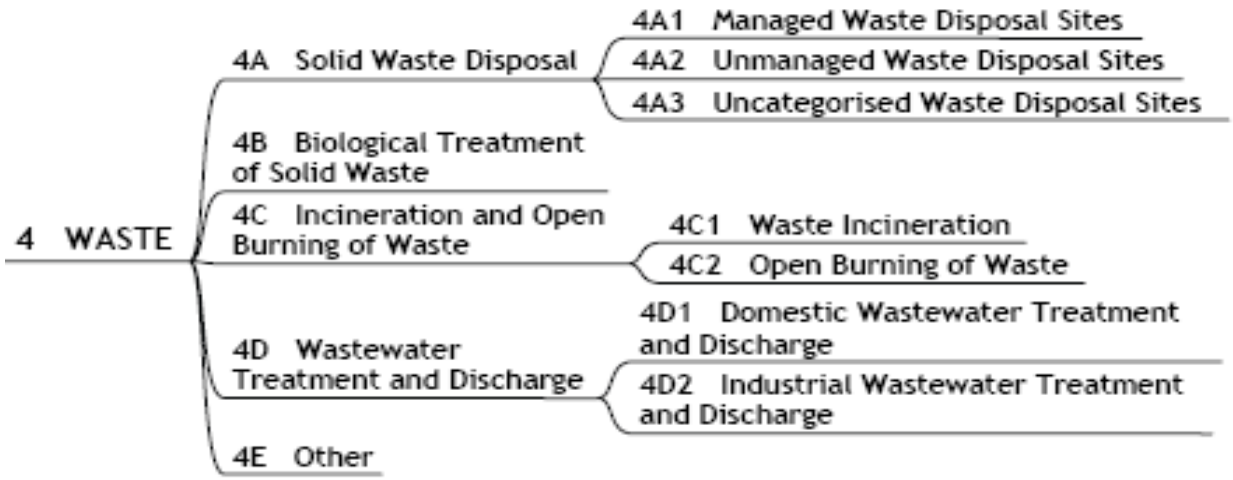
The FGD involves a small team to discuss more specific issues. The WGD includes various sectors relevant to the formulation& development of SNC document, including: (i) update of information concerning GHG inventory based on data and studies carried out by relevant institutions and (ii) development of GHG emission factor database, especially factors established for Indonesia (if available) or otherwise factors that are relevant to Indonesian condition, within the framework of the development of *National Emission Factor.*

The development of these factors will follow the formats that are used in the regional database on emission factors developed by IGES ([2007] whenever applicable.

Data used for developing GHG inventory on all waste categories are obtained from the Ministry of Environment and from the Indonesia Statistics Bureau (Biro Pusat Statistik).

- Methodology for estimating of GHG emissions from waste sector
  - Guideline IPCC 2006
  - Key Sources Activity and Emission Factors
  - Comparability
  - Compilation System
  - Transparancy
  - Completeness

- The SNC was developed by representative of relevant sectors, coordinated by Ministry of Environment as the focal point of national communication. The methodologies used in the SNC is in accordance with the UNFCCC reporting guidelines on National Communications, i.e. IPCC Guideline 2006. GHG inventory of most sector uses Tier-1.
- Key contents of Indonesian SNC:
  - GHGs inventory (2000 to 2005) and projections (2010-2025),
  - set of mitigation options and their effect to future GHG emissions level, and adaptation actions, and
  - several steps planned by GOI in supporting/implementing climate change programs, i.e development of Climate Change Trust Fund.
- Waste Sector



Inventory Compilation System

1. Inventory Preparation Agency in Waste Sector

- Most data relevant to waste sector are supplied by MoE of Indonesia, other data are from Ministry of Public Works, Buerou of Statistics, etc.
- MoE performed the GHG inventory in waste sector with help from experts,

2. Compilation System

- A committee (working group) that is consisted by government from relevant sector and academic experts is established to confirm the methodology as well as to carry out calculation and inventory.
- The activity data and EF (if available) are collected by requesting some relevant agencies and institutions.

3. Annual Caculation of GHG Emissions from Waste Sector

- GOI will conduct continuously the annual calculation of GHG emissions from waste sector in the future inventory. MoE will responsible for GHG emissions calculation and inventory.
- It will supported by Ministry of Public Work, Local Government (City Cleaning Agencies), Research Institutes, etc

Existence of documentation for the estimation methodology

1. Documentation to explain the employed methodology for estimation:

   A detailed report (Technical Report) presents methodology, assumptions that are used for GHG estimations, and sources of all relevant data

2. Inventory comparability in Indonesia

- Indonesian SNC defined the country - specific subcategories for 4A1 for EFB (empty fruit bunch) solid waste from CPO mills
- Indonesian SNC defined the country - specific subcategories for 4A1 for EFB (empty fruit bunch) solid and liquid waste from CPO mills and handlings. The estimated GHG emissions are accounted in 4A1

3. Completeness of GHG inventory by subcategory and type of emisions:

   CO2:

   - Solid waste: CO2 emissions → partially estimated (carbon content of garbage and EFB are not estmiated). Most land fills are categorized as deep disposal site (no shallow land fill). MOE are planning to conduct survey to resolve this problem.
   - Waste incineration: CO2 emisions from biogenic or others are not covered. Surrogate data will be used in the future inventory.

CH4

- Solid waste: CH4 emissions is partially estimated (CH4 content of industrial solid waste (except solid waste from CPO mills) are not estmiated. Most land fills are categorized as deep disposal site (no shallow land fill). MOE will conduct survey to resolve this problem.
- Liquid and sludge waste: CH4 emissions from liquid and sludge waste (domestic as well as industrial) are partially estimated. Specific CH4 content of industrial waste water are not estimated.
- Waste incineration: CH4 emisions from biogenic or others are not covered. Surrogate data will be used in the future inventory.

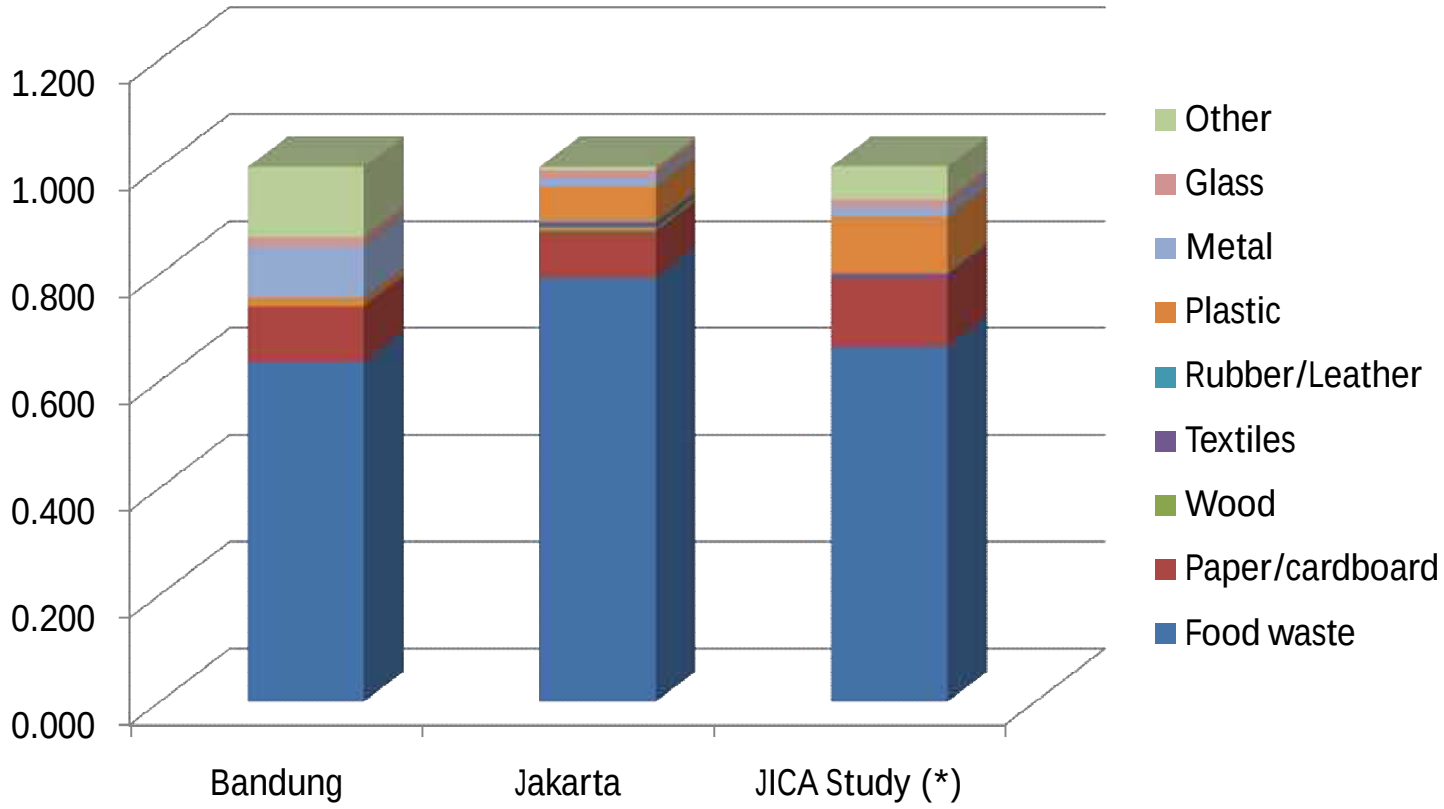
N2O

- Solid waste: N2O emissions is partially estimated (N2O content of industrial solid waste (except solid waste from CPO mills) are not estmiated. Most land fills are categorized as deep disposal site (no shallow land fill). MOE will conduct survey to resolve this problem.
- Liquid and sludge waste: N2O emissions from liquid and sludge waste (domestic as well as industrial) are partially estimated. Specific CH4 content of industrial waste water are not estimated.
- Waste incineration: N2O emisions from biogenic or others are not covered. Surrogate data will be used in the future inventory.

4. Consistency: only for time series not includes methodology and recalculation process

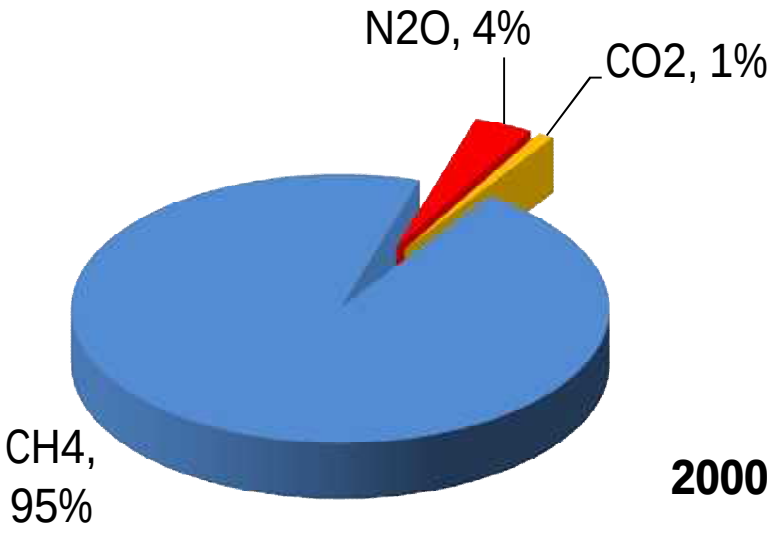
Categories in Waste Sector		Consistency			In case of "No"	
		CO2	CH4	N2O	Reason why	Plans to resolve
Example		No	No	No	Lack of activity data for the time series.	To estimate the time series of activity data, we will employ the driver based on the statistics of population.
Solid Waste Disposal						
6A1	Managed Waste Disposal on Land					
6A2	Unmanaged Waste Disposal Site					
a	Deep (>5m)	no	no		Lack of activity data for the time series.	To estimate the time series of activity data, we will employ the driver based on the statistics of population.
b	Shallow (<5m)					
6A3	Other (please specify)	no	no		Lack of activity data for the time series.	To estimate the time series of activity data, we will employ the driver based on the statistics of population.
Waste Water Handling						
6B1	Industrial waste Water					
a	Waste Water		no		Lack of activity data for the time series.	To estimate the time series of activity data, we will employ the driver based on the statistics of population.
b	Sludge					
6B2	Domestic and Commercial Wastewater					
a	Waste Water		no		Lack of activity data for the time series.	To estimate the time series of activity data, we will employ the driver based on the statistics of population.
b	Sludge					
	N2O from human sewage		no		Lack of activity data for the time series.	To estimate the time series of activity data, we will employ the driver based on the statistics of population.
6B3	Other (please specify)					
Waste incineration						
6C1	Biogenic					
6C2	Other (open burning)	no	no		Lack of activity data for the time series.	To estimate the time series of activity data, we will employ the driver based on the statistics of population.
Other (please specify)						
6D						

WASTE COMPOSITION OF SEVERAL CITIES

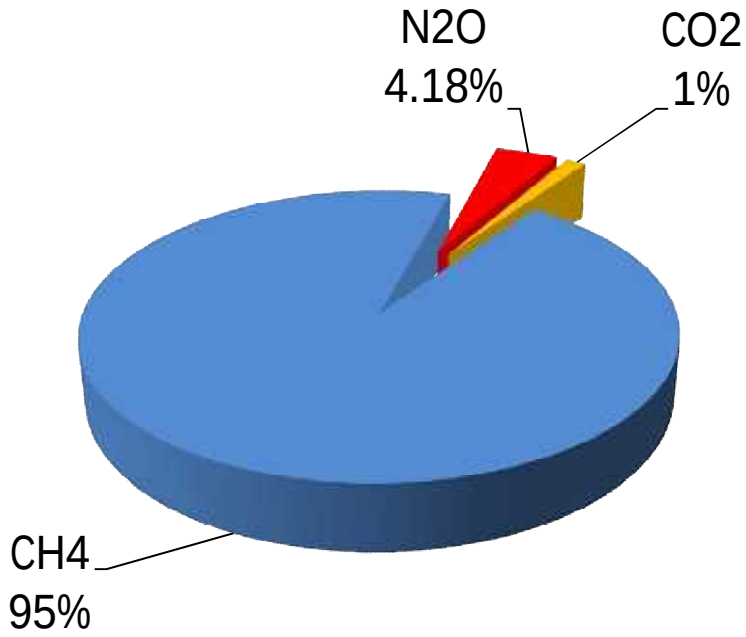


(*) Jakarta, Surabaya, Medan, Makasar

GHGs Inventory



2000



2005

CH_4 is the major GHGs emssion of Waste sector

GHG emissions from the waste sector from 2000-2005 by source category

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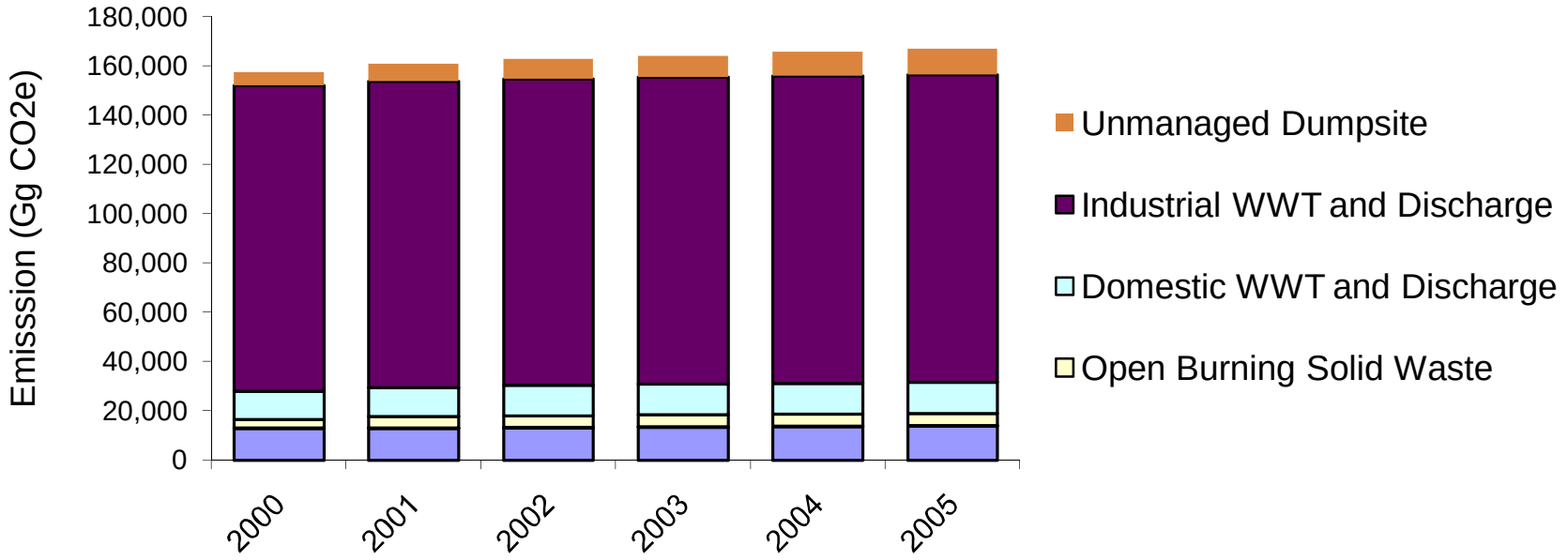
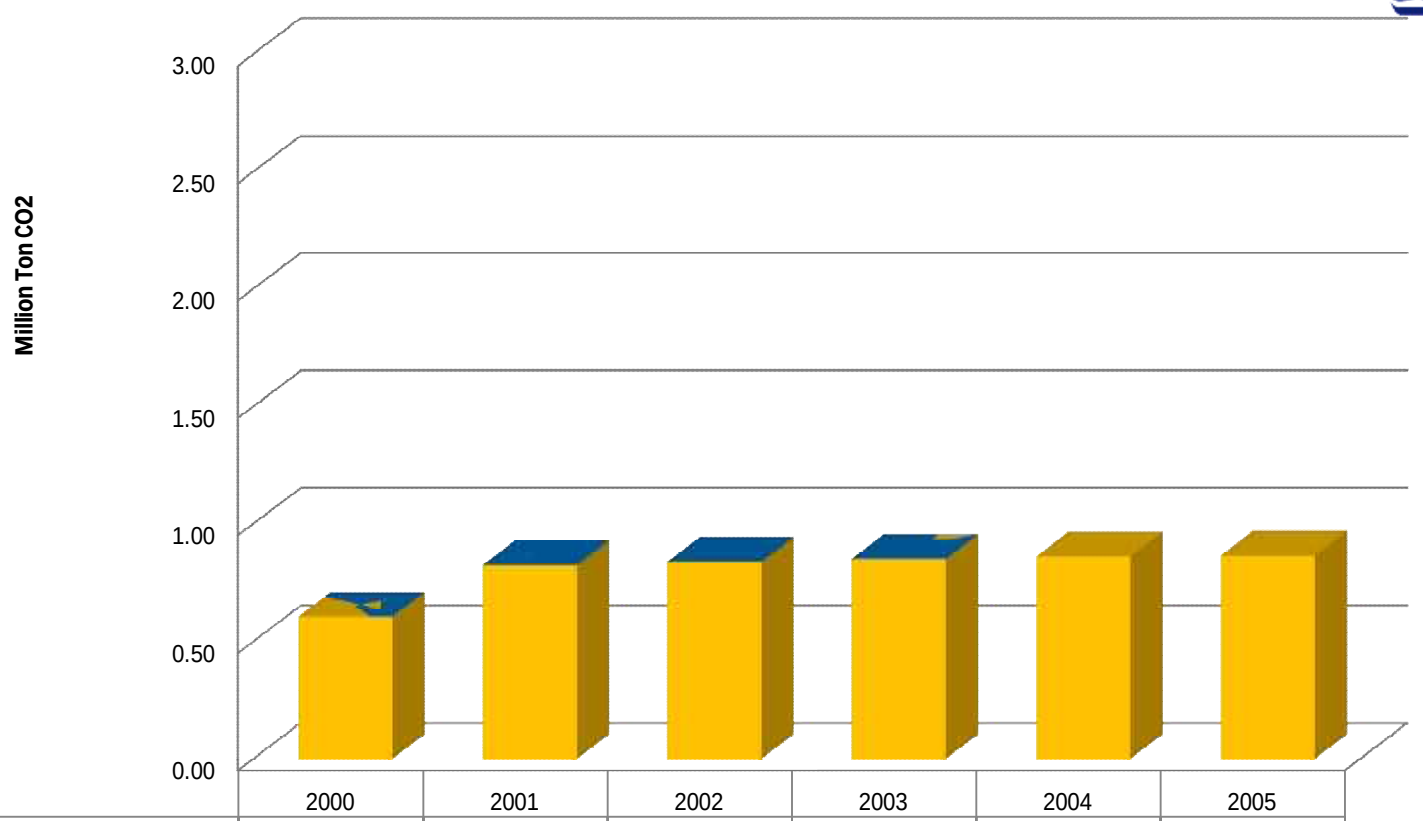
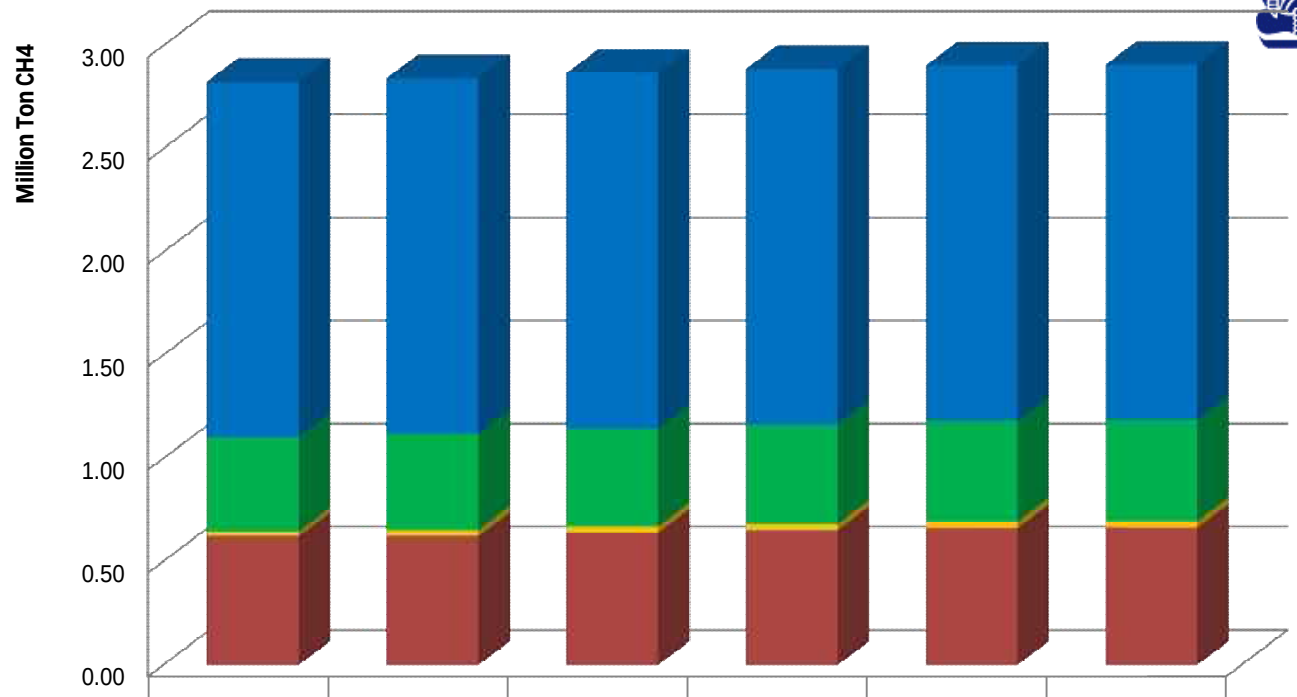


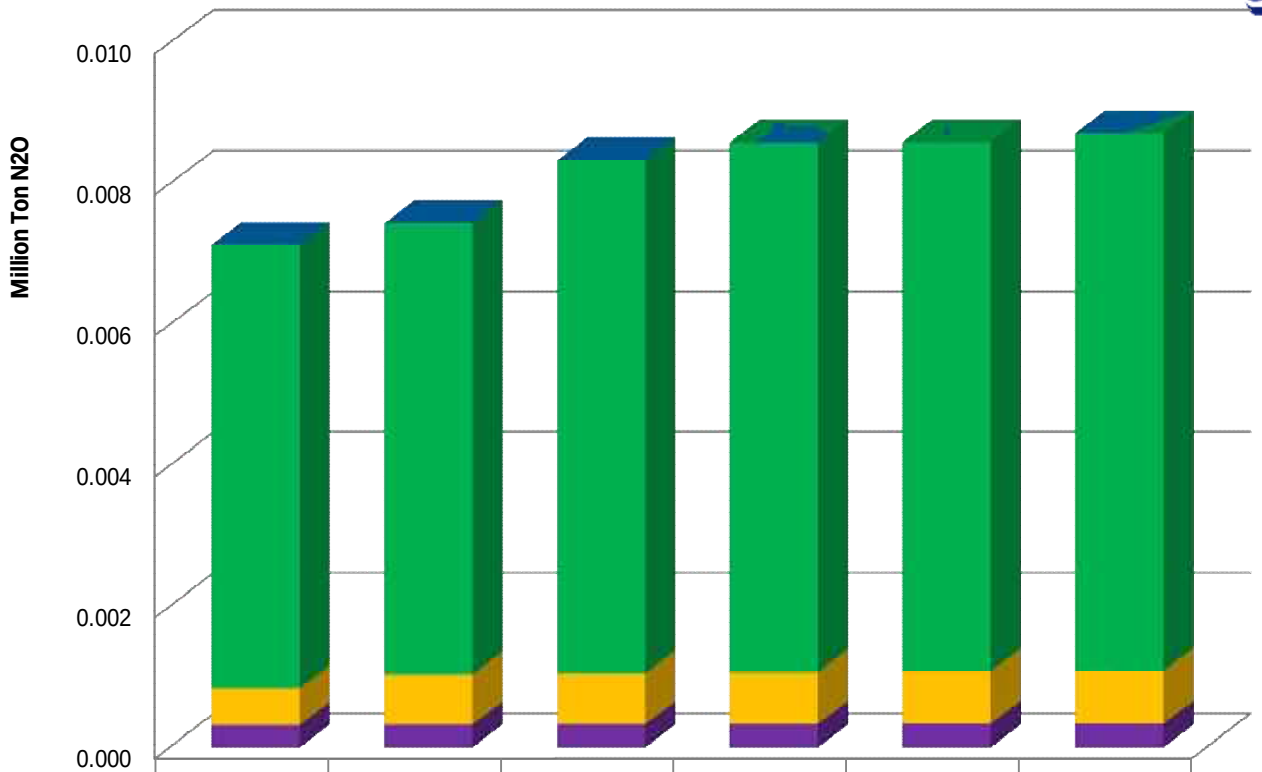
Gas	2000	2001	2002	2003	2004	2005
CO_2	1,662	2,266	2,302	2,338	2,366	2,377
CH_4	153,164	155,853	157,516	158,670	160,361	161,346
N_2O	2,501	2,699	2,982	3,066	3,072	3,108
Total	**157,328**	**160,818**	**162,800**	**164,074**	**165,799**	**166,831**



	2000	2001	2002	2003	2004	2005
Industrial WWT and Discharge	0.00	0.00	0.00	0.00	0.00	0.00
Domestic WWT and Discharge	0.00	0.00	0.00	0.00	0.00	0.00
Open Burning Waste	606.81	827.06	840.36	853.33	863.55	867.58
Waste Incineration	0.00	0.00	0.00	0.00	0.00	0.00
Biological Treatment of Solid Waste	0.00	0.00	0.00	0.00	0.00	0.00
Uncategorised Waste Disposal Sites	0.00	0.00	0.00	0.00	0.00	0.00
Unmanaged Waste Disposal Sites	0.00	0.00	0.00	0.00	0.00	0.00
Managed Waste Disposal Sites	0.00	0.00	0.00	0.00	0.00	0.00



	2000	2001	2002	2003	2004	2005
Industrial WWT and Discharge	1,722.26	1,722.26	1,722.26	1,722.26	1,722.26	1,722.26
Domestic WWT and Discharge	459.59	467.46	474.98	482.32	488.09	490.37
Open Burning Waste	22.76	31.01	31.51	32.00	32.38	32.53
Waste Incineration	0.00	0.00	0.00	0.00	0.00	0.00
Biological Treatment of Solid Waste	4.22	4.29	4.36	4.43	4.48	4.50
Uncategorised Waste Disposal Sites	0.00	0.00	0.00	0.00	0.00	0.00
Unmanaged Waste Disposal Sites	618.94	618.96	634.63	648.25	657.62	659.41
Managed Waste Disposal Sites	0.00	0.00	0.00	0.00	0.00	0.00



	2000	2001	2002	2003	2004	2005
Industrial WWT and Discharge	0.00	0.00	0.00	0.00	0.00	0.00
Domestic WWT and Discharge	6.30	6.41	7.28	7.52	7.51	7.63
Open Burning Waste	0.53	0.72	0.73	0.74	0.75	0.75
Waste Incineration	0.00	0.00	0.00	0.00	0.00	0.00
Biological Treatment of Solid Waste	0.32	0.32	0.33	0.33	0.34	0.34
Uncategorised Waste Disposal Sites	0.00	0.00	0.00	0.00	0.00	0.00
Unmanaged Waste Disposal Sites	0.00	0.00	0.00	0.00	0.00	0.00
Managed Waste Disposal Sites	0.00	0.00	0.00	0.00	0.00	0.00

- Main issue of waste in Indonesia is organic waste as the biggest composition and main source of pollution (water, soil water, and air) with less effective handling. Meanwhile for other waste, market mechanism to re-utilize this waste as raw material for industry has been established. Therefore this type of waste does not become serious environmental issue, except for some types of plastic such as plastic bags and instant noodle packaging that have no market.
- Considering this fact, policy of waste management are focused on the organic waste as 65% solution of waste issue in Indonesia.

Concerning solid waste disposal:

In urban areas, almost 60% of waste is taken to solid waste disposal site (SWDS), while in rural areas or small cities, this figure is only 30% (Indonesian Statistical Data on Environment, BPS, 2000-2007).

Major components of solid waste brought to SWDS areorganic compounds as the other types of waste (plastics, metal, etc.) are generally recycled for re-utilization.

Dominant organic compound in solid waste will affect degradable organic content (DOC) value and corresponding correction of CH_4 emissions factor in inventories.

The SWDSs in most big cities in Indonesia are considered to beunmanaged SWDS because they are simply open dumping systems; within the context of GHG emissions, they are catagorized as unmanageddeep (>5 m) waste.

Currently, incinerators for municipal solid waste are generally not used in Indonesia. Although several statistical data indicate that inceration is already used for eliminating municipal solid waste, in reality, the so-called ‘incinerator’ is actually an ‘open burning’ system.

Therefore, the calculation of CO_2 emissions from municipal solid waste is based on open burning.

Concerning domestic wastewater:
In general, the discharge pathways of domestic wastewater in urban areas in Indonesia are decentralized using individual septic tanks. In rural areas, there is almost no wastewater treatment.

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Concerning industrial wastewater:
In general,industrial wastewater is treated by the industry prior to discharge to the environment. The calculation of GHG emissions level varies according to the type of industry and the corresponding treatment technology.

Projection of GHG emissions from waste sector under BAU and alternative scenarios (Dewi *et al*., 2009)

Scenario Mitigation	2010			2020			2025		
	BAU	**S1**	**S2**	**BAU**	**S1**	**S2**	**BAU**	**S1**	**S2**
Total MSW	19,691	19,199	18,706	22,198	19,423	17,204	23,562	20,028	17,672
Unmanaged Dumpsite (CPO)	11,289	10,725	10,443	13,269	10,615	9,288	14,385	10,069	8,631
Domestic WWT and Discharge	13,568	12,890	12,551	15,287	12,230	10,701	16,227	11,359	9,736
Industrial WWT and Discharge	149,818	142,327	138,582	199,477	159,581	134,647	224,411	157,088	123,426
Total Emission	**194,367**	**185,141**	**180,282**	**250,231**	**201,849**	**171,839**	**278,585**	**198,544**	**159,465**

Year	Population	Waste Generation Mton	3 R	LFG (CDM)	New SWDS (Sanitary LF WWT)	MSW TO SWDS		Fraction of Population Open Burning Waste	Composting
						Urban	Small City		
2000	205,132,458	45,672,742	0.00	0.00	0.00	0.60	0.30	0.35	0.023
2005	218,868,791	48,731,136	0.00	0.00	0.00	0.60	0.30	0.47	0.023
2010	234,501,000	52,211,648	0.02	0.01	0.00	0.60	0.30	0.40	0.025
2015	248,912,000	55,420,257	0.03	0.05	0.05	0.70	0.40	0.35	0.030
2020	264,210,000	58,826,357	0.05	0.10	0.15	0.80	0.50	0.30	0.035
2025	280,447,000	62,441,525	0.10	0.15	0.25	0.80	0.50	0.20	0.040

KEY TECHNOLOGY for MITIGATION

Municipal Solid Waste

Technology priority list for intermediate treatment:

1. Composting (improved in mechanical)
2. MBT (+ anorganic recycling)
3. Waste to energy incineration
4. Anaerobic digestion

Technology priority list for final treatment:

1. Sanitary Landfill + LFG recovery
2. LFG Mining (for 'old' TPA)

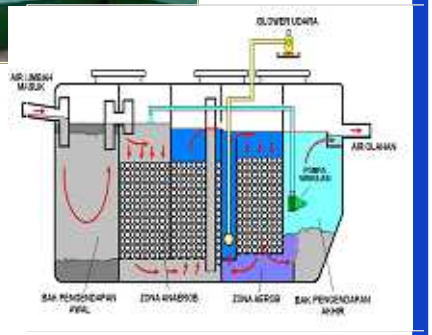
Domestic Waste Water

Technology priority list for off-site /centralized treatment:

1. Stabilization ponds
2. Aerated Lagoon
3. Oxidation ditch
4. UASB + DHS
5. Rotating Biological Contactor (RBC)

KEY TECHNOLOGY for MITIGATION

Domestic Wastewater



Technology priority list for on-site / decentralized treatment system:

1. **Communal Biofilter System**
2. **Communal UASB treatment system**
3. **Modified Septic tank + filtration**

Livestock Waste

Technology priority list for liquid waste:

1. **Anaerobic filter**
2. **Aerobic system**
3. **Stabilization ponds**

Technology priority list for solid waste:

- **Composting windrow system**

KEY TECHNOLOGY for MITIGATION

Agro-Industry Waste

Palm Oil Industry Waste

Technology priority list for liquid waste:

1. Anaerobic filter *)
2. Aerobic system
3. Stabilization ponds
4. Aerated lagoon
5. Hydrogen from biological treatment

Technology priority list for solid waste:

1. Composting
2. Combustion for steam
3. Thermal gasification super critical for hydrogen
   (Palm oil solid waste is a big potential as raw material for hydrogen fuel)

*) *is the same as biogas technology but the bio digester use support material for bacteria fixation*

MAIN BARRIER

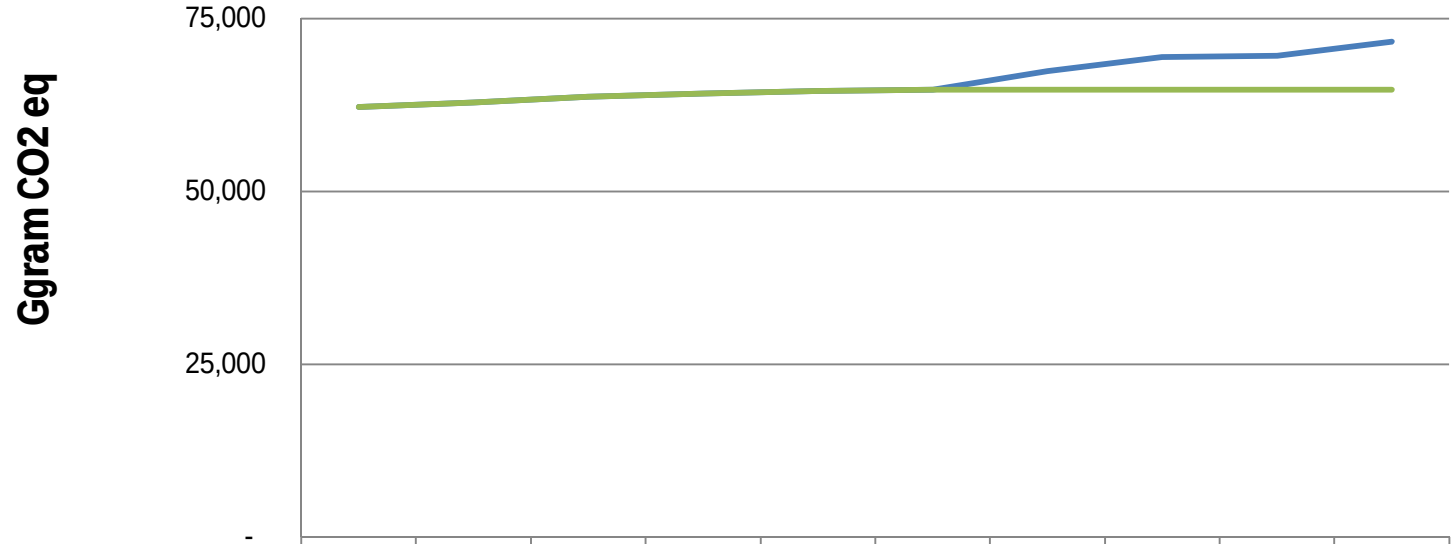
- ✓ Increase of population → will increase the waste
- ✓ Organization issues → regulator, executor, etc.
- ✓ Financial issues → priority, allocation is low, etc
- ✓ Social Aspect → community participation, lifestyle & culture

MITIGATION OPTION AND GHG LEVEL

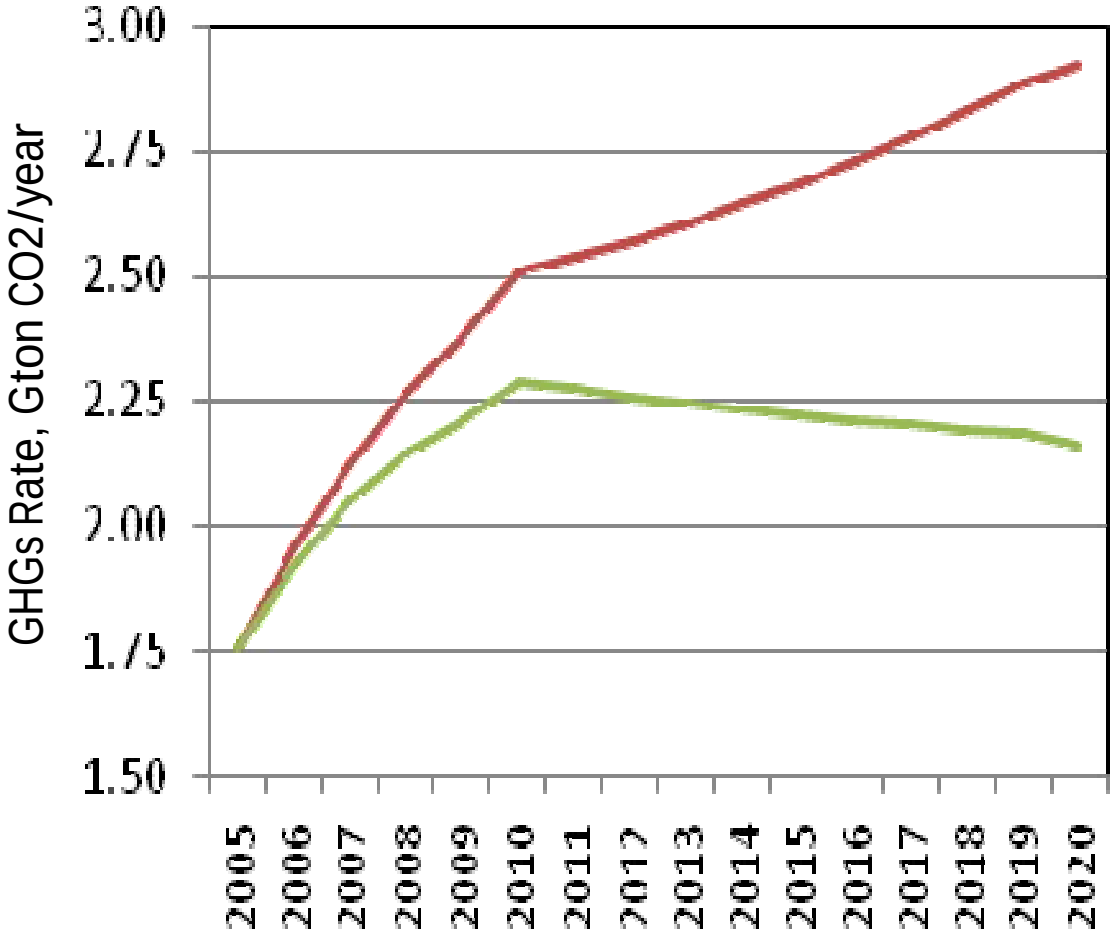
MSW

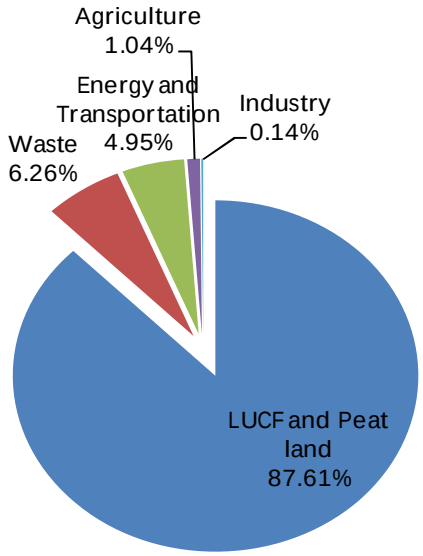
- 3 R and composting
- Install LFG recovery or flaring unit for existing land fill
- New SWDS Development (Sanitary with emission or waste treatment , i.e. LFG recovery or flaring and leachate WWT

The Impact of Mitigation in Waste Sector



	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025
BAU	62,204	62,859	63,648	64,191	64,530	64,674	67,358	69,449	69,578	71,631
3R Compost LFG New SWDS	62,204	62,859	63,648	64,191	64,530	64,661	64,661	64,661	64,661	64,661





Expected path of GHGs under BAU (red line) and under 26% non-legally binding reduction target (green line). (Source : BAPPENAS, 2010)

Sectoral climate Change mitigation programs for meeting the 26% Emission Reduction Target

Sector	Main Mitigation Program	Responsible Ministries
LUCF and Peat	Forest and land fire management, improvement of water management in peat land, land and forest rehabilitation, establishment of timber plantation in degraded lands, combating illegal logging, avoid deforestation and community empowerment	Ministry of Forestry, Ministry of Agriculture, Ministry of Environment, and Ministry of Public Work
Waste	Development of regional dump site (sanitary landfill), waste management (3R) and integrated waste water management in the for urban	Ministry of Public Work and Ministry of Environment
Energy and Transportation	Increasing the use of biofuel, applying standardization for engine with high energy efficiency, increasing energy efficiency, improving public transportation, development of *renewable energy*	Ministry of Energy and Mineral Resources, Ministry of Transportation, Ministry of Public Work
Agriculture	Introduction of less methane emitting varieties, improving irrigation efficiency, application of organic fertilizers	Ministry of Agriculture, Ministry of Environment
Industry	Improving energy efficiency and conservation, increasing the use of renewable energy etc	Ministry of Trade and Industry


Thank You
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