Estimation of landfill gas generation from the Quezon City Controlled Dumping Facility (Payatas)

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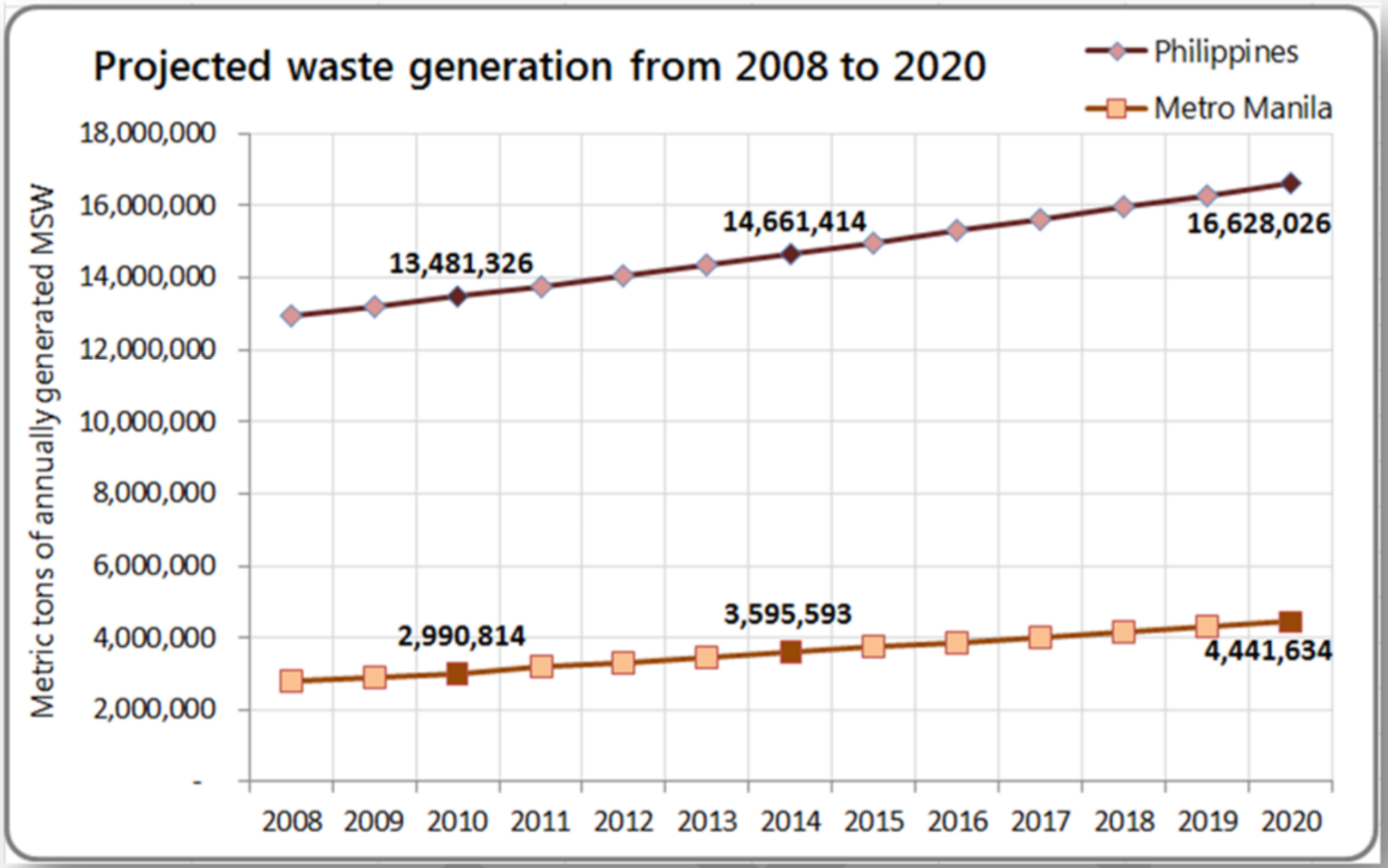
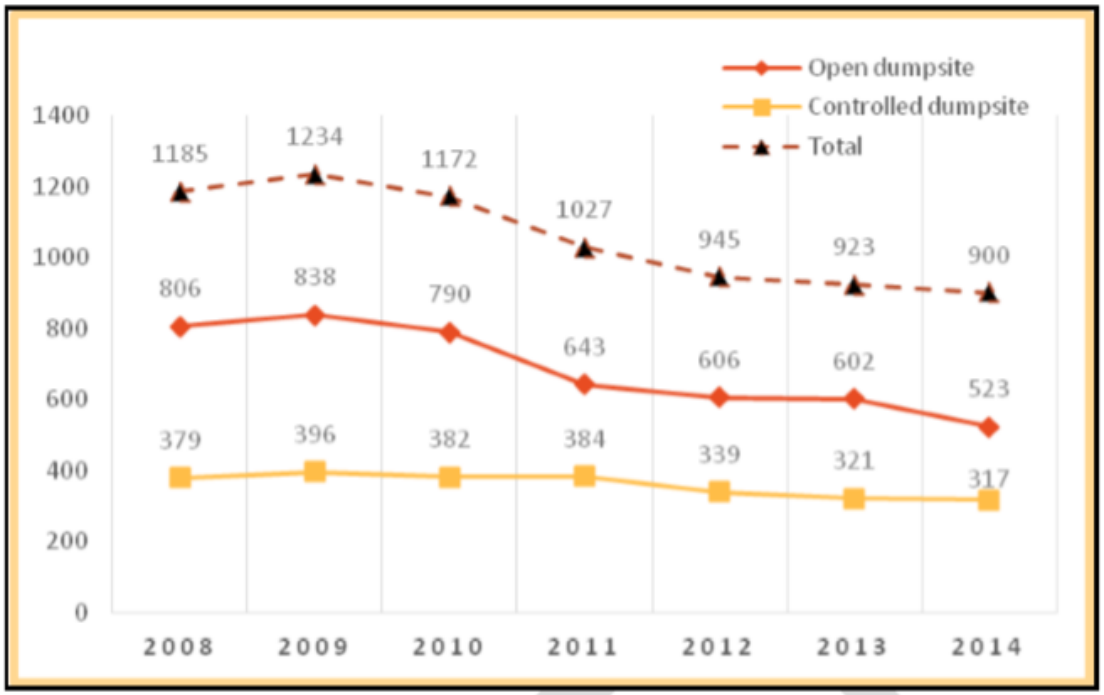


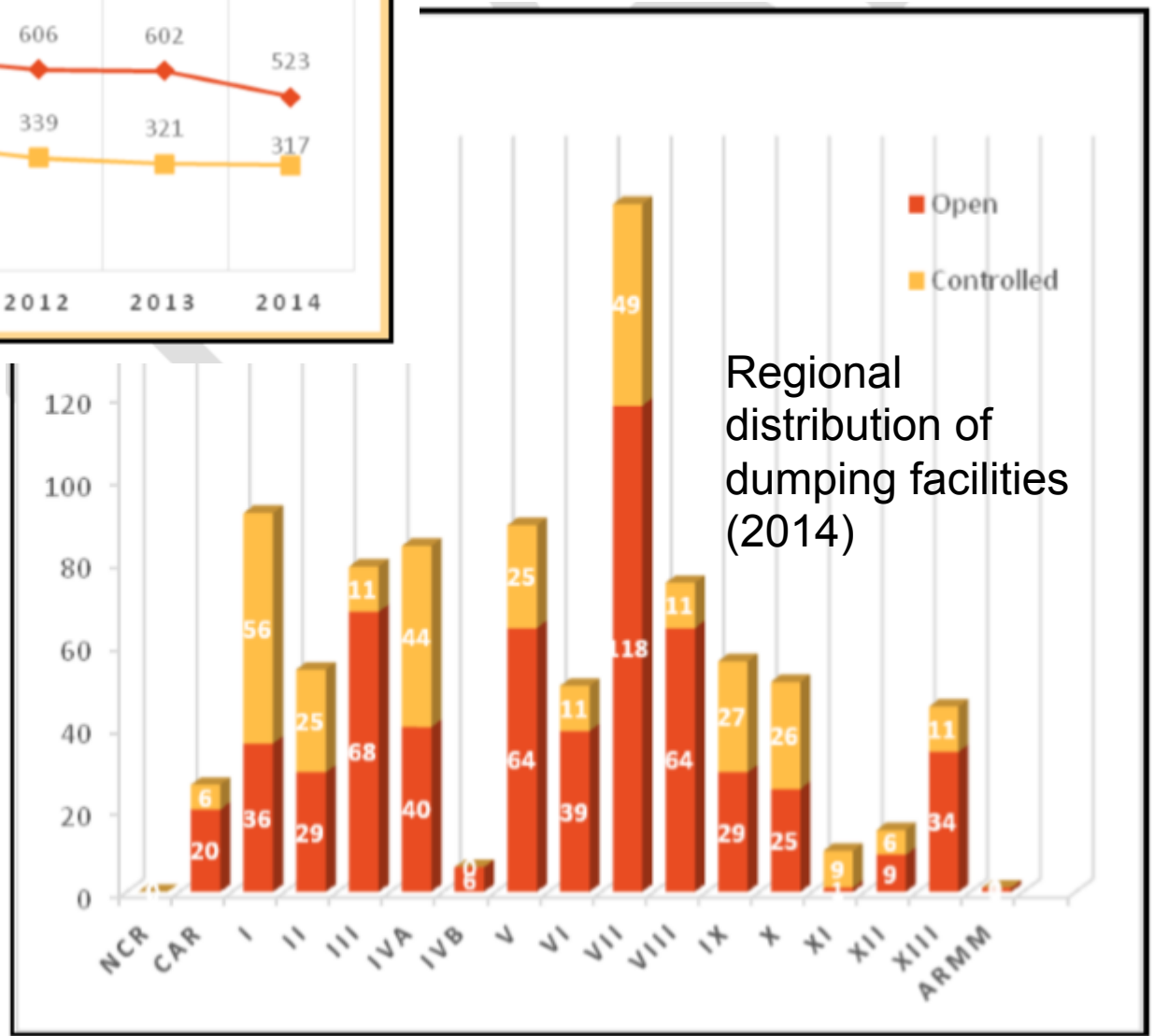
National waste generation rate = 0.4 kg/cap/day
Metro Manila waste generation rate = .79 kg/cap/day
(NSWMC, 2015)

Policy Overview
(Ecological Solid Waste Management Act)

- Segregation at Source (bio-degradable, recyclable)
- Segregated Collection
- Recovery and Processing
- Disposal Management
  - Closure of open dumpsites and controlled dumps
  - Shift to the development of Sanitary Landfills



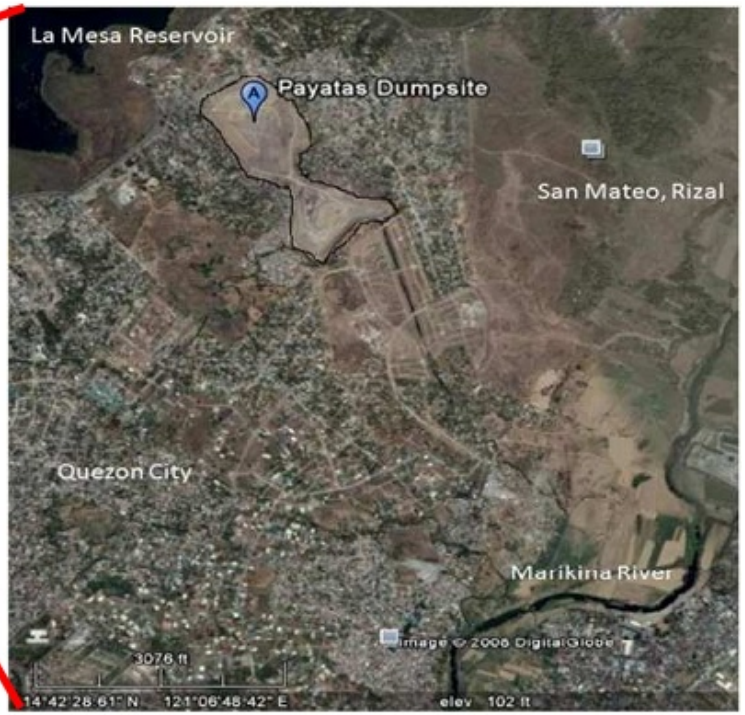
Number of open and controlled dumpsites from 2008 - 2014



Regional distribution of dumping facilities (2014)

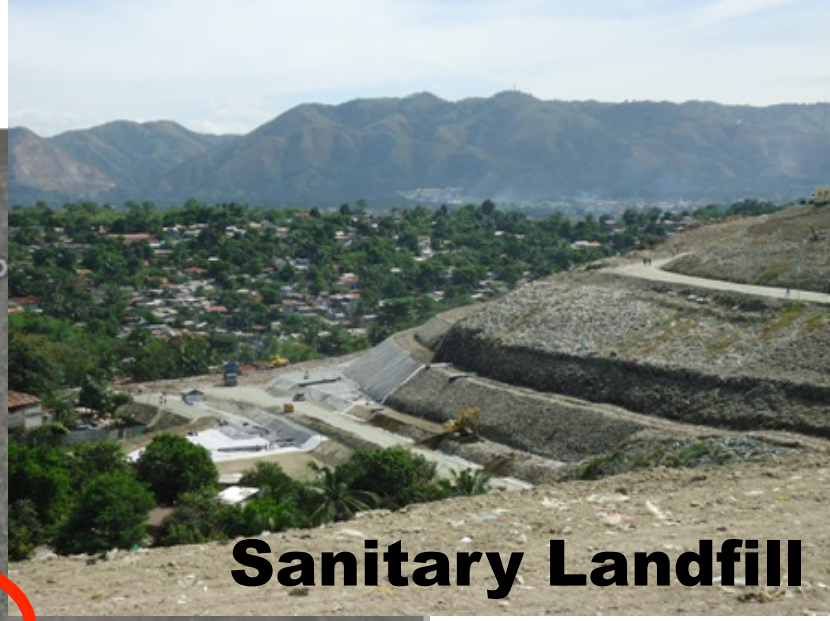
Study Area

- **In the northernmost part of Quezon City (Philippines)**
- **Operation time – since 1973**
- **Total Area - approximately 22 hectares (height up to 40m)**
- **Average waste intake - 1,100 tons/day of MSW from Quezon City**




Methane Extraction


Payatas Dump
image © 2008
elev 102 ft


Sanitary Landfill


Leachate Collection


Creek downstream

Municipal solid waste deposited in Payatas Controlled Dumpsite

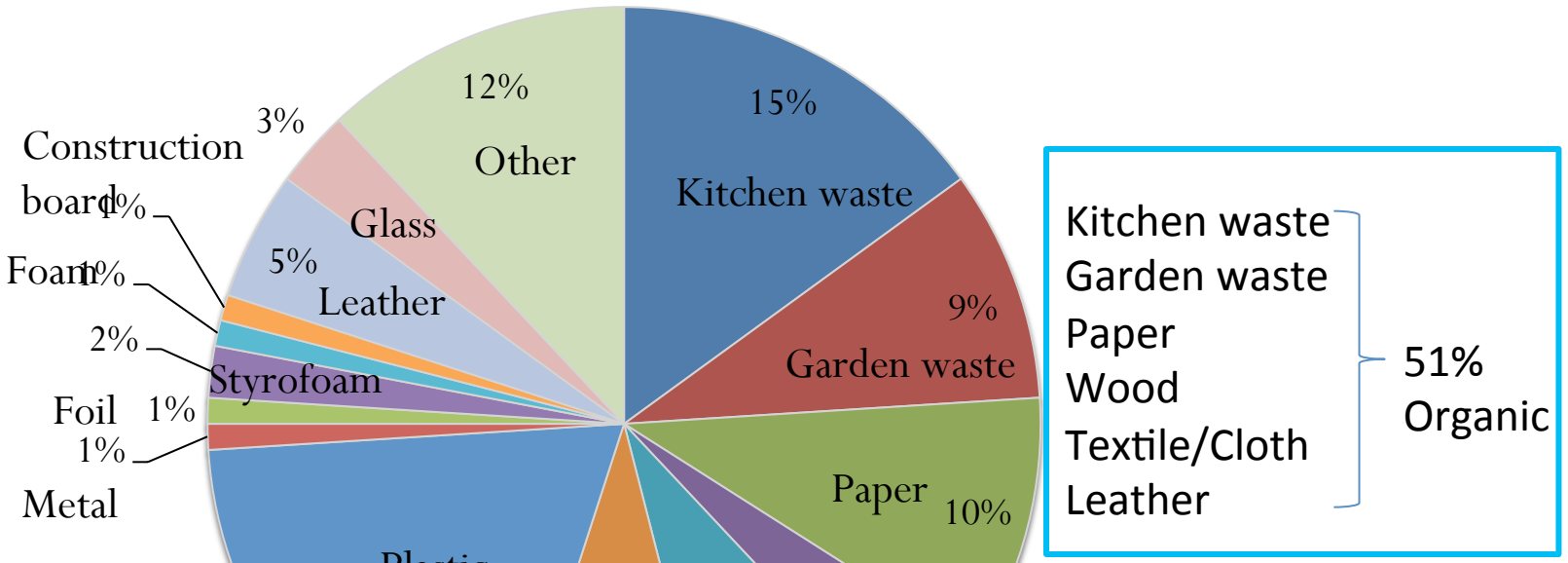
Year	**MSW (MetricTon/y)**	*Year*	**MSW (Metric Ton/y)**	*Year*	**MSW (Metric Ton/y)**
1988	547,500	*1997*	547,500	*2006*	401,500
1989	547,500	*1998*	547,500	*2007*	401,500
1990	547,500	*1999*	547,500	*2008*	401,500
1991	547,500	*2000*	547,500	*2009*	401,500
1992	547,500	*2001*	401,500	*2010*	401,500
1993	547,500	*2002*	401,500	*2011*	401,500
1994	547,500	*2003*	401,500	*2012*	401,500
1995	547,500	*2004*	401,500	*2013*	401,500
1996	547,500	*2005*	401,500	*2014*	401,500

1988-2000 –Wastes from both Manila and Quezon City
2001-2014 – Wastes only from Quezon City

Waste characterization study (2009)

- Daily waste intake: 1100 tons/day
- Sampling: daily for one month, 10 samples with 0.084m^3 volume were randomly selected after the waste pickers have collected the items that were valuable to them
- Manually sorted by waste pickers

Payatas waste composition (2009 study)



LandGEM (US EPA)

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_0 \left(\frac{M_i}{10}\right) e^{-kt_{ij}}$$

Q_{CH4} = annual methane generation in the year of the calculation (m^3/year);

i=1 = year time increment;

n = (year of the calculation) - (initial year of waste acceptance);

j=0.1 = year time increment;

k = methane generation rate ($year^{-1}$);

***L_0* = potential methane generation capacity (m^3/Mg);**

M_i = mass of waste accepted in the i^{th} year (Mg);

t_{ij} = age of the j^{th} section of waste mass Mi accepted in the i^{th} year (decimal years, eg., 3.2 years)

IPCC Method to compute Lo

Lo = [MCF • DOC • DOCF • F • 16 / 12 (Gg CH4/Gg waste)]

MCF = Methane correction factor (fraction)

DOC = Degradable organic carbon [fraction (Gg C/Gg MSW)]

DOCF = Fraction DOC dissimilated

F = Fraction by volume of CH4 in landfill gas

SWDS CLASSIFICATION AND METHANE CORRECTION FACTORS

Type of Site	Methane Correction Factor (MCF) Default Values
Managed	1.0
Unmanaged – deep (>5m waste)	0.8
Unmanaged – shallow (<5m waste)	0.4

DOC (Degradable Organic Carbon)

$$DOC = (0.4 \bullet A) + (0.17 \bullet B) + (0.15 \bullet C) + (0.3 \bullet D)$$

A = Fraction of MSW that is **paper and textiles**

B = Fraction of MSW that is **garden waste**, **park waste** or other non-food organic putrescibles

C = Fraction of MSW that is **food waste**

D = Fraction of MSW that is **wood** or straw

Determination of k (methane generation rate)

- Moisture content of the waste mass
- Availability of the nutrients for microorganisms that break down the waste to form methane and carbon dioxide
- pH of the waste mass, and
- Temperature of the waste mass
- Default value for US landfills: k = 0.05/y
- For Philippines: k = 0.18/y

LandGEM Philippine Model

- Landfill Methane Outreach Program
- Runs on *Excel* Program
- k = 0.18/yr
- Lo = 60 m3/ton
- LMOPPhilippinesModel_v1-0-payatas.xls

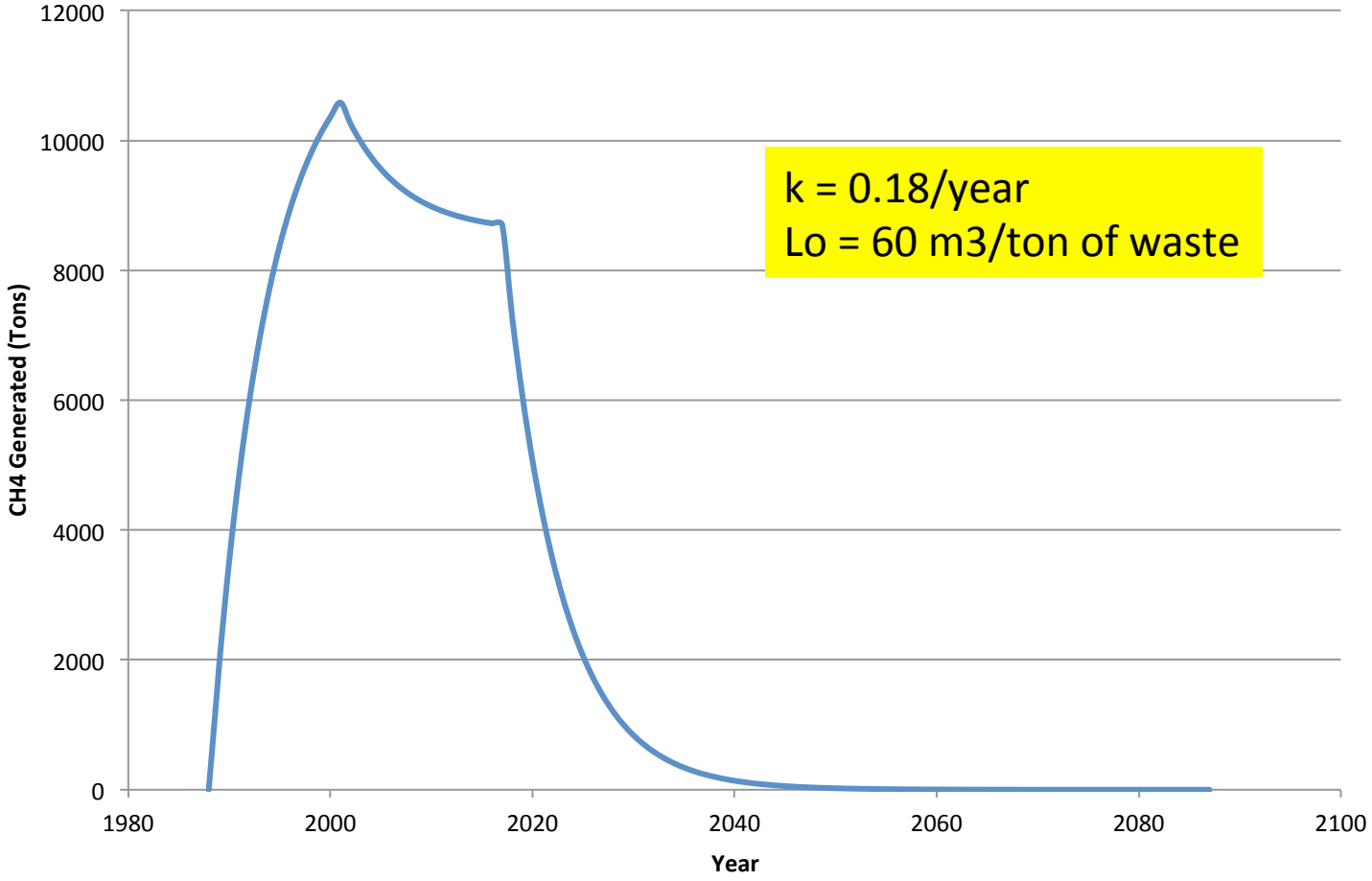
Model Parameters

Parameters	
Landfill Name	Payatas Controlled Dumpsite
Landfill Open Year	1988
Landfill Closure Year	2016
Methane Generation Rate, k (y^{-1})	0.18
Potential Methane Generation Capacity, L_0 (m^3/t)	60

Characteristics of the dumping facility

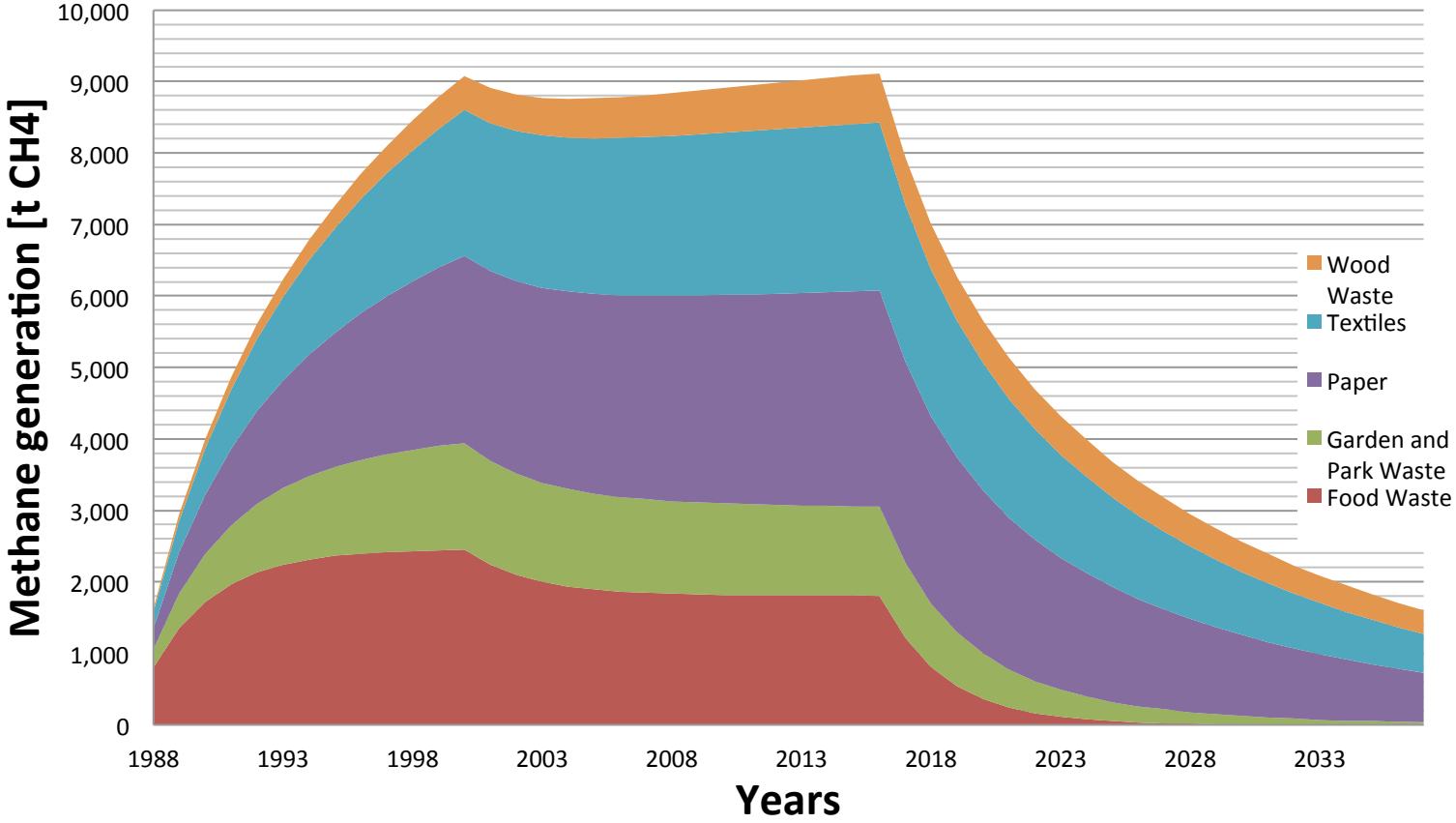
- Wastes properly compacted
- Leachate seeps along side slopes
- Average depth is greater than 10m
- Cover material is applied weekly
- No clay or geosynthetic liners used

LandGEM modeling results



Using site-specific data

Waste stream	waste composition	DOC (wet waste)	Decay rate k
Food Waste	15%	15%	0.400
Garden and Park Waste	9%	17%	0.170
Wood Waste	4%	30%	0.035
Paper	10%	40%	0.070
Textiles	13%	24%	0.070



Conclusions and recommendations

- Methane can and should be recovered and utilized, instead of being released to the atmosphere
- LandGEM is a user-friendly model that can be used to estimate landfill gas generation
- More data needed to determine site-specific inputs for k and Lo
- Important to document waste intake and its composition
- Validation of model is needed


Maraming salamat!