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Introducing a New Landfill Gas Model for Colombia

Why LMOP's country-specific models are better than the IPCC Model

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Presentation Topics

- Introduction – The need for LFG modeling and LMOP's modeling support for M2M countries
- Latest data from CDM monitoring reports on international LFG project performance
- Introducing LMOP's LFG model for Colombia
- Why LMOP's LFG models are better than the IPCC Model

Need for International LFG Modeling

- Accurate estimates of LFG recovery are critical for:
  - Evaluating LFG project feasibility and economics
  - Estimating system design and facility sizing requirements
  - Evaluating project performance (predicted vs. actual)
- International LFG modeling is still developing
  - Can be a large source of error in evaluating project feasibility and system requirements
  - Unrealistic model projections can lead to investment in uneconomical projects (or neglecting opportunities)
  - Frequent overestimation of LFG recovery in Clean Development Mechanism (CDM) projects' PDDs
  - Current standard CDM modeling method is IPCC Model (uses 4 k values); LandGEM no longer used

IPCC Model Shortcomings

- **Global methane emissions model not designed for individual landfills**
  - Uses default waste composition for continents based on limited data
- **4 climate categories, but only 2 precipitation categories**
  - 2 precipitation regimes too coarse to capture effects on k values
  - Wet vs. dry cutoff is 1000 mm/yr
  - Most landfills in countries in tropical regions (e.g. Colombia) receive more than 1000 mm/yr – no climate differentiation
  - Temperature not likely to have significant effects
- **Ratio of waste decay rates for food vs. wood too low except for tropical-wet climates**
  - Tropical-wet category – very high k values; other climate categories use much lower k values
- **No guidance on estimating collection efficiency**

LMOP's History of Support in International LFG Modeling

- Developed country-specific models
  - Mexico v. 1 (2003) and v. 2 (2009)
  - Central America (2007)
  - Ukraine (2009)
  - Colombia (2010)
  - Others (non-SCS): Ecuador, China, Philippines, Thailand
- Models reflect data from country's landfills
  - Waste composition
  - Climate
  - Flow data from operating projects (Mexico, Colombia)
  - Realistic collection efficiency estimates reflecting site conditions based on user inputs
- IPCC multiple k model structure to account for high food waste decay rates (used in SCS models)

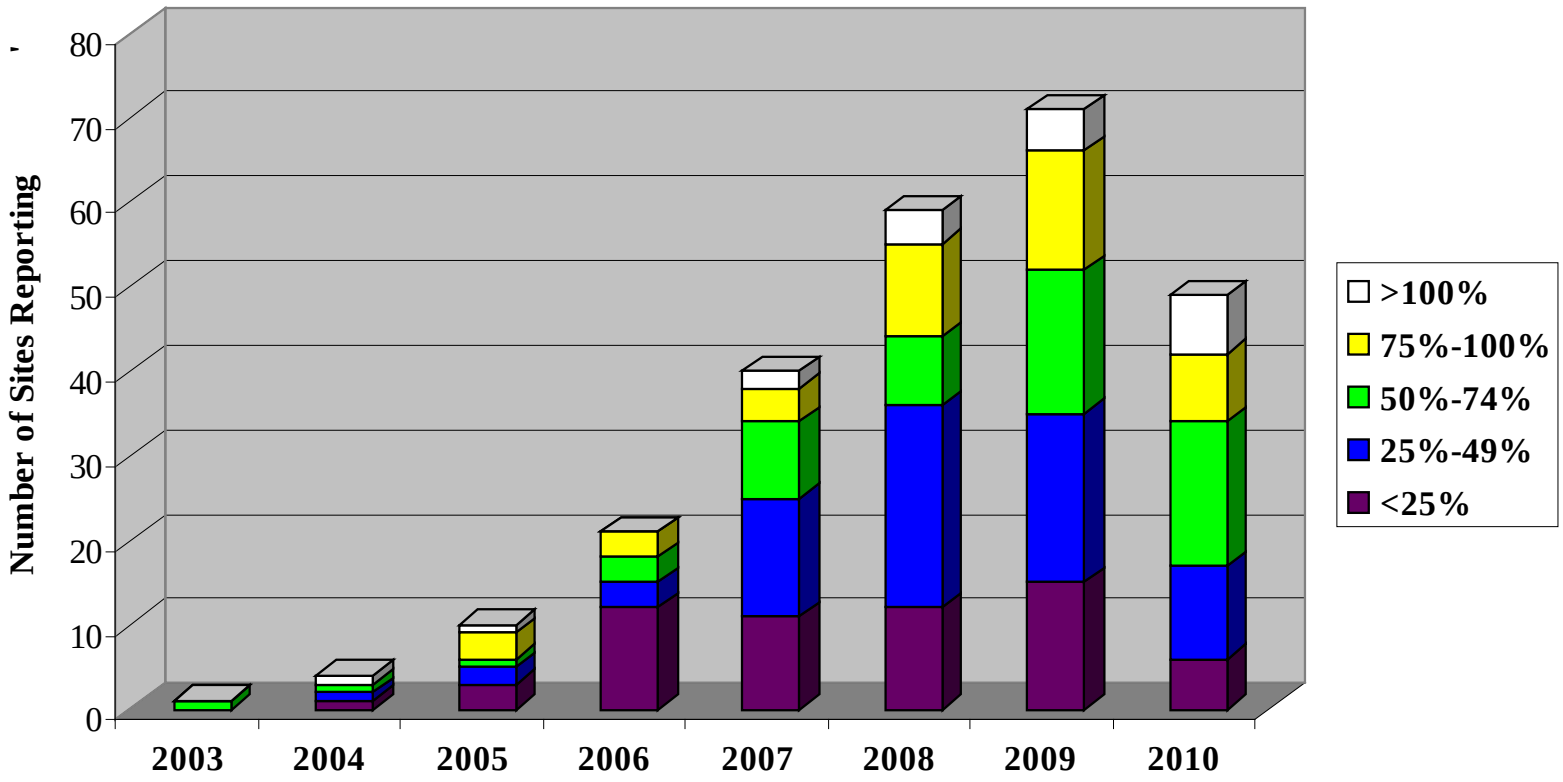
Historical Overestimation of LFG Recovery in CDM PDDs

- LFG recovery rates limited due to:
  - Poor site conditions
    - Shallow waste depths, poor compaction
    - High leachate levels due to lack of soil cover and/or poor drainage
    - Fires, waste pickers, site security
  - Partial system installation – common cause of low overall collection efficiency
  - Limited experience with LFG system operation in developing countries
- Reliance on project developers with incentives to estimate high
  - Bid process for winning a contract often rewards optimistic estimates of CERs
  - Need for independent estimate of LFG recovery

Historical Overestimation of LFG Recovery in CDM PDDs (cont.)

- Effects of site conditions and waste composition on LFG recovery rates often not accounted for in models
  - Prior use of (single-k) LandGEM with poor model k and Lo selection
  - Over-estimating achievable collection efficiency
  - Too optimistic a schedule for wellfield development in all (active) disposal areas
  - IPCC model use for "tropical-wet" sites (max. inputs)
- Measuring historic over-estimation of LFG recovery – CDM Monitoring Reports
  - Actual project results when applying for CERs indicate project performance
  - Divide actual recovery by PDD model prediction – historical average (2003-2010) = ~50%

CDM LFG Project Performance – Worldwide (% of Projected)



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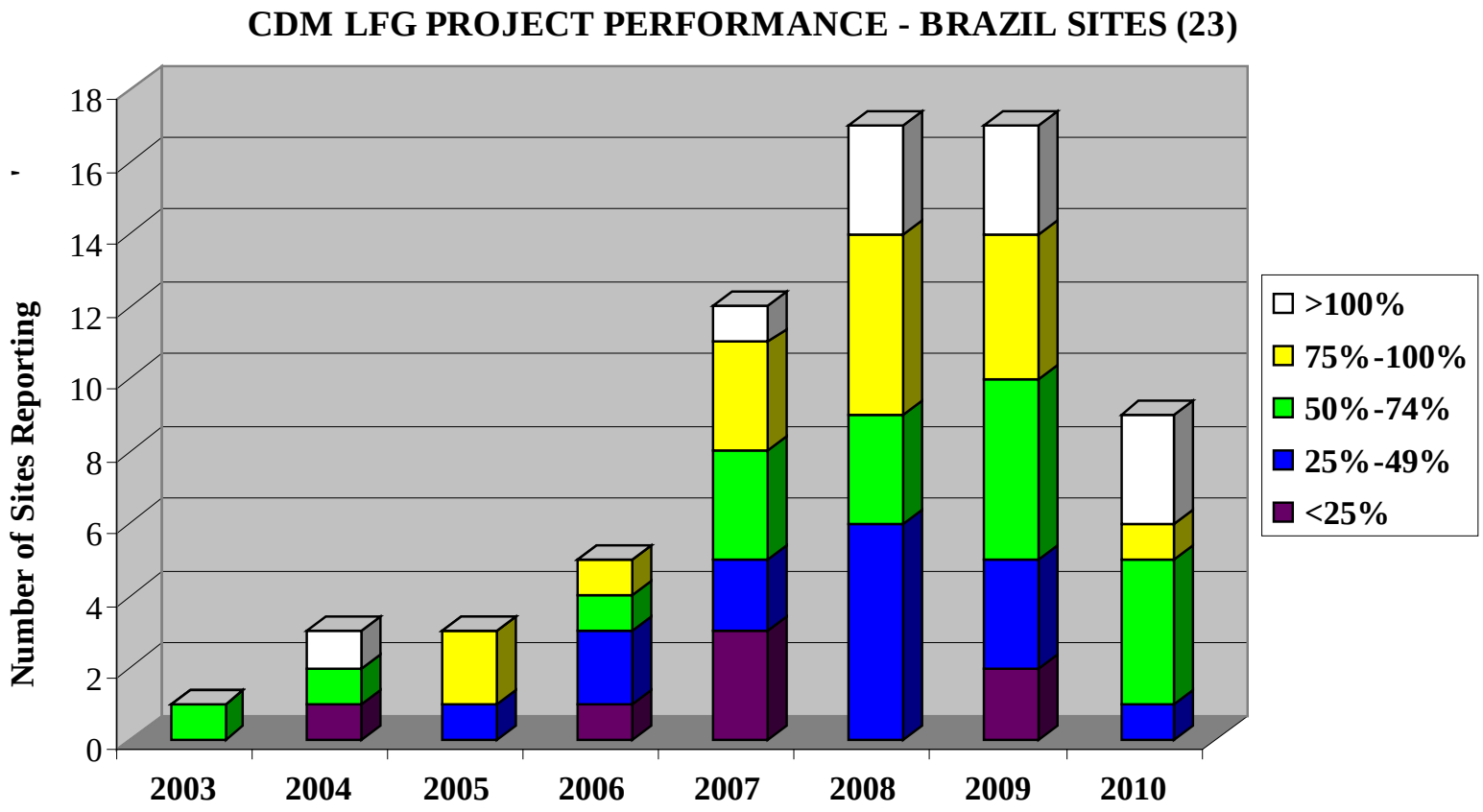
CDM LFG Project Performance – Brazil (% of Projected)



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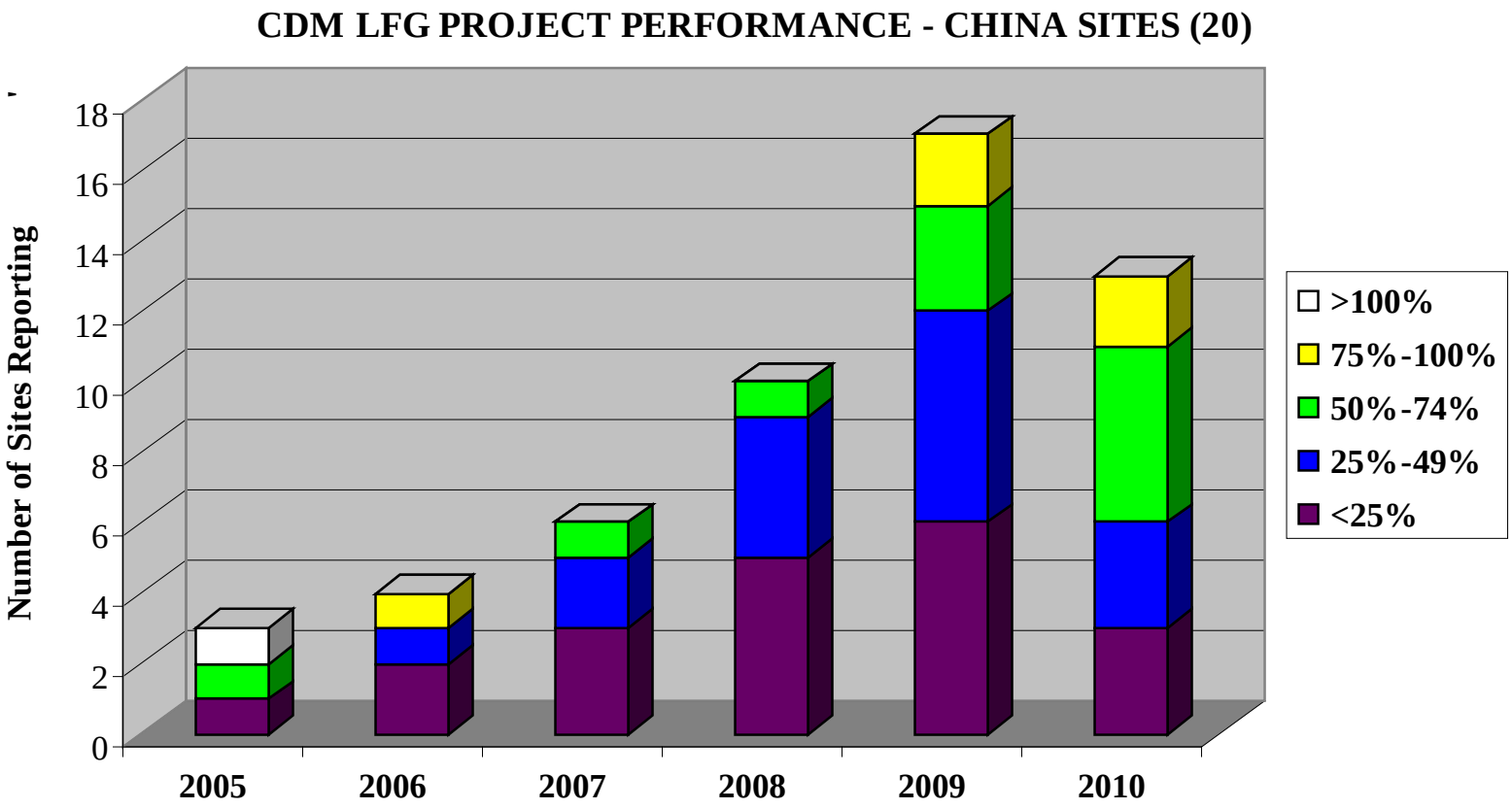
CDM LFG Project Performance – China (% of Projected)



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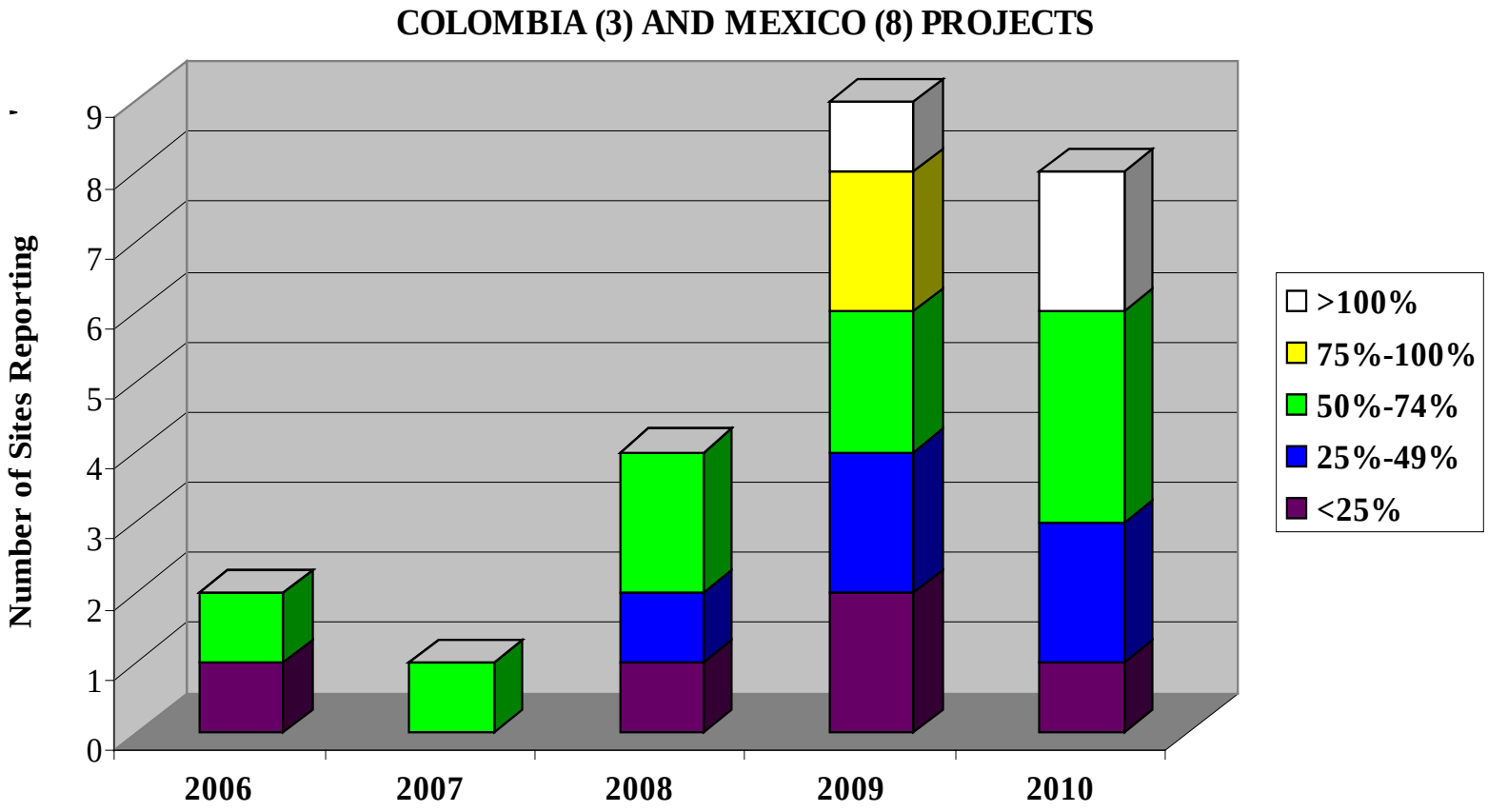
CDM LFG Project Performance – Mexico & Colombia



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Developing the Colombia Model

- Waste composition data
  - Waste composition database covers 57 cities in 21 states
  - Average waste composition values assigned to each state (site data not needed to run model)
- Climate data (precipitation)
  - Precip. largely determined by geographic region but varies widely within some states
  - Requires model user to select 1 of 5 climates; model automatically selects k values
- Site data (collection efficiency & recovery)
  1. Dona Juana Landfill in Bogota – February 2010 visit
  2. Antanas Landfill in Pasto – July 2010 visit

Dona Juana Landfill, Bogota, Colombia

Summary of Colombia LFG Model Features

- **Inputs worksheet**
  - User answers a series of questions about the site
  - Model automatically calculates model input values for: waste disposal rates, k, Lo, MCF, fire adjustment, and collection efficiency
- **Disposal & LFG Recovery worksheet**
  - Shows annual disposal and collection efficiency estimates calculated by the model
  - Allows the user to input site-specific waste disposal estimates, collection efficiency, actual LFG recovery, and baseline LFG recovery
- **Waste Composition worksheet**
  - Shows waste composition values assigned to each state
  - Allows user to input site specific waste composition data
- **Output Table worksheet**
  - Shows model results in table format
- **Output Graph worksheet**
  - Shows model results in graph format

Why LMOP's Colombia Model* is Better than IPCC

- **Country-specific LFG generation and recovery model instead of global methane emissions model**
  - Default waste composition values based on large in-country database
  - Model reflects detailed evaluation of climate and categorization of country into 5 climate zones, instead of user selecting "wet" vs. "dry" and "tropical" vs. "temperate"
  - Model assigns k values that better capture the effects of local climate on LFG generation
- **Model incorporates site data based on user inputs**
  - Automatically develops waste composition, annual disposal, and collection efficiency estimates which can be over-ridden with user data
- **Model projects LFG recovery as well as generation**
  - If project is operating, model user can apply actual flow data to adjust collection efficiency & recovery projections
- **Output provided in both table and graph format**

*Also Mexico (v.2) and Ukraine models.