Landfill Gas Capture and Electricity Generation and the Clean Development Mechanism (CDM): Shuangkou Landfill; Tianjin, China

Landfill Methane Outreach Program

January 13, 2009

Presentation Topics

- World Bank
- Global Warming and CDM
- Landfill Gas (LFG) Projects in China
- Tianjin, China – Landfill Gas Capture Project
- Conclusions

Flare: Nanjing Kun Yuan Technology Ltd. Co.

World Bank Group

- **<u>History</u>: Founded 1944 for post-war reconstruction**
- **<u>Current Role</u>: Alleviate poverty in developing countries**
- **<u>Organization</u>: 5 entities**
  - **World Bank (IBRD): Low interest loans to governments in middle income developing countries <US$10,000 per capita per year**
  - **Int'l Development Association (IDA): No interest loans / grants, GNI < US$1,097 per capita per year**
  - **International Finance Group (IFC): Loans to private sector**
  - **Multilateral Investment Guarantee Agency (MIGA)**
  - **Int'l Centre for Settlement of Investment Disputes (ICSID)**

World Bank, Carbon Finance

- **Initiated carbon finance program 1999 to stimulate market**
- **Trustee of 12 Funds / Facilities for governments and firms**
- **Carbon Finance Unit contracts to purchase emission reductions for Fund / Facility members**
- **Carbon finance contributes to sustainable development and reduction in climate change**

Solid Waste and Greenhouse Gas (GHG) Emissions

- **Methane**
  - **- Generated in anaerobic conditions in landfills**
  - **- 21x global warming potential (GWP) of CO_2**

- **Landfills**
  - **- 12%+ global anthropogenic methane emissions**
  - **- 4th largest source of non-CO_2 GHG emissions**

CDM and the Kyoto Protocol

- **Intergovernmental Panel on Climate Change (IPCC), 1988**

- **UN Framework Convention on Climate Change (UNFCCC)**

  - Voluntary program (1994), after Rio Earth Summit, to stabilize greenhouse gas (GHG) emissions

- **Kyoto Protocol**

  - Legally binding program to reduce GHG emissions

  - Ratified 2005; effective period through end of 2012

  - CDM: Provision for sale of emission reductions by developing countries to developed countries

CDM Process

- **Carbon finance, payment for performance**

- **Methodologies to measure reduction in GHG must be approved by UNFCCC**

- **Conditions include:**

  - <u>Baseline</u>: GHG emissions in the absence of action (landfill).

  - <u>Additionality</u>: GHG emission reduction that only would be achieved with CDM project

Approved CDM Methodologies: LFG

- **Large-scale**
  - **ACM001. Landfill gas projects**
  - **Related tools**
    1. **Demonstration and assessment of additionality**
    2. **Determination of methane emissions avoided from dumping waste at a disposal site**
    3. **Determine project emissions from flaring gases containing methane**
    4. **Identify the baseline scenario and demonstrate additionality**
    5. **Calculate project or leakage CO2 emissions from fossil fuel combustion**
    6. **Calculate project emissions from electricity consumption**

- **Small-scale**
  - **AMS-III.G. Landfill methane recovery**

- **Power generation, Grid connected renewable energy**
  - **AMS-I.D. Small-scale (<15 MW)**
  - **ACM0002. Large-scale**

CDM Methodology: LFG

- **First Order Decay (FOD) model - assess pot. gas collection rates**

- **FOD model factors**

  - Waste composition

  - Ambient temp. / precipitation

  - Methane correction factor

Registered CDM Projects in China, 2005-2008

(mid-November)

Year	Number of Projects	Forecast Annual Average (tCO2e/yr)
2005	3	338,016
2006	36	46,051,917
2007	114	45,662,138
2008	145	29,875,640
Total	295	121,927,711

CDM Landfill Gas Projects, Total / China

(mid-November)

- **Landfill gas projects (Registered): 89**

  - 7.0% of total registered projects

- **China**

  - Registered landfill gas projects: 12

  - Requesting registration / validation: 19

Tianjin

- **Population: 11.2 million, 5th largest city in China**
- **Waste Generation: 4,800 tpd**
- **Disposal Sites: 4 landfills and 1 incinerator**
- **Location: 150 km southeast of Beijing**

Shuangkou Landfill, Design

- **1st modern landfill in Tianjin**

- **Design features**

  - Bottom liner: HDPE

  - Leachate collection / treatment

- **Capacity: 8.5 million m3 (7.4 million tons)**

  - Landfill life: 17 years (2017)

  - 60 hectare site

- **Financing: World Bank (part of broader environmental loan).**

Shuangkou Landfill, Operations

- **Start of operations: 2001**
- **Daily waste receipts: 1,300 tpd (100 vehicles)**
- **Vehicles weighed**

  - 2.0 million tons of in-place waste
- **Site equipment: Compactors (3**

  bulldozers (4)
- **Cover: daily, soil**

Shuangkou Landfill, LFG System

- **Gas collection pipes**

  - 34 wells installed on 4 hectares

- **Flare: Nanjing Kun Yuan Technology Ltd. Co.**

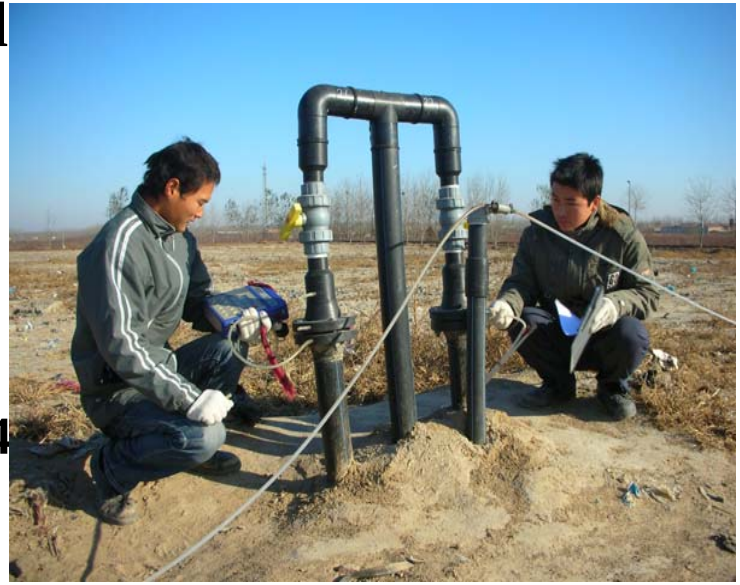
- **Combustion Generators: Caterpill**

  - Currently: 1 unit @ 1.03 MW

  - Future: 4 units@ 4.12 MW

- **Start of Operations: May 2008**

  - Gas Flow: 500 – 600 m3 /hr @50% CH4



Shuangkou Landfill, CDM

- **Registered: August 2008**

  - ACM0001, Landfill gas capture

  - AMS-I.D, Grid connected power generation (small-scale)

- **Bank: Buy certified emission reductions (CERs)**

  - Contract 635,000 tCO2e, 7 years

  - Call Option: 470,000 tCO2e

Shuangkou Landfill – Project Entities

- **Tianjin Clean Energy and Environmental Engineering, TCEEE**

  - Formed as project developer and emission reduction seller

  - Landfill operator: Tianjin Solid Waste Treatment Centre, division of Environmental Sanitation Commission that formed TCEEE with Tianjin Construction Administration Commission

- **World Bank**

  - Buyer of CERs for the Spanish Carbon Fund

  - Bank represents 12 Funds/Facilities design to purchase emission reductions

- **Nanjing Long-Term Environment Technology Development Co.**

  - Founded in 2006 from staff from Australian firm that was active in Chinese LFG market. Two other projects under development

Conclusions

- **LFG projects – important part of China's efforts to reduce greenhouse gas emissions**

- **With 100 cities with a population of a million or more plus numerous other larger urban areas, significant potential for LFG capture projects in China**

Thank You

World Bank

Charles Peterson: cpeterson@worldbank.org

Zarina Azizova: zazizova@worldbank.org

TCEEE

Mr. Qi Wenjie

Mr. Liu Baorui

Nanjing Long-Term Environment Technology Development

Ms. Jane Huang

Additional Information

Tianjin Landfill Gas Project

- **Tianjin Landfill Gas Project, CDM:** http://cdm.unfccc.int/Projects/DB/JQA1193375340.58/view

General

- **World Bank's Carbon Finance Unit:** www.carbonfinance.org
- **World Bank's Urban Solid Waste Management:** http://go.worldbank.org/A5TFX56L50
- **2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5: Waste:** http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html
- **UNFCCC's CDM:** http://cdm.unfccc.int/index.html

Additional Information

(Continued)

Selected Large-Scale Methodologies

- **LFG - ACM0001, Consolidated baseline and monitoring methodology for landfill gas project activities**
  http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_BTH14FSTZKN0WN9PBDUG9D2U83HXBQ

- **LFG to Power – ACM0002, Consolidated baseline methodology for grid-connected electricity generation from renewable sources**
  http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_323M30IDF1IH6AG3GRCJ4PKR9CKM7P

Selected Small-Scale Methodologies

- **LFG - AMS-III.G, Landfill methane recovery**
  http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_341FT628YO0PX9D2BW9IDMHSTPY139

- **LFG to Power - AMS-III.D, Grid connected renewable electricity generation**
  http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_PHPV5WESACMBTJ2YY54GAJYSIEI3HD