

**The Global Methane  
Initiative**

# **Development of Landfill Gas Technology in Ukraine – Status and Prospects**

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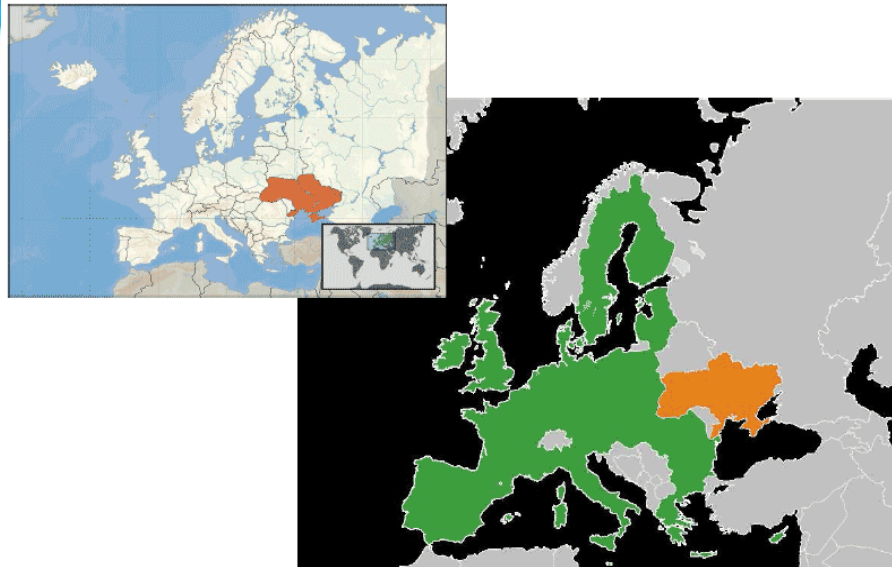


# Presentation Structure

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- Ukraine – general information
- Ukrainian MSW management and landfills
- LFG capture and utilization potential
- M2M/GMI projects
  - Landfill gas assessment (Chernivtsy, Mariupol)
  - Infrared heaters at Ukrainian landfills (Khmelnitskiy)
  - Ukrainian LFG model. Version 1.0
  - Recent field tests and lab measurements
- Full scale commercial LFG projects
  - JI projects (Mariupol landfills, etc.)
  - LFGE projects (Kiev landfill)
  - Other (Kharkiv landfill)
- Problems and prospects of LFG technology development in Ukraine
  - Technical
  - Political
  - Financial

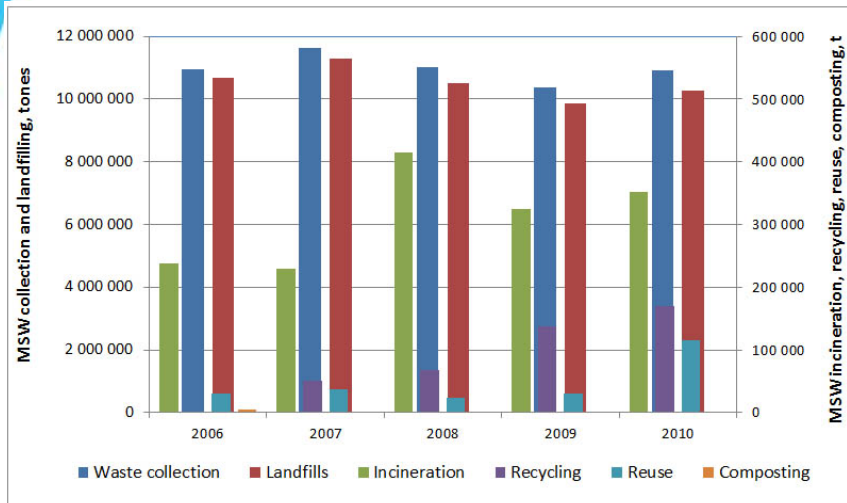
# Ukraine – General Information



- Population total – 46 mill
- Population urban – 31 mill
- Area – 603,700 km<sup>2</sup>
- Population density – 76 inh./km<sup>2</sup>
- MSW – 10-12 mill t/year

- Waste generation rate per capita per year is approximately 360 kg
- There are 4,500 landfills, normally one per settlement.
- Potential of landfill gas available for energy production is about 400 mill m<sup>3</sup>/year, equivalent to 0.21 mill toe or 6.0 mill t CO<sub>2</sub>

# Municipal Solid Waste Management in Ukraine



Municipal waste management in Ukraine is inefficient and in need of reforms:

- 96% of wastes are disposed at landfills and dumpsites
- 4% is incinerated, recycled or reused.

There are no industrial facilities for composting of organic domestic and green solid wastes.

- In accordance with National Inventory, 1990-2009 methane emissions from solid waste was:
  - 327 thousand tons in 1990
  - 415 thousand tons in 2009
- Waste sector is the only sector in the national inventory has shown an increase of GHG emissions in reported period.
- Solid Waste Disposal on Land (SWDL) is the most significant GHG source in waste sector in National GHG Inventory of Ukraine.

# Ukrainian Landfills and Waste Dumps

- There are **700** landfills located around the towns.
- No more than **50** of them can be considered as potential candidates for recovery and utilization of landfill gas.



Old landfills typically have:

- Steep slopes (due to up from bottom waste loading)
- Fire events
- Large working face with minimal cover
- Poor compaction (bulldozer)
- Leachate flooding



# Experimental studies of LFG generation

Before installation of full scale LFG collection systems, several feasibility studies and measurement programs were conducted at Ukrainian landfills in 2005-2010.

The objective was to refine the projections of the LFG model generation and recovery model based on LFG flow and methane concentration data.

The pump tests consisted of the installation of at least three vertical extraction wells, several monitoring probes, collection piping, and a blower powered by electricity.

Typical pump test duration was up to six weeks.



*Those studies were performed with the support of U.S. EPA Landfill Methane Outreach Program (LMOP), as a part of M2M/GMI, an international initiative to assist partner countries to reduce global methane emissions.*

# Ukrainian LFG Model. Version 1.0

$$Q_{CH_4} = \sum_{i=1}^n \sum_{j=0.1}^1 k \cdot L_0 \cdot \left[ \frac{M_i}{10} \right] \cdot e^{-ktij}$$



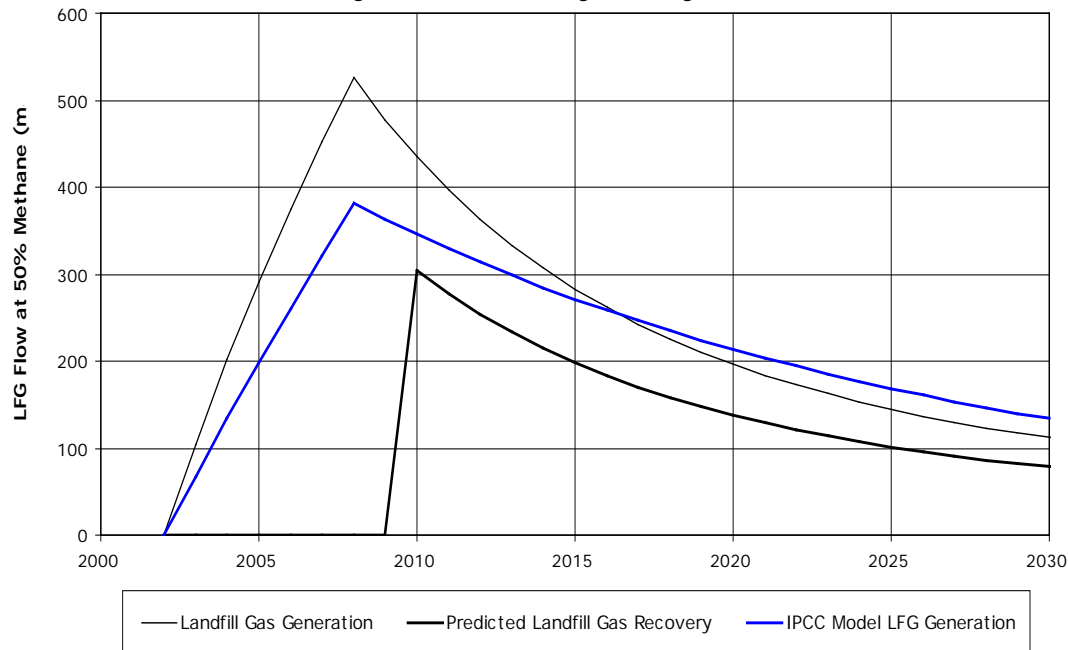
Precipitation (mm/yr)  
 Region 1: 360-429 (red)  
 Region 2: 430-499 (yellow)  
 Region 3: 500-599 (green)  
 Region 4: 600-699 (blue)

Waste Category:	L <sub>0</sub> Values (m <sup>3</sup> /Mg)
1. Food, Other Organics	69
2. Garden and Park Waste	126
3. Paper and Textiles	214
4. Wood, Rubber, Leather, Straw	201

Climate Region:	1	2	3	4
Annual Precipitation Range, mm:	360-429	430-499	500-599	600-699
Average Annual Precipitation:	389 mm	456 mm	558 mm	645 mm
Average 24-Hour Temp. (°C):	8.9	9.2	7.3	7.7
Waste Category:	Assigned k Values (1/year):			
1. Food, Other Organics	0.110	0.120	0.140	0.150
2. Garden and Park Waste	0.055	0.060	0.070	0.075
3. Paper and Textiles	0.022	0.024	0.028	0.030
4. Wood, Rubber, Leather, Straw	0.011	0.012	0.014	0.015

# Ukrainian LFG Model. Version 1.0

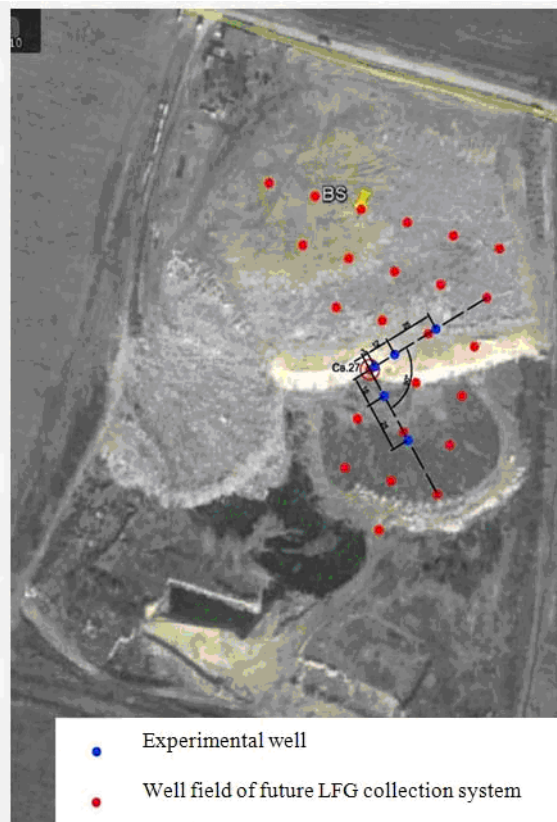
Landfill Gas Generation and Recovery Projection  
Sumy Landfill, Sumy, Sumy Oblast



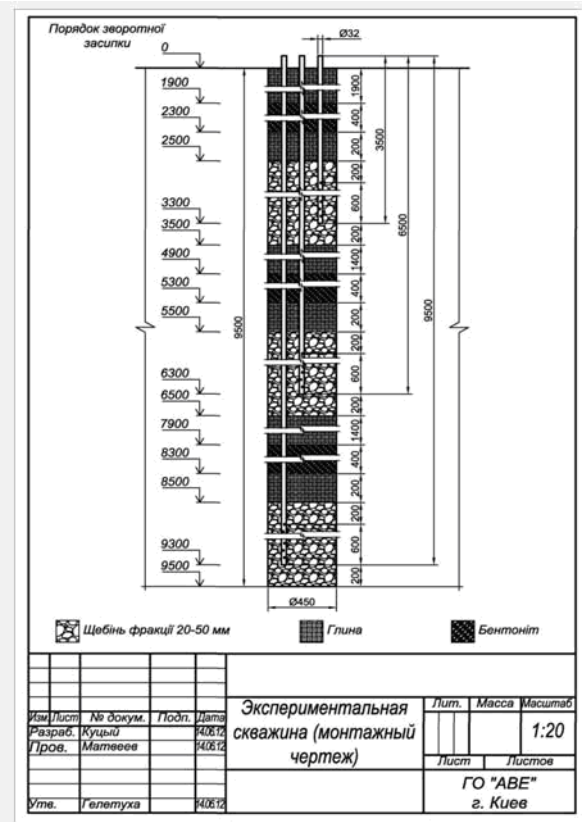
- Model accounts for fires by applying a “fire adjustment factor”
- Collection efficiency calculated by model based on site management practices, waste depth, well field coverage of waste area, soil cover type and extent, bottom liner, waste compaction, focused tip area, and presence of leachate



# Recent Field Tests and Laboratory Measurements



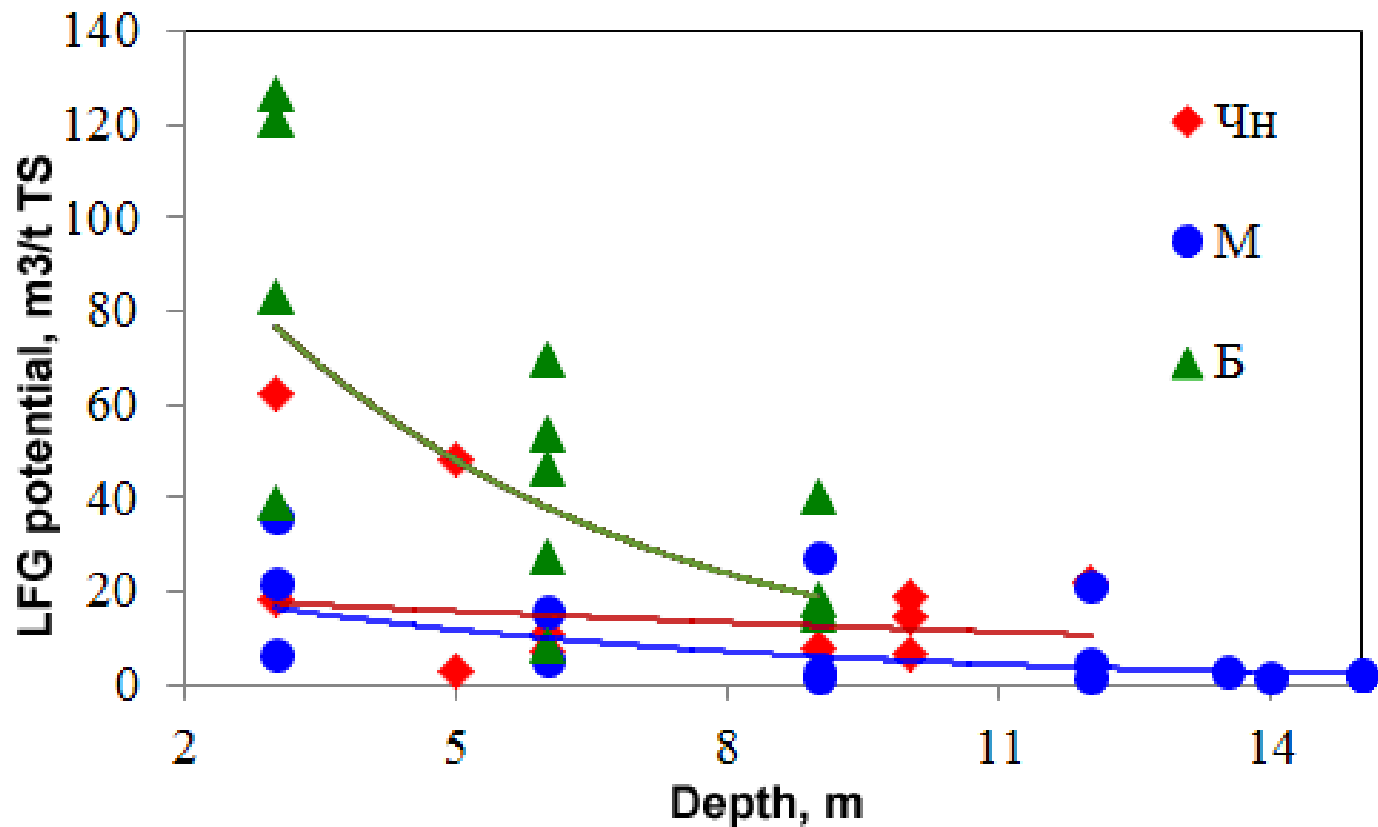
Borispol landfill general view



Experimental well setup

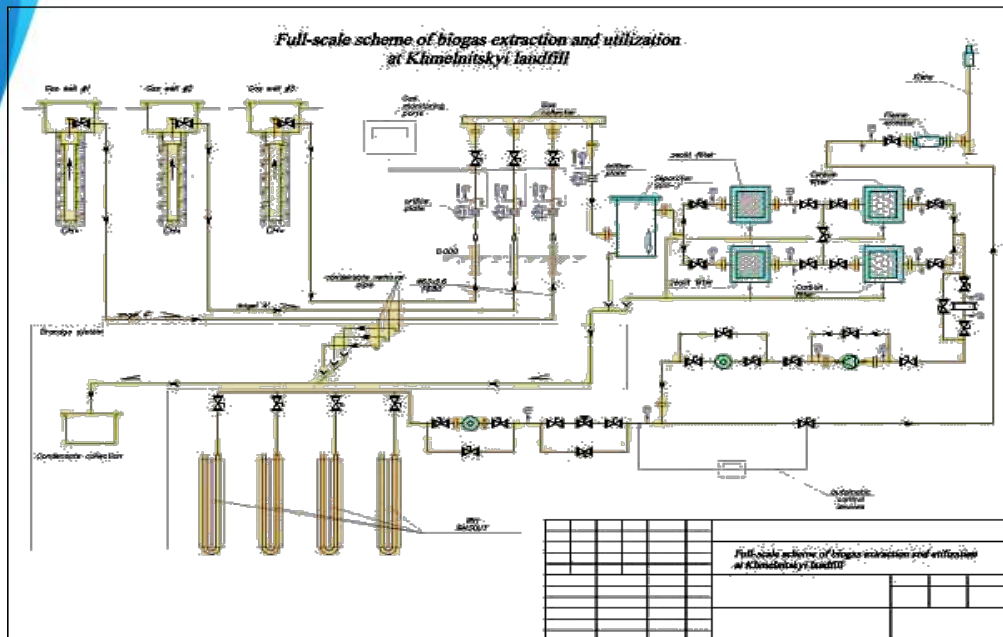
The GMI LFG Model could be further improved with comparison with field tests, laboratory measurements and actual LFG collection information that is now available

# Recent Field Tests and Laboratory Measurements



# GMI projects

## Infrared Heaters Based on LFG



Heated area – 2 x 126 m<sup>2</sup>

Type of IR-heater – *Roberts Gordon Black Heat U30*

Capacity – 30 kW

Number of heaters - 4



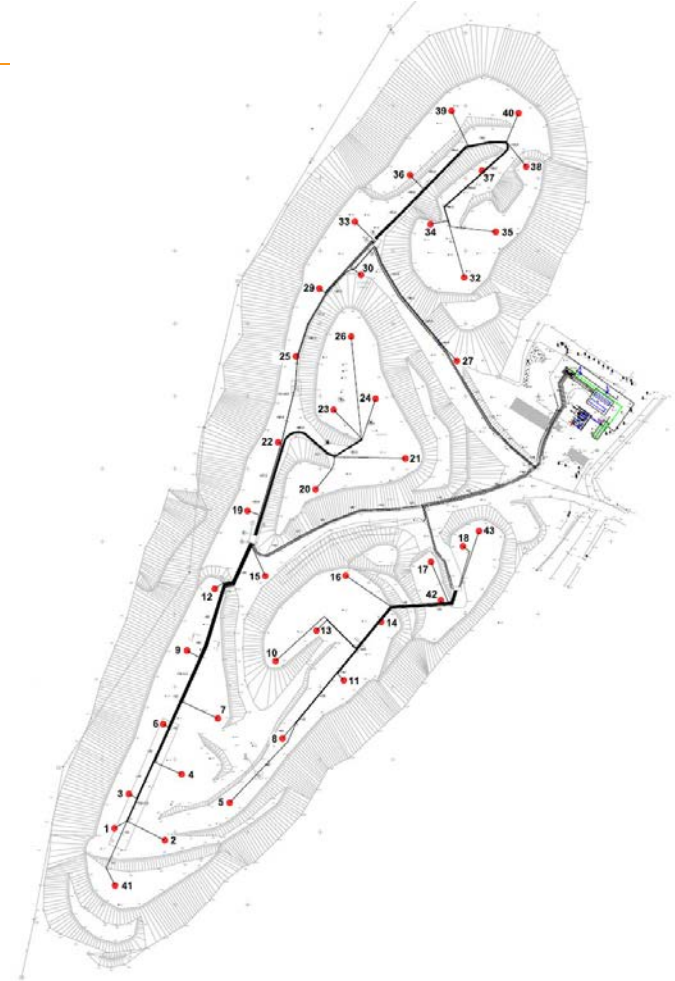


# LFG Project in Mariupol (Joint Implementation)



Population – 480,000  
Starting year – 1967/1976  
Closure – 2009/2011  
MSW – 120,000 tones/year  
Area – 12+12 hectares  
Depth – 30/20 meters  
Waste in place – 2.5+2.5 mill tones

52 wells,  
3 gas collection points,  
total piping – 6.4 km



Start up – February 2010  
Stage 1 – flaring at Hofstetter  
HOFGAS® – Ready 800



# LFG project in Mariupol Landfill #1 - construction



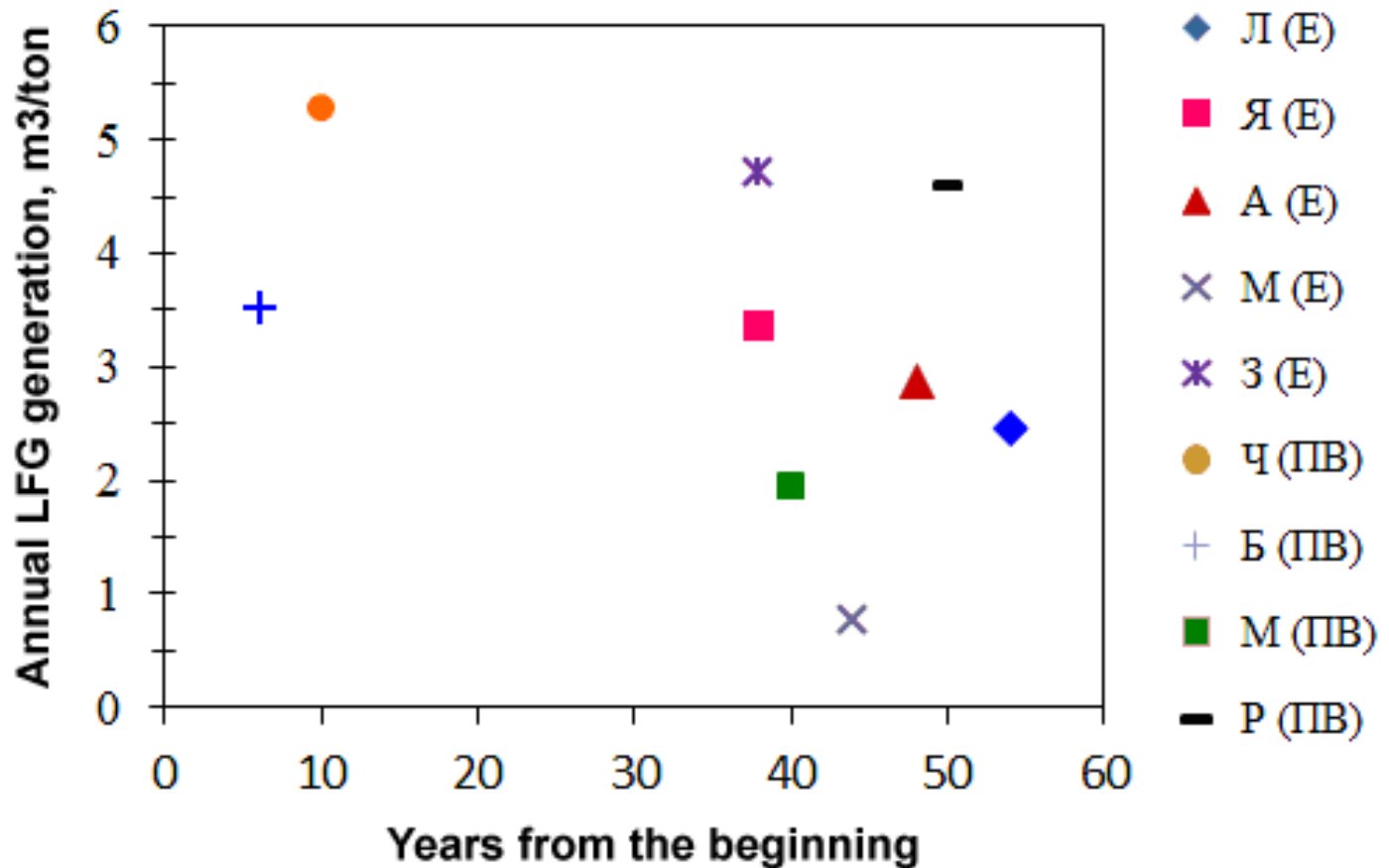


# Joint Implementation Projects at Ukrainian Landfills

Landfill name/ Project location	Project type	2008	2009	2010
Yalta	JI/Flare	0,698	28,540	23,933
Alushta	JI/Flare	2,373	16,821	16,095
Mariupol – 1	JI/Flare/ CHP	-	-	10,050
Kremenchug	JI/Flare	-	-	-
Lviv	JI/Flare	-	-	-
Lugansk	JI/Flare	-	-	-



# Joint Implementation Projects at Ukrainian Landfills



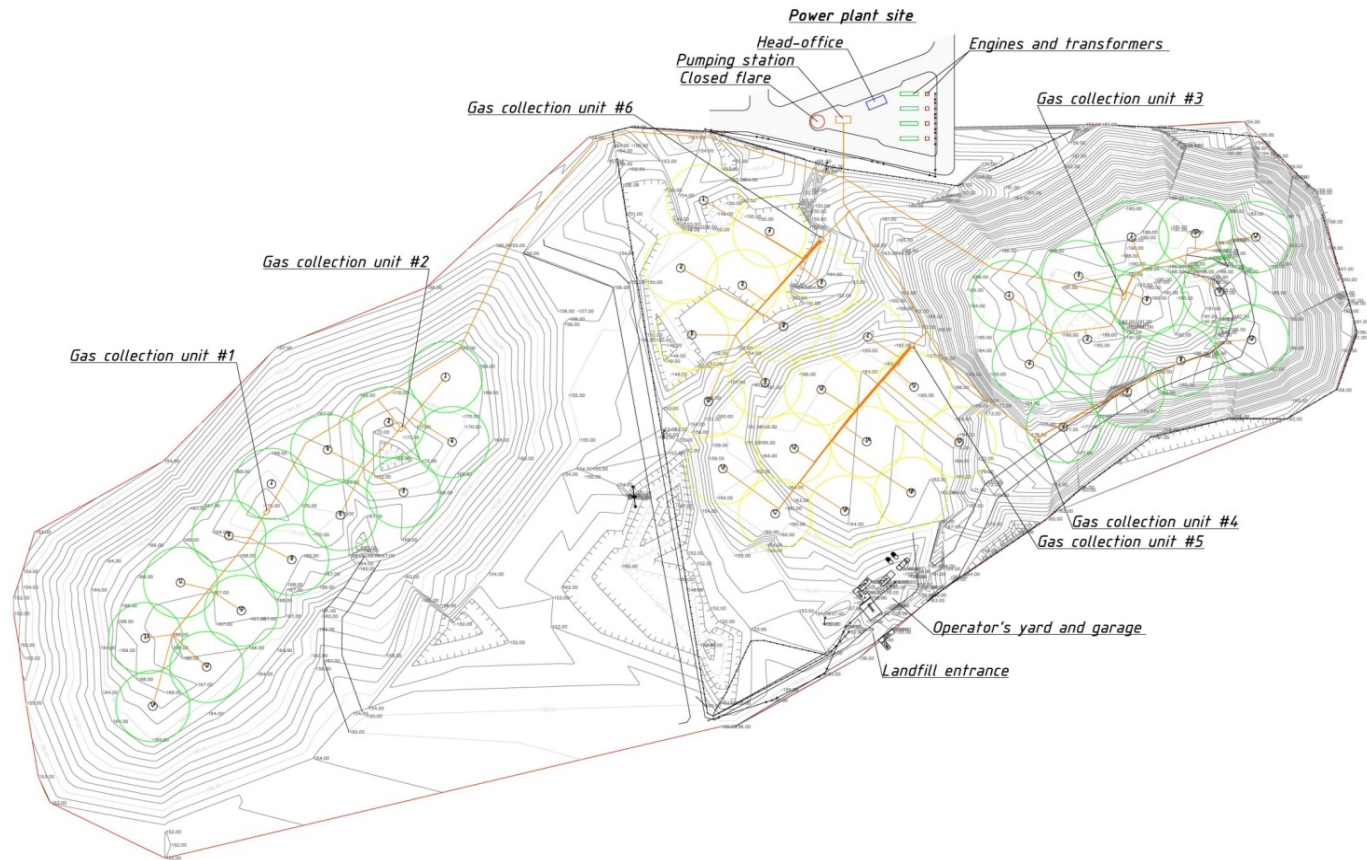
# LFG-Energy Projects in Ukraine



Kiev landfill #5  
Start up – April 2012  
Electrical capacity – 5 x 180 kW

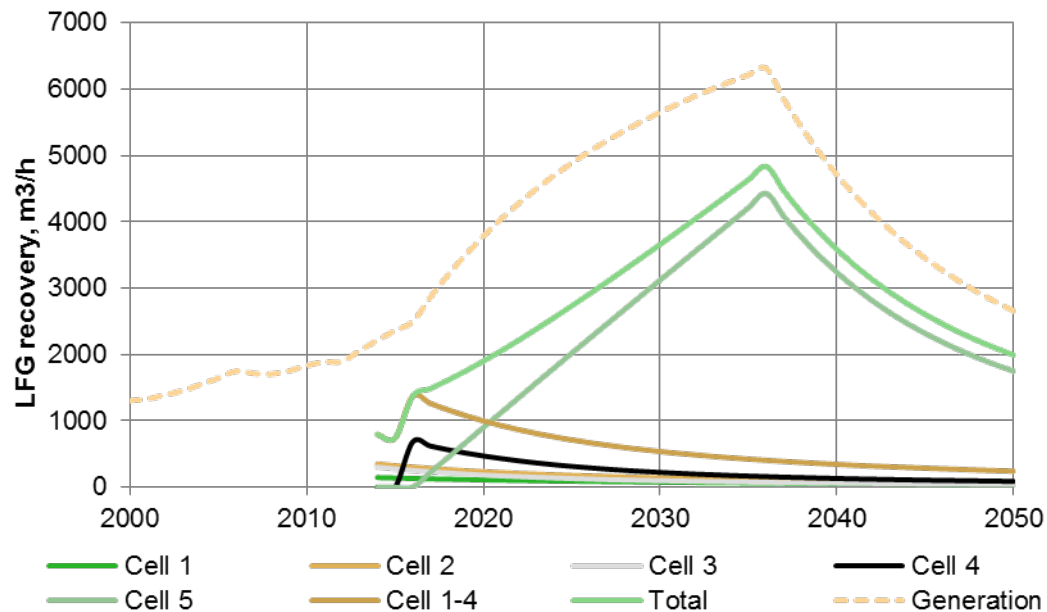


# LFG-Energy Projects in Ukraine



Kharkiv landfill  
Start up – ?  
Electrical capacity – 1.3 MW (in 2014) - 5.0 MW (in 2025)

# LFG-Energy Projects in Ukraine



Kharkiv landfill LFG projection



# Problems of LFG Technology Development in Ukraine

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- Key point - financial conditions and level of interest of the owner/operator of the landfill site
- Low waste management tariffs. Co-financing from owners (municipalities) and operators can not be expected
- Procurement of reasonable financing can be a challenge in addition to declining prices for greenhouse gas credits
- Local design and construction rules and standards do not always support progressive engineering solutions at landfills and should be significantly improved
- Poor conditions and a lack of reliable technical data at some landfills limit feasibility of potential LFG projects

# Prospects of LFG Technology Development in Ukraine

- Previously, LFG projects at old landfills could not be implemented without Kyoto Protocol
- Today LFG-Energy projects are supported by Green Tariffs
  - 0,13 - 0,15 Euro/kWh
- The main opportunities for LFG projects are at towns with populations greater than 200,000 – 33 towns
- Implementation of new regional landfill strategy and closure of old landfills will stimulate LFG project development
- The usual method of LFG utilization is power generation by IC-engines
- Conditions that would improve LFG project development:
  - Increased natural gas prices
  - Government support of green tariffs for electricity, taxes, and custom exemptions, etc.
  - Construction of new landfills and improved operation

# Thank You (Спасибо) for Your Attention

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