

# *Landfill Methane Utilization Opportunities in Ukraine*

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## Ukraine – general information

- 48 millions inhabitants
- 60% - urban population

	City	Group	Population	Waste per capita	Total annual waste
				t/year	t
1	<b>Kyiv</b>	<b>the largest</b>	<b>2 642 000</b>	<b>0,275</b>	<b>726 550</b>
2	<b>Kharkiv</b>	<b>the largest</b>	<b>1 621 600</b>	<b>0,275</b>	<b>445 940</b>
3	<b>Dnipropetrovs'k</b>	<b>the largest</b>	<b>1 189 900</b>	<b>0,275</b>	<b>327 223</b>
4	Donets'k	the largest	1 121 400	0,290	325 206
5	<b>Odessa</b>	<b>the largest</b>	<b>1 095 800</b>	<b>0,290</b>	<b>317 782</b>
6	Zaporizhzhia	large	897 600	0,300	269 280
7	<b>L'viv</b>	<b>large</b>	<b>807 300</b>	<b>0,300</b>	<b>242 190</b>
8	Kryvyi Rih	large	729 400	0,300	218 820
9	Mariupol'	large	522 900	0,300	156 870
10	Mykolaiv	large	515 400	0,300	154 620
11	<b>Luhans'k</b>	<b>large</b>	<b>505 100</b>	<b>0,300</b>	<b>151 530</b>
12	Makiivka	big	425 600	0,300	127 680
13	Vinnytsia	big	384 400	0,300	115 320
14	Sevastopol'	big	371 400	0,300	111 420
15	Kherson	big	368 300	0,300	110 490
16	Simferopol'	big	357 000	0,300	107 100
17	Horlivka	big	336 100	0,300	100 830
18	<b>Poltava</b>	<b>big</b>	<b>323 600</b>	<b>0,300</b>	<b>97 080</b>
19	<b>Chernihiv</b>	<b>big</b>	<b>310 500</b>	<b>0,300</b>	<b>93 150</b>
20	Cherkasy	big	307 600	0,300	92 280



## Landfill gas potential



Ukrainian towns generate **10 mln tones** of MSW.

More than **90%** of MSW is disposed at the landfills. There are **700** landfills located around the towns.

Only **140** of them can be considered as suitable for extraction and utilization of landfill gas.

**90** biggest landfills contain **30%** of MSW total amount.

Based on this facts, potential of landfill gas available for energy production comes to about **400 mill m<sup>3</sup>/year** that is equivalent to **0.21 mill toe**.



## Landfill sites



- Kyiv (Kiev)
- Kharkiv (Khar'kov)
- Dnipropetrovs'k (Dnepropetrovsk)
- Odesa (Odessa)
- Chernigov (Chernihiv)

- L'viv (Lvov)
- Luhans'k (Lugansk)
- Poltava
- Khmel'nitskiy
- Bila Tserkva (Belaya Tserkov')

## Landfill sites - summary

Town	MSW acceptance rate	MSW in place	Area,	Depth	Start year	Project	CO <sub>2</sub> reduction	Project cost
	th. tons/yr	mln tons	hectare	m			t CO <sub>2e</sub> /yr	Mln Euro
Lviv	230	8,4	33,3	35	1959	4,5 MW <sub>e</sub>	160,000	4,5-6,8
Odessa	150	2,3 (5,3)	11,7 (30)	22-25	1972	4-6 MW <sub>th</sub>	65,000	1,1
Poltava	90-100	6,2	14,7	30-35	1974	2,0 MW <sub>e</sub>	75,000	2,0-3,0
Chernihiv	105	4,0	24,6	10-20	1961	2,0 MW <sub>e</sub>	90,000	2,3-3,0
Lugansk	75	1,7	8,0	20-25	1979	1,5 MW <sub>e</sub>	54,000	1,5-2,2
Khmelnitskiy	70	2,7	17,4	20-30	1953	1,5 MW <sub>e</sub>	60,000	1,7-2,3



## Kiev landfill



- Kiev population – 2,642,000
- Time since landfill opened - 1986
- Average annual waste acceptance rate, cub. M – 2,000,000
- Area, hectares – 35,5
- Depth, m – up to 20
- Current MSW in place (mln tons) –7.5

- Location - 40 km from Kiev
- heat/power consumers within 3-4 km - no



## Odessa landfill

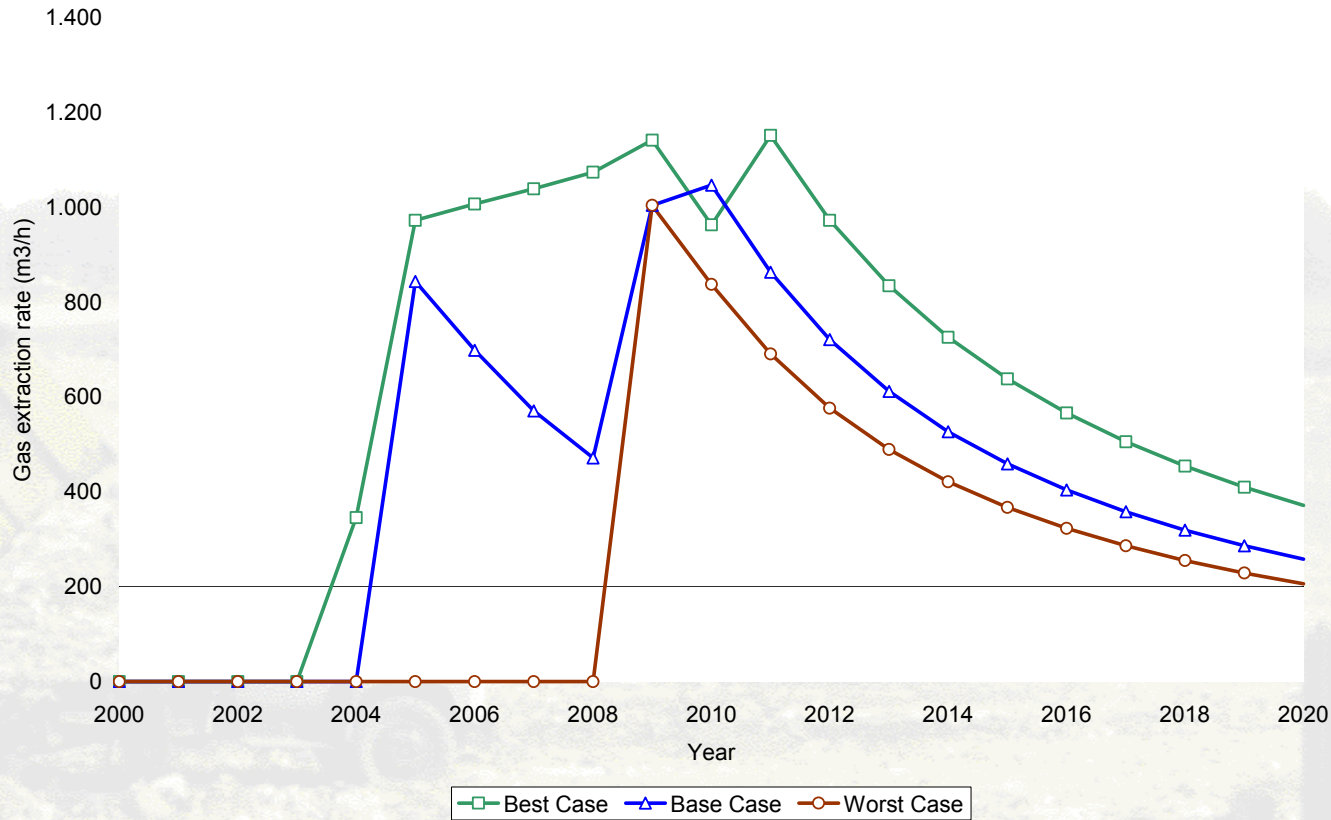


- Odessa population – 1,096,000
- Time since landfill opened - 1972
- Average annual waste acceptance rate, – 1,000,000 m<sup>3</sup>
- Area, hectares – 11.7 (30)
- Depth, m – 22 - 25
- Current MSW in place (mln tons) –2.3 (5.3)

- Waste composition (construction debris in %) – 15
- Location – in town
- Big cement factory nearby



## Odessa landfill



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Net amount of Landfill gas extracted	0	4.631.040	6.089.611	6.529.903	6.933.094	7.884.000	7.884.000	7.718.587	6.533.011	5.615.679	4.893.388
CO2 reduced through CH4 extraction	0	41.838	55.015	58.992	62.635	71.226	71.226	69.731	59.021	50.733	44.208
Total amount of NG gas eq. utilised	0	2.322.000	3.054.000	3.275.000	3.477.000	3.954.000	3.954.000	3.871.000	3.276.000	2.816.000	2.454.000
CO2 reduction through fossil fuel replacement	0	4.364	5.740	6.155	6.534	7.431	7.431	7.275	6.157	5.292	4.612



## Odessa landfill

The neighbor cement works nearby can be heat consumer. The natural gas consumption of the company for industrial needs is approximately 5 million m<sup>3</sup> per month, including heat-only-boiler, which consumes approx. 170 000 m<sup>3</sup> per month during winter.



Investment			
Total initial investment	971.619	Euro	
CO2 credits up-front financing	50%	Of CO2 credits value	
Investment subsidy	0	Euro	
Net initial investment	455.487	Euro	
Process equipment investment	688.283	Euro	
Equity/debt ratio	50%		
Equity investment	227.743	Euro	
Loan	227.743	Euro	rate
Depreciation	6,70%	Linear	period
Discount rate	8%		
Profit tax	30%		



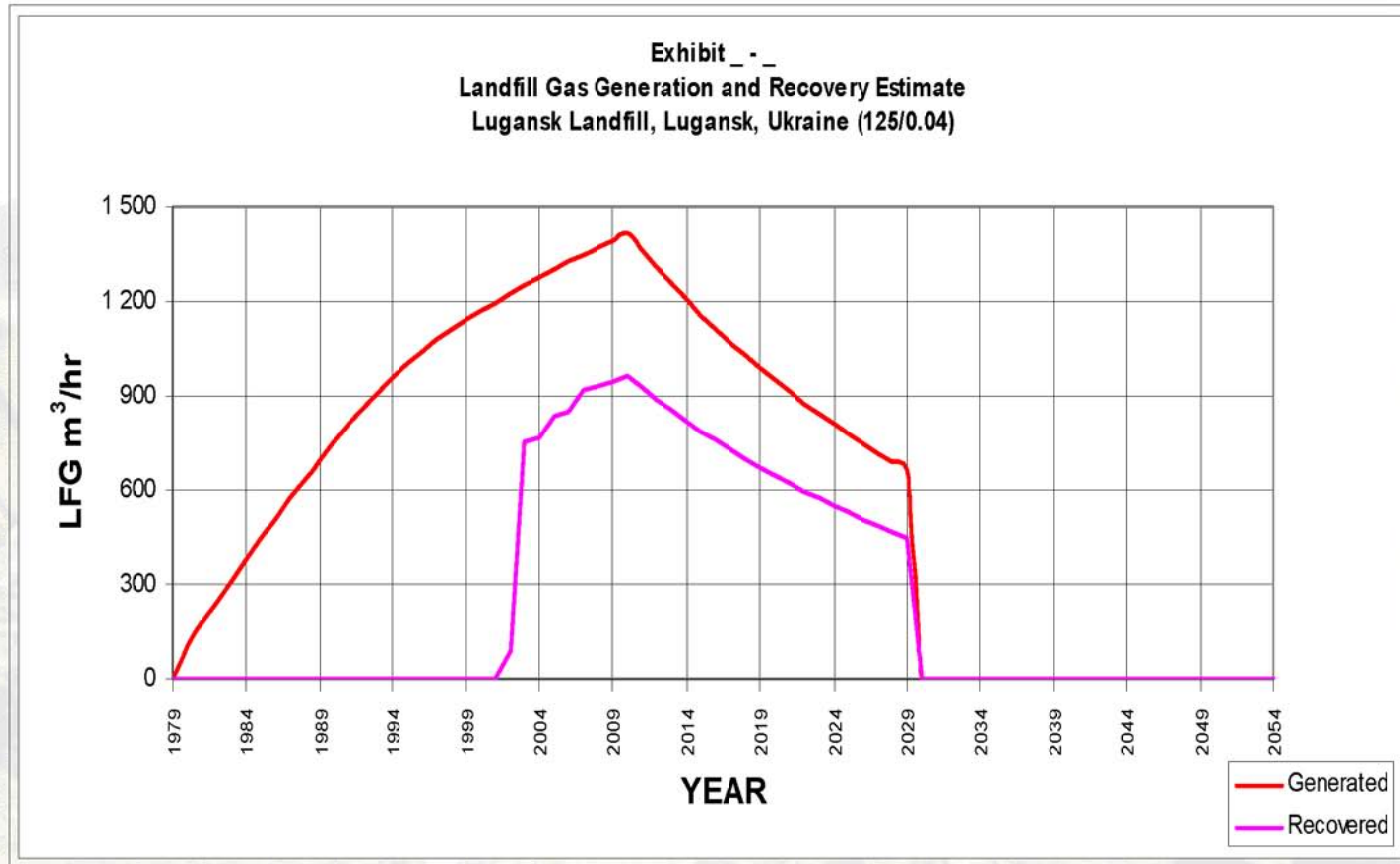
## Lugansk landfill



- Lugansk population – 505,000
- Time since landfill opened - 1979
- Average annual waste acceptance rate, cub. M – 300,000 – 350,000
- Area, hectares – 8
- Depth, m – 20 - 25
- Current MSW in place (mln tons) –1.6
- Waste composition (construction debris in %) – 15
- Location - 25 km from Lugansk
- heat/power consumers within 3-4 km – town of Alexandrovsk



# Lugansk landfill



70,000 t CO<sub>2</sub>-eq./a



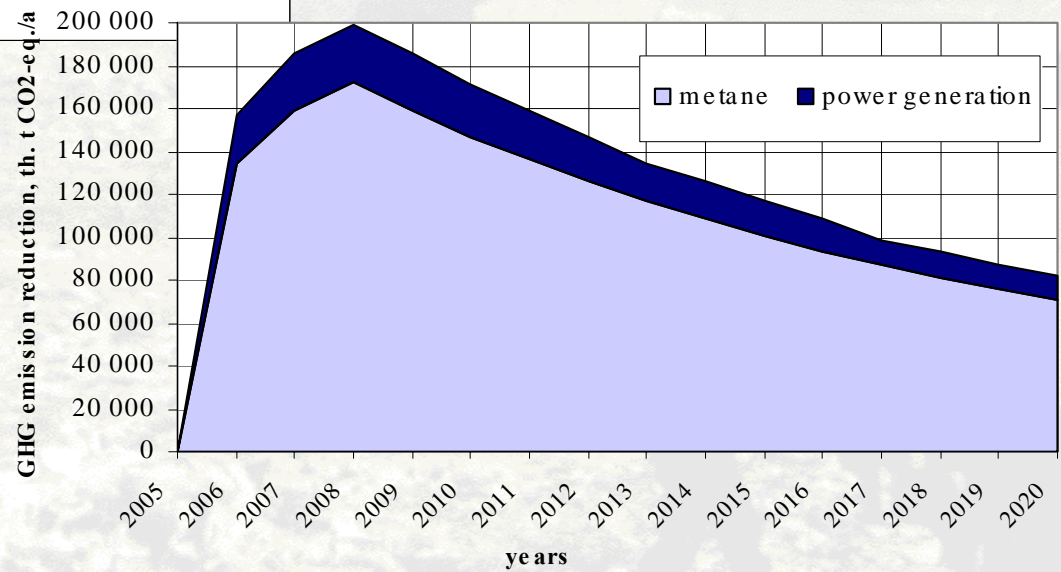
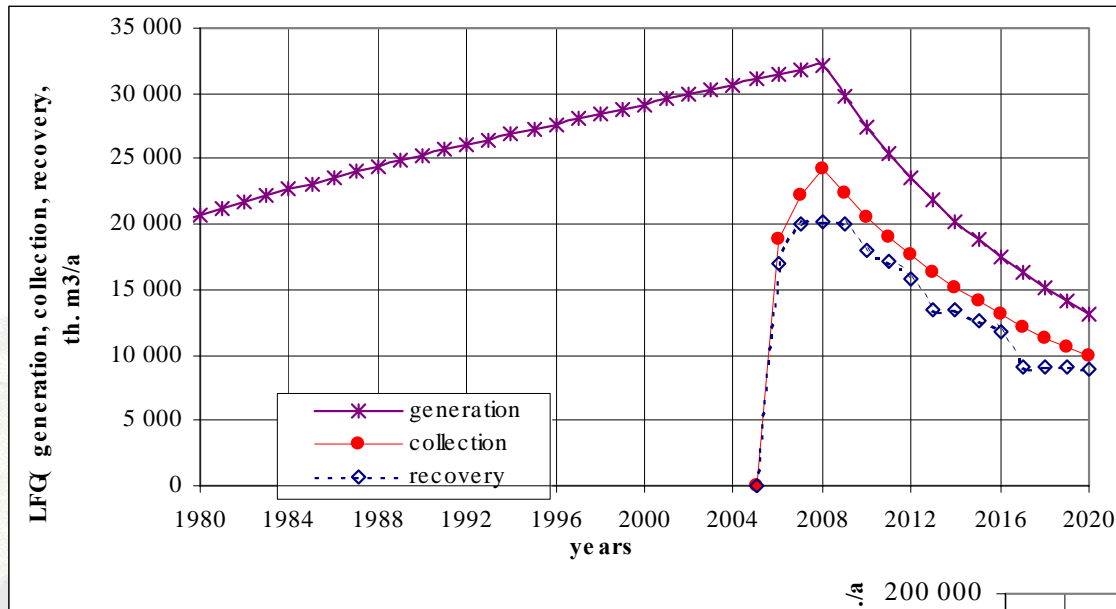
## Lvov landfill



- Lvov – 807,000 inhabitants
  - Time since landfill opened - 1959
  - Average annual waste acceptance rate, cub. M – 900,000
  - Area, hectares – 33,3
  - Depth, m – 35
  - Current MSW in place (mln tons) –8.4
- 
- Waste composition (construction debris in %) – 20
  - Location - 1 km from town



## Lvov landfill





## Belaya Tserkov' landfill



- Belaya Tserkov' population – 208.000
- Time since landfill opened - 1940
- Average annual waste acceptance rate, cub. M – 170,000
- Area, hectares – 10.7
- Depth, m – 10-20
- Current MSW in place (mln tons) – 2.0
- Waste composition (construction debris in %) – 20
- Location – 1.5 km from town
- heat/power consumers within 3-4 km – DH company



# Thank you for your attention

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