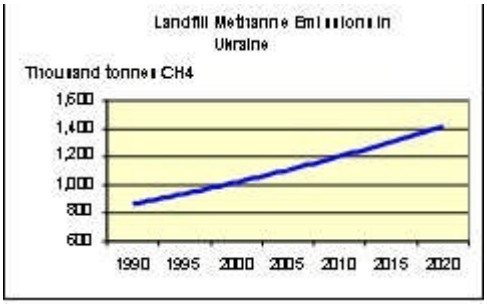
Landfill Gas Recovery and Utilization in Ukraine

Landfills are the preferred method for treating Municipal Solid Waste (MSW) in Ukraine - about 96% of all MSW is disposed in landfills and dumpsites. The organic component of the MSW decomposes under anaerobic conditions in landfills and generates landfill gas (LFG) with a 50% content of methane, which emits to the atmosphere, thus contributing to the global warming effect. Many Ukrainian landfills represent the uncontrolled open-air dumps operated without any environmental protection measures and this uncontrolled release of the LFG increases risk of fire and explosion at the landfill site. Traditionally each Ukrainian city has at least one landfill, and there are about 100 cities with population above 50,000 inhabitants, 26 of them are Oblast (Region) centres. Since methane has a Global Warming Potential 23x that of CO_2, reducing emissions by capturing LFG and using it as an energy source can yield substantial energy, economic and environmental benefits. All municipalities in Ukraine are facing growing financial pressures, and are assuming more and more fiscal responsibilities as the central government passes more responsibilities down to the local levels of government. Additional sources of revenue must be found if municipal governments are expected to meet their financial obligations and continue to provide essential services to the citizens. LFG recovery and utilization projects will allow to municipalities throughout the country to reduce their energy expenses and obtain revenue from generating and selling electricity or selling medium Btu fuel to local industry or district heating companies, as well as revenue from additional tipping fees and sale of GHG credits.

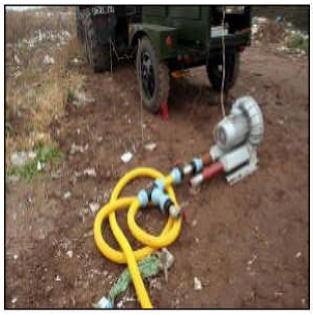


LFG projects can provide municipalities in Ukraine with a reliable source of income by turning existing landfills (i.e., liabilities) into revenue producing assets for years to come.

LFG Project at Chernighiv Landfill Provides 33% Rate of Return

Background - E^3 staff was responsible for the development and implementation of an LFG project at the Chernighiv Oblast landfill. An installation of nested probes for a baro-pneumatic test was done in November 2006 in the west-North part of the Chernighiv landfill using seven existing wells, to determine waste condition, leachate level and methane concentration. Barometric pressure tests were conducted at depths between 3 meters and the leachate level. The baro-pneumatic data collection procedure included continuous recording of baro-pneumatic pressure data over a 4-day period and a vapor extraction pump test, which consisted of pumping the extraction well with a portable compressor and monitoring the pumping rate, atmospheric pressure, pressure in the extraction well, and pressures in the nearby gas monitoring wells. Overall, the results of the analysis show that gas permeabilities are relatively high, and a significant amount of surface leakage was observed, which is consistent with no cover soil on the Chernigiv landfill. The vertical gas permeabilities are high enough to indicate that little barrier to vertical flow exists in the landfill, and conditions for LFG are quite good.

Equipment used in Field Data Collection



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Project Design - The project concept is based on the assumption that a gas engine operates on landfill gas in a cogeneration mode, supplying almost equal amount of electric and thermal energy (1403 kW electric and 1422 kW thermal) according to design specifications. Two options for waste heat utilization are considered – a) thermal energy is utilized on-site at the landfill; and, b) the thermal energy is utilized in the municipal heating system via a local boiler room. Economic benefits of the project include two components – a) direct revenue and savings from utilization of LFG as a fuel in the gas engines to generate and sell electricity to the grid, and use of waste heat from the engines to reduce natural gas consumption currently used in the production of thermal energy in the nearby local boiler house; and b) revenues from sale of carbon credits on the GHG market.

Project Results - The Chernighiv landfill is capable of generating between 5,382 and 5,641 Mg/yr of LFG, with a total estimated methane generation of 27,561 Mg over the remaining 5 year life of the landfill, if the landfill was covered and brought to the conditions required by the normal landfill operations. Technical actions necessary for project implementation include:

- Cover the landfill space. Such a cover should be recommended in any case as a typical measure for the landfill operation. It can help to prevent fires and will reduce or eliminate fugitive emissions of LFG.
- Install LFG collection system that will include flaring system and instrumentation for gas flow measurement.
- Install gas cleaning, dehumidification, temporary storage and pumping system.
- Installation of the engine, waste heat recovery system, and interconnection to the local electric grid.

Total Capital Investment

Total capital investment for implementation of the project is:

Landfill Cover and LFG Collection System	$768,000
LFG Preparation and Supply System	$816,000
Delivered JMC 420 GS – LL with heat recovery	$1,654,400
Installation Cost	$500,000
Total Installed Cost	**$3,738,400**

Electricity and Thermal Energy Generation

The tariff for electricity sold by the enterprise to the grid from the cogeneration system is 37.03 UAH/kWh ($7.406 cent/kWh), and net electricity sales to the grid (gross generation less parasitic loads and internal consumption) is 1,403 kW. Therefore, revenue from generation of electricity on-site will consist of 1,403 kW/hr x $0.07403 = $103.86/hr or $830,913/year (at 8000 hr/year). Thermal energy generated by the cogeneration plant will be sold to the local municipality replacing heat generated by boilers in the boiler room. The genset is generating 1,422 kWh of thermal energy per hour (1,223,516 Kcal). Assuming the average efficiency of the municipal boiler room as 80% (fuel energy input vs. energy content at the boiler room output), and cost of the natural gas for industrial customers at 1132 UAH ($226.4 USD) per 1000 scm, the cost of fuel replaced by the thermal output of Jenbacher will consist of $38.49 USD per hour or $307,920/year (at 8000 hr/year). Therefore, total annual revenues from the sale of electrical and thermal energy from the system are estimated at $1,138,800/year

Financial Analysis

The results of the financial analysis indicate a very robust project with strong financial indicators – IRR of 33% and payback under 3 years.

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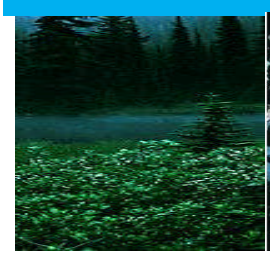

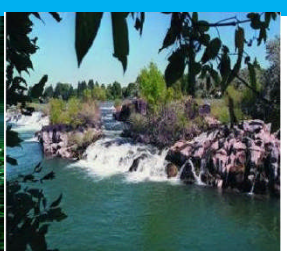

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