## GENERAL INFORMATION

| PETUS description of tool in use | |
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| **Name of the case** | **Municipal System for Biogas Extraction and Utilisation** |
| **Name of the tool** | **Multicriteria analysis (**Brown, Vence and Associates, Inc.) |
| **Country** | Bulgaria |
| **City / region**<br>Total area (km2)<br>Population<br>Density (people/km2) | Bourgas<br>512.2 sq. km<br>209 727 inhabitants (2002)<br>366.52 inhabitants/sq. km |
| **Tool user's profile**<br>a. Organisation name (municipality, NGO, national or regional department, company, etc.)<br>b. Field of activity<br>c. Detailed contact/feedback (project website, e-mail, address, tel., fax) | **Project Leader**<br>Municipality of Bourgas<br>26 Alexandrovska Str.<br>Bourgas, Bulgaria<br>Tel: +359-56-841-303/843-891<br>Fax: +359-56-841-303/841-368<br>Website: http://www.obstina-bourgas.org/uk/<br>E- mail: todorov@obstinab.bse.bg<br>Contact Person: Venelin D. Todorov, Deputy Mayor<br><br>**Project Partner**<br>Brown, Vence and Associates, Inc. (BVA)<br>*(Providing solid waste and energy management solutions to public and private sector)*<br>198 Cirby Way Suit 170<br>Roseville, California 95678 USA<br>Tel: 01-916-786-0600<br>Fax: 01-916-786-2438<br>Website: http://www.brownvence.com/<br>E- mail: mbrown@brownvence.com<br>Contact Person: Michael Brown, President |
| **Reviewer, date** | Aneta Markova, last update April 2005 |

**Short description of the case**

The case study presents a municipal approach to finding an appropriate solution for the treatment of organic household waste during the implementation of the National Waste Management Program (adopted in 1999). The problem identified in Bourgas municipality in mid 1990s concerned the fact that the existing municipal landfill was already filled up and the emergence of ecological and health problems was reported (soil and water pollution in a protected area nearby caused by inadequate treatment of the household waste in the existing landfill). In parallel with the construction of a new landfill local authorities tried an approach not traditional for Bulgarian practice to deal with the existing waste problem. The project (initiator: Municipality of Bourgas; partners: local NGO *Greener Bourgas* and a consultancy company; funded by *Ecolinks* Programme, USAID) aimed at the implementation of economically effective and environmentally acceptable system for biogas extraction and utilisation. A comprehensive methodology was applied to assess the social, ecological and economic aspects of various options for biogas capture and conversion. An assessment of the potential markets for the recovered energy, an analysis of the different technologies to convert biogas into marketable products and a review of the institutional context including ownership issues and facility operations. The project was a pilot one for Bulgaria and the experience was expected to be applicable in similar cases in the country.

This case study is related to **'better management for the disposal of waste'** (PETUS important issue in waste sector)

| **Sector** | Waste | Energy | Water | Transport | Green/blue | Building & Land Use |
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| | **X** | | | | | |

| **Scale of project** | Component | Building | Neighbourhood | City | Region |
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| | | | | | **X** |
| **Status of project** | Starting up | Ongoing | Finished | Start date | End date (exp.) |
| | | **X** | | 2000 | |

| **Key words**<br>*biogas, waste treatment, landfill, energy* | |
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| **Project** | |
| **a.** Object (building, city park, wind farm, etc.) | **a.** Biogas extraction system from municipal landfill |
| **b.** Type of activity (regeneration, renovation, new development, etc.) | **b.** New development |
| **c.** Type of product (plan, scheme, design project, etc.) | **c.** Design project |
| **Tool** | |
| **a.** Character (according to WP3final0704.doc) | **a.** Assessment method |
| **b.** Benchmarks (qualitative or quantitative) | **b.** Quantitative and qualitative benchmarks |
| **c.** Availability (paid/ free) | **c.** Paid tool |
| **Decision-making process** | |
| **a.** Stage of the tool implementation (preliminary, midterm, etc.) | **a.** Preliminary stage |
| **b.** Level (political, technical, etc.) | **b.** Technical level |
| **c.** Public participation | **c.** Public demonstration of the biogas extraction system |

**DETAILED INFORMATION**

| **A. Detailed description of project and tool** | |
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| **1. Description of context** (existing strategies, laws, policy, action plans, etc.): EU, national, regional, municipal | The analysis made by experts of Bulgarian Ministry of Environment and Water in 2000 outlines general strengths and weaknesses in the waste management sector in the country. In the report presented (National Strategy for the Environment and Action Plan 2000-2006) the implemented national, municipal and company programmes on waste management are considered relevant to EU legislation. Yet, some peculiarities of the local context have to be taken into consideration:<br>(i) The only currently applied waste treatment method in the country is landfilling.<br>(ii) There is no system of separate collection, packaging, recycling, etc. of municipal solid waste.<br>(iii) The municipal solid waste fees do not cover all the waste collection and disposal expenditures as required by legislation.<br>A number of key documents for the successful management of Bulgarian waste sector, treat the problems emerging:<br>▪ The *National Strategy for the Environment and Action Plan 2000-2006* traces three main groups of action for the improvement of waste management: (i) establishment of an integrated system of waste treatment facilities; (ii) establishment of operational mechanisms of the system for waste separate collection, recycling and reuse; (iii) considerable improvement of settlements' cleanness (20 actions with time limit and expected effects are envisaged).<br>▪ The *Law on the Reduction of the Harmful Impact of Waste upon the Environment (RHIWEA)* introduces a comprehensive approach to waste management for the first time in Bulgaria and transposes the requirements of |

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| | the EU Frame Directive on Waste (Directive 94/62/EC, 20 December 1994, on packaging and packaging waste).<br>▪ The *National Waste Management Programme* defines a number of objectives: treatment of waste with minimum risk for the public health and environment; establishment of an appropriate system of installations and facilities for integrated waste management; public participation and education programmes, etc.<br>▪ *Municipal Waste Management Programmes* have been adopted in each Bulgarian municipality following the methodological guidelines of the Ministry of Environment and Water (MoEW). The programmes are expected to facilitate problem-solving in waste management at the local level.<br>▪ *Company waste management programmes* are considered a useful instrument for both business companies (generating waste over a fixed quantity) and for the municipal administrations (providing a clearer view of the industrial, constructions and hazardous waste on the territory of the municipalities). The firms are obliged to prepare their waste management programs following methodological guidelines of the MOEW. |
| **2. Description of project**<br>**a.** Background (What caused the initiation of the project?; What was the problem? Who initiated the project?); | **a.** The Municipality of Bourgas initiated the project as a pilot for Bulgaria in January 2000. It was based on the Municipal Waste Management Programme (1998-2008). The Municipality jointly with Brown, Vence & Associates, Inc. (BVA, USA) investigated possible options for extracting and utilising landfill biogas from municipal landfill Bratovo, one of the few sanitary landfills in Bulgaria. Partial funding for the investigation was provided by Ecolinks, an USAID (United State Agency for International Development) initiative focused on finding market-based solutions to industrial and urban environmental problems in Central and Eastern Europe and the former Soviet Union. A local environmental NGO (Greener Bourgas Foundation) was also a project partner.<br>The partnership built between different levels (international, national and local) could be considered an innovative approach to integrate solutions of economic, social and environmental problems (local - pollution of the water resources around and global - Greenhouse Gases). |
| **b.** Objectives/aims (sustainability statement – what issues of sustainability were attacked); | **b.** The Municipality includes city of Bourgas which is the fourth largest in Bulgaria. Bratovo landfill opened in 1981 and is expected to reach its full capacity and close in 2007. *(Fig. 1)*<br>The landfill currently receives 60,000 tonnes of solid waste annually generated by households and industry in the region which has a population of 270,000 people. Landfill biogas (LBG) results from the decomposition of biological waste which is a component of general household waste.<br>The project aims to implement an efficient system for biogas extraction and utilisation from existing waste landfills. This utilises methane which results from municipal waste decay. Thus existing pollution is converted into useful source of electric and heating energy.<br>The following potential markets for energy recovered from LBG generated by Bratovo landfill were assessed: selling electricity to the National Energy Company (NEC), selling gas to the District Heating Plant, selling electricity or biogas to a neighbouring industrial facility, and selling compressed natural gas (CNG).<br>Several proposed options in the LBG utilisation project were all aimed at the installation of a LBG Collection and Monitoring System to help control methane emissions. The implementation of a landfill biogas system was expected to reduce methane emissions by 17 300-29 400 tons over a period of 20 years. |


***Fig.1.*** *City of Bourgas and existing landfill location*

**c.** Time interval and stages of project realisation;

**c.** The project was envisaged in four stages:

(i) Preliminary investigation – choosing a biogas extraction system among possible alternatives which included analysis of the existing biogas volume, market value of the product, opportunities for technical implementation and environmental impact;

(ii) Financial analysis of the construction process of the chosen system.

The conclusion drawn after the implementation of the two stages was that using the biogas for electricity production would be the most efficient alternative in this particular case. *(fig. 2)*

(iii) System construction – analysis of existing opportunities for financial support; technical testing of the biogas extraction system;

(iv) Exploitation.

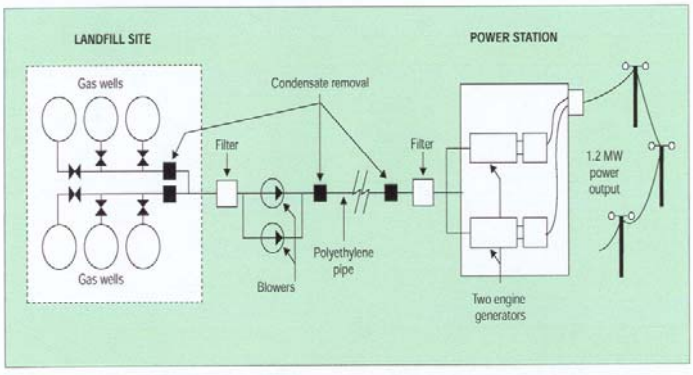


***Fig. 2*** *LBG Power Plant technology scheme*

**d.** Financing – amount, sources, institutions involved, partnerships, levels.

**d.** The project was financed by a USAID grant of US$ 50 000. According to the analysis presented, the project implementation would cost approximately US$ 3.2 million (6.4 million BGN). Three basic forms of financing were considered:

- public ownership and operation,
- public/private joint venture with private operation,
- private ownership and operation.

The municipality met major difficulties in finding financial sources and because of this, the project has not yet been realised

It was estimated that the implementation of the recommended project would need approximately 18 months. A strategic partner (investor) had to be selected at the very beginning of the process.

**e.** Other sectors involved in the particular project/problem

**e.** The project is linked to the energy sector by the possibilities for connecting to the local energy system or selling the electricity produced to a private customer,

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| (conflicts and/or links) | an electric transmission or distribution enterprise, or NEC. |
| **3. Description of tool**<br>**a.** Character (according to WP3final0704.doc) - calculation tools, process tools, assessment methods, generic tools, simulation tools, guidelines, framework tools, schemes, indicators and monitoring, checklists, case-specific tools; | **a. Multicriteria analysis** was applied to assess various social, ecological and economic aspects of biogas production and implementation:<br>▪ *Analyses of energy markets*<br>- Assessment of potential markets for the energy produced from LBG;<br>- Criteria for assessing different market opportunities: market reliability; delivery costs; pricing and price stability; unique requirements; ease/difficulty of contracting;<br>- Analysis of potential market options.<br>▪ *Identified quantities and characteristics of the biogas generated at Bratovo Landfill* - The amount and nature of biogas generated at the landfill were determined. Existing information on forecast methane production and accelerated biogas generation by using biological reaction methods was compiled (data on biogas production at the landfill including production forecasts to the year 2007).<br>▪ *Developed plans for LBG collection and destruction (burning) systems*<br>- Design and costs of LBG collection system;<br>- Destruction system design.<br>▪ *Reviewed technology options*<br>The list of criteria used to evaluate the options included: degree of demonstration in similar situations, reliability, O&M (operation and maintenance) requirements, emissions and efficiency.<br>- Conversion technology options and their commercial availability;<br>- Criteria for evaluating the options;<br>- Conversion option alternatives.<br>▪ *Economic analysis of alternatives* - assessing economic costs and benefits for a range of project alternatives.<br>▪ *Identified options for project financing and setting up institutional arrangements* – analysis of the organisational structure, technical and economic requirements, and alternatives for the development of a biogas utilisation enterprise at Bratovo landfill.<br>▪ *Assessment of the environmental impacts of selected alternatives* - analysis of environmental impacts of the project proposal.<br>▪ *Recommendations and action plan* - includes a time line and estimated costs of each task<br>The tool comprises a set of benchmarks (qualitative and quantitative) to assess LBG alternatives. The criteria used to develop the recommendations include: characteristics of available LBG supply, marketability of products, technical reliability of the installation, economic feasibility, ability to finance the project and environmental impacts. |
| **b.** Availability of the tool (web-based / paper, paid / free, etc.) | **b.** The tool could be purchased from BVA , USA. |
| **c.** Based on existing tool or newly elaborated; | **c.** The tool is based on an existing one (developed by BVA experts USA) |
| **d.** Adaptation of the tool to the local context (are there local experts involved in tool's development?) | **d.** Analyses were based on preliminary experience of BVCA experts. Local experts were not involved in the development of the project.<br>The tool used in this case study is an operational one. There is no information available on how the tool was adapted to the local context.<br>Experts used the national and international standards and data available in the municipality to develop the project. Consultations with NEC were carried out regarding opportunities for selling the electricity to be produced. |
| **e.** Other tools implemented to support the project development | **e.** Current and future levels of methane gas production at Bratovo landfill were estimated based on a 1995 feasibility study of a LBG project at Bratovo landfill by the Spanish consulting firm COGERSA and E-Plus computer program developed by USAID. |
| **B. Tool implementation** | |

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| **1. Argumentation for choosing the tool**<br>**a.** What were the reasons for the implementation of the tool? (voluntary or requested by what local, national, etc regulation) | **a.** The main reason for choosing the tool was to assist with the complexity of the interrelated problems and the need for a high-level expert evaluation of both biochemical processes and health issues. |
| **b.** Who took the initiative for choosing /elaboration the tool? | **b.** The Municipality of Bourgas and BVA (with the support of an EcoLinks Challenge Grant) collaborated to conduct an assessment of Bratovo landfill biogas emissions and review options for capturing the biogas or converting it into a useable energy resource. |
| **c.** What were the criteria for choosing the tool? | **c.** The tool is considered to be effective in meeting European standards for waste management, the requirements of the National Strategy for the Environment and Action Plan 2000-2006 (NSEAP) and Bourgas Municipal Programme for Waste Management (1998-2008). |
| **d.** Was there knowledge of other tools and were they considered? | **d.** The multicriteria approach applied was based on the experts' experience. There was no consideration given to the use of other tools concerning this problem. |
| **2. Barriers for the tool implementation**<br>What were the main problems in the tool implementation? (Regulation, information available, public awareness, lack of clear SD definitions and benchmarks, communication etc.) | The main problems concerned the lack of adaptation of the tool to the particular case and low availability of data in Bulgaria needed for the tool. |
| **C. Influence of the tool on the decision-making process** | |
| **1. Description of the decision-making process/ procedures**<br>**a.** Stages | **a.** The process comprises several steps: the Municipal Council has made the decision to develop the project; a partner search for development of the project; project development; project assessment by the Municipal Environmental Commission; final decision for the project implementation; monitoring of the system exploitation and efficiency. |
| **b.** Levels (political, technical, etc.) | **b.** The Municipal Environmental Commission employs experts to consider and discuss environmental project proposals. Their opinions are then reported to the Municipal Council that is to take a political decision. |
| **c.** Sources of information used during the dmp; | **c.** The assessment was based on information provided by E-Plus computer program which collected the database for the biogas production at Bratovo landfill. This program uses a first order decay function as a basis for calculating methane generation. The main inputs to the model were the quantities of annual waste disposal registered since the landfill opened in 1983 and a forecast of future waste disposal rates. |
| **d.** Who are the decision-makers? | **d.** Both experts and municipal politicians were involved in the decision-making process at different stages. |
| **e.** Who made the final decision for the project implementation? Was it political or technical decision? | **e.** The Municipal Council made the final political decision for the project implementation. |
| **2. Tool in decision-making process**<br>**a.** At what stage was the tool implemented? By whom? (experts, politicians, etc.) | **a.** The tool was implemented by experts at a preliminary project stage. |
| **b.** How did the tool output influence the process (added or skipped levels/stages in | **b.** The Multicriteria approach applied to assess the economic, environmental and social benefits provided opportunities for choosing the sustainable solution of using biogas. The decision taken for applying the utilisation system for biogas |

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| the existing decision-making process, etc.)? | extraction was a solution for solving the environmental problems whilst obtaining economic benefits. |
| **c.** Quantitative goals or benchmarks defined? (If YES, which – and what were they compared to?) | **c.**<br>**Environmental goals**<br>The biogas system implementation was expected to reduce greenhouse gas emissions, water and air pollution. Benchmarks used were consistent with national standards. The proposed 'LBG-to-electricity' Plant, reduced uncontrolled emissions of methane and carbon dioxide to the atmosphere, compared to a landfill without a conversion plant, where methane is released to the atmosphere.<br>**Economic goals**<br>The comparison of different system alternatives was based on expert-defined criteria. It was used to assess the project revenues from electricity sales. |
| **d.** Was the tool used to support argumentations? | **d.** The analysis outcomes provided the Municipality with arguments for searching for potential investments/investors in order to convert biogas into marketable product. |
| **3. Transparency of decision-making process**<br>**a.** How was the information of the dmp disseminated? - directly (decision makers – public) or indirectly (decision makers - NGO, PR company, etc. - public); sources of dissemination used (mass media, internet, brochure, etc.) | **a.** A workshop on LBG utilisation technologies in Bulgaria involving multiple parties - local and national government representatives, private enterprises, and media representatives, further expanded the knowledge regarding LBG conversion. Also, by convening these different parties, an implementation network was initiated for promoting the installation of an LBG conversion system at Bratovo Landfill and for encouraging LBG use in other parts of the region. |
| **b.** How was the public involved? | **b & c.** The municipality and BVA experts organised public demonstrations of principle approaches and results of biogas practical implementation during the project development in order to increase public awareness and commitment and to assess attitudes of different groups. |
| **c.** Was there a public discussion over the project and at what stage of the project development? | |
| **D. Expert assessment/analysis/comment of the tool effectiveness** | |
| **1. Assessment by tool users**<br>**a.** Were there measurable improvements as a result of the tool implementation? If YES, what? If no: why not? | **a.** As the project implementation is not finalised yet, it is difficult to fully assess the effectiveness of the tool applied in this case. |
| **b.** Were there any spun-off's or unintended consequences? | **b.** The consequences of implementing the multi-criteria analysis has been:<br>**Strengths** are related to the opportunity provided for linking a wide range of issues and fields of professional competence:<br>▪ local community health;<br>▪ environmental problems of the area;<br>▪ energy efficiency of using renewable energy sources;<br>▪ financial opportunities to turn biogas extraction into a self-supporting structure.<br>**Weaknesses**<br>No assessment is made of the influence of the planned facility on other urban infrastructure sectors. |
| **c.** General view on the tool? Lessons learned? | **c.** The experience of using the renewable energy source is valuable as an approach in respect of turning weaknesses into strengths. |
| **d.** Potentials for further use of the tool? | **d & e.** Other municipalities and landfill owners in Bulgaria and throughout Central and Eastern Europe can benefit from the range of LBG utilisation technologies evaluated at the Bratovo Landfill through this project. |
| **e.** Will the actors recommend it or use it in other cases - why | |

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| / why not? | |
| **2. Reviewer's assessment** of the tool (usefulness, sustainability relevance, who are the actors excluded? etc.) Suggestions and needs for further development of the tool | The tool covers environmental, economic and social aspects to develop the project for sustainable landfill management. The analyses explicitly stress economic benefits as answering the particular conditions in the country.<br>As a part of the municipal waste management policy the project should be consistent with the assessment of the whole municipal waste infrastructure – from collecting to recycling.<br>The tool was used only by experts; it was difficult for non-experts to assess expected outcomes.<br>Local experts should be more actively involved in the project in order to get the experience needed and to use their knowledge of the local context.<br>The social benefits could be more comprehensively considered.<br>'*When implementing an international partnership project, extra time should be allotted for work completion due to business cultural differences and language differences.*' (Venelin D. Todorov, Deputy Mayor, Municipality of Bourgas) |
| **E. Additional information on the case study available** | |
| Websites | **Municipality of Bourgas**<br>http://www.obstina-bourgas.org/uk/<br>**Ministry of Environment and Water**<br>http://www.moew.government.bg/index_e.html<br>**Executive Environment Agency**<br>http://nfp-bg.eionet.eu.int/ncesd/index.html<br>**GREENER BOURGAS Foundation**<br>http://www.greenbourgas.org<br>**Brown Vence & Associates Incorporated**<br>http://www.brownvence.com/basiclayout.html (information available about the project) |
| References *concerning the case but also the key words or problem* (papers, articles, reports, laws, etc.) | National Strategy for the Environment and Action Plan 2000-2006;<br>Municipal Waste Management Programme, Municipality of Bourgas;<br>National Waste Management Programme;<br>Landfill Biogas Extraction and Energy Utilisation System at the Bratovo Landfill in Bourgas, Bulgaria – final report (prepared by Municipality of Bourgas and Brown, Vence & Associates, March 2001) |
| Other sources (Interviews, conferences, discussions, etc.) | Interviews with**:**<br>**Venelin Todorov,** Deputy Mayor, Municipality of Bourgas *(March 2004)*<br>**Atanaska Nikolova**, Project manager, Greener Bourgas Foundation *(March 2004)*<br>**Roumiana Ilieva**, Head, Department of Municipal and Building Waste Management, Ministry of Environment and Waters *(March 2004)* |
| Contact details for further information | **Daniela Genova**<br>Email: eco_secretary@obstina-bourgas.org |