

# Assessment of Landfill Gas Recovery and Use in Bulgaria

Novi Sad 9<sup>th</sup> December 2010

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EnEffect - Bulgaria



# Center for Energy Efficiency EnEffect

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- Established 1992
- Founders – financial support of Battelle/PNNL (USA) in co-operation with the U.S. EPA, U.S. DOE and USAID
- Structure – CEE EnEffect – NGO, EnEffect Consult Ltd.,
- Networking – Secretariat of Municipal EE Network and of RENEUER
- Fund Manager - Bulgarian Energy Efficiency Fund
- Activities – EE and RES, audits, project development, financial engineering, Municipal Energy Planning

EnEffect 

# Current Situation in Bulgaria

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- Number of landfills – 57 (cities > 20000 inhabitants)
- Non-regulated dumps – 5135 in '2001 (3554 closed till 2004)
- Low level of separate collection of recyclable materials
- Low level of pre-treatment
- Most of old landfills (before 1997) are not erected properly
- Fast fill in of landfills

# Current Situation in Bulgaria

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## Legal Framework

- Fully harmonized with EU legislation

## Key documents

- Waste Management Act
- Ordinance No 8 for construction and operation of landfills
- National Waste Management Program 2009 - 2013

# Current Situation in Bulgaria

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## Legal Framework - Recent changes (2010)

- Full municipal responsibility
- Obligations on selection, erection, operation, closure, monitoring of landfill
- Preliminary activities for new LF 3 years before the close of existing one
- Monthly money transfers from the LF owner to Regional Inspection for future decommissioning
- Sanctions for usage of non-regulated dumps
- Disposal fee – 3 BGN/t; in 2014 35 BGN/t

# Current Situation in Bulgaria

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## By 2009

- All 56 regional landfills should have been completed
- Unfortunately only 26 built and not yet at full capacity
- Reason – not enough applications to ISPA
- As result available EU money went unused

# Current Situation in Bulgaria

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## 2010

- LF development has been accelerated
- Support to municipalities in preparation of 23 additional projects in amount of 220 mil. BGN for 2011
- Three opportunities for financing
  - Operational Program “Environment”
  - State budget money
  - EMEPA – former National Environment Protection Fund

# Current Situation in Bulgaria

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- **Requirements according to the “National Program for waste management 2009-2013**

1. Regional landfills – 145 mil. Euros
2. Sorting facilities - 150 mil. Euros
3. Reloading stations - 35 mil. Euros
4. Decommissioning of existing dumps – 148 mil. Euros
5. Liquidation of uncontrolled dumps – 5 mil. Euros
6. Installations for treatment sludge wastes – 26 mil. Euros
7. Installations for treatment of construction wastes – 20 mil. Euros

**TOTAL - 529 mil. Euros**



# Current Situation in Bulgaria

## Regional landfill Russe



# Current Situation in Bulgaria



**Regional landfill  
Sandanski**



**Regional landfill  
Madan**

# Current Situation in Bulgaria

In process of development



# Current Situation in Bulgaria

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- **The problems could not be solved only with EU financing (23 LF)**
- **Low potential of state and municipal budgets**
- **Solution**
  - Involvement of private sector, PPP
  - Survey of potential
  - Development of bankable projects

# General Approach For Landfill Resource Assessment

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- Determine landfill management practices
- Determine quantity of waste
- Determine LFG composition and extraction data
- Identify possible LFG end-users

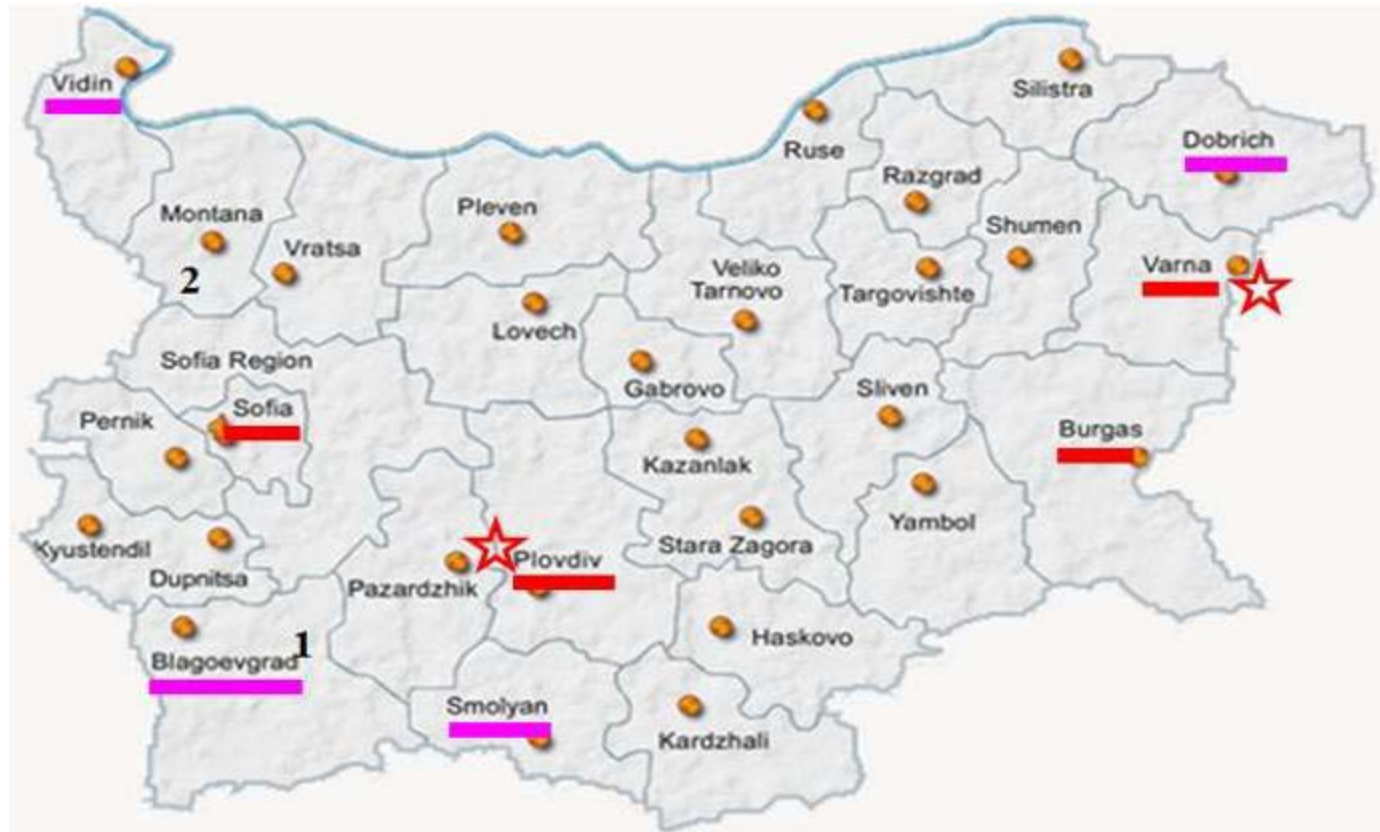
# US EPA Grant - Scope of Work

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- Survey and complete a resource assessment at selected landfills using the US EPA LandGem model
- Develop two business cases
- Design and install a website to track project status and provide results (*[www.eneffect.bg](http://www.eneffect.bg)*)

# Location of Selected Landfills

★ Business plans    — Modeling    — Potential



# Business Cases for LFG Recovery Projects

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- Two business cases were developed:
  - Tsalapitsa Landfill (Plovdiv)
  - Aksakovo/Varna Landfill
- Two financial strategies were analyzed:
  - Municipally owned and operated
  - Municipal concession to an Energy Service Company (ESCo)



# Aerial View of the Tsalapitsa Landfill



# Additional Views of the Tsalapitsa Landfill



# Tsalapitsa Landfill Characteristics

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- Operational since November 1999; currently accepts about 140,000 tons/year
- Serves three municipalities
- Maximum capacity of 3,434,648 m<sup>3</sup> in 12 cells, about a 10-year operational lifetime

# Tsalapitsa Landfill Characteristics

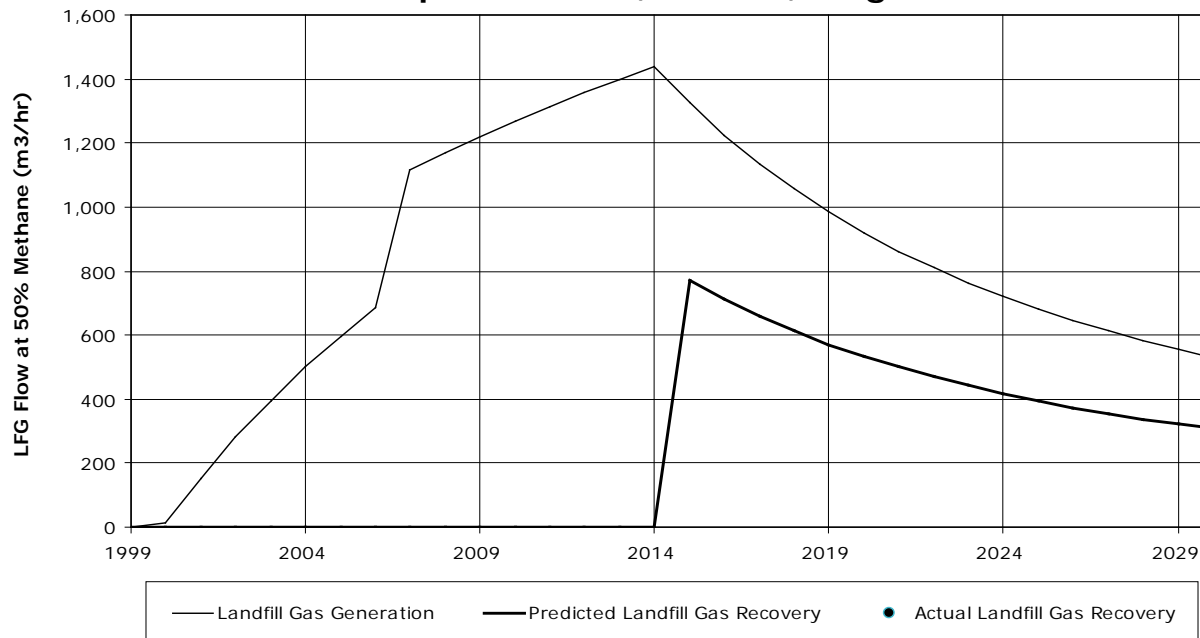
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- Leachate collection system of two collection ponds; no leachate recirculation system.
- Insulating foil to cover waste and shape the disposal facility.
- Two vertical gas capture wells in each of 12 cells
- Plans for reclamation and gas recovery

# LandGem Model Results

800 kilowatt gas generator used for 6,000 hours/year to produce electricity output of 4,800 megawatt-hours (MWh)

**Landfill Gas Generation and Recovery Projection  
Tsalapitsa landfill, Plovdiv, Bulgaria**



# Implementation of Gas Generator at Tsalapitsa Landfill (Plovdiv)

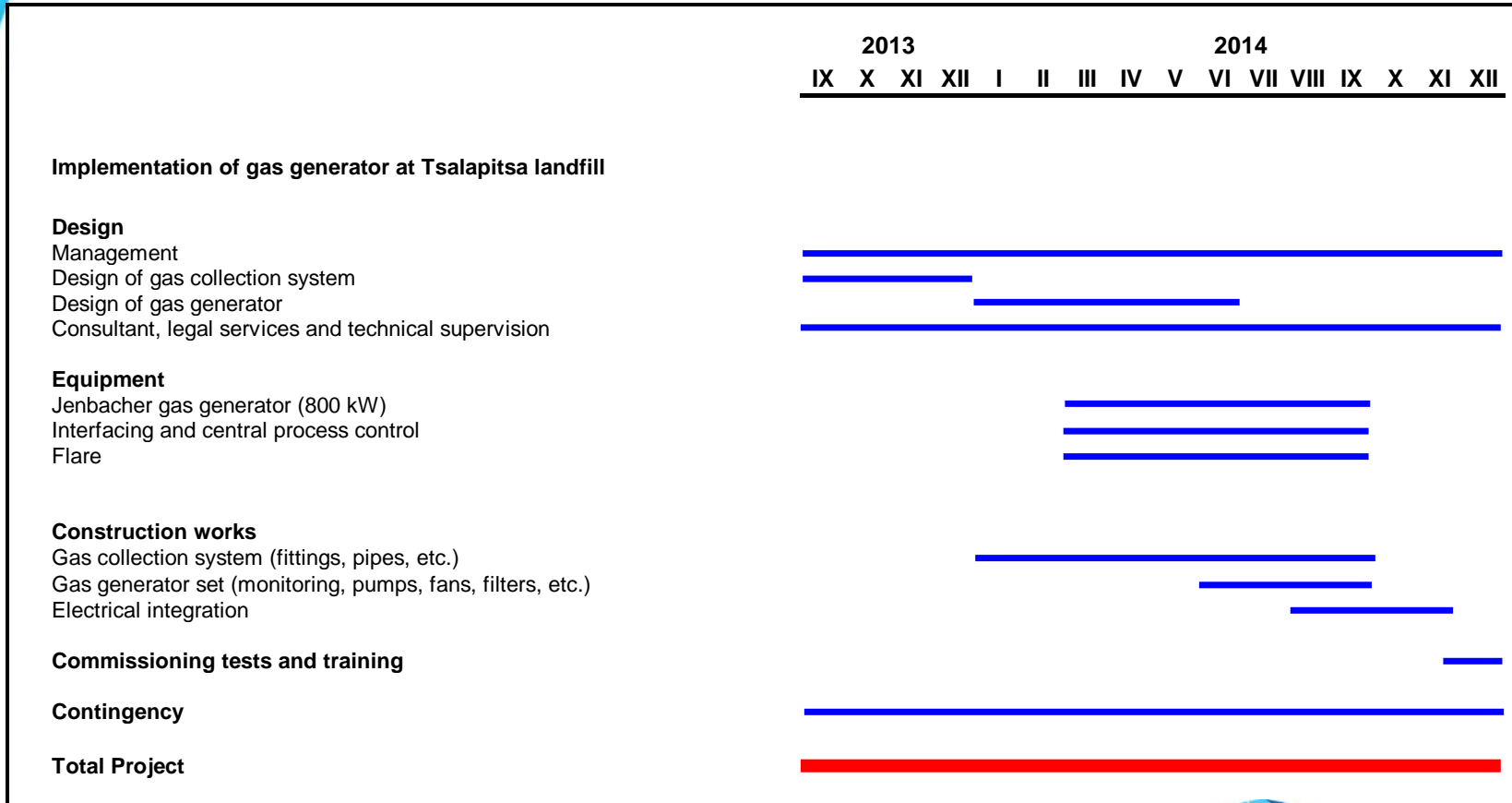
## Implementation of gas generator at Tsalapitsa landfill

1. Expected condition	Value	Unit	Sources
Installed capacity	800	kW	Modelling
Working hours of the generator	6,000	h	Assessment
Annual electricity production	4,800	MWh/yr	Calculation
Electricity own needs	72	MWh/yr	1.5% Jebacker
Electricity sold to the grid	4,728	MWh/yr	Calculation
Electricity price	129	EUR/MWh	Decision No C-30
Income from sold electricity	611,599	EUR/yr	Calculation
<b>2. Savings</b>			
O&M costs	-138,356	EUR/yr	Jenbacker & Assesment
Annual revenues and savings	473,244	EUR/yr	Calculation

## Gas Generator at Tsalapitsa Landfill (Plovdiv): Total Investment (Euros)

Investment Item	Municipality	Bank	Project Total
Design		229,957	229,957
<u>Equipment</u>			719,566
Gas generator (800 kW)		560,000	
Interfacing and controls		70,000	
Flaring		89,566	
<u>Construction Works</u>			780,000
Gas collection system		360,000	
Pumps, fans, filters, etc.		112,000	
Electrical integration		168,000	
Civil works	140,000		
Commissioning Test	20,000		20,000
Contingency		86,476	86,476
*****	*****	*****	*****
<b>Total by Funding Source</b>	<b>160,000</b>	<b>1,675,999</b>	<b>1,835,999</b>

# Tsalapitsa Landfill (Plovdiv) - Construction Schedule





# Tsalapitsa Landfill (Plovdiv): Financing

Loan Terms: Interest rate of 3 Mo. Eurobor plus 6.2% (total of 6.863%) with a grace period of 16 months

<b>Project Cost</b>		
	<b>EUR</b>	<b>%</b>
Total Base Project Cost	1,835,999	95.2%
Interest during Construction	59,548	3.1%
Management Fees during Construction	32,512	1.7%
<b>Total Project Cost</b>	<b>1,928,058</b>	<b>100.0%</b>
<b>Base Capital Structure</b>		
Debt	1,675,999	91.3%
Equity	160,000	8.7%
<b>Total Investments</b>	<b>1,835,999</b>	<b>100.0%</b>
<b>Financial Scheme</b>		
Requested Loan #1 under the BEERECL	1,675,999	86.7%
Project Sponsor Contribution		
Project Cost	160,000	8.3%
Interest during Construction	59,548	3.1%
Management Fees during Construction	32,512	1.7%
Additional Working Capital	5,422	0.3%
Total Project Sponsor Contribution	257,482	13.3%
<b>Total Sources of Funding</b>	<b>1,933,480</b>	<b>100.0%</b>

# Energy Service Company (ESCO) Variants

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- Analysis of a Municipality “Base Case”
- Analysis of 7 variants:
  - ESCo pays concession fees between EUR 66,411 and EUR 200,000
  - ESCO pays the concession fee and invests 20% of the loan amount as equity

# Tsalapitsa Landfill (Plovdiv): Cash Flow Results - Base Case and ESCo Variants

Parameters	Municipality	ESCO variants						
	Base case	66,411	100,000	100,000 Eu&20%	150,000	150,000 Eu&20%	200,000	200,000 Eu&20%
Loan amount	1,675,999	1,675,999	1,675,999	1,467,999	1,675,999	1,467,999	1,675,999	1,467,999
Loan term (months)	66	74	81	71	93	81	113	97
Equity	160,000	160,000	160,000	368,000	160,000	368,000	160,000	368,000
PBP	4.12	4.76	5.17	5.19	5.91	5.95	6.91	6.96
IRR	21.64%	17.71%	15.60%	15.52%	12.21%	12.12%	8.38%	8.26%
NPV	1,137,810	715,555	502,981	496,669	186,878	179,669	-127,094	-135,828
<b>With Grant 15%</b>								
PBP		4.10	4.45	4.56	5.09	5.22	5.94	6.11
IRR		20.75%	18.55%	18.08%	15.04%	14.57%	11.12%	10.63%
NPV		923,323	710,750	678,652	394,646	361,653	80,675	46,155
Municipality contract (concession tax for 15 years)		996,165	1,500,000	1,500,000	2,250,000	2,250,000	3,000,000	3,000,000

# Conclusions – Tsalapitsa Landfill

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- **Project is low risk**
- **Financial parameters are very good:**
  - *With 100% municipal loan: Payback = 4.12 years, IRR = 21.64%*
  - *With investor paid gas collection system: Payback = 2.96 yrs, IRR = 31.76%*
  - *With various concession fees and ESCO equity: Payback = 2.97 to 6.11 yrs, IRR = 30.20% to 10.63%*
- **Cash-flow from emissions trading**
- **Municipality has sufficient capacity to organise and manage projects**
- **Plovdiv Municipality is ready to grant a concession to potential investors**

# Thank you!

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