Chemcontrol a/s
Lindholmvej 3
5800 Nyborg
Denmark

FICHTNER
Sarweystrasse 3
10191 Stuttgart
Germany

Polyconsult ECO Ltd.
Buntovnik Str. 15/ap.15
1420 Sofia
Bulgaria

Phare

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Preparation of the ISPA Application Form

for the project

"Establishment of National Hazardous Waste Centre"

WASTE SURVEY

FINAL

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Executive Summery

The first task in the preparation of the ISPA application for "Bulgarian National Hazardous Waste Centre" (NHWC) is to undertake a waste survey. The survey shall be used to define preconditions for the conceptual design and logistics for the NHWC.

This paper presents the amount of waste generated and accumulated in Bulgaria according to information sheets provided by the Ministry of Environment and Water (MoEW).

Radioactive, hospital and municipal waste together with explosive waste has been excluded from the survey, as these types of waste either require special treatment or may be disposed of to normal municipal landfills.

The survey also includes a number of methods normally used to predict the amount of waste generated and the results of these methods applied for Bulgaria.

Discussion concerning forecast on the future waste generation is included taking a number of parameters effecting the generation of waste into consideration. Based on these forecasts recommendations on types of facilities required and capacity is given. Details on how the system should be operated and detailed information on the treatment methods shall be found in the conceptual design and the basic design.

During the end of December 2000 a number of 2,921 information sheets covering 1998 and 1999 were entered into a spreadsheet. Each entry has been evaluated with regard to disposal method and whether the quantity reported was realistic to take into consideration when calculating the potential amount of waste for the centre.

The data shows that there is considerable amount of hazardous waste generated in Bulgaria. According to the information sheets 1,959,965 tonnes was generated in 1999. Also the amount of accumulated waste reported is substantial amounting to 145,200,603 tonnes. This number is, however, reduced to 24,001,513 tonnes when mining waste and waste from Neftochem is excluded. Approximately 95% of the 24,001,513 tonnes are for disposal at the landfill.

In order to establish a more realistic basis, mining waste and waste from Neftochem have been deducted in the realistic scenario of the survey. This is due to the mining waste being considered to represent a minor environmental risk. Regarding Neftochem the waste is excluded as the company already have incineration capacity and furthermore another project regarding on site incineration is ongoing. Furthermore, the amount of some of the other waste types has been reduced to an amount, which can be expected to be sent for disposal at the NHWC (realistic scenario). The reductions are based on our experience from other countries, and the adjustments are important when establishing the capacities for the individual facilities has to be established.

Taking these adjustments into consideration the 1999 realistic scenario for accumulated waste is reduced to 716,162 tonnes and the amount of generated waste is reduced to 168,208 tonnes.

1999 – Realistic Scenario	
Treatment	**Tonnes**
Landfill	102,100
Incineration	52,177
Physical-Chemical treatment	3,936
Recycling	9,538
Asbestous Landfill	457
Total	**168,208**

Geographic distribution of the waste data shows that most of the waste is generated in the Sofia district (35%) followed by Lovetch (9.1%) and Plovdiv (6.1%). In the Sofia district the waste is generally for landfill (81%).

With respect to incineration waste the quantities are more or less equally spread between Lovech, Sofia, Gabrovo, Burgas, Pazardjik and Varna please refer to section 3.5.

For waste, which shall be treated by physical-chemical treatment the Sofia district generates 75% of the waste.

The waste survey has identified the largest waste generators in Bulgaria as follows:

1999 – Major Waste Generators Waste Generated (Realistic Scenario – 168,208 tonnes)			
Company	Prodominent treatment	Tonnes	%
KREMIKOVTZI AD	LF	50,344	29.9
VELUR AD	INC-2	9,703	5.8
KZM AD	LF	9,477	5.6
OLOVNO-ZINKOV Komplex –AD	LF	8,790	5.2
Balkan Pharma	INC-2	5,530	3.3
NEFTOHIM	INC-2	5,310	3.2
KRZ	LF	4,657	2.8
SEVKO	INC-2	4,200	2.5

The majority of these companies are accumulating large quantities of hazardous waste, KREMIKOVTZI AD reporting an accumulated amount of 10,935,498 tonnes.

In addition to these companies UMPM and Panagiurski mini EAD also are accumulating very large quantities of hazardous waste, Panagiurski mini EAD reporting the largest amount of all 63,766,368 tonnes.

The amount of waste identified based on the information sheet are close to the quantities found by other methods normally used for estimating waste amounts. However comparing the

findings of this survey with the findings of the Kaiser study shows that the amount of waste has been reduced dramatically. One explanation might by that the studies was based on different legislation, thereby using other classification for hazardous waste.

The survey shows a need for construction of disposal facilities for hazardous waste in Bulgaria. The waste generated is composed of waste types, which will require different treatment methods similar to the usual facilities, which is usually found in western European countries for treatment and disposal of hazardous waste:

- Secure landfill
- Solidification
- Physical-chemical treatment
- Incineration including flue gas cleaning
- Laboratory facilities

We trust that the capacities mentioned above will guarantee that the hazardous waste generated and accumulated in Bulgaria is treated and disposed of in a safe and environmental sound way for the years to come.

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1. Introduction

The waste survey is one of the most important prerequisites for the conceptual design and the basic design, as all decisions concerning treatment and disposal methods, possibilities of waste minimisation programs, means of transportation, etc. will depend on the findings here.

The objectives of the survey are to determine, with a certain degree of accuracy, types and amounts of waste generated, the waste distribution between various industries, the size of the waste generating industries, the generation rate of the waste per employee or per produced unit, etc.

However, getting reliable information on waste generation is often a difficult job as the waste generators do not always have a clear picture themselves or are reluctant to disclose the information for competitive reasons or due to the fact that the waste is not presently being disposed of properly. Also, as it is often very time consuming and therefore costly for the industry to establish the data, and finally very little enthusiasm is to be expected when dealing with hazardous waste.

For this study it has been a great benefit that the MoEW has been closely involved in allowing access to the information sheets regarding hazardous waste which submitted every year by the industry. The participation of the MoEW EEA has allowed for co-operation with the industries allowing site visits and comments on the present situation with respect to hazardous waste.

Finally the MoEW EEA has been of great help correcting the data entered from the information sheets and introducing data which was missing.

1.1 General

The waste survey will focus on the following aspects:

- Models to estimate the amount of waste.
- Kaiser Study
- Waste Survey based on the data from the MoEW EEA leading to information on:
    - Generated amount of waste
    - Accumulated amount of waste
    - Classification related to treatment
    - Local distribution of waste
    - Major waste generators

These pieces of information should allow for a decision regarding location and capacity of a centre.

2. Prediction of Waste Generation.

A number of models for estimating the amount of waste have been prepared over the years. Below a few of these models will be applied to estimate the situation in Bulgaria.

2.1.1 Per Unit of Gross Domestic Product

H. Yakowitz (*Background Information Concerning Hazardous Wastes in non-OECD countries, 1985)* has attempted to estimate the quantities of hazardous waste produced in different countries.

In his paper it is estimated that newly industrialised countries annually produce about 2,000 tonnes of hazardous waste per billion USD Gross Domestic Product (GDP). In the case of Bulgaria the National Statistic Office reports the national GDP (1999) to be 22,776,444,000 Levs (11,950,000,000 USD)

Using these figures to calculate the amount of waste results in an amount of 23,900 tonnes.

In doing this kind of calculations one must bear in mind that the estimate must be seen in the light of the different definitions of hazardous waste (scheduled waste) found in the different countries. Also the amount of 2,000 tonnes per billion USD must be questioned.

2.1.2 Per Unit of Population

Total generation of scheduled waste could be set to the following amounts:

- 100 kg per person per year for highly industrialised countries with a strong chemical sector.
- 6 kg per person per year for OECD countries with predominantly agricultural economies

The GDP for Bulgaria was for 1999 according to the homepage of Bulgarian National Statistics divided in the following way :

Industry	23 % of GDP
Agriculture:	15 % of GDP

Based on these figures the amount of waste generated in Bulgaria is estimated to be 25 kg per person per year.

Taking the current population of Bulgaria of 8.4 million (homepage of Bulgarian National Statistical Office) the amount of waste is calculated to 210,000 tonnes of hazardous waste per year.

2.1.3 Amount of Waste Correlated to Number of Employees

A number of researchers have proposed a kind of coherency between the number of employees in a distinct industry and the amount of waste generated in the industry in question. Many attempts have been made in order to approximate the factors to be allocated to the individual types of industries. One of the attempts has been made using actual deliveries from Danish waste generators to the centralised treatment plant in Denmark (Kommunekemi).

The table below shows the amount of waste collected by Kommunekemi according to their classification system and taking the number of employees of the companies into consideration. The classification is based on the chemical composition and the final treatment. In this way a waste factor for amount of waste per employee can be calculated, within the different classification groups.

In order to utilise the information the Kommunekemi classification has been modified to the methodology used in this study as shown in the table below.

Amount of Waste Correlated to Number of Empoyees								
KK-CODE	**A**	**B**	**C**	**H**	**K**	**T**	**X**	**Z**
Kg/employee	11.06	17.10	41.15	171.07	0.06	1.60	97.27	9.19
Survey Code	INC-1/2	INC-3/4	INC-1/2	INC-1/2	RECYC	INC-3/4	PCT/LF/RECYC	INC-2

Summarising the amount generated for each survey code the quantities are as below. It has not been possible to relate the number of employees to different types of waste in this study but a number of assumptions have been made.

According to the homepage of the Bulgarian National Statistics (1997) the number of employees was 3,030,000 and when assuming that

- 15% of the employees generate waste for INC-1/2 (incineration not halogenated)
- 5% of the employees generate waste for INC-3/4 (incineration - halogenated)
- 80% of the employees generate waste for RECYC/PCT/LF (Recycling, Physical/ Chemical Treatment and Landfill)

the following amounts can be calculated.

Survey Code	**INC-1/2**	**INC-3/4**	**RECYC / PCT / LF**
Kg/employee	58.12	9.35	48.67
Tonnes	26,415	1,417	117,976
Total (Tonnes):			**145,808**

It is not possible to separate the quantities for recycling, PCT and landfill, however, the major part of the waste will be for landfill.

2.2 Kaiser Study

In 1995, Kaiser also prepared a detailed waste survey. The study showed that 14.2 million tonnes were generated in Bulgaria during 1994 of these 13 million tonnes were waste streams from mineral processing.

This finding is different to the finding in this study, which estimates the total waste generation to 1,959,965 (optimistic scenario including all reported waste). The reason for this large difference is difficult to explain. However, the following aspects provide some explanation.

- The two surveys take different types of waste into consideration, due to different regulation. Kaiser study was done under Order 153 this survey is done under Order 323.
- The waste classification was changed between the surveys.
- Production may have been reduced.

One indicator showing that the difference in quantities is likely to be due to different regulation is that the MoEW EEA has informed that “Elacite Mirkovo” (RIEW Sofia) has reported 11,200,000 tonnes of industrial waste, which would have been included in the Kaiser study. Taking this amount into this study would bring the total in the same range as the Kaiser study.

Focusing on the amount of waste for incineration the Kaiser study estimate the amount to 656,599 tonnes (4.6% of the total amount reported). In the current study the amount for incineration account to 4.7% of the total amount reported, which means that the fraction for incineration has been reduced dramatically in parallel with the other waste.

3. Data from Information Sheets

The study is based on the information sheets collected by the local inspectorates for 1998 and 1999. In total selected information from 2,921 information sheets has been entered into an Excel spreadsheet. The number of information sheets were almost the same for 1998 (1,447 sheets) and 1999 (1,474 sheets)

In Appendix B selected waste data from the information sheets are shown for 1998 and 1999.

3.1 Methodology

The data from the info-sheets has been evaluated based on the description of the waste, the classification code as stated in the “Bulgarian Waste Management Legislation”, attached in Appendix A, and the physical appearance of the waste.

Based on these evaluations the waste has been separated into the following groups.

Treatment Codes	
Code	**Description**
ASBEST	Waste containing asbest for landfilling
HOSP	Hospital waste
INC-1	Liquid organic waste for incineration
INC-2	Solid organic waste for incineration
INC-3	Liquid halogenated organic waste for incineration
INC-4	Solid hologenated organic waste for incineration
LF	Inorganic waste suitable for landfill
MUN	Waste which can be disposed of to municipal landfill
PCT	Liquid inorganinc waste suitable for physical chemical treatment
RECYC	Waste containing materials which may be recycled, also includes mercury waste

Each treatment code represents a specific treatment and shall be used for the design of the waste treatment facility. It is important to split the waste for incineration into a number of groups as the physical appearance (liquid/solid) influences on the design in the same way the halogenated waste must be identified as the fluegas cleaning must be specially designed if large quantities are generated.

The data of the survey has been compared with the information collected by the Environmental Executive Agency, and some minor differences, which it has not been able to identify, exist. However, the overall quantities are in line with the data from the Agency.

As the hazardous waste centre only shall receive hazardous waste, hospital and municipal waste are excluded from the survey

3.2 Scenarios

In order to predict the amount of waste, which it is realistic to consider potential waste for the facility, 3 waste scenarios have been prepared.

- Optimistic
- Pessimistic
- Realistic

The optimistic scenario takes all waste reported on the information sheets into consideration only leaving out only waste for incineration from Neftochem as this company has its own incinerators and a new project handling the internal generated waste in under way.

Also mining waste has been excluded as the quantities are extremely large and effect of obtained by transferring the waste to a secure landfill will only improve the environment slightly. It should be considered to build decentralised landfills for this type of waste, as it would minimise the need for transportation.

The pessimistic and the realistic scenario reduce the amount of waste for certain types of waste unlikely to be taken to the centre. In the same way the amount of waste has been reduces from companies having such large amount of waste that it is unrealistic to expect all waste to be taken to the centre.

The blue fields indicate that some corrections to the data have taken place either due to the characteristics of the waste, the amount of waste, or others handling the waste. The table in appendix F page provides information on most of the corrections.

The table in Appendix B also includes some yellow fields which is information submitted by the MoEW EEA subsequently.

Finally, a few red fields are included indicating data, which has been let out of the survey.

3.3 Generated Waste according to Treatment

Based on the data on the information sheets (item 4.2) and the assumptions mentioned above the following amount is calculated for the 3 scenarios.

Code	**1999 (Tonnes)**			**1998 (Tonnes)**		
	Optimistic	Realistic	Pessimistic	Optimistic	Realistic	Pessimistic
LF	382,850	102,100	70,196	328,773	76,333	67,554
INC-2	55,127	45,240	44,032	164,666	73,410	65,888
PCT	18,036	3,936	3,153	17,601	5,451	3,151
INC-1	14,724	6,913	5,936	14,297	6,339	5,344
RECYC	57,100	9,538	6,790	11,763	9,999	9,999
INC-4	23	23	23	47	47	47
ASBEST	457	457	457	101	101	101
INC-3	1	1	1	15	15	15
Total	**528,318**	**168,208**	**130,588**	**537,263**	**171,695**	**152,099**

A number of waste types (explosives, mining, hospital and municipal waste) have been left out when calculating the basis, also waste from the largest generators who have or will have own disposal facilities is excluded.

The data for 1999 has been deducted 36,492 tonnes from Neftochem for incineration (INC-2) and 1,395,155 tonnes for landfill (LF). This means that the total amount of waste generated in 1999 as stated on the info-sheets amount to 1,959,965 tonnes.

Although the total amounts reported for 1998 and 1999 are almost identical it can be seen that the amount for INC-2 waste is reduced considerably in the data for 1999 and that the landfill waste (LF) has increased. Furthermore, the recycling waste (RECYC) has increased.

When considering the realistic scenario the quantities are very similar indicating that the amount of waste generated, to some extend, is stable.

3.4 Accumulated Waste according to Treatment

The data on the information sheets (item 13.2) has also been analysed according to the quantities accumulated at the waste generators.

The optimistic scenario for 1999 has been deducted 574,706 tonnes of waste from Neftochem which shall be incinerated and 120,624,384 tonnes from a number of companies which will have to be sent for disposal at the landfill. This means that the total amount of waste accumulated at the generators in 1999 according to the info-sheets amounts to 145,200,603 tonnes.

Due to the present difficult financial situation in Bulgaria it must be expected to be difficult to encourage the generators to send the accumulated waste for treatment, furthermore the extremely large quantities makes it economically very difficult to handle the accumulated waste.

Code	**1998**			**1999**		
	Optimistic	Realistic	Pessimistic	Optimistic	Realistic	Pessimistic
LF	17,986,591	767,275	430,071	18,102,165	582,878	238,057
INC-2	792,111	69,248	42,880	5,276,680	69,071	36,187
PCT	31,133	1,683	1,683	46,729	2,502	2,502
INC-1	4,306	2,919	2,659	25,143	7,484	4,173
RECYC	24,305	6,094	3,077	541,281	53,729	18,288
INC-4	52	52	52	13,5	13,5	13,5
ASBEST	109	109	109	904	484	400
INC-3	1	1	1	0	0	0
Total	**18,838,608**	**847,381**	**480,532**	**24,001,513**	**716,162**	**299,621**

As it can be seen there is a large difference in the quantities in the optimistic and the realistic scenario, this is due to the fact that only a small fraction of the accumulated waste is taken into consideration when calculating the realistic scenario

3.5 Largest Waste Generators (1999)

The data has been analysed in order to identify the largest waste generators. The analysis uses the realistic scenario for the generated waste and the optimistic scenario for the accumulated waste. This is done to illustrate how large the accumulated waste problem is for the companies.

According to the data the largest generators are:

Company	Amount Generated (Realistic Scenario) (Tonnes)	Amount Accumulated (Optimistic Scenario) (Tonnes)
KREMIKOVTZI AD (LF)	50,344	10,935,498
VELUR AD (INC-2)	9,703	1,050,300
KZM AD (LF)	9,477	528,400
OLOVNO-ZINKOV Komplex –AD (LF)	8,790	647,181
Balkan Pharma (INC-2)	5,530	81,981
NEFTOHIM (INC-2)	5,310	7,200
KRZ (LF)	4,657	-
SEVKO (INC-2)	4,200	55,000
UMPM (LF)	3,957	6,774,538
Total	**101,968**	**83,846,466**

As it can be seen the largest waste generators generates waste, which shall be disposed of to secure landfill. The 10 largest waste generators in total generate 64% of the total waste in the realistic scenario. If the optimistic scenario is used the percentage would be much higher.

For the accumulated waste it can be seen that a few number of companies possesses 58% of the accumulated waste.

3.6 Generated Waste by District

In order to have an overview of where the waste is generated the data has been sorted according to the 28 districts Bulgaria is divided into. Sofia City and Sofia Disgtrict is calculated as one and referred to as Sofia District.

In Appendix C the amount of waste from the realistic scenario has been transferred to a map of Bulgaria, illustrating the distribution of the waste. The Sofia district is the largest waste generator, however when splitting up the waste into landfill waste and incineration waste, as shown in appendix C, the Lovech district generates more waste for incineration than the Sofia district. For landfill waste the Sofia district still is the largest generator.

For the Lovich incineration waste the major type of waste is liming waste from VELUR AD (7,500 tonnes). For Gabrovo district, sludges from treatment of industrial water (4,200.0 tonnes) from SEVKO AD are included.

In both cases it may be questioned whether this large amount of waste is realistic to be received at the facility. Reducing these amounts means that the amount of waste for incineration is almost similar for the major waste generation areas.

District	1999 (Tonnes)		1998 (Tonnes)	
	Realistic	Optimistic	Realistic	Optimistic
Sofia	59,241	280,794	41,339	187,477
Lovetch	15,375	30,730	12,341	13,287
Plovdiv	10,234	58,480	22,305	192,567
Burgas	9,956	10,937	9,962	10,662
Karjalic	8,791	44,980	6,844	37,302
Gabrovo	8,625	13,304	9,003	10,353
Varna	8,525	27,757	1,758	4,517
Pazardjik	6,624	7,540	8,548	9,615
Razgrad	5,590	5,766	7,780	7,787
Haskovo	4,193	21,134	5,632	42,966
Veliko Tarnovo	3,381	10,030	3,108	3,704
Vratza	2,714	8,255	1,326	8,316
Kiustendil	2,096	2,987	4,6	45
Stara Zagora	1,577	1,711	3,239	3,556
Ruse	1,524	1,525	483	1,259
Blagoevgrad	1,187	1,463	1,965	2,158
Pernik	934	4,523	672	6,677
Dobrich	524	740	1,695	15,289
Montana	471	571	584	1,211
Pleven	267	1,267	696	5,361
Shumen	233	258	3,017	10,090
Sliven	205	205	169	169
Yambol	116	116	211	226
Targovishte	108	119	123	246
Smolian	22	56	121	169
Vidin	16	16	34	34

Generated waste per district

3.7 Waste handled by Others

The amount of waste, which is handled by enterprises operating competing waste disposal facilities, was by the MoEW, told to account for less than 1% when leaving out car batteries, and the waste from Neftochem.

Therefore the amount disposed by other has not been taken into consideration in this study

4. Summery on Waste Predictions

When comparing the different method of calculating the amount of waste is can be seen that they vary considerably. The results are summarised in the table below

Method	Quantity Generated (tonnes/year)
Gross Domestic Product	23,900
Population	210,000
Number of Employees	145,808
Kaiser Study 1995 Reported Reported (excluding waste from mineral processing	 14,200,000 1,200,000
Info-sheets 1999, Reported Reported (excluding waste from mineral processing) Optimistic forecast Realistic forecast	 1,959,965 564,810 528,318 168,208

As it can be seen the quantities calculated by the "Number of employees" method and the info-sheets are very similar also the population method predict waste amounts in the same region. The GDP method obviously can not be used for Bulgaria.

Furthermore, when comparing the "Number of Employees" method and the info-sheets it is seen that the quantities related to different treatment option are relatively similar. However, it must be realised that a number of assumptions have been made when calculating the quantities using both the "Number of Employees" method and the population method.

Treatment	"Number of Employees" method (tonnes)	Info-sheets (tonnes)
Incineration	27,832	52,177
Solidification/Landfill/PCT	117,976	102,100

We recommend emphasising on the data provided by the information sheets, this is due to the many assumptions, which have been made in the other predictions and the fact that the MoEW EEA has assisted in reviewing the data from the information sheets.

5. Future Generation

When designing the waste centre a forecast on the future generation has to be made in order to estimate the quantities 20 years from now.

5.1 Forecast on Quantities

In order to predict the future generation of waste, 3 forecasts has been prepared. The 3 forecasts (high, medium and low) take into consideration the following factors:

- GDP
- Fee to be paid
- Improved enforcement
- Public awareness
- Introduction and cleaner technologies and waste minimisation
- Competition from other disposal operators,

As seen earlier it is common practice to link the GDP and the amount of waste generated, In this study the GDP forecast has been provided by the MoEW and in the scenarios it is estimated that the GDP contribute 50%, 30% and 15% to the growth,

When the centre is build it must be expected that the waste generators will reduce the quantities, as there is a fee to be paid. In the long run, however, it must be expected that the generated waste will arrive at the centre.

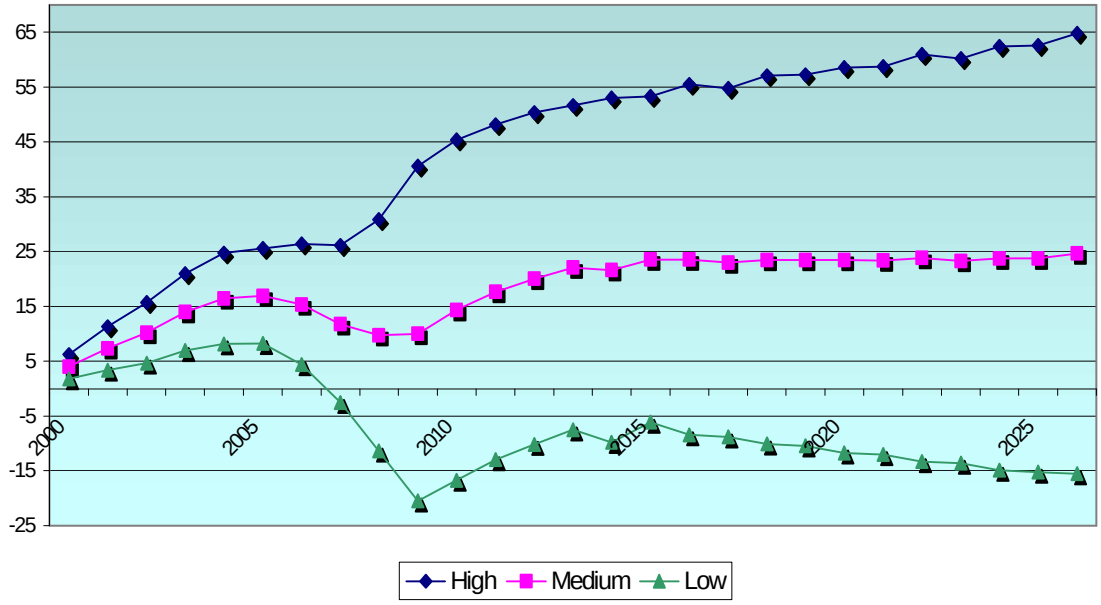
Improved enforcement by the local inspectorates is a very important tool to increase the quantity of waste available for the centre. However, there seems to be a close contact between the inspectorates and the waste generators. The large number of information sheets submitted to the inspectorates also proves this, and therefore it must be expected that the enforcement will have little effect.

Experience from Europe shows that public awareness has an impact on the amount of waste delivered to the centre. As normal workers starts to question the doubtful disposal the waste generators will be forced to deliver the waste to the centre.

Also introduction of cleaner technologies and waste minimisation has been seen expanding in Europe in order to reduce the quantities for disposal. The effect must be expected to be relatively slow in Bulgaria due to lack of funds for investment in the new technologies.

Depending upon the fee structure new disposal companies will arise and compete with the centre. Due to the ISPA funding it must be expected that the competition will be limited.

Please refer to Appendix D for detailed information on the factors influencing the waste generation. The sum of the factors is displayed in the graph below.



Sum of factors affecting the waste generation

5.2 Capture Rate

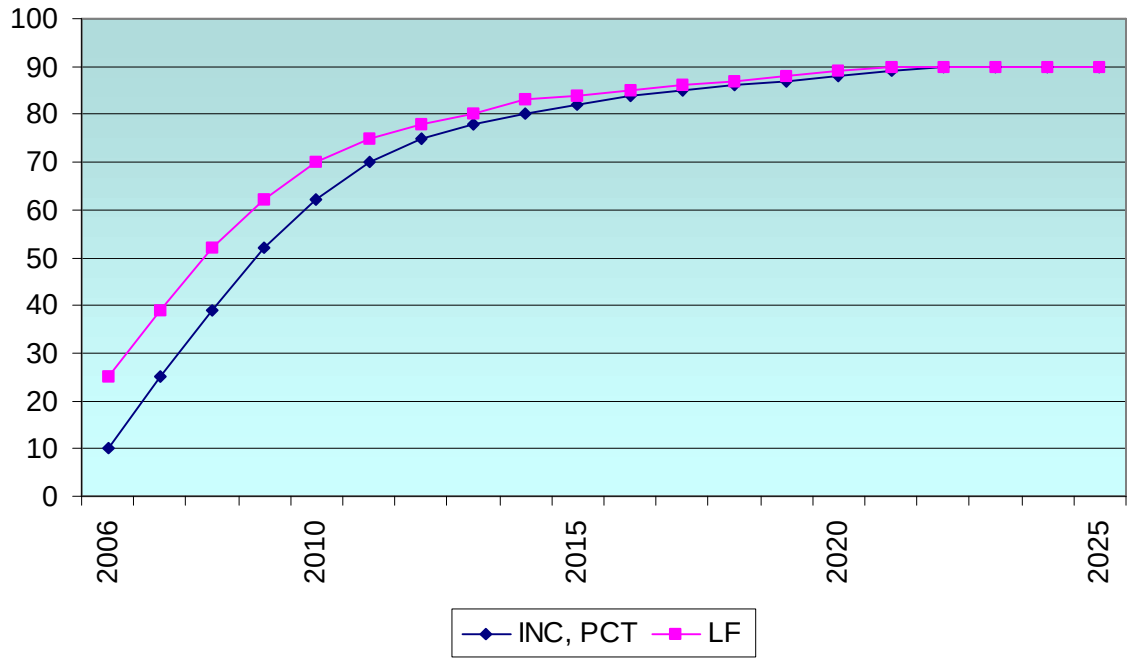
Besides the forecast for waste generation a capture rate has been taking into consideration. The capture rate indicates how much of the potential generated waste actually will be collected.

Experience shows that it will take a number of years before large quantities of the generated waste actually will be collected,

In Denmark in the early 70's it took around 10 year to reach a reasonable capture rate, which was only achieved because of increased enforcement and raising public awareness. Other experience from Malaysia shows that the 80% collection target was reached within a few years. This is expected to be due to the fact that legislation had been in place 10 years ahead of the establishment of the hazardous waste management centre. Furthermore, the fact that many companies are connected to European and American based companies having an environmental policy in place have made the implementation easier,

For Bulgaria, we expect the collection of newly generated waste to start very slowly and then within 5-8 years reach a capture rate of around 80%. This is mainly due to the financial situation and that the legislation is relatively new. For the landfill waste we have assumed a slightly more fast response as this waste often is large quantities occupying large areas, and therefore creating a problem for the companies.

We expect that the maximum capture rate will be 90%.



Capture Rate

5.3 Forecast for Quantities for the Individual Treatment Facilities

In order to predict the quantities for each treatment facility a basis has to be established. The data on the generated waste has been used to define this basis. Especially for the waste for incineration the quantities has been reduced, compared to the data from the information sheets, as it seems there is a trend towards generating less waste.

Treatment	Quantity Basis (Tonnes)		
	Optimistic	Realistic	Pessimistic
LF	350,000	110,000	70,000
PCT	15,000	4,000	3,000
INC-1	15,000	8,000	5,000
INC-2	50,000	37,000	30,000
INC-TOTAL	65,000	45,000	35,000
SOLI	33,000	8,000	4,500
RECYC	25,000	10,000	5,000
ASBEST	500	250	100

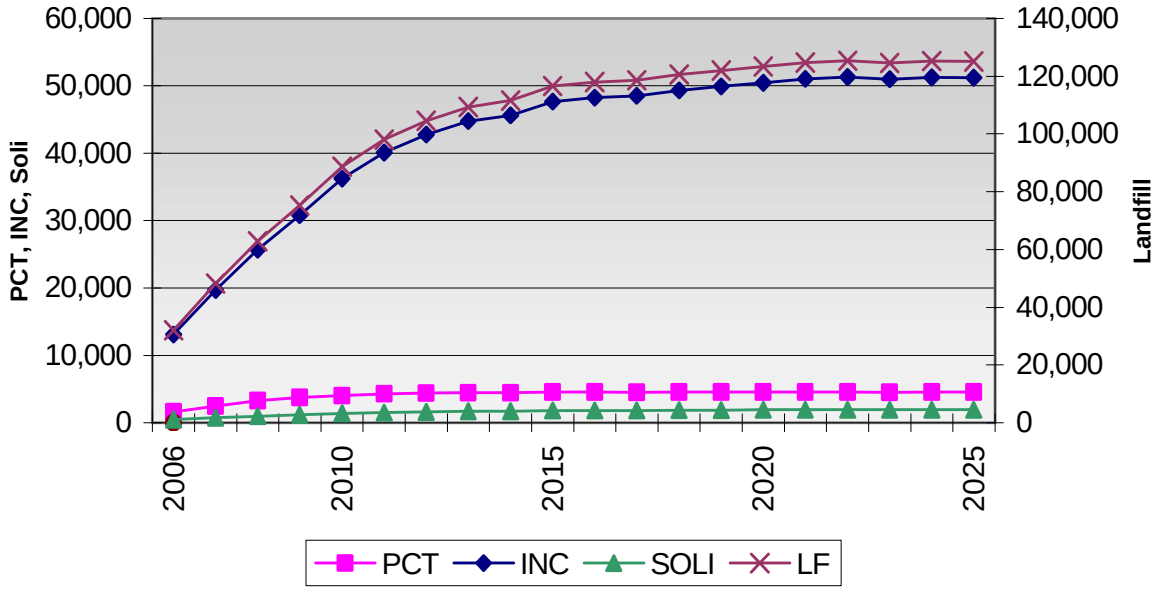
For each of the 3 scenarios for waste generation (optimistic, realistic and pessimistic) an forecast for the future generation has been made. In order to illustrate different scenarios 3 forecasts for the growth (high, medium and low) based on a number of factors influencing the generation of waste (section 4.1) have been used for the calculation.

All together this provides a matrix of which only the 3 outer cases are displayed in the graphs (marked in yellow below). This is done, as there is only little difference between, for example, the "Optimistic-High" and the "Optimistic-Low" case for incineration only result in a difference of less than 1,000 tonnes in the year 2025.

	Growth Forecast		
Waste Quantity	High	Medium	Low
Optimistic	**Optimistic-High (HIGH)**	Optimistic - Medium	Optimistic-Low
Realistic	Realistic – High	**Realistic – Medium (MEDIUM)**	Realistic-Low
Pessimistic	Pessimistic - High	Pessimistic - Medium	**Pessimistic-Low (LOW)**

Taking the capture rate (section 4.2) into consideration for each of these cases the amount collected for each year can be calculated. Below the quantities for the medium case is displayed.

For further detailes on the "High", "Medium" and "Low" forecast for landfill, incineration and physical chemical treatment please refer to Appendix E.



Forecast on Collected amounts of Future Waste Generation

6. Conclusion and Recommendation

In the study effort has been given to predict how much of the waste reported, it is realistic to take into consideration as potential waste for a NHWC. The methodology of this survey takes into account the fact that not all waste reported as hazardous waste in context of an economical feasibility study is to be considered as waste realistic to be disposed of to the NHWC. Consequently, a number of waste streams have been reduced, as the waste normally will be disposed of by alternative methods.

The finding of the waste survey is that a considerable amount of waste are generated in Bulgaria in 1998 and 1999. In 1999 the total amount of waste reported was 1,959,965 tonnes. However, the amount which, could be expected to be available for the centre, is predicted to be 168,208 tonnes (realistic scenario).

A method has been used to forecast the future waste generation development predicts that this amount will increase to 235,000 tonnes (“Medium case”) in the year 2025. The most optimistic “High case” predict an amount of 879,000 tonnes to be generated in 2025.

The amount of generated waste may change according to economic growth and public awareness as described in more detail in the section on future development in the waste generation.

The identified waste generation based on the information sheets is similar to the quantities estimated by the forecasts using data on population and number of employees. This comparison verifies the reliability of the information by the sheet survey.

Also the quantities accumulated are considerable 716,162 tonnes (1999 realistic scenario) and represent a large problem to be solved. Most of the waste is suitable for landfilling and due to the large quantities it is recommended that the waste be disposed of to secure on-site landfills to avoid costly transportation.

Most of the waste is generated in the Sofia district (35%) followed by Lovetch (9.1%) and Plovdiv (6.1%). In the Sofia district the waste is generally suitable for landfill (81%).

The quantities of waste to be incinerated are generally found in Lovech, Sofia, Gabrovo, Burgas, Pazardjik and Varna districts please refer to section 3.5 for further details.

Waste, which shall be treated by physical-chemical treatment generally originates from the Sofia district, which generates the majority of this type of waste.

The survey, in the same way as the Kaiser study, verifies that a few numbers of companies generate most of the waste, simplifying enforcement by the MoEW.

The types of waste generated and accumulated in Bulgaria are similar to waste types generated in European countries and will require the same types of disposal facilities,

including landfill, solidification, physical-chemical treatment and incineration as found in Western Europe.

Based on the results of the waste survey, the expected future waste generation and the capture rate we recommend to establish the design basis described below. This design basis will be used for conceptual and basic design, EIA study and the financial analysis.

The recommendations are based on the concept of utilising the operation capacities of the facilities to a high degree. For the first years of operation the excess capacity can be utilised to dispose of some of the accumulated waste.

By operating the facilities at full capacity the centre will be seen as a success compared to a larger facility operating at say 50% capacity. In case too much waste is collected the waste may be accumulated and application for funding/support of additional treatment capasity/methods may take place.

Incineration:

40,000 tonnes/year

The amount of waste for incineration amount to 52,177 tonnes in 1999. However, for the forecast a basis of 45,000 tonnes has been used for the medium case resulting in a waste collection of 13,000 in the year 2006 raising to 51,000 tonnes of waste in the year 2025.

This quantity exceeds the capacity of the incinerator, however, the data shows a trend towards less generation of waste especially for incineration waste. Furthermore, it must be questioned whether the method of predicting waste amount is reliable on a time scale up to 2025. Also the economic situation of Bulgaria is very uncertain and must be taken into consideration.

Furthermore, focus has been on setting up a facility which will operate at full capacity for the majority of it lifetime. In the initial years of operation the capacity chosen will allow for treatment of some of the accumulated waste.

By choosing a high capacity there is a risk of having a large expensive facility running at low capacity after the accumulated waste has been treated.

The capacity of 40,000 tonnes/year will be in accordance with the low case, which predict a quantity of 27,000 tonnes collected of in the year 2025 starting from 9,000 tonnes in 2006.

Physical/chemical Treatment:

2,000 tonnes/year

The amount of waste for PCT amount to 3,936 tonnes in 1999 and for the forecast a basis of 4,000 tonnes has been used for the medium case, resulting in a waste collection of 1,600 in the year 2006 raising to 4,500 tonnes of waste in the year 2025.

According to this medium case the capacity of 2,000 tonnes/year is much too small. However, our professional experience tells that the actual quantities collected for PCT usually turn out lower than the quantities identified in waste studies. Therefore the capacity has been chosen according to the low scenario, which predict collection of 1,100 tonnes in 2006 raising to 2,300 tonnes in 2025.

Designing the facility to work in a one shift operation will allow for increasing the capacity simply by changing to 2 or 3 shift operation. The size of the facility will furthermore allow for a simple design.

Landfill:

4 cells of 250,000 tonnes.

The quantities for landfilling are considerable. It is recommended building 4 cells, each having a capacity of 250,000 tonnes. Having four cells allow for discharge of water from the cells not in use. When planning for the site it must be taking into consideration that enough area should be made available for additional cells.

Alternatively, and perhaps a better solution, the landfills for hazardous waste can be build locally in connection with the landfill for municipal waste as it has already been practised in some areas and is planned in others. This solution would reduce the concerns and associated cost related to transporting large amount of waste.

It may also be considered to build the landfill in stages a suggestion would be to first build two cells and see how the response from the waste generators.

Solidification

5,000 tonnes/year

Experience shows that a small amount of the waste for landfill will have to be solidified before being placed at the secure landfill. For design purposes capacity be set at 5,000 tonnes per year.

Designing the facility to work in a one shift operation will allow for further capacity increase by changing to 2 or 3 shift operation. The size of the facility will furthermore allow for a simple and relatively low cost design.

We trust that the capacities mentioned above will guarantee that the hazardous waste generated and accumulated in Bulgaria is treated and disposed of in a safe and environmental sound way for the years to come.

Appendix A

"Bulgarian Waste Management Legislation"

Appendix B

Selected Waste Data from Information Sheets

1998 and 1999

Appendix C

Allocation of Waste in Bulgaria

Appendix D

Factors Influencing on Waste Generation

Appendix E

Forecast on Waste Collected for

Landfill, Incineration and PCT

Appendix F

Assumptions used for Estimating

Realistic and Pessimistic Scenario

The table below indicates how much of the waste has been taken into consideration when calculating the realistic and pessimistic scenario for then generated waste.

The modifications are introduced for certain types of waste that it, based on our experience, is not likely that the centre will to receive the total quantity.

Certain companies are also included as they have such large amount of waste that it is not realistic that they will provide all waste for the centre.

Company	Waste Code / Name of Waste	Total Amount (Tonnes)	Included in Realistic Scenario		Included in Pessimistic Scenario	
			%	Tonnes	%	Tonnes
Liquid waste for incineration (INC-1)						
	12 xx xx	3,370	20	674	10	337
	13 xx xx	6,394	20	1,279	10	639
Solid waste for incineration (INC-2)						
	05 xx xx	1,853	20	371	10	185
	16 07 00	243	15	36	10	24
TOPLOFIKATZIA-SOFIA	13 01 07 Isolation materials	14.2	10	1	10	1
KREMIKOVTZI AD	13 05 02 Sludge from interceptors	10,000	20	2,000	10	1,000
NEFTOHIM	19 08 04 Petrol precipitations	200	15	30	10	20
Waste for Landfill (LF)						
	10 xx xx	289,120	20	57,824	5	14,456
	12 02 99	23,834	20	4,767	10	2,383
	19 08 04	42,211	15	6,332	10	4,221
OLOVNO-ZINKOV KOMPLEKS-AD	11 02 02 Zinc production remains	18,100	25	4,525	15	2,715
Waste for Physical/Chemical treatment (PCT)						
KREMIKOVTZI AD	19 02 02 Neutralized water	15,666	10	1,567	5	784
Waste for Recycling						
	16 06 00 Lead batteries	846	0	0	0	0
KZM AD	10 04 01 Lead sluge	31,100	15	4,665	10	3,110
OLOVNO-ZINKOV KOMPLEKS-AD	10 04 01 Pb concentrate	23,860	15	3,579	10	2,386
Excluded from Survey						
05 01 00 Oil waste from Neftochem (INC-2)						
VMZ-EHD 16 04 03 Explosives PIMA EAD 16 04 03 Explosives						
01 00 00 - Mining waste for Landfill (LF) Panagiurski mini EAD; BIMAK AD COPPER MINES GORUBSO ZLATOGRAD GORUBSO-Laki AD KREMIKOVTZI AD OSOGOVO EAD						

Assumptions on waste generation

The table below indicates how much of the waste has been taken into consideration when calculating the realistic and pessimistic scenario for the accumulated waste.

The modifications are introduced for certain types of waste that it, based on our experience, is not likely that the centre will to receive the total quantity.

Certain companies are also included as they have such large amount of waste that it is not realistic that they will provide all waste for the centre.

Company	Waste Code / Name of Waste	Total Amount (Tonnes)	Included in Realistic Scenario		Included in Pessimistic Scenario	
			%	Tonnes	%	Tonnes
Asbestos waste						
Haskovo Vulkan	10 33 13 asbestos metal pieces	560	25	140	10	56
Liquid waste for incineration (INC-1)						
	12 xx xx	15,823	20	3,165	5	791
	13 xx xx	22,072	20	4,414	5	1,104
Solid waste for incineration (INC-2)						
	01 00 00 – 04 xx xx	1,108,741	1	11,087	0.5	5,544
	05 xx xx	3,535,336	1	35,353	0.5	17,677
	16 07 00	193	15	29	10	19
Balkanfarma (Antibiotic AD)	07 05 02 Sludges from waste water treatment plant	16,705	20	3,341	10	1671
	07 05 08 micell- waste from pharmaceutical production	65,130	20	13,026	10	6,513
MASHSTROI AD	10 09 01 Casting cores and moulds containing organic binders	3700	50	1,850	20	740
BARTEX	12 04 99 Sludge from WWTP	3800	10	380	10	380
KREMIKOVTZI AD	13 05 02 Sludge from interceptors	517,150	0	0	0	0
NEFTOHIM	19 08 04 Petrol precipitations	7,200	10	720	5	360
Waste for Landfill (LF)						
	10 xx xx	8,032,434	5	401,622	1	80,324
	19 08 04	734,834	5	36.742	2	14,697
METIZI	19 02 01 Inorganic wastes containing metals	29,560	15	4,434	10	2,956
KREMIKOVTZI AD	13 05 02 Sludge from slag pond	9,165,265	0	0	0	0
OLOVNO-ZINKOV KOMPLEKS-AD	19 02 02 Zinc production remains	96,619	10	9,662	5	4,831
Waste for Physical/Chemical treatment (PCT)						
KREMIKOVTZI AD	19 02 02 Neutralized water	43,566	5	2,178	5	2,178
KREMIKOVTZI AD	19 02 02 Neutralized water	3,154	10	315	10	315

Waste for Recycling						
	16 06 00 Lead batteries	4,197	0	0	0	0
OLOVNO-ZINKOV KOMPLEKS-AD	10 04 01 Pb concentrate	506,295	10	50,630	3	15,189
	15 01 06 Pb remains	30,767	10	3,077	10	3,077
Excluded from Survey						
05 01 00 Oil waste from Neftochem (INC-2)						
VMZ-EHD 16 04 03 Explosives PIMA EAD 16 04 03 Explosives						
01 00 00 - Mining waste for Landfill (LF) Panagiurski mini EAD; BIMAK AD COPPER MINES GORUBSO ZLATOGRAD GORUBSO-Laki AD KREMIKOVTZI AD OSOGOVO EAD						

Assumptions on Accumulated Waste