ROAD MAP TO ESTABLISHING ENVIRONMENTAL SOUND MANAGEMENT OF POPS PESTICIDES AND OTHER HAZARDOUS WASTE IN THE EECCA REGION

Food and Agriculture Organisation of the United Nations

IHPA
International HCH & Pesticides Association

Group photo of participants of workshop "The Road Map to sustainable Elimination of Obsolete Pesticides in the Eastern Europe, Caucasus and Central Asia"27-29 October 2014 in Belarus

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CONTENTS

GLOSSARY

Legacy waste: past and generated hazardous waste
Waste arisings: waste which is generated yearly
Counterfeit (fake) pesticides: (ECPA)
Counterfeit and illegal pesticides are untested and unauthorised. They can therefore result in yield losses for farmers, but potentially also pose risks to human health, the environment and farmer livelihoods. Countries that fail to manage this problem, risk their reputation as traders and exporters of safe produce.

ABBREVIATIONS

ACAP	The Arctic Contaminants Action Program
EECCA	Eastern Europe, Caucasus and Central Asia
EAU	Eurasian Union
EEU	Eurasian Economic Union
EU	European Union
ESM	Environmentally Sound Management
FAO	Food and Agriculture Organization of the United Nations
FAO PSMS	Pesticides Stock Management System developed by FAO and used by the countries
GDP	Gross domestic product
GEF	The Global Environment Facility
HCB	Hexachlorobenzene
HCH	Hexachlorocyclohexane
HTI	High Temperature Incineration
IHPA	International HCH & Pesticides Association
Kt	Kilotonne, a unit of mass equal to one thousand tonnes (10^6kg)
Mt	Megatonne, a unit of mass equal to one million tonnes (10^9kg)
Gt	Gigatonne, a unit of massequal to one billion tonnes (10^{12} kg)
NIP	National Implementation Plan under Stockholm Convention
OPs	Obsolete Pesticides as defined under Stockholm Convention
POPs	Persistent Organic Pollutants as defined under Stockholm Convention
Tt	Teratonne a unit of mass equal to one trillion tonnes (10^{15} kg)
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
WDI	World Development Indicators

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1. EXECUTIVE SUMMARY

The International HCH and Pesticide Association (IHPA) has as part of the EU-FAO project "Improving capacities to eliminate and prevent recurrence of obsolete pesticides as a model for tackling unused hazardous chemicals in the former Soviet Union" GCP/RER/040/EC been tasked with completing a regional survey of destruction capacity for pesticide and other hazardous chemical wastes.

Data on waste quantities has been collected from 12 countries by national consultants and supplemented by data on hazardous waste from Ministries and national statistical institutions. It is for the first time that such a detailed inventory of obsolete pesticides, POPs and other hazardous wastes has been carried out, presenting as well the legacy waste volumes per country as the annual arisings.

In the highly industrialized countries (Russia, Ukraine, Kazakhstan and Belarus) the amounts of hazardous waste are high and therefore short term action for the development of proper hazardous waste management and destruction capacity to start up the elimination of obsolete pesticides and other POPs wastes is recommended. This will help prevent the build up of significant additional legacy volumes that pose escalating risks for human health and the environment.

A Road Map, applicable for all countries in the EECCA region has been developed including the main and common elements of an environmentally sound management system for hazardous waste (including inventories, legal and regulatory frameworks, organization, destruction capacity, innovation and prevention). But starting points, speed and routes may and will differ between countries. And it will take time.
Based on the experiences of other parts of the world, it will take at least 10 to 20 years to arrive at full implementation. The international donors have initiated this process and will continue to give support to the countries. But it is the responsibility of the governments to make the necessary commitments, to allocate resources, to define principles and create a firm legal basis, with effective enforcement and open communication in order to arrive at a well-managed implementation.

It is therefore that governments of the countries have been invited to express their commitment in a letter of endorsement. Several countries have responded to this invitation and disclosed their ideas about the future developments. These letters can be used to continue the dialogue, to define actions for co-operation in order to arrive at the development of capacities needed for proper management and sufficient destruction capacity.

2. INTRODUCTION AND STUDY CONTEXT

The International HCH and Pesticide Association (IHPA) has as part of the EU-FAO project "Improving capacities to eliminate and prevent recurrence of obsolete pesticides as a model for tackling unused hazardous chemicals in the former Soviet Union" GCP/RER/040/EC been tasked with completing a regional survey of destruction capacity for pesticide and other hazardous chemical wastes. The scope of the survey focused on Obsolete Pesticides (OPs), but also took account of Persistent Organic Pesticides (POPs)[1] and other hazardous wastes arising in the Eastern Europe, Caucasus and Central Asia (EECCA) region.

The study is focused on the technical and financial feasibility of the options for environmentally sound management (ESM) of pesticide waste and other hazardous chemicals in all EECCA countries in order to gain economies of scale for any technical solution. The concept of ESM is defined under the Basel Convention. The ultimate aim of the study is to develop a "Road Map" to guide national governments, regional institutions, the donor community, hazardous waste producers and hazardous waste disposal companies in the establishment of adequate capacity for ESM of hazardous waste in the region.

Data on waste quantities has been collected from 12 countries by national consultants and supplemented by data on hazardous waste from national statistical institutions. **Fout! Verwijzingsbron niet gevonden.Fout! Verwijzingsbron niet gevonden.Error! Reference source not found.** shows the collected data grouped in waste streams. **All national authorities are kindly requested to verify whether the data used are correct or the best available and to suggest any improvements that can be made. It is vital for the usefulness of the report to receive input from the concerned national authorities.**

It is noteworthy that the amount of annual arising of counterfeit (fake) pesticides (even with the missing data) is approximately 7% (based only on the information from Russia and Ukraine) of the existing legacy of OPs and POPs. From the other 10 countries no information is yet available, but it is expected that this amount will be much higher. It is important to understand that any interventions to build capacity for ESM of pesticide wastes needs to fit in a framework of strengthened regional capacity for the life-cycle management of pesticides. Strengthened pesticide and waste legislation, and its enforcement, together with the promotion of sustainable pest management will reduce reliance on pesticides and reduce the generation of new pesticide wastes.

Information on potential treatment technologies presented in chapter **Fout! Verwijzingsbron niet gevonden.Fout! Verwijzingsbron niet gevonden.Error! Reference source not found.** is based on the latest update on the Basel Convention Technology fact sheets (due to be published at the beginning of 2015*).*

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[1] Persistent Organic Pollutants are defined and controlled under the Stockholm Convention

The data on waste quantities have been discussed with representatives of the EECCA countries at a workshop 27 to 30 October 2014 at Green Cross Training Centre in Smolevitchy, Belarus, and these data have formed the basis for the design of a future regional management system.

3. LEGISLATION, ENFORCEMENT, INTERNATIONAL CONVENTIONS

3.1 National Legislation in the countries

Under the study, assessments have been made of national legislation on pesticides and hazardous wastes, including their definitions and disposal requirements, as well as the capacity for their enforcement. In order to understand the main issues of the assessment a brief overview of the main Pillars, Sections and individual items have been listed in the following

The result of the assessment has been laid down in a report per country, containing the following four main pillars:
Pillar I - General background information (International Treaties participation) – see section 3.2
Pillar II – Regulatory framework on waste management
Section I Political & Legal Framework including Situation with stocks of obsolete pesticides
Section II Specific Laws and Regulations that govern waste management
Section III Institution(s) involved in waste management (focus on pesticides)
Section IV -Analysis of existing national waste management legislation

- *Theme 1: Scope*
- *Theme 2: Definitions*
- *Theme 3: Register of Pesticides Waste and General Classification of Waste*
- *Theme 4: Licensing*
- *Theme 5: Trans-boundary movement, Import / Export*
- *Theme 6 : Economic Initiatives*
- *Theme 7: Transport*
- *Theme 8: Labelling requirements*
- *Theme 9: Packaging and containers*
- *Theme 10: Emergency procedures*
- *Theme 11: Disposal obligations*
- *Theme 12: Incineration*
- *Theme 13: Recording, monitoring, and reporting*
- *Theme 14: Offences and penalties*
- *Theme 15: Official controls and inspection*
- *Theme 16: Research and development*

Pillar III - Information supplementing legal analyses – from other Experts with questions on 3 Topics
Pillar IV - Disposal, Storage, Recycling and Recovery Facilities – practical information from other Experts with questions on 4 topics

All Sections and listed themes have been benchmarked against the international Conventions Stockholm Convention/Basel Convention, good regulatory practices as well as selected EU directives. EU regulations.

In this way the national consultants could create a good picture of the gaps and needs.
In general the following needs for improvement are found in several countries. The list below can therefore serve as a checklist for the renewal of legislation and organization:

- Legislation is often old fashioned and has a long history of inconsistent repairs
- Principles (e.g. polluter pays, protection of human health and environment, extended Producer's responsibility) as a basis for legislation are often lacking
- There are no clear definitions of hazardous waste
- For enforcement of legislation, penalties are insufficiently defined, officers in charge for enforcement are not well trained
- Statistical data are not collected in a systematic way and data quality is insufficiently defined and managed

- Regulations regarding producer responsibility are only in few countries obligatory
- For pesticides, the boundary zone between agricultural application and pesticides considered as waste material is unclear

For detailed information per country is referred to the individual country reports. Generic recommendations are presented in APPENDIX 11

3.2 International conventions

The most relevant international conventions are the Basel, Rotterdam and Stockholm conventions, dealing with respectively: the trans-boundary transport of hazardous waste; import and export notifications for hazardous chemicals; and the elimination of obsolete pesticides and POPs.
Most countries have ratified all three conventions. This applies for Armenia, Georgia, Moldova, Ukraine, Kazakhstan, Kyrgyzstan and Russian Federation.

The Rotterdam Convention is still to be signed by Belarus and Azerbaijan, while Tajikistan has not yet signed the Basel Convention.
Turkmenistan and Uzbekistan have not yet signed both the Rotterdam and Stockholm Conventions.

Apart from signing and ratification, the key issue is of course the implementation of these conventions. Using the Stockholm Convention as an example, the countries are at different stages of its implementation.

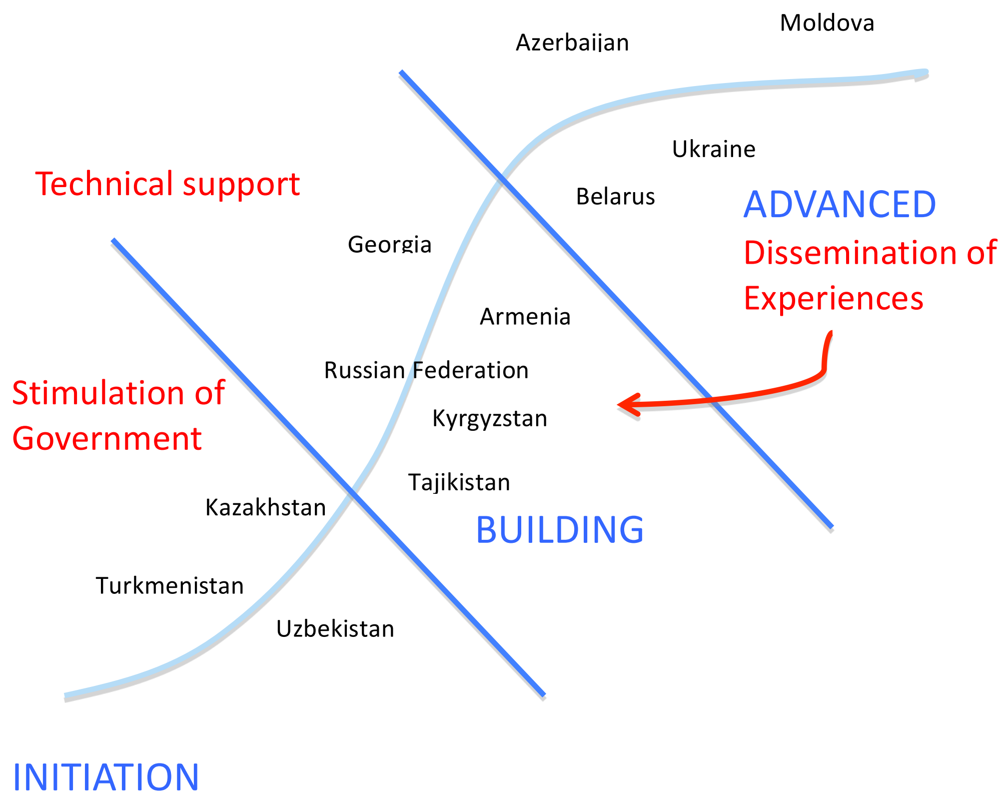


Figure 1 Countries of the EECCA Region in the different phases of implementation of the Stockholm Convention, status 2014. Three phases in blue, main focus per phase in red

These stages are:

- "Initiation" where governments are dealing with the signing of the convention and the preparation of inventories of POPs in the country;
- "Building" with the development of National Implementation Plans (NIPs); and
- "Advanced" (implementation) with the completion of the execution of the NIP: repackaging, storage and /or transport for destruction.

Figure 1 shows the actual status of the EECCA countries in the implementation of the Stockholm Convention. For each of the three phases it is indicated where donors in their support should focus on (stimulation of governments, technical support and dissemination of experiences). The countries that have arrived in the advanced implementation phase have gained broad experiences and are thus enabled to give assistance to other countries.

3.3 Role of Eurasian Customs Union

The Eurasian Economic Union (EEU), also known as the Eurasian Union (EAU) is a political and economic union, which was established by a treaty signed on 29 May 2014 between the leaders of Belarus, Kazakhstan, and Russia. A treaty to enlarge the EEU to Armenia was signed on October 9, 2014. Kyrgyzstan has signed a roadmap for its accession and a treaty to include the country into the union is to be signed on December 23. The Union will officially go into effect on 1 January 2015 (EEC, 2013, 2014).

The Customs Union of Belarus, Kazakhstan, and Russia came into existence on January 1, 2010. The Customs Union's priorities were the elimination of intra-bloc tariffs, establishing a common external tariff policy and the elimination of non-tariff barriers (EEC, 2013, 2014).

According to the legislation of the Custom Union, the import, export or transit of the hazardous wastes from the territory of Russia, Belarus, Kazakhstan is forbidden. It means that Kazakhstan and Russia are restricted in their capacity to send, according to the Basel Convention, the OPs for elimination to the EU Member States where the main incineration plants are located.

In the final quarter of 2014, a revision to the legal articles of the Customs Union is being considered by the members that will allow member states of the Union to export, import and to permit transit of hazardous wastes according to the requirements of the Basel Convention. It is expected to be approved during 2015. It is anticipated that countries will be allowed to move the wastes for disposal only under special permissions of the ministry of environment of each of the relevant member countries.

It should be mentioned that Azerbaijan, Georgia, Moldova and Ukraine are not members of the Customs Union. As such they can export waste under the requirements of the Basel Convention to dedicated hazardous waste treatment installations in the EU member states, provided of course that the transport route does not transit territory of the Customs Union.

4. VOLUMES OF OBSOLETE PESTICIDES (OPS), POPS AND OTHER HAZARDOUS WASTE IN THE EECCA REGION

4.1 Methodology for data collection and related sources

The data collection has been based on the IHPA study of the national waste management consultant's reports for 11 of the 12 EECCA countries. They have collected, according to a prescribed and formatted structure, specific legacy waste and the summaries of specific contemporary annual waste arising's from the Ministries of Environment or related organisations or committees in each country. In a number of countries these data are available on various national websites.

Many of the OPs data come from project data that have been collected from recent reports from on-going projects such as GEF financed UNDP projects for the landfills in Armenia and Georgia. Also results of inventory works in countries that made use of the FAO PSMS system have been used such as for Kyrgyzstan and latest updates of the NIPs have been used for Tajikistan.

PCB data were derived mostly from NIPs, although it is known that these data are very general and often were not based on actual field visits. In the Table in APPENDIX 1 showing all the waste streams per country for the EECCA region, a large number of explanatory notes have been made in order to identify the sources of information. Where needed, assumptions and calculations have been made in order to obtain concrete numbers for the various waste streams.

4.2 Types and categories of waste

In order to get an overview of the main waste streams, i.e. wastes and soils and other components that need to be disposed of in an ESM, the following main categories have been established:

Main hazardous waste groups are defined as 'Legacy Wastes' and 'Annual Arising's' in order to distinguish between past and currently generated hazardous waste. This has been done to ensure in addition to legacy waste as a one-time action, the Annual Arising's waste which is generated yearly will be considered as part of a long-term sustainable strategy for the planned solutions.

4.2.1 Legacy wastes (in tonnes)

1. **POPs pesticides and obsolete pesticides (OPs)** (POPs as defined in the Stockholm Convention)
2. **Industrial POPs** (as defined in the Stockholm Convention)
3. **Contaminated soils**: As many of the OPs were originally manufactured before 1989; their containers have been subject to corrosion and physical damage causing the contents to leak. The leaked pesticides have in many cases penetrated soils and now represent a risk of further contamination of ground and surface waters as well as populations close to the sites of contamination.
4. **Burials:** As well as polygons where a number of POPs OPs and forbidden pesticides were officially disposed of during former Soviet times, there are also burials that occurred after the privatization of stores, where the private sector buried the contents of the stores they bought. Here it is frequently extremely difficult to define exactly the materials to be dealt with. Such sites may involve POPs pesticides waste, OPs waste or contaminated soils. It may be that if the waste has been spread considerably and mixed with soil whereby the total quantity of the material for disposal has increased significantly.
5. **Contaminated containers**: These being the containers that contain pesticide residues. They have originated from previous re-packing exercises where the contents have been transferred to new packages or because the containers have corroded or been damaged and the contents have leaked out. Containers consist of all sorts of materials including steel, plastic, paper/cardboard and jute bags.
6. **Hazardous waste:** Waste classified in the countries as toxic and /or hazardous waste that has accumulated over many decades. Waste classification system is based on Soviet approach,

which divides wastes into five classes according to level of hazard (toxicity). These five classes are ranging from extremely toxic to non-toxic classes. However, there are neither exact criteria for the classification of waste types nor definitions for a "hazard" (UNECE).

4.2.2 Annual arising's (in tonnes per year)

- Hazardous waste that arises as by-products of industrial processes.
- Empty containers that arise from the routine use of pesticides in agriculture and public health.
- Counterfeit (fake) pesticides (illegally produced pesticides) are increasing in the region (IHPA, Malkov-1, -2), in the EU (EUROPOL, 2011) and globally (FAO/WHO, 2008).

4.3 Outcomes of the hazardous waste inventory in the EECCA region

The waste quantities from the EECCA countries are listed in Table 1 and details can be found in APPENDIX 1. An explanation of the methodology of data gathering has been given in section 4.1

The data have been analysed in section 4.3.1.

Table 1 Data on waste volumes as collected in 2013 and 2014

	Legacy Waste				Annual Arisings		
Waste cat / Country	Σ Pesticide waste	Σ other POPs	Σ Pesticide Contaminated soils	Σ Hazardous waste	Σ Pesticide waste	Σ Oily -Tar waste	Σ Hazardous waste
Armenia	864	17 000	11 069				60 530
Belarus	7 950	740	2 750	968 000 000	825	30 000	33 260 000
Georgia	6 470	550	177 120			1 018 000	
Moldova	4 900	1 200	2 500				418
Ukraine	24 500	43 000		4 500 000 000	25 000	3 242 900	419 000 000
Azerbaijan	11 000	146	25 840	1 764 000		61 420	160 500
Kazakhstan	56 930	190 848		9 790 000 000		400 000	355 952 000
Kyrgyzstan	3 446	2 133	48 350	93 690 000		1 884	4 784 027
Russia	70 000	35 000		61 319 000 000	22 500		5 000 000 000
Tajikistan	15 000		228 900				
Turkmenistan	11 457			32 300			1 000
Uzbekistan	17 718						
Total EECCA	230 235	290 617	496 529	76 672 486 300	48 325	4 754 204	5 813 218 475

Legend
- (red) No data on volumes, need to be collected
- (yellow) No data on volumes, but other data available as e.g. number of sites

4.3.1 Data quality and uncertainties

OPs and POPs waste are recorded as more than 230 000 tonnes, including storages and burials. This number is perceived as reasonably reliable. Previous surveys have often only been based on old archive data and were missing field data. At present field surveys have been made in many, although not all, countries. In most of the countries like Armenia, Azerbaijan, Belarus, Georgia, Kyrgyzstan, Moldova and Ukraine field inventories have been implemented so the situation in the field is much better known. On the other hand, the real amounts are only clear when detailed investigations and/or the real clean-up works are carried out. It should also be mentioned that there is no information available on the amounts of the pesticides burials in Russia (see APPENDIX 1). It is expected that Russia has large quantities of OPs that could exceed the total of the amount recorded for the entire region (The Guardian, 27 November 2012).

Costs of inaction:
An important conclusion can be made from the experiences of the recent detailed investigations in two GEF financed and UNDP implemented pesticides burial sites at Nubarashen in Armenia and Ialguja Georgia. In Armenia original volumes of 512 tonnes and in Georgia about 2 800 tonnes of OPs have been documented from the old archives, but now the detailed investigations show a remarkable increase in volumes.
For the Nubarashen site in Armenia:
a) Pure Pesticides waste: 605 tonnes
b) Contaminated soils: 5 100 tonnes of contaminated topsoil with traces of pure pesticides, and slightly contaminated top cover landfill body: 1 513 tonnes
c) Heavily contaminated top soil with traces of pure pesticides in landfill body: 1 916 tonnes.
Total quantity: 9 134 tonnes.
This is about 18 times more than the original amount being disposed during a 10-year period from mid 1970s until mid-80s. From 1980 to 2013 (end of feasibility study) this would be 33 years.

For the Iagluja site in Georgia:
Latest data from UNDP project show:
a) 6 320 t POPs pesticides and mixed with other chemicals;
b) Strongly contaminated topsoil – 4 800 tonnes and
c) Strongly contaminated subsoil – 2 640 tonnes;
d) Slightly to moderately contaminated topsoil soil – 20 080 t.
Total quantity: 33 840 tonnes. This is roughly nearly 12 times more than the original quantity that has been disposed in the period from 1976 till 1989 over a period of 32 years till 2014.

In summary these problems of relatively limited-size have increased considerably over the years due to non-action. This indicates clearly that action has to be taken before the situation deteriorates further as this will disproportionately increase future clean-up costs.

Industrial POPs are estimated to be more than 290 000 tonnes. This number has been generated from the NIPs and is therefore more uncertain, as it is based upon a limited amount of field inventories or no more often no inventories at all. The correct number is therefore expected to be significantly higher. For Tajikistan, Turkmenistan and Uzbekistan there is no data.

The total volume of OPs and POPs waste and industrial POPs waste is more than 520 000 tonnes, which is sufficiently substantial to justify the construction and treatment of one or two medium size hazardous waste treatment plants in the region.

The **quantities of annual hazardous waste arising's** for Georgia, Tajikistan and Uzbekistan are missing and the number given for Turkmenistan of 1 000 tonnes per year seems unrealistically low. The total annual hazardous waste arising's reach at least 5.8 Gt, which amounts to more than 57 times the quantity the EU Member States generated in 2010 (101.4 Mt), indicating there is a lot to be gained by proper hazardous waste management in the region.

The arising high volumes of hazardous waste in the countries will secure:

- continuity of treatment operations once OPs and other POPs have been destroyed; and
- a regular supply of high calorific waste to support the combustion of non-flammable wastes such as pesticides. In Table 2 the high calorific waste is listed as the sum of oily and tar waste.

Therefore efforts were made to collect data on the volumes of high calorific waste. There are two ways that have been used to obtain these volumes. The first approach is to summarize the specific waste streams from the detailed waste classes (conforming to Basle or EU criteria) to a roughly estimate the high calorific wastes. So far this approach led toa total amount of 4.7 Mega tonnes (Mt) for the region, but this number does not include the major contribution of Russia, which is expected to deliver at least 70 to 80% of the total amount. Even though the amount is big it will be of great use to secure effective operation as mentioned under the second bullet above. Another approach is to estimate the percentage subject to treatment, when the required detailed information about the waste categories is not available. The conservative estimate was used that only 4% of the legacy hazardous waste is amenable to treatment. Treatable wastes are estimated to be most of the organic waste streams (see explanatory note [b2]for Belarus in APPENDIX 1). Most of the inorganic waste is comprised of, for example, mining waste, which can only be treated but with significantly different technologies. The percentage is based on information obtained on the classification in Belarus. This approach results in approximately 232 Mt annually high calorific value waste in the region. Both approaches confirm that sufficient volumes of high calorific waste are available for these treatment plants.

The **legacy hazardous waste quantities** are estimated at 4.54 Gt. It should be noted that information from Moldova and Armenia is missing. The amount of hazardous waste for treatment is assumed to be 182 Gt of legacy hazardous waste. It is expected that major attention will be paid first to currently arising wastes, which need urgent solutions. Legacy waste are unlikely to have major attention for treatment in the near future, due to the fact that the amounts are much larger and are not yet considered as a threat as no real information about any risks or consequences of inaction is available yet. However, it is expected that these locations will become an issue for treatment in cases of obvious problems which get publicity. Events such as direct exposures with health consequences for populations living near or on top of such sites, as well as cases of food poisoning for humans and animals and widespread environmental damage will result in escalated demands for action. There is no information on contaminated empty containers throughout the region.

The **quantities of contaminated soil** have been estimated to be approximately 500 000 tonnes. This estimate is based on very limited information. Contaminated soil is a new issue, where awareness is absent and until recently, only Moldova has started to address the issue. In Ukraine already 4 500 sites have been indicated, and in Russia it was indicated that in 40 Regions more than 760 Ha of land are contaminated with DDT, and more than 200 000 Ha land are contaminated with OPs. Actual quantities cannot be given at this stage as proper field investigations are lacking. However it is expected that the volumes of contaminated soil will be extremely large. The amount mentioned here is therefore assumed to be the 'tip of the iceberg' and should be treated as highly questionable (optimistic).

More information about first estimate of quantities and the related risks of contaminated soils will be made available by the Blacksmith Institute during 2015. They are at present in the process of assessing a large number of sites in a number of the EECCA countries.

4.4 Status of disposal activities of OPs and POPs in the region today

Mainly Belarus (since 1997), Moldova (since 2003) and Ukraine (since 2001) have been active in the management of OPs and other POPs.

4.4.1 Belarus

In Belarus, 2 618 tonnes of POPs containing wastes (pesticides and PCBs) were destroyed by high temperature incineration at specialized facilities in Germany and France in the period 2011- 2013.

4.4.2 Ukraine

During the period 2007 - 2014approximately 52 000 tonnes of POPs have been repacked and transported for disposal to various EU-member countries, (see Figure 2), where they were safely disposed of.

Large quantities of stored HCB waste stemming from the production of carbon tetrachloride (CTC) and ethylene tetrachloride (ETC) at the former Kalush Chemical and Metallurgical Industrial Complex have been a major part of the total Ukrainian export.

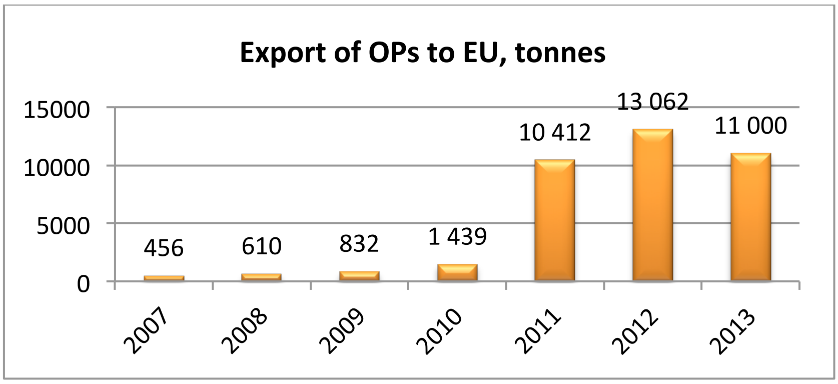


Figure 2 Export of OPs to the EU (IHPA 3, Malkov)

4.4.3 Moldova

In Moldova from 2007 to 2014, 3 555 tonnes of obsolete pesticides and PCBs have been repacked and transported for disposal in EU. The remaining 1 000 tonnes are expected to be disposed of in the EU before the end of 2015.

Example of Progress Moldova has been shown in the following overview Table 2 (Gheorghe Salaru et al, 2015, to be published)

Table 2 Elimination of OP stocks in Moldova

Project	Financing Agency	Implementing / coordinating Agency	Period of eliminatio n works	Amount of OP eliminate d, tons	Present status (Oct. 2013)
▪ *POPs stockpiles management and destruction*	▪ GEF/WB ▪ MD Gov ▪ NEF	▪ MoE (POPs PMT)	▪ 2007-2008	1 293	▪ Finished
▪ *Remediation of environ-mental burdens caused by pesticides in Moldova:* - *Stage 1* - *Stage 2*	▪ CzDA	▪ CzDA ▪ MoE (POPs PMT)	▪ 2011-2013 ▪ 2013-2015	202 250	▪ Finished ▪ Ongoing
▪ *Elimination of obsolete pesticides stocks with major risks (liquid OP)*	▪ NEF	▪ MoE (POPs PMT)	▪ 2013-2014	200	▪ Ongoing
▪ *Disposal of dangerous pesticides from the Transdniestrian Region of Moldova*	▪ OSCE	▪ OSCE Mission to Moldova ▪ MoE (POPs PMT)	▪ 2013-2014	150	▪ Ongoing
▪ *Destruction of pesticides and hazardous chemicals in the Republic of Moldova*	▪ NATO/ OSCE ▪ NEF	▪ NATO ▪ MoD	▪ 2013-2014	1 269	▪ Ongoing
▪ *Improving capacities to eliminate and prevent recurrence of OP as a model for tackling unused hazardous chemicals in the former Soviet Union*	▪ EC/FAO	▪ FAO ▪ MAFI	▪ 2013-2015	250	▪ Ongoing

It is expected, presuming a successful completion of all projects that are now under implementation that all stocks of pesticides stored in warehouses will be eliminated by the end of 2015.

4.4.4 Armenia
In Armenia one GEF funded UNDP project is under implementation, however no export and disposal activities have started.

4.4.5 Georgia
In Georgia there is one GEF funded UNDP project under implementation. Within the framework of this project 230 tonnes have already been exported in 2014.

4.4.6 Kazakhstan
Kazakhstan has been exporting 500 tonnes of PCB to Germany in 2009 and 80 tonnes of PCB to France in August 2014. It should be mentioned the overland transport was not possible as the Custom union does not allow transport through the Russian Federation yet. The PCB has therefore been transported by air.

Table 3 Summary of OPs and POPS exported and disposed off during 2007 - 2014

Country	Amount of Obsolete and POPs Pesticides (tonnes)	Amount of industrial POPs (tonnes)	Total Amount of OPs and POPs Pesticides and Industrial POPs (tonnes)
Armenia	0	0	0
Belarus	1 794	824	2 618
Georgia	230	0	230
Kazakhstan	0	580	580
Moldova[1]	2 662	893	3 555
Ukraine	26 000	26 000	52 000
Total	***30 686***	***28 297***	***58 983***

[1]Per 1 November 2014

As can be seen in Table 3 the total OPs and other POPs exported to Europe for destruction is nearly 59 000 tonnes, with approximately 22 000 tonnes being HCB from Ukraine. The waste has been treated by high temperature incineration (HTI). About 52% of the exports have been OPs.

The average cost of repacking, shipment and disposal in high temperature incinerator (HTI) in the EU is approximately 3 000 USD per tonnes. Half of this amount is related to transportation. Hence by the end of 2014, more than 180 million USD has been paid for treatment and final disposal of OPs and POPs waste.

5. EXPECTED FUTURE HAZARDOUS WASTE MARKET STRUCTURE

5.1 Introduction

The twelve countries of the EECCA region are in different phases of development, have different GDP characteristics and differ significantly in population size and income per capita. The collection of macro-economic data to compare with the findings from the status reports leads to a better understanding of both the data as presented in the status report, and the different circumstances that prevail in each country.

5.2 Characteristics of GDP and population

In Table 4 and Table 5 data are presented for all the EECCA countries regarding GDP, population, and the distribution of GDP over the three main activities of agriculture, industry and services.

Table 4 Data on GDP and populations

Country	GDP M US$ /yr	GDP / capita US$ / yr	Population millions
Armenia	9 910	3 505	3
Belarus	71 710	7 575	9
Georgia	15 829	3 602	4
Moldova	7 254	2 230	4
Ukraine	177 431	3 900	43
Azerbaijan	73 560	7 812	10
Kazakhstan	224 415	13 172	17
Kyrgyzstan	6 473	1 263	6
Russia	2 096 777	14 612	146
Tajikistan	6 987	1 037	8
Turkmenistan	41 851	7 987	6
Uzbekistan	56 796	1 878	30
source	World Bank	World Bank	UNDESA
reference year	2013	2013	2014

Table 4 shows the four largest economies being Russia, Kazakhstan, Ukraine and Belarus. Regarding population, the largest numbers of inhabitants are found in Russia, Ukraine, Uzbekistan and Kazakhstan.
The highest GDP per capita figures (please note that these are no income figures!) are found in Russia, Kazakhstan, Turkmenistan, Azerbaijan and Belarus. It is remarkable to see that the GDP per capita figure of Ukraine is much lower than in the countries mentioned above.

Table 5 presents the distribution of GDP across agriculture, industry and services. The countries with the highest percentages for agriculture are: Armenia, Kyrgyzstan, Tajikistan, Uzbekistan and Moldova. These are also the countries with the lowest figures for GDP per capita.

The highest contributions from industry are found for Azerbaijan, Belarus, Russia, Kazakhstan and Armenia.
Section 5.4 describes the relation between this share and the volumes of hazardous waste as found in the status reports.

The highest contribution from services is found in Georgia, Turkmenistan, Moldova and Ukraine. There are no further details collected for the services part of the economies.

Table 5 Breakdown of GDP

Country	Agri %	Ind %	Serv %
Armenia	21%	37%	42%
Belarus	9%	46%	45%
Georgia	9%	22%	70%
Moldova	14%	20%	66%
Ukraine	10%	30%	61%
Azerbaijan	6%	63%	31%
Kazakhstan	5%	38%	57%
Kyrgyzstan	21%	34%	45%
Russia	4%	38%	58%
Tajikistan	21%	23%	56%
Turkmenistan	7%	24%	68%
Uzbekistan	19%	32%	49%
source	CIA World Fact Book		
reference year	2013		

5.3 Agriculture, OPs and POPs

Table 6 Data agriculture part of GDP and legacy volumes of OPs and POPs

Country	GDP M US$ /yr	Agri GDP M US$ /yr	Σ Pest + POPs tonnes	PPW/AGDP tonn/M US$	PPW/AGDP M US$/M US$	PPW/GDP M US$/M US$
Armenia	9 910	2 081	17 864	8.6	2.1%	0.45%
Belarus	71 710	6 454	8 690	1.3	0.3%	0.03%
Georgia	15 829	1 425	7 020	4.9	1.2%	0.11%
Moldova	7 254	1 016	6 100	6.0	1.5%	0.21%
Ukraine	177 431	17 743	67 500	3.8	1.0%	0.10%
Azerbaijan	73 560	4 414	11 146	2.5	0.6%	0.04%
Kazakhstan	224 415	11 221	247 778	22.1	5.5%	0.28%
Kyrgyzstan	6 473	1 359	5 579	4.1	1.0%	0.22%
Russia	2 096 777	83 871	105 000	1.3	0.3%	0.01%
Tajikistan	6 987	1 467	15 000	10.2	2.6%	0.54%
Turkmenistan	41 851	2 930	11 457	3.9	1.0%	0.07%
Uzbekistan	56 796	10 791	17 718	1.6	0.4%	0.08%
source	World Bank	calculated	status rep	calculated	calculated	calculated
reference year	2013	2013	legacy			

PPW = **Σ Pest + POPs waste**

AGDP = **Agri GDP**

destruction costs at US$ 2 500 per tonne

In the second column of Table 6 the size of the agricultural part of GDP is presented in absolute figures. The countries with the highest numbers are Russia, Ukraine, Kazakhstan and Uzbekistan. The legacy volumes for the sum of OPs and POPs as presented in Table 1 in section 4.3 are included for comparison. The highest ratios for legacy volumes versus agricultural GDP are found in

Kazakhstan, Tajikistan, Armenia and Moldova. No relationship is found with the size of the agricultural GDP.

When the costs for destruction of the OPs plus POPs wastes are calculated at 2 500 US$ per ton, the one-time costs range from 0.3% (Russia and Belarus) to 5.5% (Kazakhstan) of the agricultural GDP. When related to the total GDP, the figures range from 0 01% for Russia to 0.54% for Tajikistan.

This leads to the conclusion that the costs for the destruction of OPs and POPs wastes are affordable, in the macro-economic sense, for all countries in the EECCA region.

5.4 Industrial GDP breakdown and Hazardous Waste volumes

Based on the breakdown of GDP as presented in Table 4, a further breakdown of the industrial GDP is presented in Table 7. Based on the 2012 World Development Indices, the data for oil & gas and other natural resources have been collected. When subtracting these figures from total industrial GDP, the assumption has been made that the remaining part of the industrial GDP relates to industrial manufacturing. This calculation has been made on the assumption that the annual arisings of hazardous waste are proportional to industrial manufacturing activity.

Table 7 Composition of Industrial part GDP

Country	GDP M US$ /yr	Ind GDP M US$ /yr	Oil & Gas M US$ /yr	other Nat Res M US$ /yr	Manufact M US$ /yr
Armenia	9 910	3 667	-	515	3 151
Belarus	71 710	32 987	1 076	717	31 194
Georgia	15 829	3 482	32	111	3 340
Moldova	7 254	1 451	7	29	1 415
Ukraine	177 431	53 229	3 371	4 791	45 067
Azerbaijan	73 560	46 343	29 130	147	17 066
Kazakhstan	224 415	85 278	60 816	11 445	13 016
Kyrgyzstan	6 473	2 201	52	926	1 223
Russia	2 096 777	796 775	339 678	52 419	404 678
Tajikistan	6 987	1 607	21	105	1 481
Turkmenistan	41 851	10 044	14 397	-	-
Uzbekistan	56 796	18 175	6 759	5 112	6 304
source	World Bank	calculated	World Bank	World Bank	calculated
reference year	2013	2013	WDI 2012	WDI 2012	WDI 2012

Other Natural Resources: Forestry, Coal and Mining; Manufacturing = remaining part of Industrial GDP

The highest absolute figures for industry GDP are found in Russia, Kazakhstan, Ukraine and Belarus. The highest figures for oil & gas are found in Russia, Kazakhstan and Azerbaijan. For other natural resources the highest figures are found in Russia, Kazakhstan, Uzbekistan and Ukraine. For the remaining part of industrial GDP, industrial manufacturing, the highest absolute figures are found in Russia, Ukraine, Belarus, Azerbaijan and Kazakhstan.

On the other hand **Table 7** shows that in absolute figures the following countries have a relatively small industrial economy: Armenia, Georgia, Moldova, Kyrgyzstan and Tajikistan.

Table 8 Manufacturing part GDP and Annual Arising's of HW Volumes and related costs

Country	GDP M US$ /yr	Manufact M US$ /yr	Haz waste tonnes / yr	HW / Man tonnes/M US$	cost HW M US$ / yr	HW/Man %	HW/GDP %
Armenia	9 910	3 151	60 530	17	61	2%	1%
Belarus	71 710	31 194	33 260 000	1 008	33 260	107%	46%
Georgia	15 829	3 340	vital data missing				
Moldova	7 254	1 415	418	-	0.4	0.03%	0.01%
Ukraine	177 431	45 067	419 000 000	7 872	419 000	930%	236%
Azerbaijan	73 560	17 066	160 500	3	161	1%	0.2%
Kazakhstan	224 415	13 016	355 952 000	4 174	355 952	2 735%	159%
Kyrgyzstan	6 473	1 223	4 784 027	2 174	4 784	391%	74%
Russia	2 096 777	404 678	5 000 000 000	6 275	5 000 000	1 236%	238%
Tajikistan	6 987	1 481	vital data missing				
Turkmenistan	41 851	-	vital data missing				
Uzbekistan	56 796	6 304	vital data missing				
source reference year	World Bank 2013	calculated WDI 2012	status reports 2014	calculated	destruction costs	calculated	

= costs affordable

= high HW volumes and costs

destruction costs at US$ 1 000 per tonne

Costs for HW treatment have been calculated at a unit price of 1.000 US$ per tonne

Table 8 shows that the ratios between the manufacturing part of GDP and the inventory volumes of annual arisings of hazardous waste vary a lot. The ratios for the hazardous waste volumes divided by the manufacturing GDP figures vary between 13 (Azerbaijan) and 12.158 tonnes per million US$ Manufacturing GDP (Kazakhstan). This calls for a careful check on the estimated waste volumes on the one hand and further investigation into more detailed economic parameters/data to relate the waste volumes.

Table 8 also demonstrates that the **costs for hazardous waste destruction are very to extremely high in Kazakhstan, Ukraine, Kyrgyzstan and Belarus**, when comparing with the GDP value for industrial manufacturing. As for these countries the costs for the annual arisings of hazardous waste are more than the GDP figures for industrial manufacturing, the costs for hazardous waste treatment cannot be easily included in the costs of the related products. This calls once again for a thorough review of the figures. Nevertheless the conclusion is clear that **for countries with high annual arisings of hazardous waste, delays in the start of destruction of these wastes could lead to draconian costs in the future.**
For the green marked countries in Table 8: Azerbaijan, Armenia and Moldova, the costs for destruction of hazardous waste are affordable at the macroeconomic level.

For the red marked countries: Tajikistan, Turkmenistan and Uzbekistan, vital data are missing. Especially for Uzbekistan it is recommended to collect these data in the short term, given the relatively high figure for manufacturing.

The brown marked countries: Kazakhstan, Ukraine, Kyrgyzstan, Belarus and Russia are also the countries where, given the high volumes of annual arisings, destruction capacity could be developed in the short term. In these countries it can be expected that there are always sufficient hazardous waste volumes continuing to arise to keep these destruction facilities running.

5.5 Available Disposal Capacities in the countries

5.5.1 Introduction

This chapter gives a brief overview of existing disposal capacities that are presently available, and also initiatives that could assist other countries. None of the countries has capacity for environmentally sound management of hazardous waste. It should be mentioned that Azerbaijan has been successful in environmental clean-up and in sound chemical and waste management since 2009 and can be used as an example for other countries in the region. An overview of the experiences on co-incineration in cement kilns of Geocycle, a global Waste Co-Processing Network, and experiences on co-incineration in the United Kingdom, can be found in APPENDIX 6 of this report. Cement kilns are in all countries of the region and represent a potential solution. The cement kiln issue is dealt with in a separate study (Alternative Resource Partners, 2014*).*

5.5.2 Azerbaijan

(Zoï Environment Network 2013, see also IHPA Waste Management Report for Azerbaijan by Islam Mustafayev).

Azerbaijan’s successes in environmental clean-up and in sound chemical and waste management provide several examples for others to follow. The clean-up of the Absheron Peninsula – an area with high concentrations of both pollution and people – is a special case. Azerbaijan’s key achievements here include the construction of a new national hazardous waste management site and the oil industry’s modern hazardous waste sites. The country has made significant improvements in the Balakhani solid municipal waste landfill, thereby addressing the problems associated with historical oil, mercury, persistent organic pollutants and ozone-depleting substances. The country is also developing a national solid municipal waste strategy that will apply the experience gained in the Absheron Peninsula to other parts of the country. Other types of waste will be covered by specific strategies.

Figure 3 Impression of the Balakhani Waste-to-Energy Facility and sorting plant

Figure 4 Modern hazardous waste disposal site and improved storage facility for obsolete pesticides at Jangi

Absheron Peninsula environmental clean-up and improvements

In the last ten years the World Bank has financed several projects that aim to improve the environment in the Absheron Peninsula. The total financing from donors exceeds USD 200 million (including new funding) and is being supplemented by governmental co-financing. In addition, private sector actors – such as oil companies – have invested in waste minimization, clean-up and recycling programmes. These projects are helping to rehabilitate land polluted by the legacy of onshore oil production on Absheron, to reduce environmental pressure from today's oil and gas extraction, to dispose of hazardous industrial waste from defunct enterprises safely, and to improve urban solid and liquid waste management in the Baku metropolitan area. An estimated 10 000 ha on the Absheron Peninsula and surrounding areas are affected by oil and chemicals and the contamination of about 2 000 ha polluted during Soviet-era oil production is a notorious legacy that required priority clean-up.

Mechanical methods are used for the clean-up of highly polluted soil, while bioremediation is used for less polluted soil. Between 2009 and 2011, over 800 ha were remediated using one or the other of these methods, notably at the Bibi Heybat and Binaqadi oil extraction and storage areas close to Baku. Once a pollution hotspot, the area is now a park. The large-scale clean-up of the Baku Bay, targeting sunk vessels and obsolete infrastructure, resulted in removal of more than 4 500 tonnes of scrap metal and 500 tonnes of other waste from the seashore and seabed.

Sumgait chemical industry legacy and recent initiatives

With a population of 310 000, Sumgait is the third largest city in Azerbaijan and lies 30 km north of Baku. It was once the industrial hub of chemical production, metal production and equipment manufacturing in the Soviet Union and had a dozen industrial plants and factories employing thousands of workers, who were housed just a few kilometres from these enterprises. Industrial facilities occupy up to one third of the city area. Ten years after the end of the Soviet Union, more than half of the population had some form of chemical-related illness. Children were particularly sensitive to the environmental stress.

The most critical problem – mercury sludge from chlor- alkali production – was solved by the development of the national hazardous waste management site built with financing from the World Bank in full compliance with European Union regulations. The landfill, which has been in operation since 2004, has a capacity of 250 000 cubic metres; over 40 000 cubic metres have already been used for the disposal of mercury soil and sludge, a major operation that was conducted in 2009. The remaining space is available for commercial waste disposal. Təhlükəli Tullantıların (Hazardous Waste) LTD, which was established by the Ministry of Ecology and Natural Resources, operates the national hazardous waste management site in the best manner possible.

Other information on hazardous waste and soil treatment

British Petroleum (BP) in Azerbaijan (IHPA-4, 2014)) has since 2001 built up a considerable capacity for treatment of contaminated drilling materials by the use of four thermal desorption plants.

The treatment comprises Indirect Thermal Desorption (ITD) including a rotary furnace with temperatures up to 450 °C. To June 2014, 35 611 tons of BP's drilling cuttings from offshore drilling have been processed, and generated 3 751 tonnes of recovered base oil for re-use. At present (2014) a new plant is under construction and, with this the four ITD-plants will have a total capacity of 160 tons/day (40 tons/day each). This means that BP soon will have a capacity of around 32 000 tons/year available in the country. Soils contaminated with pesticides are potentially amenable to treatment by ITD. The desorbed pesticides can be either directly destroyed in an in-line thermal oxidizing unit or condensed and repacked for disposal in an external high temperature incinerator.

It could be an option to combine BP's infrastructure in a national plan for hazardous waste management including pesticide contaminated soils. It has yet to be investigated if there is interest from BP in entering into such cooperation.

BP has over the last 10 years stored 20 000 ton of wastes which will be treated by ITD. With the built infrastructure this stockpile can be treated within 1.5 years.

The international cement company Holcim has applied for a licence of its cement kiln to burn shredded tyres as an alternative for fuel. Since 2004, Holcim has been in discussion with the authorities in Azerbaijan to issue permits.

Indirect Thermal desorption treatment plant as is used in the oil industry for treatment of drilling cuttings and recovering of fuel (Source: THOR)

View on plant from the control room of the plant (Source: THOR)

5.5.3 Belarus

Belarus has a relatively small and privately owned modern hazardous waste incinerator (capacity 150kg/h). The installation is owned by CISC "Avgust Bel" and is licensed by the government. It treats hazardous waste from the company itself, including waste from manufacturing of pesticides.

Photo: Visit to CJSC «Avgust-Bel» (pesticide producer, obsolete pesticide incinerator), April 2014. Venue: Druzhny settlement, Pukhovichsky District, Minsk Oblast. The plant consists of a large area of the pesticides production and a hall with an incinerator and a storage facility with a small Russian built incinerator disposing of out of specification and returned pesticides. This Turmaline machine is small and is unavailable for any more disposals other than from Avgust Bel. IN-50.4M has a capacity of 150 kg/h)

View on hazardous waste incinerator at August Bel Factory in Belarus

View on waste stored awaiting treatment at the August Bel pesticide factory

Photo: Visit to Chechersk hazardous waste facility, April 2014 near Gomel in Gomel Oblast.
The capacity of the Chechersk facility has a capacity of 216 000 tons; One facility has a capacity of 101 881 tons and the other one of 114 119 tons. The capacity can be enlarged accordingly depending on the market situation.

View of the front of one of the existing facilities

Hazardous waste placed inside the facility in 7 m deep reinforced concrete cells. On the bottom wastes being packed in steel boxes

5.5.4 Kazakhstan

The World Bank is working in Kazakhstan on the project "Hazardous Waste Treatment and POPs Waste Elimination in Kazakhstan: Development of a Feasibility Study on Construction of POPs/Industrial Hazardous Waste Disposal" (www.devex.com). The total estimated investment budget is between US$100-120 million with the main financing partners being the Government of Kazakhstan, World Bank and Global Environment Facility (GEF). The objective is to construct at least one facility for the disposal of hazardous waste, preferably including POPs waste or similar, and at a capacity of 50 000 ton/annum or more. The project preparation is to be implemented in 2013, and possibly in 2014. The main investment Project is expected to become effective in 2015 with an implementation period of six years (2015-2021).

The latest status of the project is as follows (Dauren Khassanov, 11 December 2014):
The main analytical part of the project on the existing problems of Kazakhstan with POPs-containing waste is completed, and the preliminary assessment of the environmental impact of the planned facility is ready; public hearings will be held by the end of the year.

At present, the construction site of the project owner (the Ministry in consultation with the Government) is selected with a plot of land of 50 hectares. In accordance with the plan of work in this area geological, hydrogeological and engineering surveys are now being conducted.

5.5.5 Russian Federation

On July 24-25 2014, a combined mission with representatives from FAO-IHPA-The Arctic Contaminants Action Program (ACAP) visited the "Ecoresurs" high temperature incineration facility in Krasnoyarsk, which is the only facility in the Russian Federation with a licence to dispose of pesticides. The facility started operation in June 2013, but is not working at full capacity due to lack of waste supply.

The incinerator type IN-50 (the producer's serial number) is produced by Russian CJSC (Closed Joint Stock Company) "Turmaline", and has received a positive response from State ecological expertise in April 2013 (equivalent to an EIA process). As at December 2014 the permit application is being processed by the permitting authority, and the permit to operate is therefore not yet available. The facility capacity was quoted as 2 000 kg of solid waste/hour or 300 kg liquid waste per hour. The excess heat is to be used for heating the buildings in wintertime.
The mission concluded that it appears that it would be possible to use the facility for destruction of pesticides and/or PCBs, and the installation appears to meet the basic requirements for destruction of many types of hazardous waste, and operates with sufficiently high temperature and flue gas

cleaning. In the case of international co-financing of a future waste management system, it would be necessary to confirm compliance with the EC incineration directive (EC) 2000/76 or other international standards required by the concerned financial institutes before this plant could be included as part of the treatment options for destruction of pesticides or PCBs.

Photo: CJSC Turmalin high temperature incinerator in Krasnoyarsk, Russia (FAO-ACAP-IHPA mission)

General view on the facility

Rotary kiln (approx. 2,8 m in diameter, 10 m long)

Flue gas cleaning systems

5.5.6 Ukraine

In Ukraine, the "S.I. Group (Consort) Ltd." is in partnership with the French company Tredi planning to construct two multimodal waste management centres. Each of these will include an incineration facility with a total annual capacity of 15K MT. The first centre will be located to the North of Kiev, in the Ivankov District (close to Chernobyl area). A land plot has already been purchased. The second centre will be located in the industrial heart of Ukraine – the Dnepropetrovsk oblast. Although the main direction of work of this centre will be the storage of other toxic wastes, mostly stemming from the Eastern part of Ukraine, a similar incinerator is also planned at this location (IHPA -3, 2014,).

6. HAZARDOUS WASTE MANAGEMENT IN THE EUROPEAN UNION

6.1 Historical developments in EU on hazardous waste management

Before starting to discuss the present situation of hazardous waste management in the EU, it is important to look back to describe some typical examples of how developments have taken place that possibly could also occur in the EECCA in the near future.

Competition between cement industry and High Temperature incinerators: Example of market for solvents

During mid-90s, a strong competition between cement industry and a major HTI (High Temperature Incineration plant) broke out in in the Belgium and The Netherlands. At the start of the conflict the HTI had a much bigger solvent market that was about 15 times the solvent turnover of the competing cement kiln, but within a period of 5 years, the cement kiln was able to increase their turnover of solvents with 300% at the expense of the HTI. The result was that the HTI had to be closed and even though the concerned government had subsidized the HTI for the last 2 years with more that 35 million € per year, the plant was not able to compete any more. The cement kiln used the solvents for the co-processing of hazardous waste and at the same time to save on fuel costs for the cement production; the HTI was in need of solvents for better treatment of solid waste and as waste with a high calorific value in order to save energy costs. In the end, the cement industry had the significant advantage of producing cement to generate basic income from this process. In contrast, the HTI had its income only from the waste supply and was losing income when prices started getting lower and lower. In the end the HTI was not able compete any more against the cement kiln.

Denmark: Public private partnership and country wide collection points

In Denmark, a kind of public corporation, Kommunekemi A/S, was established by the federal government to provide sound waste management capacity. Kommunekemi A/S has developed central waste management collection points throughout the country. Danish companies must either treat wastes on-site or use the Kommunekemi A/S facility. While initially funded by the government, Kommunekemi A/S is now somewhat self-supporting through user fees (Susan E. Bromm). In 2009 Kommunekemi has been taken over by the Swedish private organization NORD Group and is very active on the international hazardous waste market.

UK example of early investment in high technology plants – but governments allowed landfills to accept hazardous waste at the same time

The UK hazardous waste disposal capacity has been almost wholly funded by the private sector. With the rise in the general concern for the environment, companies responded quickly to this need through the 1970s by developing a number of specialised treatment facilities. However, the continued availability of landfill co-disposal sites accepting hazardous wastes effectively provided a cost barrier to investment in the hazardous waste treatment sector. In the 1980s treatment plants relied heavily on imports from Europe to remain operational, as other countries made use of the UK for 'buffer' capacity while their own facilities were expanded to meet growing demand. By 1987, it was reported that only 4 commercially available merchant incinerators were operating, while a further 7 had closed since 1974. (David C. Wilson and Richard Smith).

6.2 Current situation

The European Union legislation requires all EU member states to prepare hazardous waste management plans and ensure capacity for treatment, either individually or as part of a cross-border/regional approach. Hazardous waste may furthermore be used as a source of energy. The nearest treatment facility may be just across the border, and/or the waste streams may be small and/or expensive and complicated to treat, in which case it may not be feasible to build up country-based facilities. It is therefore recognised that trans-boundary movement of hazardous waste contributes to a sound and efficient management system.

A recent report from the European Environment Agency *(*EEA 2012*)*, highlights the following key points,

- In 2009, EU Member States generated *74 Mt of hazardous waste* in total (28 % more than in 2000)
- In the period 2001–2009, hazardous waste *exports* from Member States grew by 131 %, from 3.2 Mt to 7.4 Mt
- Almost all hazardous waste exports from EU Member States are to other Member States (97 % in 2009)
- In 2001 EU Member States *imported* around 3 Mt of hazardous wastes, whereas in 2009 that figure reached 8.9 Mt (an increase of 197 %). This means that there was a net import from outside the EU of 1.5Mt (8.9-7.4 Mt)
- In 2009 the Netherlands was the biggest exporter of hazardous waste among EU Member States (2.7 Mt) and Germany was the biggest importer (3 Mt)
- Around three-quarters of EU trans-boundary waste movements are for recovery operations such as recycling of materials or use as fuel, with the remainder being moved for disposal

The trans-boundary movement of hazardous waste in the European Union is illustrated in Figure 5, below *(*ref IBID*).* It represents the 30 largest waste streams, in total 7.4 Mt (equivalent to 10% of the total waste streams), that were exported in 2009.

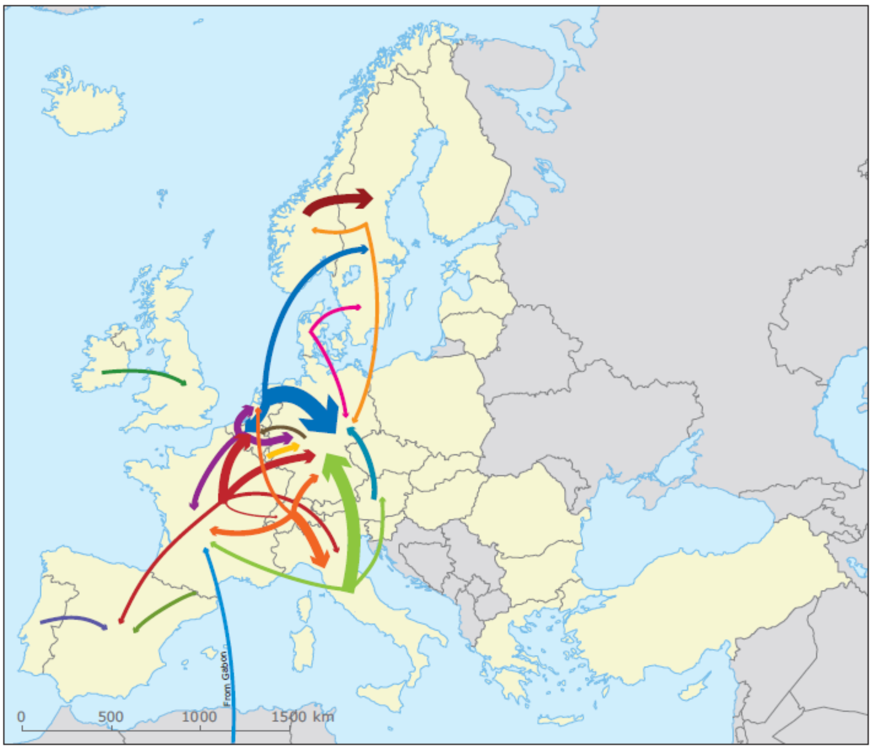


Figure 5 Trans-boundary movement of Hazardous Waste in Europe. Waste streams representing 80% of the trans-boundary movements.

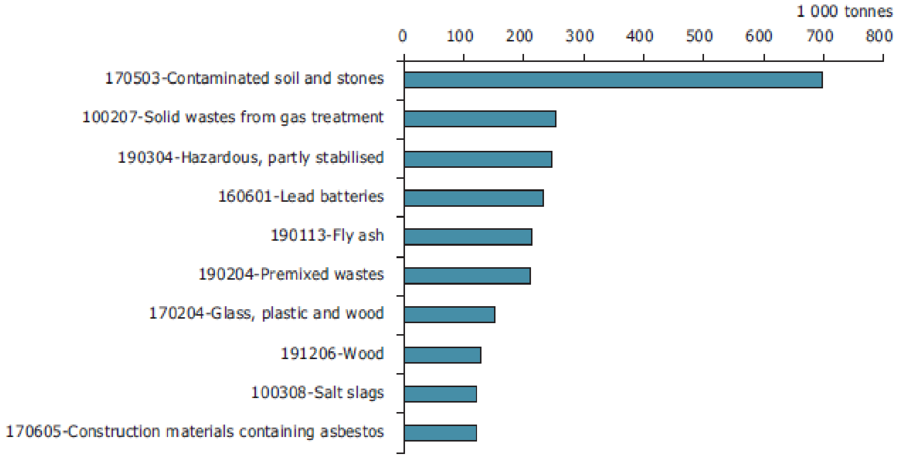
It appears from Figure 5 that Germany is the largest importer of hazardous waste. This is explained by a variety of factors including the diversity of facilities, its substantial waste management capacity, the availability of advanced technologies and Germany's location in the middle of Europe, bordering many countries.

The Top10 tonnages for hazardous waste subject to trans-boundary movement are shown in Figure 6, below. It shows even contaminated soil is subject to export, in spite of transportation costs and environmental impacts.

The European study shows that 90% of the waste is treated within the country of origin. The study does not give any exact driver for trans-boundary movement of hazardous waste, but points to the fact that recovery/disposal facilities often require specific technologies depending of the type of waste, are dependent on economies of scale or suffer from imbalances in the industrial production waste streams.

In comparison the EECCA study area includes an estimated hazardous waste stream of approx. 450 Mt/year or approximately 6 times the waste stream in the EU area.

Figure 6 Top-10 of waste moved across borders



Source: ETC/SCP, 2009, based on data from 16 countries.

Figure 6 shows the waste streams moved across borders. It is perhaps surprising that contaminated soil is the largest part of the trans-boundary movement, as this intuitively would seem extremely costly. According to the EECCA study, soil is exported because of lack of national treatment solutions.

The European hazardous waste management system is based on uniform legislation and strict law enforcement. Confidence in the need for a long term market for hazardous waste is the key for private investors supplying often highly advanced and capital intensive technologies (12th Forum 2013).

Investors that are planning to construct and operate plants of a given capacity need to be certain that a long-term and stable market exists. The market is dependent on legislation and its enforcement.

7. A ROAD MAP FOR THE DEVELOPMENT OF ENVIRONMENTALLY SOUND HAZARDOUS WASTE MANAGEMENT IN THE EECCA COUNTRIES

7.1 Introduction

In order to create the conditions for adequate hazardous waste management in the EECCA countries, using the experiences as described in chapter 6, a Road Map has been developed with five different tracks, each dealing with important aspects, these being:

- Inventory of waste volumes
- Legal framework
- Aspects of organization
- Achieving hazardous waste destruction capacity
- Programming for Innovation and Prevention

These five tracks are explained in the next paragraphs.

Each track is visualized in Figure 7. The tracks are divided into four phases. The four phases are:

- Assessment & commitment
- Principles & legal basis
- Enforcement & communication
- Implementation & management

It can be expected that each phase needs a time span of 2 to 5 years. Therefore the execution of all activities as presented will demand a period of around 10 – 20 years.

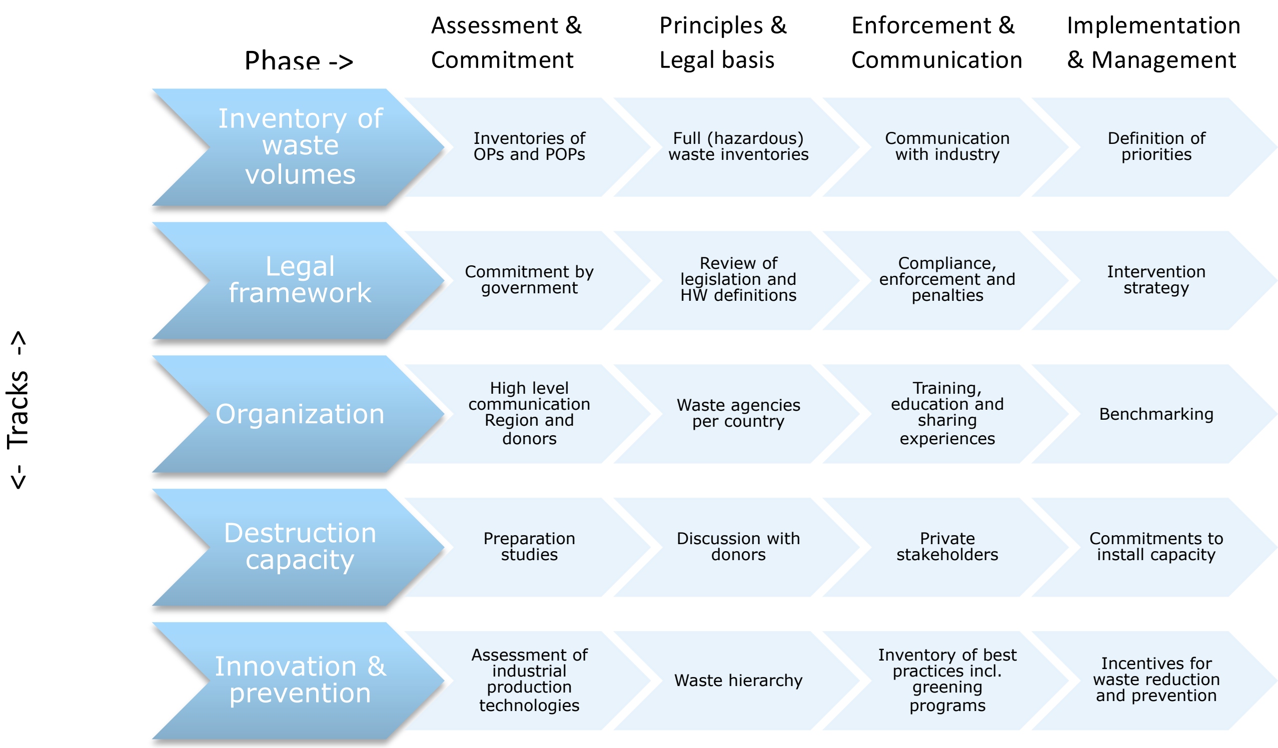


Figure 7 Gantt chart for different tracks of implementation of hazardous waste management

This Road Map is developed to assist the governments of the countries in their implementation of hazardous waste management. The text of this chapter 7 contains suggestions and recommendations. In section 7.7 specific recommendations are made for 'next step actions' to governments of countries that are in a similar situation. But in the process of implementation there are more stakeholders than just governments, such as international donors, industry, NGOs and the waste sector. For these four groups of stakeholders specific recommendations have also been given in section 7.8.

This study and Road Map development have been initiated and financed by the international donors. How the international donors intend to assist the governments of the countries is described in section 7.8.1. The World Bank is willing to facilitate the realization of initial hazardous waste destruction capacity in the EECCA region. The outcomes of this study provide guidance in finding the preferred investment options. These recommendations are described in section 7.10.

7.2 Inventory of waste volumes

The inventories of OPs and POPs are carried out under regulations of the Stockholm Convention. However, as described in section 4.3.1, in some countries, such as Tajikistan, Turkmenistan and Uzbekistan, the volumes of OPs and POPs are not known sufficiently. In these countries, additional efforts are necessary to create these inventories first.

The inventory of hazardous wastes including OPs and POPs is the responsibility of each country, including the allocation of budgets. In several countries a substantial effort is still needed to complete the (hazardous) waste inventory. This is mainly the case for the annual arisings of pesticides wastes and oily-tar wastes. The information in chapter 4 and related annexes can be helpful to identify the additional tasks to be done.

It is recommended to carry out these inventories to a level of information that enables the execution of scenario development and economic impact analysis. This sets requirements for the application of the right chemical analysis and testing methods, registration of place of origin and industrial process, volumes etc. Also the utilisation of the right statistical methods is important to provide data that can be reliably used for investment and planning, without the burden of seeking unnecessary accuracy.

Once this information is made available, and under the track of the "Legal framework" the outlines are developed for hazardous waste definitions, compliance, enforcement and penalties, the discussion with industry (Phase 3) can start about the expected consequences for hazardous waste management. On the cost side expenditure will rise to meet the inevitable additional costs for hazardous waste destruction and the consequences of any violations of the new legal obligations. But there are also gains; the options for participation in innovation and waste prevention programs will lead to cost savings and better access to international markets. How all this will work out in the future when commitments are made by industry to deliver destruction capacities will only become clear when such meetings are held. The authorities have to decide to what degree they want to involve industry in these processes of decision taking (although governments are recommended to introduce multi-stakeholder decision processes) (K. N. Probst and T. C. Beierle, 1999).

The final phase will be agreement on all the necessary relevant parameters, including:

- principles (e.g. polluter pays),
- hazardous waste definitions,
- monitoring programmes,
- methods for statistical and analytical analysis and testing,
- flows of information,
- methods for matching (and contract form) between waste producers and disposal contractors,
- logistics and systems for tracking and tracing.

And these are just examples of measures which are necessary to create fair and equal conditions for all stakeholders in order to prevent waste tourism and illegal practices. It is recommended that in this phase the priorities for the destruction of hazardous waste are defined, based on e.g. the risks related to landfilling or storage, and the development timetable for the future destruction capacity.

7.3 Legal framework

In most of the EECCA countries, governments have already decided to start the process of developing hazardous waste management. This commitment is evident from the allocation of budgets for the execution of the next phases. These decisions of the governments are often based on perceived risks due to the landfilling or storage of hazardous wastes. In the phase of awareness raising NGOs play an important role in addressing the interests of society and public concern. This social awareness precedes the (renewed) definition of the legal framework.

Once this commitment is made by the government, one of the first tasks to be done is the review of the existing legislation. This assessment needs to be executed at two levels. Relatively small efforts will be necessary for the assessment of compliance with international conventions (see section 3.2 , regarding Basel, Rotterdam and Stockholm conventions). The second more extensive task is the review of national (in some countries including regional) legislation and the identification of an improvement program. Therefore it is recommended to involve international legal experts, to exchange information across the EECCA Region, and to build networks with international experts and donors (see also under the track 'Organization' in section 7.4).
In the redefinition of the legislation, two aspects for special attention are principles (such as polluter pays) and (re-) definition of hazardous waste.

In the third phase, definitions of compliance measures, organization of control mechanisms, the required capacities and mechanisms needed for compliance and application of civil and criminal law, with corresponding penalties included, are all major tasks. Special attention is also to be given to communication. On the one hand communication is recommended concerning risks and protection levels to the public, whilst on the other hand engaging industry about risks, liabilities, and costs as well as savings and benefits is important.

Based on the combination of newly designed adequate legislation and communication with the different stakeholders, the government can define the preferred intervention strategy. Key in the definition of this intervention strategy is the orchestration of the different tracks in this Road Map. In APPENDIX 11 a list of suggestions for improvement of legislation is presented. In addition the detailed reports of the legal assessments per country are available as a first assessment of the recommended improvements in legal frameworks (see APPENDIX 11).

7.4 Organization

Governments that take already a front position in the implementation of hazardous waste management, together with UN organizations and other international donors, can play an important role in creating a high level platform (Ministerial level) for communication between countries in the region, donors and international experts. Such a platform can be supported by expert teams and through workshops and conferences. It is important that experts can exchange experiences and develop effective co-operation on the different tracks and phases of the road map. Also the use of EU Twinning programs have been proven to create regional or bilateral cooperation that can work on the realization of objectives and facilitate better use of experiences available in a number of the EU member states.

In phase 2 the founding of waste agencies is recommended to national governments. Such multi-disciplinary teams of experts can participate in international exchange of information as well as act as a think tank for the Ministries involved. Such an agency will also play a key role in communication with the large number of stakeholders relevant to waste management.

In the third phase, waste agencies can also assess the gaps in information and the expertise of the different stakeholders in the country, as well as the need for training and education. They can organize on a national level the exchange of information between the different stakeholders, and the communication between waste producers, collectors and destructors. They can also play an important role in indicating to the government the need for modifications in the legislation and monitoring. Finally, they can accommodate all parties involved in the activities for defining priorities as described in the last section of section 7.2.

In the last step, benchmarking can be organized between industries in order to stimulate waste reduction programs at individual industrial sites, between waste treatment facilities (on elements such as prices, performance, acceptation criteria etc.) and reporting on trends in waste production, treatment costs and technology development. Waste agencies can also build the bridge to programs for innovation and prevention.

7.5 Destruction capacity

The first step for the instalment of destruction capacity is the realization of preparatory studies. International donors can play an important role in facilitating such studies in the early stages of market development. These studies are important to mobilize the different stakeholders and to survey opinions, willingness to invest, levels of commitment and attitude of co-operation between different stakeholders. These first studies enable parties to discuss the different technologies and the potential scenarios without direct confrontation, which will have undesirable consequences.

In the second step, governments can discuss with donors and other stakeholders the perceived structure of the future hazardous waste market and how this is to be facilitated. This discussion should enable the government to better understand the conditions required for the different stakeholders to invest and the options for financing through loans and/or grants.

The outcomes of this phase can be discussed in phase 3 with private stakeholders, these being the waste industry at both national and international level, the waste producing industry, and (inter-)national or regional investors.

The last step is the decision taking about the legal entities to be established (public, private or PPP) for destruction facilities, the role of stakeholders, the design of waste contracts and the choice of technologies.

7.6 Innovation and prevention

Given the large volumes of hazardous waste found in different countries and the related expected large costs for the destruction of hazardous waste, it will be necessary to start in the short term, in parallel with the preparation of destruction capacity, a program for innovation of industrial processes and waste prevention. Such a program will start in the first phase with an assessment of the existing industrial production technologies and a benchmark with production facilities in other countries. This analysis will present a first picture of the potential gains from waste reduction or elimination.

The second phase can be the introduction of the principles of waste hierarchy (avoid, reduce, reuse, recycle, recovery, landfill or destruct). This is a good moment to start an intensive communication with the waste producing industry.

This communication program can be continued during the next step, the development of so called ‘greening of the industry’ programs. This is dealing with systematic assessments and reduction of energy demand and waste arisings, application of sustainability principles and programs, collection and dissemination of information about best practices for effective production and waste and energy reduction. In the last step, governments can stimulate the participation of industries in such innovation and prevention programs over specific incentives. Free information, training and education, co-development and co-financing of innovation programs are examples of such incentives.

7.7 Next step actions

Regarding the suggestions for 'next step actions' some groups of countries with comparable status in the process have been identified. These are found in the next sub-paragraphs.

7.7.1 Inventories of OPs and POPs not yet finalized

This regards four countries: Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. The last two countries have not yet signed the Stockholm Convention and are recommended to do so. This will give them access to (financial) support in creating an inventory of OPs and POPs and the drafting of a National Implementation Plan. Kyrgyzstan and Tajikistan have already ratified the Stockholm Convention, but have not yet completed their inventories. All four countries are encouraged, when needed, to get support from other countries in the decision of the government to commit themselves to the implementation of hazardous waste management. The countries are also advised to (continue to) participate in both high level and technical sessions in order to share experiences with other countries on these developments. It is worth mentioning that failure to act whilst others progress is likely to result in often illegal transfer of waste to these (non-acting) countries with increased risk, damage and cost to these countries in both the short and long term.

7.7.2 Hazardous Waste inventories not yet finalized

The next group of countries are those countries that have already completed the inventories of OPs and POPs, but not yet the full hazardous waste inventories. This regards Armenia, Georgia and Moldova. The governments of these countries have already made their commitments for the tackling of legacies of OPs and POPs. In this group of countries Moldova is a frontrunner in the implementation of Stockholm. For these three countries it is recommended to consider broader commitments and related additional budgets for the completion of the hazardous waste inventories and the start of the revision of the legislation. This might also imply that several Ministries have to become which also may need additional efforts and commitments. Also the governments of these countries are invited to continue their participation and contribution to international sessions on these subjects.

7.7.3 Countries with expected or proven large volumes of hazardous waste

The next group of countries: Russia, Ukraine, Kazakhstan and Belarus are generally of the same status as the countries mentioned under section 7.7.2, but have a much bigger size of industrial sector (see also section 5.4). This leads, apart from the recommendations as presented under section 7.7.2, to two additional suggestions for 'next step actions': Given the much larger hazardous waste volumes it is recommended they start the preparation of creating the necessary destruction capacity. Preparatory studies and discussions with donors will help to generate in the short term a picture of the tasks to be done for adequate hazardous waste management. The volumes as found in the status reports (section 4.2.2) are so large, that apart from destruction capacity, maximising efforts in prevention and reduction will be important. Therefore it is recommended to start identifying early wins in improvement of industrial processes.

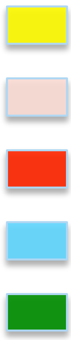
7.7.4 Azerbaijan

Azerbaijan is in a special position, as the inventories of hazardous waste are completed and also the first preparatory studies for waste destruction have been completed. This means that the level of information regarding hazardous waste in Azerbaijan seems to be the best in the EECCA region. High oil & gas incomes combined with a not so high degree of industrialization justify the expectation that the costs for hazardous waste destruction will be affordable. Joint initiatives of governments, academia and the waste sector could lead to good progress in communication with industry (phase 3). From these perspectives Azerbaijan could become a frontrunner in the implementation of hazardous waste management.

7.8 Roles and contributions of other stakeholders

What means 'other' in the title of this paragraph? It has been explained in section 7.1 that the implementation of environmentally sound hazardous waste management is a primary role for the

governments. That is the reason why as well the sections 7.2 to 7.6 (details of the Road Map) as section 7.7 (next step actions per (group of) countries) are written from mainly the perspective of the governments. But in the next subsections the roles and perspectives of the other stakeholders (other than governments) are proposed. This is done for respectively the international donors, the industry, the NGOs and the waste sector.
The colors used in these sheets represent the following roles and contributions:



= stimulate

= participate

= initiate

= advocacy

= financial instruments (e.g. loans and grants)

7.8.1 Roles and contributions of international donors

Figure 8 shows the suggested roles for the international donors. Most suggested roles (indicated in yellow) are related to (top to bottom) stimulation of full hazardous waste inventories, assisting government in the development of their commitments, assistance in the design and build of the required organizational structures and the mobilization by the government of private stakeholders.

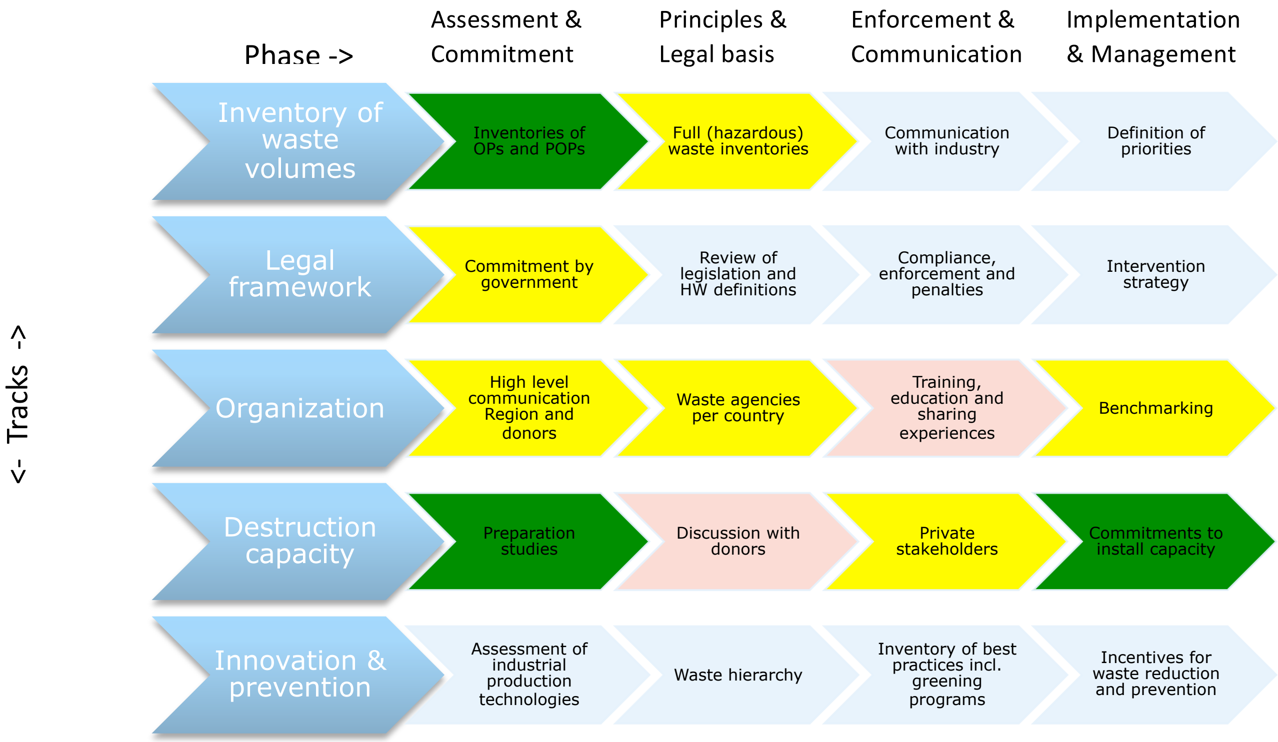


Figure 8 Suggested roles ad contributions of international donors

Participation by the international donors is recommended in (by preference on level of the EECCA region) meetings to share experiences, promotion of training and education and discussion with governments and other stakeholders in the planning of destruction capacity. Financial instruments as loans and grants, provided by the international donors are mainly focused on the inventories of OPs and POPs in the frame of the Stockholm Convention, the execution of preparatory studies for the development of destruction capacity (like this study) and the facilitation of first investments in the destruction capacity.

7.8.2 Roles and contributions of the industry

Figure 9 illustrates the suggested roles and contributions of the industry. The role of the multinational and large national industry in the environmental field is interesting. Industries that have production facilities in different jurisdictions tend to assist governments in the application of international principles, codes and guidelines. Where in the past the multinational industry experienced the legislation as an extra cost with no or limited added value, now it is more and more perceived as a reputational protection and a protection against unfair competition by companies that produce without respecting any environmental law or regulation. Due to that we can notice that the industry even requests from time to time for strict enforcement of environmental legislation by the government in order to create an equal level playing field. It is from this perspective that the following recommendations are given.
First of all the industry could (assist to) stimulate systems for benchmarking (in the middle at the right in the scheme) in order to get international principles applied, controlled and enforced. In the upper row (inventory) the industry can participate in the completion of the hazardous waste volumes and in the last phase in the decision taking regarding priorities. The large industry can offer their assistance in initiating the discussion with government and promote the participation by national large and mid-sized industry. In the development of the legal framework the industry could be involved in the definition of fair enforcement principles: affordable in its consequences but severe enough to create the understanding industry wide that the laws and principles are to be

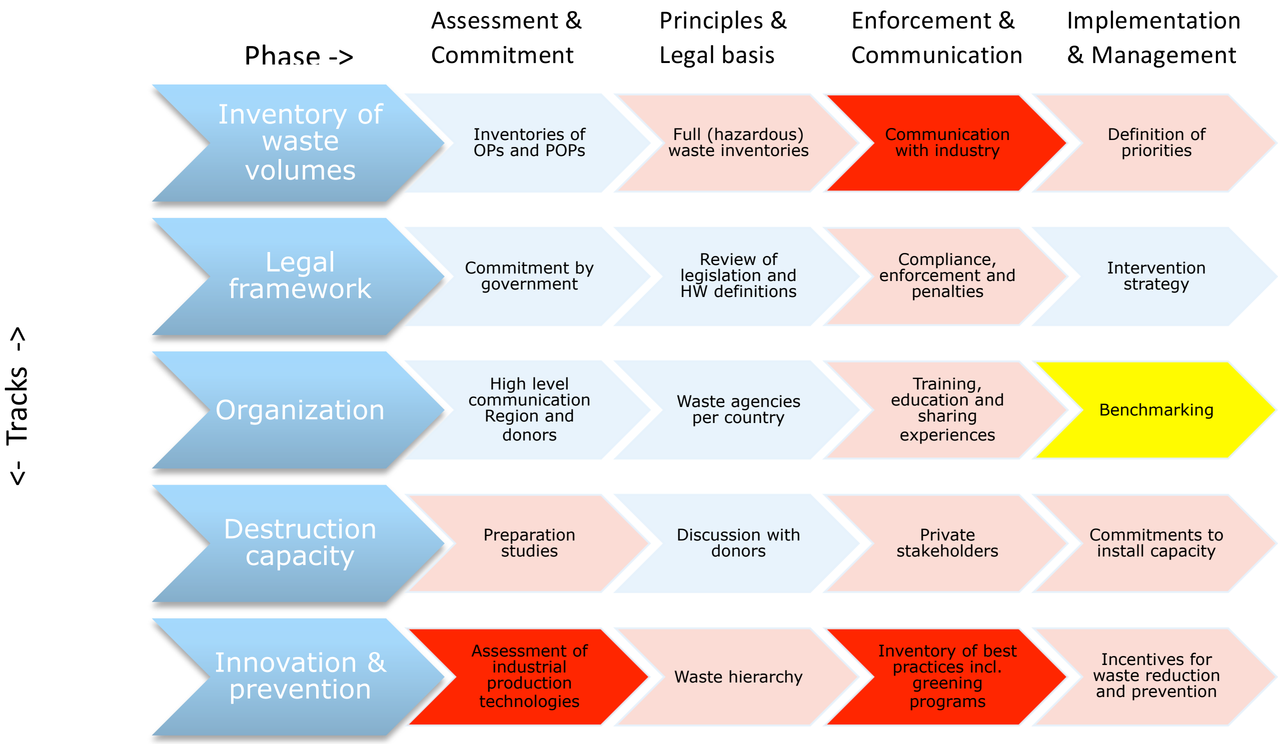


Figure 9 Suggested roles and contributions of the industry

respected. International experience can also contribute to sharing of experiences, training and education (track organization, phase 3). Concerning destruction capacity development, governments are suggested to invite the industry as producer of hazardous waste in these developments. The industry has a broad knowledge base in processes and characteristics of raw materials. And as in the end the industry has to pay for hazardous waste destruction, there is also a gain in participating in the development of destruction capacity.

In the bottom of the scheme, the industry probably will be the most important stakeholder in all four phases. And they can play an role as initiator for technology assessments and inventories of best practices.

7.8.3 Roles and contributions of NGOs

Figure 10 presents the recommended roles and contributions of NGOs. The NGOs defend the interests of the society, the environment or those affected by contamination not able to defend their own rights. We call this here the role of advocacy. Because their role of both defensive (to protect victims) as offensive (to accuse or block the polluters). Another role is their participation in discussions and in decision taking processes. This participation is displayed in Figure 10 in yellow and found in the upper row in contribution in the inventories. Usually NGOs have a lot of information about the presence of contaminants and this is very helpful to speed up inventories. In sessions for exchange of information their input makes the picture more complete.

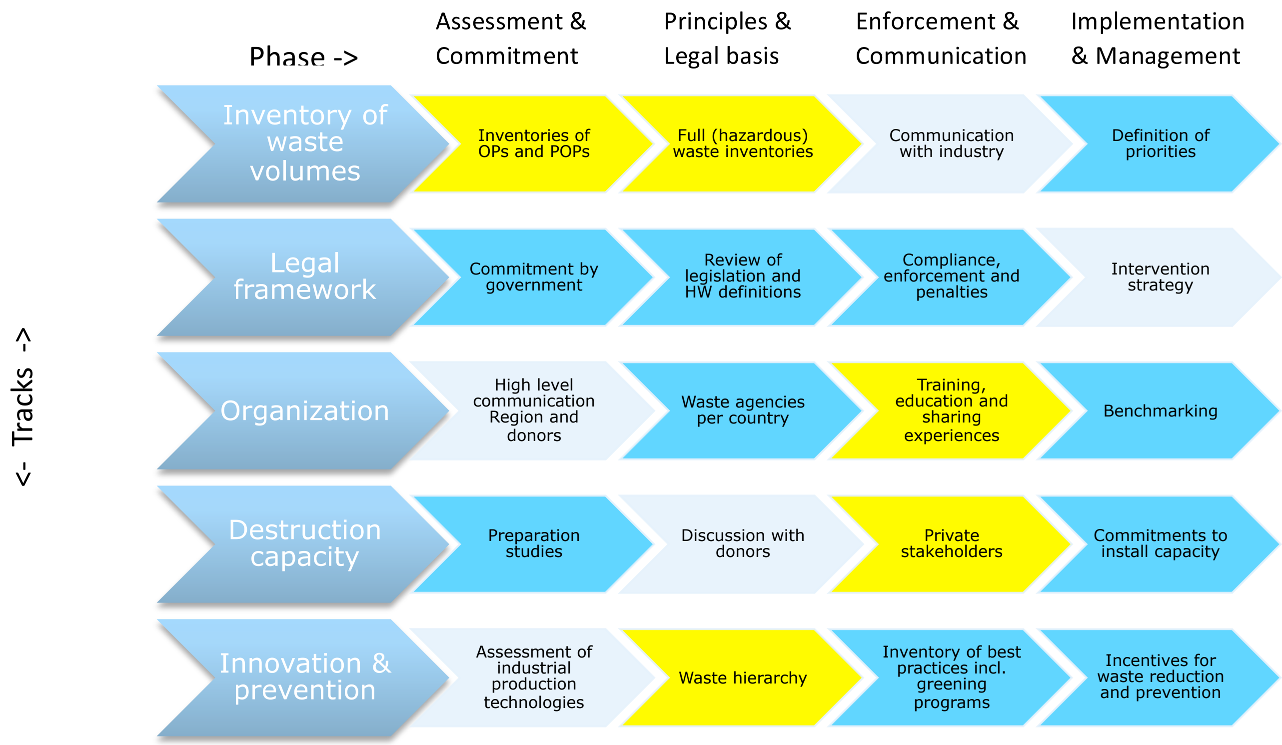


Figure 10 Suggested roles and contributions of NGOs

And a lot of experts are part time involved in NGOs. NGOs can also be consulted as private stakeholders in the development of destruction capacity and in the introduction of principles of waste hierarchy. NGOs will play their advocacy role in steps in the process where decisions are to be taken. The blue arrows in the scheme above present an estimate where the NGOs will raise their voice. It is upon the decision of the government and other stakeholders which role they want to give NGOs in opinion building and decision taking.

7.8.4 Roles and contributions of the Waste sector

The waste sector plays of course its primary role in the development of destruction capacity. As private parties they can propose to the government initiatives for destruction plants. And they will play an important role in the commitments to realize this capacity. It is therefore recommended to involve the waste sector as well in each phase of the track destruction capacity as to involve them (at least on level of consultation) in all decisions in the last column. It is suggested, when organizing training and education, workshops and conferences, to offer the waste sector opportunities to share their experiences.

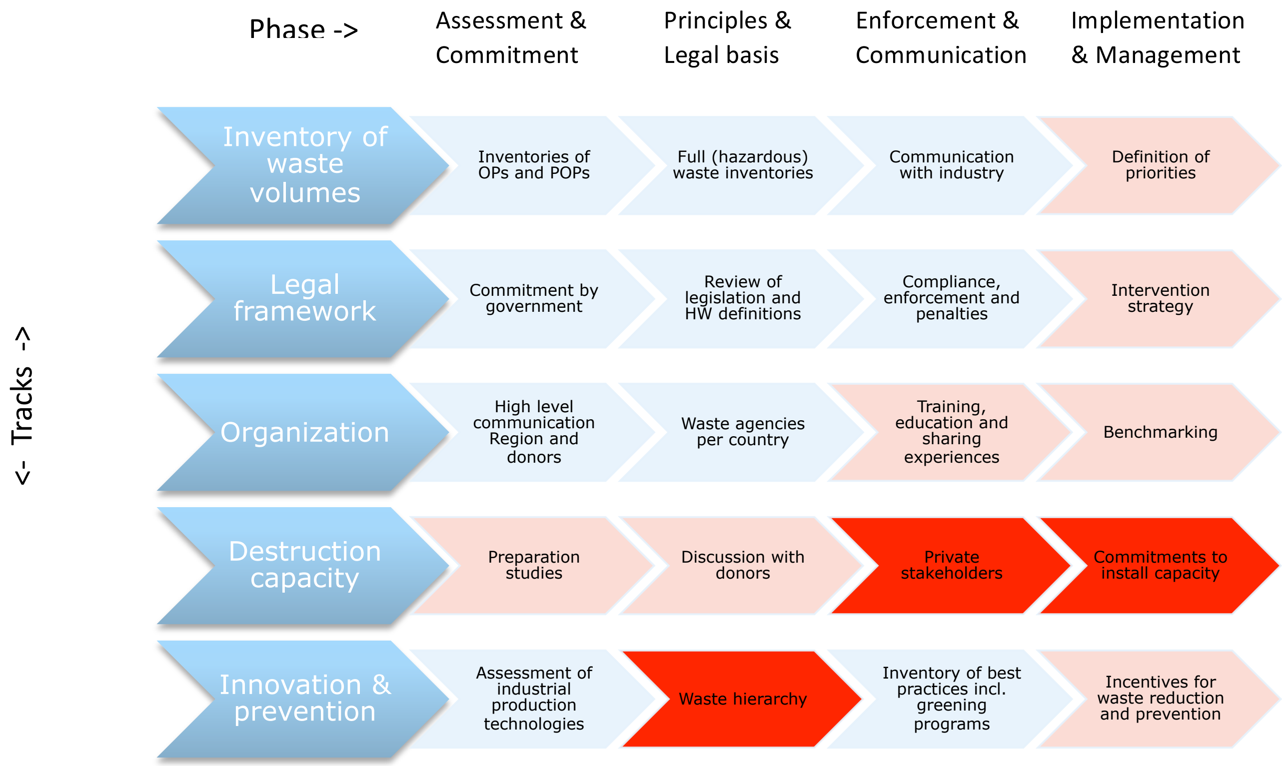


Figure 11 Suggested roles and contributions of the waste sector

7.9 Responsibilities of governments; support by international donors

In subsection 7.8.1 the proposed contributions of international donors are described. At the left side of the scheme the donors facilitate with expertise and financial instruments the start of inventories and studies, at the right side of the scheme they facilitate in the same way the initial investments in destruction capacity. But as well in section 7.1as in the introduction of 7.8 it is underlined that the responsibility has to be taken by the governments. This leads to a more supportive role of donors in the rest of the activities in the scheme and an involvement that ends once the conditions for the implementation have been created and the first destruction capacity is under construction.

7.10 Initial investments in destruction capacity

It is assumed the international donors intend to facilitate initial destruction capacity in the EECCA region.
To progress this intention the next decisions that need to be taken relate to (in no specific order):

- Country
- Regional function
- Potential co-investors
- Technology
- Capacity

To address these issues the international donors are recommended to carry out a feasibility study.

Based on the outcomes as presented in this report, already some preliminary answers can be suggested:

It is recommended to install this capacity in a country with a high volume of hazardous waste. The highest volumes have been found in Russia, Kazakhstan, Ukraine and Belarus. As a second criterion for country selection the potential for reliable enforcement of law is recommended. High scores on this aspect are found in Belarus and Azerbaijan.
Looking at regional function of the destruction capacity, out of the aforementioned countries Ukraine, Belarus and Kazakhstan are preferred.
Potential private co-investors are available in Ukraine; public investors are found in Belarus and Kazakhstan where the governments are willing to share the investments in their country. In Kazakhstan there is already a long-term commitment for investment by the World Bank and .the Global Environment Facility (GEF)

Regarding the aspects of initial market mechanisms, capacity planning and technology guidance, recommendations can be found in the chapters 8 and 9.
The experiences of other countries are that in the budgeting for initial destruction capacity the risks of discontinuities in operational earnings have to be included (see also section 6.1).

8. ASSESSMENT OF WASTE MANAGEMENT OPTIONS

8.1 Importance of economy of scale

It should be noted that in this section costs have been expressed in US Dollars at an exchange rate of (€/USD= 1.25).

An obsolete and POPs pesticides program alone and/or in combination with industrial POPs destruction program has a limited duration as it will deal with the current recorded legacies of approx. 520,000 tonnes spread over the EECCA region. Depending on the capacity of the needed treatment plant the duration of full destruction can vary from 2- 15 years. The necessary investment may be in the order of 10-50 million USD depending on the installed capacity.

An economic analysis based on the experiences the countries has been made. The prices for obsolete pesticides and industrial POPs waste per tonne for have been collected for Belarus, Moldova and Ukraine. All prices include repackaging, transport and disposal to dedicated hazardous waste facilities in the EU:

Belarus: 2 000 USD/t (ref Ministry of Environment Yuri Solovjev, Belarus 24.10.2014)
Moldova: 2 875 USD/t (ref Ministry of Environment Ion Barbarasa, Moldova 24.10.2014)
Ukraine: 2 750 USD/t (ref Mikhail Malkov, FAO Consultant, Ukraine, 24.10.2014)
(Ukraine: 3 750 – 4 375 USD/tonne (ref Mikhail Malkov, FAO Consultant, Ukraine, 24.10.2014). (this is only valid for HCB special waste)

The mean value used for the region is 2 575 USD/tonne.
shows for the costs for the different waste streams volumes when treated in EU Member states.

Table 9 Scenario for export for treatment in EU member states

EECCA countries	Total Volume In Tonnes	Average Unit price USD per tonne	Total costs to be made for export to EU Mio USD	Yearly costs to be made for export to EU Bio USD
Obsolete and POPs pesticides + burials	230 000	2 575	592	
Industrial POPs	290 000	2 575	748	
Yearly arising hazardous waste	5 813 000 000	2 575		**15 000**
4% of yearly arising hazardous waste[1]	232 000 000	200[2]		**46**
			1 340	

[1] for the waste amenable to destruction by HTI (High Temperature Incineration)from the two approaches; the one searching for oily and tar waste, it was not possible (see also under 3.3.1) to identify the total sum, as the major contribution of Russia, which is expected to deliver at least 70 to 80% of the total amount was lacking. Therefore the other approach of 4% of the total arising hazardous waste has been selected for this table.

[2]the 4% of total hazardous waste due to its calorific value has been included at a lower price of USD 200/tonne

Table 9 shows the export option where obsolete and industrial POPs pesticides are brought to facilities in Europe will amount to approx. 1.34 billion USD, not including the overall environmental and social costs connected to the transportation. Repackaging and transport costs account for approximately half of the total costs. The export option will free the region for obsolete pesticides and other POPs waste, but the investment will not provide benefits for the region itself, e.g. knowledge, technology and capacity to solve other hazardous waste management challenges. The international community's investment into obsolete pesticide and industrial POPs waste removal may therefore be seen as an opportunity to carry out some of the investment to a national and/or regional hazardous waste infrastructure. Hence the obsolete Pesticides and industrial POPs destruction program can be used to kick-start a wider national and regional hazardous waste program.

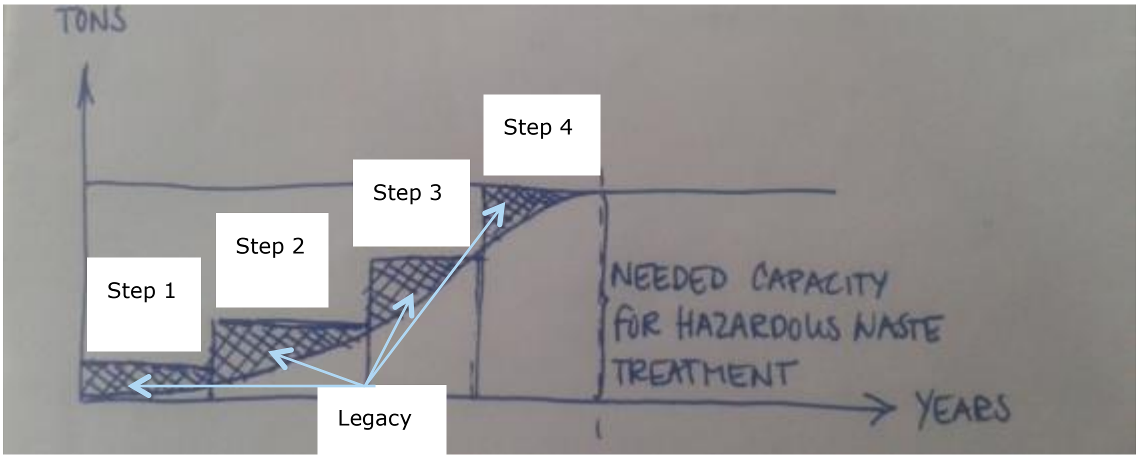
8.2 Possible capacity development scenario

Figure 12 below shows the principles in using legacy waste in building up treatment capacity for a hazardous waste management system. The market demand for the hazardous waste treatment is determined by the scale and nature industrial activities that generate regular arisings of hazardous waste and the regulation and law enforcement that governs its disposal. A fully sustainable and transparent market, where hazardous waste will be collected and brought to regulated treatment facilities will not be reached immediately. In the build-up period investors may be reluctant to invest in treatment facilities as there is no guarantee of a market in the short, medium or long term.

Treatment capacity may most likely be built up in stages, and the legacy waste can be mobilised into the market by national and international funding of e.g. obsolete and industrial POPs waste destruction programs in order to ensure that treatment plants can operate at a reasonable rate of return.

In Figure 12 the curve illustrates how law enforcement may be developing a market for management of hazardous waste. The steps represent investments into treatment capacity. The shaded areas show how mobilisation of legacy waste can compensate for a relatively little market size in the beginning, and the investment in capacity will reach a reasonable rate of return more quickly.

Figure 12 Principles for using legacy waste to build up hazardous waste treatment capacity.



The combined shaded area represents the legacy waste that is mobilised for ensure sufficient waste amount throughput as new waste disposal capacity is brought on line.

9. TECHNOLOGY ASSESSMENT

9.1 Overview of available technologies

The reported legacy volumes of obsolete and POPs pesticides, including burial sites (230 000 tonnes) and the quantities of industrial POPs (290 000 tonnes) could to make a considerable contribution for the investments into specific technology that can only deal with POPs related wastes. As mentioned above, legacy waste may be seen in the context of a broader hazardous waste management system.

In many places in Europe, such as Denmark and Germany, hazardous waste treatment has initially been run by public organisations, for example in a joint-municipal set-up, and these waste management organisations have only been privatised when the market has proven sufficient for private investments. Different experiences made in Europe have been described in chapter 6

A wider scope of a waste management system however also means that the technology assessment should focus on technologies that are able to treat a wider range of hazardous waste other than just the obsolete, POPs pesticides and industrial POPs.

The technology assessment will target:

- the updated list of POPs technologies for which Fact Sheets are being finalized by the Secretariat of the Basel Convention, as well as
- hazardous waste technologies designed to eliminate a wider range of hazardous waste *(ref: IHPA Technology study, 2012, not published)*

The technologies that treat POPs waste and POPs contaminated soils are shown in . The last column indicates if the assessment has also been carried out for wider hazardous waste categories. It is furthermore noted, if the technology is fixed and/or mobile. The technologies described in "1-page summary sheets" (APPENDIX 5 Overview of Summary Fact Sheets) will make use of the IHPA technology study material and will be supplied with a Suitability Rating Symbolas benchmark).

Table 10 Treatment technologies for OPs, POPs, organic and inorganic hazardous waste

No	Technology	OPs	POPs	HW org	HW inorg
1	Alkali metal reduction				
2	Base-catalysed decomposition (BCD)				
3	Catalytic hydrochlorination				
4	Cement kiln co-incineration				
5	Gas Phase reduction (GPR)				
6	Hazardous waste incineration				
7	Plasma arc				
8	Potassium tert-butoxide method				
9	Supercritical water oxidation (SCWO)				
10	Waste-to-gas conversion				
11	Autoclaving (no destruction!!)				
12	Specially engineered landfill				
13	Permanent storage in underground mines and formations				

14a	Ball milling – waste				
14b	Ball milling – soil (MCD)				
15a	Thermal Desorption followed by final destruction				
15b	In Situ Thermal Desorption (ISTD) followed by final destruction				
16	Vitrification				

	Legend	**Explanations**
	Green	Proven full scale experience
	Orange	Pilot experience
	Yellow	Potential suitability
	Red	Not suitable
	Grey	Not sufficiently documented
	Dark Blue	Alkali metal reduction: Strong limitation for POPs treatment and is only applied for PCB and low concentrations, but has been applied for more than 20 years globally, and can be used as supplementing technology to larger plants (treatment train)
	Blue	Catalytic hydrochlorination and Potassium tert-butoxide method: Strong limitation for POPs treatment and is only applied for PCB and low concentrations and only in Japan
	Purple	Autoclaving is not a destruction technology, but a technology that removes the contaminants (PCB contaminated oil) from other materials that hereafter may be recycled and maybe generate substantial returns. The technology is applied mainly for removal of PCB and can be applied together with any other waste destruction technologies and finds its application for the recycling of large quantities of transformers.
	Pink	1. Ball milling – soil (MCD) is only applicable for contaminated soils 2. (In Situ)Thermal desorption followed by final destruction: is only then applicable for waste. If thermal desorption is not followed by final destruction the technology can only be applied for contaminated soils!
	Black	All listed technologies are methods for the destruction and irreversible transformation of POPs. Only 2 methods (No 12 and 13) are containment technologies which can be applied when neither destruction nor irreversible transformation is the environmentally preferable option.
For the purpose of this report no Fact sheets have been made for Alkali metal reduction, catalytic hydrochlorination, Potassium tert-butoxide, as explained in chapter 8.2.1 Verification of suitability of waste treatment technologies and Table 11 of the same chapter. Also no Fact sheet has been made for Autoclaving as it is no destruction technology.		

The combination of the newest updates of the Fact sheets, being developed for POPs only, together the country case assessment of the wide spectrum of hazardous waste for twelve technologies described in the Fact sheets is a good base for a selection of the preferred technologies. An example of a country case where two specific technologies have been evaluated for suitability for treating a specific hazardous waste stream is shown in Table 11

To illustrate this, a small part of the excel sheet has been inserted as Table 11 (for details, see APPENDIX 3 and APPENDIX 4). On the left side in horizontal direction, one can see the specific waste type followed by the quantity of each type of waste of that country. On the headings of the table are in vertical direction written the experiences of the technology that has been assessed. In this case two technologies are shown: so called Vitrification technology and a hazardous waste incinerator. Four categories of experiences have been compared:

- Commercial experience (green)
- Pilot plant tests (dark yellow)
- Not tested but potentially applicable
- Not applicable.

By comparing these different experiences for the categories of hazardous waste streams of the pilot study country, a good picture can be obtained of the range of waste that the technology has been treating, is able to treat, eventually treat in the future, or its potential ability. By showing the various technologies next to each other one can compare and validate them against each other. In the Appendices, two tables are included. APPENDIX 3 covers the technologies that can deal with inorganic and organic waste. APPENDIX 4 covers the technologies that can deal only with organic hazardous waste.

The Basel Convention Fact Sheets have been specifically developed for POPs waste, and do not always include soil. A number of the technologies can however also treat POPs contaminated soils, but next to the listed ones, other technologies are on the market and should be taken into consideration.

Table 11 Example of specific technology assessment against classified hazardous waste streams

		Annual waste arising	Vitrification		HTI
LEVEL 3 - Specific Waste Type		**Tonnes**			
No	Name				
01	Gases (excluding Greenhouse gases)				
02	Obsolete ozone depleting gases				
01	Liquid waste containing mercury	11636			
02	Solid waste containing mercury				
01	Lead Acid Batteries				
02	Mercury batteries				
03	Ni/Cd batteries				
04	Manganese dioxide and alkali batteries				
05	Lithium & Lithium ion batteries				
06	Nickel-metal hydride batteries				
07	Mixed batteries				
01	PCB containing waste (>50mg/kg)	2			
02	Other POP-containing waste	19406			
01	Liquid and sludge inorganic waste	3741306			
02	Solid inorganic waste	337761			
03	Spent pot lining (inorganic)				
01	Asbestos containing waste	525			
01	Waste lubricating oil	18546			
01	Solvents containing halogens and/or sulphur	3492			
01	Liquids and sludges containing halogens and/or sulphur	9333			
02	Solids containing halogens and/or sulphur	6000			
01	Solvents without halogens and sulphur	28299			
01	Liquid and sludge organic waste	183660			
02	Solid organic waste	21810			
03	Spent pot lining (organic)				
01	Tarry waste	12084			
02	Bituminous waste	1000			
01	Brine	15660			
01	Fly ash				
01	Bottom ash				
01	Ferrous metal slag	2019400			
02	Non-ferrous metal slag		Applicable[2]		
03	Other		Applicable[2]		
01	Foundry sand	720			
02	Refractory waste	3009			
03	Other (more detail needed before determination can be made)				
01	Large Household Appliances				
02	Small Household Appliances				
03	Office, information & Communication Equipment				
04	Entertainment & Consumer Electronics and toys, leisure, sports & recreational equipment and automatic issuing machines				
05	Mercury containing lamps				
06	Lighting equipment				
07	Electric and Electronic tools				
08	Security & health care equipment				
09	Mixed WEEE				
01	Contaminated scrap metal waste				
01	Health care risk waste				
01	Sewage sludge				
01	Miscellaneous	21678	Applicable[1]		
	Total Annual waste arising in tonnes	6433649			

Explanatory notes to Table 11:

Waste Classifications are used in South Africa

Level 1not shown in this Table but in the Appendix

Level 2: HW 01 till HW 99 Major Waste type: not shownin this Table but in the Appendix

1^{st} and 2^{nd} Column Level 3: specific waste type as shown in the Table

3^{rd} Column: Annual waste arising in tonnes

Columns 4-5: technology that is benchmarked for various stages of development:

Green: Example Vitrification with Commercial Experience

Brown: Example Vitrification with Demonstration Experience

Yellow: Example Vitrification no Experience but considered applicable

Red: Example Vitrification not treatable

Columns 9-12 same but for hazardous waste incinerator (HTI)

A full assessment of potential a larger number suitable technologies for treatment of organic as well as organic/inorganic waste is enclosed in Appendix 3 and 4.

9.2 POPs treatment technologies

The latest updated Basel technical guidelines *(Ref SBC)* for the environmentally sound management of wastes consisting of/containing/or contaminated with POPs, includes twelve methods for the destruction and irreversible transformation of POPs. In the meantime the number methods have been increased to sixteen as can be seen in Table 10. The guidelines are regularly updated to follow up on technical and legal developments. At present, the guidelines are under review and it is expected that the newest version will be available in the beginning of 2015.
Under Article 6 of the 'Stockholm Convention on Persistent Organic Pollutants', "Parties shall take appropriate measures so that wastes consisting of containing or are contaminated with persistent organic pollutants (POPs) are disposed of in such a way that the POP content is destroyed or irreversibly transformed in a way that they do not any longer exhibit the characteristics of POPs or otherwise are disposed of in an environmentally sound manner."

Where neither destruction nor irreversible transformation is the environmentally preferable option for wastes with a POP content above the lower limits (50 mg/kg), countries may allow such wastes to be disposed of by other methods than the destruction methods. Therefore, also containment technologies such as specially engineered landfill and permanent storage in underground mines and formations are a possibility.

Table 10 includes technologies with the ability to treat POPs waste and/or POPs contaminated soils. In this context, it should also be considered that many technologies on the market are combined in "treatment trains" i.e. operated in series. For example, such combinations have been implemented for BCD (Base-catalysed decomposition) and also GPR (Gas Phase reduction) in combination with thermal desorption. As Thermal desorption is much more economic in soil projects than BCD that has its advantage in treatment of high strength (high concentrated) waste. When treating the soil thermal desorption volatilizes the contamination in the soil and collects the pure or concentrated product. That pure product can then be treated afterwards very well by the BCD. In case of GPR, the thermal desorption also pre-treats the incoming waste at a lower temperature as the GPR is working and is able to volatilize all hazardous waste and by that way facilitate the next step of the full destruction process of the GPR at a higher temperature. These examples show the synergy of the different technologies.

9.2.1 Verification of suitability of waste treatment technologies

For the purpose of this study a technology review has been conducted in order to verify if whether technologies are able to treat a large variety of waste including mixtures of obsolete pesticides waste and the logistics and conditions under which the waste will be delivered to the treatment plant. The review has also included other waste, e.g. high PCB concentrations and other organic hazardous waste.

Those technologies with strong limitations in their applications have not been taken into consideration in further work. As can be seen in Table 12, a number of the PCB treatment technologies have strong limitations and are only suitable for low PCB concentrations. The Ball Mill technology has gained operational experience in China, but the capacity is until now very small and experience from large scale applications is not yet available. The Ball milling in China can accept higher concentrations, but this Ball Milling is often mixed with the Ball milling – soil (MCD)that treats exclusively soil and no waste.

Table 12 List of technologies not suitable; refer also to Table 10, above

No.	Technology	Motivation for elimination waste treatment
1	Alkali metal reduction	Only PCB, low concentrated, but has been applied for more than 20 years globally, and can be used as supplementing technology to larger plants (treatment train)
3	Catalytic hydrochlorination*	Only PCB, low concentrated and applied only in Japan
8	Potassium tert-butoxide method	Only PCB, low concentrated and applied only in Japan
14a	Ball milling –waste	Only Chinese plant on market with limited capacity. The former Japanese plant has stopped its activities

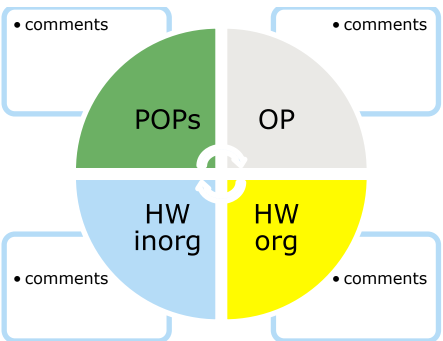
9.3 Presentation of suitable technologies for further review

9.3.1 Benchmark

The following technology summaries are intended to give an overview of the available technologies. Each technology is assessed for its suitability to be included in a comprehensive hazardous waste management system. See also APPENDIX 5.

9.3.2 Suitability rating method

A suitability rating symbol has been developed in order to facilitate a quick overview of the different technologies' applicability in a future hazardous waste management system. The rating symbol is described below. The rating symbol uses a traffic light colouring to express the suitable of the technology for treating the main waste streams. The traffic lights are supplemented with a grey colour which is used, when the technology is not assessed to be sufficiently documented.



Legend		
Green	:	Proven full scale experience
Orange	:	Pilot experience
Yellow	:	Potential suitability
Red	:	Not suitable
Grey	:	Not sufficiently documented
POPs	:	Stockholm Convention definition
OP	:	Obsolete Pesticides
HW inorg	:	Inorganic hazardous waste (IHPA country case study)
HW org	:	Organic hazardous waste (IHPA country case study)

Figure 13 Suitability Rating Symbol

All technologies that are in Table 10 marked with a green colour in the last column are described in technology Fact Sheets in APPENDIX 5

10. IMPRESSIONS-RESULTS OF BELARUS WORKSHOP 27-29 OCTOBER 2014

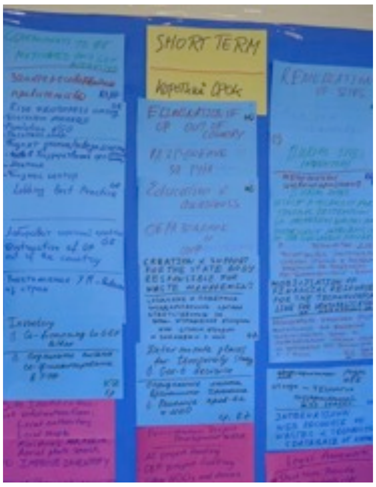
From 27th till 29th of October, at the Green Cross Education and Rehabilitation Centre "Ecology and Health", in Smolevitchy, Belarus, IHPA has held the international Workshop under the title “The Road Map to sustainable Elimination of Obsolete Pesticides in the Eastern Europe, Caucasus and Central Asia”. It is for the first time that for the solution of these problems a road map has been discussed and was worked out! The draft Road map was discussed and worked out jointly with the experts and government representatives from the countries.

During the workshop a full three days programme was implemented (see also APPENDIX 12). During the first day, brief overviews and presentations of the assessment of the legal situation and the waste management situation in each country have been made. Also the first group discussions were held by the legal expert group and the waste management expert group on the formulation of a draft of the road map for the region.

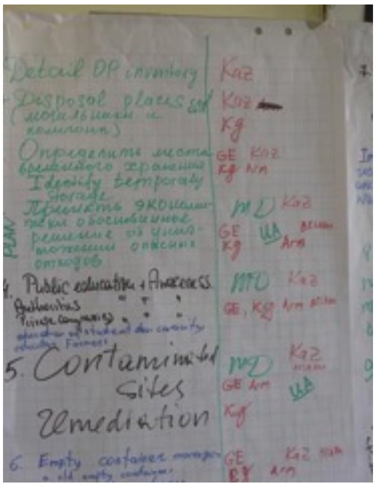
The second day was fully focussed on the contaminated land issue and was organized by Blacksmith Institute. This session was of particular interest as hardly any soil investigations in the region have been implemented. Additionally there is a general lack of public and political awareness. It is expected that the region will be confronted with similar problems to those that have been dealt with by the industrialized countries over the last 30 years. Blacksmith is expected to prioritize high risk sites for further investigation and development of risk reduction strategies in a number of the EECCA countries during 2015. The session finished with a discussion on a possible road map for contaminated land for the region.

On the third day, the Summary of the Feasibility Study and Conceptual Design for a ‘multi-platform’ destruction and decontamination facility for the environmentally sound management of Obsolete POPs pesticides was presented by John Vijgen, IHPA which was followed by Summary Feasibility Study for environmentally sound destruction and decontamination of Obsolete and POPs pesticides in cement kilns in Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan by Ed Verhamme.

The remaining part of the day was used for the working group activities. The final discussions for the legal Road map were held by the Legal Working group, in parallel with the combined Waste Management Working Group which joined with the Contaminated land Group.
In the final Workshop session all participants joined and contributed to the setup of the total road map which was worked out on the so-called Sticky Wall. Here all participants wrote down and explained their country issues on stickers and put them on the sticky wall (see photos on the next pages). The Road map process was a huge success, as really everybody came forward with ideas and inputs from their country. It was clear that the participants believe they can make a difference with an own strategy of their country and in cooperation with the other countries. After the break, then all inputs were re-arranged in the various categories of the Road Map.
The workshop is a first result of works of the activities of national consultants in each of the countries that have produced a legal and waste management assessment report for their country. Together with the results of a feasibility study for the establishment of a regional OPs-POPs treatment centre, the strategy has been discussed and had resulted in a first version of the Road Map report that will be discussed at the Steering Committee of the partnership project “Improved Pesticide and Chemicals Management in the former Soviet Union”, where the Food and Agriculture Organization of United Nations and the European Union are supporting the countries in strengthening their capacity to manage hazardous waste.



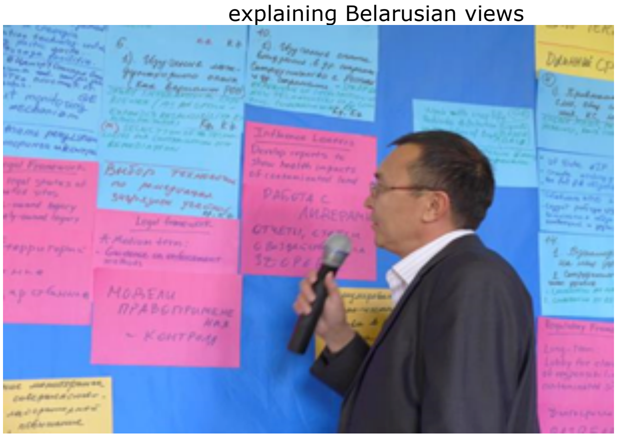
First results of short term actions



Speicific Country priorities

Ms. Galina Mihalap, Belarus explaining Belarusian views

Ms. Zulfira Zikrina, Kazakhstan convincing participants abiout the importance of the country's needs



Ali Khalmurzaev, Kyrgyzstan showing the Kygyzstan points

Valentin Plesca and Andrei Isac from Moldova

Facilititating the process John Vijgen, Sandra Molenkamp, Bram de Borst and Wouter Pronk

Final comments from Iordanca - Rodica Iordanov

Richard Thompson supporting the discussion on the final Road Map

Presentation for the Group

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APPENDICES

APPENDIX 1 WASTE STREAMS FOR THE EECCA COUNTRIES

Table for the EECCA region and explanatory notes in the following pages

	Legacy Wastes										Annual Arisings					
Waste cat	OP + POPs Pest	Ind POPs	Cont soils[1]	Burials	Contam contain	Haz waste	Health care waste	Oily waste	Inorganic waste	Chem, indus waste	Haz waste*	Empty contain	Fake pest	Oily waste	Inorganic waste	Health care waste
Country	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonne/y	tonne/y	tonne/y	tonne/y	tonne/y	tonne/y
Armenia	150 a2	17.000 a1	11.069 a3	605 a2	109 a5		100 a1	17.000 a1			60.530 a4		13			
Belarus	7200,00 b1	740 b1	2.750 b1	750 b1		968.000.000 b1		10.746 b1	30.000.000 b1		33.260.000 b1	825 b1		30.000 b2	9.300.000 b1	5.000 b1
Georgia	150,00 c1	550 c1	177.120 c3	6.320 c1				27.120 c1	11.777.300	781.120				1.018.000		2.433
Moldova	1.000 d1	1.200 d1	2.500 d1	3.900 d1							418 d1					
Ukraine	11.000 e1	43.000 e2	e3	13.500 e5		4.500.000.000 e4	1.000.000 e5	230.000 e5			419.000.000 e1	5.000 e1	20.000 e1	3.242.900 e6	397.000.000 e1	3.000 e1
	19.500	62.490	193.439	25.075	109	5.468.000.000	1.000.100	284.866	41.777.300	781.120	452.320.948	5.825	20.000	4.290.900	406.300.000	10.433

	Legacy Wastes										Annual Arisings					
Waste cat	OP + POPs Pest	Ind POPs	Cont soils[1]	Burials	Contam contain	Haz waste	Health care waste	Oily waste	Inorganic waste	Chem, indus waste	Haz waste*	Empty contain	Fake pest	Oily waste	Inorganic waste	Health care waste
Country	tonnes	tonnes	tonnes	tonnes	tonnes	Tonnes	tonnes	tonnes	tonnes	tonnes	tonne/y	tonne/y	tonne/y	tonne/y	tonne/y	tonne/y
Azerbaijan	2.000 f1	146 f1	25.840 f2	9.000 f1	250 f3	1.764.000 f1	14.821 f1				160.500 f1			61.420 f1	132.000 f1	1.886 f1
Kazakhstan	56.930 g1	190.848 g2			g3	9.790.000.000 g1		4.500.000 g1	5.200.000.000 g1		355.952.000 g1			400.000	1000000000 g1	
Kyrgyzstan	446 h2	2133 h5	48.350 h1	3.000 h3	56 h8	93.690.000 3			10.164.332 h1		4.784.027 h4			1.884 h7		14.821 h6
Russia	70.000 n	35.000 i1	i3			61.319.000.000 i2					5.000.000.000 i1	4.500 i1	18.000 i1			
Tajikistan[2]	5.000 j	304 j	228.900 j2	10.000 j												
Turkmenistn	k1			11.457 k1		32.300 k2					1.000 k2					
Uzbekistan	L1			17.718 L1												
	134.376	228.431	303.090	51.175	306	71.204.486.300	14.821	4.500.000	5.210.164.332		5.360.897.527	4.500	18.000	463.304	1.000.132.000	16.707
Total EECCA	153.876	290.921	496.529	76.250	415	76.672.486.300	1.014.921	4.784.866	5.251.941.632	781.120	5.813.218.475	10.325	38.000	4.754.204	1.406.432.000	27.140

Legend on colours

Red	Quantities are missing and need to be collected
Orange	Quantities are missing but some other data are available such as number of sites

Explanatory notes:

1 Contaminated soils: there is not much information available on this issue, so it is difficult to interpret data. Black Smith has started to make

2 inventories and site assessments in a number of the FSU countries and first concrete data are expected to be available during summer of 2015

Tajikistan has made availabe new data of the NIP update, under restriction that they are draft data as the final NIP update is not approved yet!

Explanatory Country notes:

a1 **Armenia**

a2 NIP 2005

a3 IHPA Report: National consultant – Albert Haroyan, Technical assessment of the management of obsolete pesticides and POPs waste and soil contamination in Armenia within the framework of a Disposal Study for Obsolete Pesticides in the Former Soviet Union, November 2014

a4 IHPA Report with followong explanations: Contaminated soils: a) Nubarashen: 5100 + 1503 + 1916= 8519 tons ; b) Storage sites 0.5-0.7 ha = 0.6 ha = 6000 m^2 X 0.25 m = 1500 m^3 X 1.7 t/m^3 = 2550 tons (assumption 0.25 m depth) -Total volume Contaminated soils: 11069 tons

National Statistical Service of the Republic of Armenia: Waste generation by source, hazardous classes and years 2013:

http://armstatbank.am/Selection.aspx?rxid=002cc9e9-1bc8-4ae6-aaa3-40c0e377450a&px_db=ArmStatbank&px_type=PX&px_language=en&px_tableid=ArmStatbank%5c8+Environment+and+energy%5cEnvironment%5c(I)+Waste%5cI1-new-2013.px

a5 Note that the number is significantly different from the number given by UNITAR National Chemicals Management Profile , 2009, which indicates 12500000 t/y, whereas the statistic data of 2013 indicate 60.53 tonnes /year

IHPA Report: under 8.5 Collection Centres for empty containers: In the frame of the GCP/RER/040/EC Project

(calculated empty containers -375 units, wooden pallets and boxes-114 units)

a) empty containers 375 pcs--> 250 l 4= 1m3--> 375/4=94 m^3

b) pallets 1 pallet: 0.8 X 1.2 X 0.14= 0.13 m^3 X 114 pcs= 15 m^3 --> sum empty container and pallets: 109 m^3= 109 tons (Volume for price)

b1 **Belarus**

b2 IHPA Report: National consultant – Marina Belous, Technical assessment of the management of obsolete pesticides and POPs waste and soil contamination in Belarus within the framework of a Disposal Study for Obsolete Pesticides in the Former Soviet Union

Belarus Hazardous waste legacy: info Minitry of Environment 21.10.2014. Marina Belous: volume of accumulated wastes as of now -all in all about 968 million tons of wastes (96 % of them make halite wastes and clay-salt sludges); so 4% is estimated to be treatable

c1	**Georgia**
c2	IHPA Report: National consultant - Khatuna Akhalaia, Technical assessment of the management of obsolete pesticides and POPs waste and soil
	contamination in Country Georgia within the framework of a Disposal Study for Obsolete Pesticides in the Former Soviet Union
	Newest data UNDP project: a) 6320 t POPs pesticides and mixed with other chemicals in Iagluja polygon and 150 t in old storages.= total 6470 t
	b) Strongly contaminated topsoil – 4800 t, Strongly contaminated subsoil – 2640 t Total Highly contaminated soil: 7440 tonnes
	c) Slightly contaminated soil – 20 080 t
c3	c) IHPA report Khatuna Akhalaia: under 2. Contaminated sites: 22 sites are contaminated with average 2 ha each.
	So a first total estimate of 44 ha contaminated land can be made.
	Explanation of quantity of contaminated soils: Assumption 0,2 m depth X 440 000 m2= 88 000 m3 X1,7 t/m3= 149 600 t
	Total volume contaminated land: a)+b) +c) = 7440 + 20080 + 149 600 = 177120 t
d1	**Moldova**
	IHPA Report: National consultant - Andrei Isac, Technical assessment of the management of obsolete pesticides and POPs waste and soil
	contamination in Moldova within the framework of a Disposal Study for Obsolete Pesticides in the Former Soviet Union
	Ukraine
e1	IHPA – 3, Waste Management Report Ukraine, 2014, Annex to Report, Mikhail Malkov, Publication in preparation
e2	IHPA Report: National consultant, Mikhail Malkov, Technical assessment of the management of obsolete pesticides and POPs waste and soil
	contamination in Ukraine within the framework of a Disposal Study for Obsolete Pesticides in the Former Soviet Union
	200.000 capacitors à 75 kilo (estimate) = 15 000 tonnes, 5000 transformers à 4 tonnes (estimate) = 20 000 tonnes .
	8000 tons PCB. Total quantity: 15000 + 20000 + 8000 = 43000 t
e3	Ukraine contaminated soils: a) 4500 sites have been indicated but quantities cannot be given at this stage. b) About 44 Ha of HCB contaminated
	land in Kalush polygon, small quantity of illegaly buried HCB in the surroundings
e4	UNECE Committee on Environmental Policy ENVIRONMENTAL PERFORMANCE REVIEWS UKRAINE , 2007, Second Review, The amount of solid waste
	(industrial and household) accumulated in landfills in Ukraine is very high, totalling more than 25 billion tons.
	Accumulated hazardous (toxic) waste amounts to 4.5 billion tons
e5	Mikhail Malkov information received from MENR, 2013, 24 November 2014: Vinitsa: 2 500 tonnes, Gorlov: 11 000 tonnes.
	Total Burial volume: 13 500 tonnes, Legacy health care waste: 1 Mill tonne, oily waste: 230 000 tonnes
e6	IHPA Report: Oily waste: a) Used oils: 39,900 MT p/a b) Used Chemical catalyzers: 1,300 MT p/a c) Chemical sludge and residues: 3,201,700 MT p/a.
	Total oily waste: a)+b)+c)= 39900 + 1300 + 3201700=3242600 t/y

	Azerbaijan
f1	IHPA Report: National Consultant, Islam Mustafayaev, Technical assessment of the management of obsolete pesticides and POPs waste and
	soil contamination in Azerbaijan within the framework of a Disposal Study for Obsolete Pesticides in the Former Soviet Union
f2	Azerbaijan: 76,000 m^2 - Estimated 0,2 m depth--> 15,200 m3 --> spec weigth 1,7--> 25,840 tons
f3	1000 containers à 250 l. = 1000 X 0,25 m3= 250 m3= 250 tons
f4	Bruto annual hazardous waste generation is 185,400 tonnes/year, Recycling of hazardous waste-24,900 tonnes/year,
	hazardous waste disposal-113,000 ton/year (landfilled). Netto Annual hazardous waste disposal =185400-24,900= 160,500 tons/year
	Kazakhstan
g1	IHPA Report: National consultant, Zulfira Zikrina , Technical assessment of the management of obsolete pesticides and POPs waste and soil
	contamination in Kazakhstan within the framework of a Disposal Study for Obsolete Pesticides in the Former Soviet Union
g2	From IHPA report, but it has to be stated that the volume stated is based on nation-wide information
	Calculation is as follows: 200 000 tons.
	56,000 capacitors in operation and 116 transformers) = 56,000X(75kg)= 4200tonnes + 116 (x4t) =464 tons. Total 4664 tonnes ;
	exported in UNDP project: 10,000 capacitors=10,000 (75kg) = 750 tonnes: Total left in the country: 3914 tonnes
	Total: 200 000 + 3914 = 203 914 tonnes
g3	169660 pcs: 1pc = 250 l 4pcs = 1m3--> 169660/4= 42415 t-- In case we use a whole seize spectrum from 30 l to 250 l,
	then the volume will decrease to: 169660 X 0,14 m3= 23752,4 m3 or tons
	Kyrgyzstan
h1	IHPA Report: National consultant, Tatiana Volkova, Technical assessment of the management of obsolete pesticides and POPs waste and soil
	contamination in Kyrgyzstan within the framework of a Disposal Study for Obsolete Pesticides in the Former Soviet Union
h2	From [h1] (IHPA report) 333 tons of OPs were reported. Appendix 7 reported additionally 113 t of Organic phosphorous compounds . So total is 446 t
	Khatuna Akhalaia (Obsolete Pesticides Management Specialist, Obsolete Pesticides in Kyrgyzstan, Inventory of Obsolete Pesticides, Chui; Isyk-Kul;
	Narin; Talas and Batken Oblasts, March 2012, Initiative for Pesticides and Pest Management in Central Asia and Turkey, GCP/RER/035/TUR
h3	Kyrgyzstan info: feed-back Forum 2007 and 2011, see http://www.ihpa.info/docs/newsletters/IHPA-POPs-Newsletter-No22.pdf
h4	Email 19 November 2014 received from Nat consultant Tatiana Volkova, stating she received from the coordinator of the Basel Convention the total
	amount of wastes of 4 784 026,789 tons (without municípal waste) for 2012
	Further listed in Appendix 7:
h5	Industrial POPS: Appendix 7: Y10 Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or
	polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs) 100 ton
	IHPA report: data for the southern region and Chui region: a) PCBs contained in transformer oils identified -36 m^3 X 0.72 kg/l=26 t,
	b) Oils contaminated with PCBs during operation (identified) -20 t , c) Number of condensers -82 pcs X 4t/pcs= 328 tonnes
	d) The amount of oil in capacitors-2065 t. Total Industrial POPs: a) + b) + c) + d) = 26 + 20 + 32 + 2065 = 2133 tonnes

Kyrgyzstan continuation

h6 Y1 Clinical wastes from medical care in hospitals, medical centers and clinics 14820,589 ton

h7 Y8 Waste mineral oils unfit for their originally intended use 1789 ton

h8 Khatuna Akhalaia (Obsolete Pesticides Management Specialist, Obsolete Pesticides in Kyrgyzstan, Inventory of Obsolete Pesticides, Chui; Isyk-Kul; Narin; Talas and Batken Oblasts, March 2012, Initiative for Pesticides and Pest Management in Central Asia and Turkey, GCP/RER/035/TUR

491 pallets: 1 pallet: 0.8 X 1.2 X 0.14= 0.13 m³ X 419= 56 m3= 56 ton

Russia

i1 National consultant, Mikhail Malkov, Technical assessment of the management of obsolete pesticides and POPs waste and soil contamination in Russia within the framework of a Disposal Study for Obsolete Pesticides in the Former Soviet Union

See also http://www.mnr.gov.ru/upload/iblock/cef/gosdoklad%20za%202012%20god.pdf

Table 53 :113.665 Mln MT – dangerous wastes of I-IV Classes of Danger

i2 IHPA WM Report Russia: Table 59: 61.3188 Mln MT of dangerous waste (I-IV class of danger) stored in existing polygons in 2012

Таблица 53 - Объем образования опасных и твердых бытовых отходов в Российской Федерации

Объем образования отходов, млн. т	2007	2010	2011	2012
Из общего объема образования опасных отходов (I-IV класс опасности) образовано отходов	287,6528	114,368	120,162	113,665
-I класса опасности	0,1813	0,167	0,143	0,051
-II класса опасности	1,3114	0,71	0,655	0,459
-III класса опасности	11,051	16,671	15,79	11,643
-IV класса опасности, из них	275,1091	96,82	103,574	101,512
-объем образованных твердых бытовых отходов	н.д.	н.д.	н.д.	н.д.
Общий объем образования опасных отходов (I-IVкласс опасности) на единицу ВВП в текущих ценах (т/млн. руб.)	8,652	2,4697	2,1534	1,8157

Таблица 51 - Объем образования отходов в Российской Федерации

Объем образования отходов, млн. т	2007	2010	2011	2012
Общий объем образования отходов, Из него:	3899,3	3734,7	4303,3	5007,9
- сельское хозяйство, лесоводство и рыболовство (р.А+В ОКВЭД)	26,6	24,1	27,5	26,2
- Добыча полезных ископаемых (р. С ОКВЭД)	2785,2	3334,6	3818,7	4629,3
- Обрабатывающие производства (р. D ОКВЭД)	243,9	280,1	280,2	291,0
- Строительство (р. F ОКВЭД)	62,8	11,1	14,1	14,6
- Производство и распределение электроэнергии, газа и воды (р. Е ОКВЭД)	70,8	68	58	28,4
- Прочие виды экономической деятельности (р. G+...Q ОКВЭД)	н/д	16,9	104,7	18,3

Table 5.3: Total use and disposal hazardous waste Classe I -IV

i3 *hazardous waste (I-IV class of danger) by type of NACE*

200,256 Ha of OPs contaminated land in 40 Regions

i1 National consultant, Mikhail Malkov, Fake pesticides 18000 t/y

Russia continuation

Таблица 52- Объем образования опасных отходов в Российской Федерации по видам ОКВЭД

Объем образования отходов, млн. т	2007	2010	2011	2012
Общий объем образования отходов на единицу ВВП в текущих ценах (т/млн. руб.)	117,281	80,647	77,121	80,0
Общий объем образования опасных отходов (I-IV класс опасности) Из него:	287,6528	114,368	120,162	113,665
- сельское хозяйство, лесоводство и рыболовство (р.А+В ОКВЭД)	н.д.	н.д.	н.д.	н.д.
- Добыча полезных ископаемых (р. С ОКВЭД)	н.д.	н.д.	н.д.	н.д.
- Обрабатывающие производства (р. D ОКВЭД)	н.д.	н.д.	н.д.	н.д.
- Строительство (р. F ОКВЭД)	н.д.	н.д.	н.д.	н.д.
-Производство и распределение электроэнергии, газа и воды (р. Е ОКВЭД)	н.д.	н.д.	н.д.	н.д.
- Прочие виды экономической деятельности (р. G+...Q ОКВЭД)	н.д.	н.д.	н.д.	н.д.

Таблица 59 - Захоронение и хранение опасных отходов в Российской Федерации по классам опасности

Объем захоронения и хранения отходов	2010	2011	2012
Из общего объема образования опасных отходов (I-IV класс опасности) передано на захоронение и хранение	67,855	77,814	61,3188
-I класса опасности	0,075	0,076	0,0027
-II класса опасности	0,350	0,203	0,1157
-III класса опасности	3,237	3,207	0,8047
-IV класса опасности, из них:	64,193	74,328	60,3957
-Объем твердых бытовых отходов переданных на захоронение и хранение	н.д.	н.д.	н.д.
Проектная мощность объектов хранения и захоронения отходов	н.д.	н.д.	н.д.
Фактический объем заполнения объектов захоронения отходов на конец отчетного периода	н.д.	н.д.	н.д.

Tajikistan

J1 IHPA Report: National consultant, Timur Yunusov, Technical assessment of the management of obsolete pesticides and POPs waste and soil contamination in Tajikisstan within the framework of a Disposal Study for Obsolete Pesticides in the Former Soviet Union

OPs waste quantities : from MB report summarized total of 20 000 tons of waste is 15500 tons in burial sites and 4500 t storages

J1 Acc to IHPA Report, has about 5000 tons disappeared due to waste mining and this would leave at present 15000 tons

J2 Tajikistan (World Bank Study Tauw a) 34600 m3 highly cont soil= 34600 X 1.5= 51900 tons

b) 118000m³ low contaminated soils (<50mg/kg) = 118000 X1.5= 177000 tons c) total volume =228900 tons

J3 Industrial POPs= 184 tons + 24 transformers X 4 t/pcs = 96 tons + 3206 condensors X 75 kg/pcs = 24 tions. Total 184 + 96 + 24= 304 tons

Turkmenistan

k1 About 1,000 t of toxic waste are generated annually

The State Concern TurkmenChemistry was responsible for collecting OPS and Toxic waste at abandoned factories and storage sites from territory of Turkmenistan and disposing of it in safe storage. Three sites were developed for long-term storage of OPs and toxic chemicals. These are located in:

- Karipata in Mary Province;
- Zerger in Lebap Province;
- Takhta in Dashoguz Province.

These storage sites were rehabilitated by TurkmenChemistry during the territory clean-up and currently are fenced, guarded and regularly inspected.

It is estimated that these sites contain about 1,671 t of obsolete pesticides besides other toxic waste.

IHPA Legal Assessment Report: National Consultant, Yolbars Kepabanov, 2014: There are man-made waste disposal Hazar chemical plant in Khazar (formerly Cheleken). In addition, toxic waste landfills are in Mary province "Karipata" in Lebap "Zerger" and Dashoguz "Tahta"

Turkmenistan have been cleared of toxic waste (mostly pesticides)

k1 Special infrastructure for waste pesticides does not exist. There landfills pesticides. Disposal of waste pesticides was charged "Turkmenhimiya".

b) information on the facilities are not available. In turn, in 2010, toxic waste was removed 11,456.7 tons.

c, d, e , g) measures for the prevention of environmental pollution in the management of hazardous waste provided

k2 UNECE, Turkmenistan, Environmental Performance Reviews, First Review, ECE/CEP/165, 2012

NEAP stated that 32,300 t of industrial toxic waste were accumulated on the territory of Turkmenistan in 2000. Of this total, 79 per cent is oil sludge from oil fields, 15 per cent is waste containing oils, 5 per cent pesticides and 1 per cent other waste. About 1,000 t of toxic waste are generated annually.

Uzbekistan

L1 World Bank funded pilot project “Technical Study of Obsolete Pesticides in Uzbekistan” (World Bank, Project 100020592) 2009-2012, consortium Tauw: Tauw Company (The Netherlands), Milieukontact International (The Netherlands), International HCH & Pesticides Association (Denmark), Witteveen+Bos Company (The Netherlands), Green Cross (Switzerland)

APPENDIX 2 WASTE STREAMS: AZERBAIJAN SUCCESS STORY (FROM ZOI 2013)

Success stories

Azerbaijan's successes in environmental clean-up and in sound chemical and waste management provide numerous examples for others to follow. The clean-up of the Absheron Peninsula – an area with high concentrations of both pollution and people – is a special case. Azerbaijan's key achievements here include the construction of a new national hazardous waste management site and the oil industry's modern hazardous waste sites. The country has made significant improvements in the Hovsan wastewater treatment facilities and in the Balakhani solid municipal waste landfill, thereby addressing the problems associated with historical oil, mercury, persistent organic pollutants and ozone-depleting substances. The country is also developing a national solid municipal waste strategy that will apply the experience gained in the Absheron Peninsula to other parts of the country. Other types of waste will be covered by specific strategies.

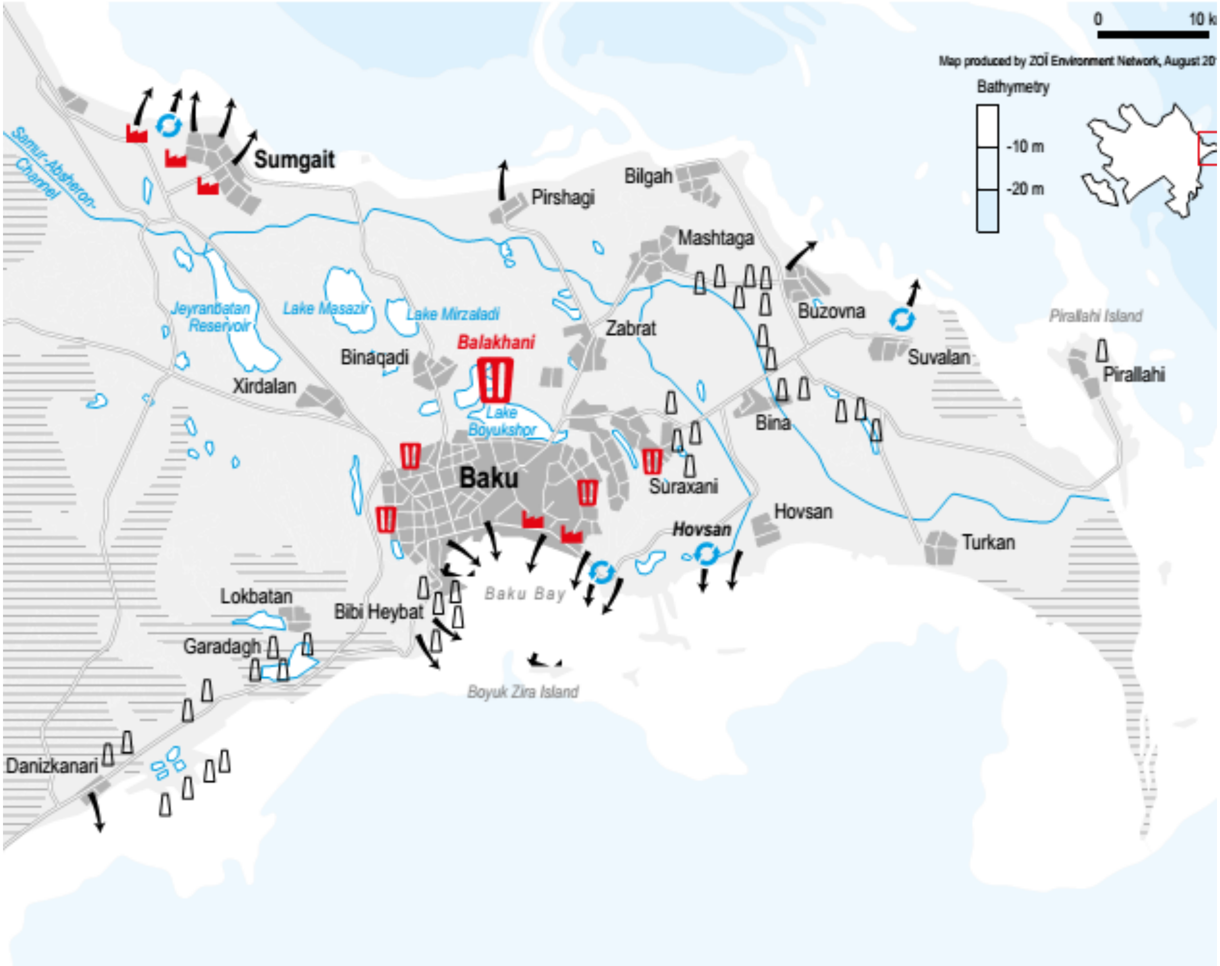
Absheron Peninsula environmental clean-up and improvements

In the last ten years the World Bank has financed several projects that aim to improve the environment in the Absheron Peninsula. The total financing from donors exceeds USD 200 million (including new funding) and is being supplemented by governmental co-financing. In addition, private sector actors – such as oil companies – have invested in waste minimization, clean-up and recycling programmes. These projects are helping to rehabilitate land polluted by the legacy of onshore oil production on Absheron, to reduce environmental pressure from today's oil and gas extraction, to dispose of hazardous industrial waste from defunct enterprises safely, and to improve urban solid and liquid waste management in the Baku metropolitan area.

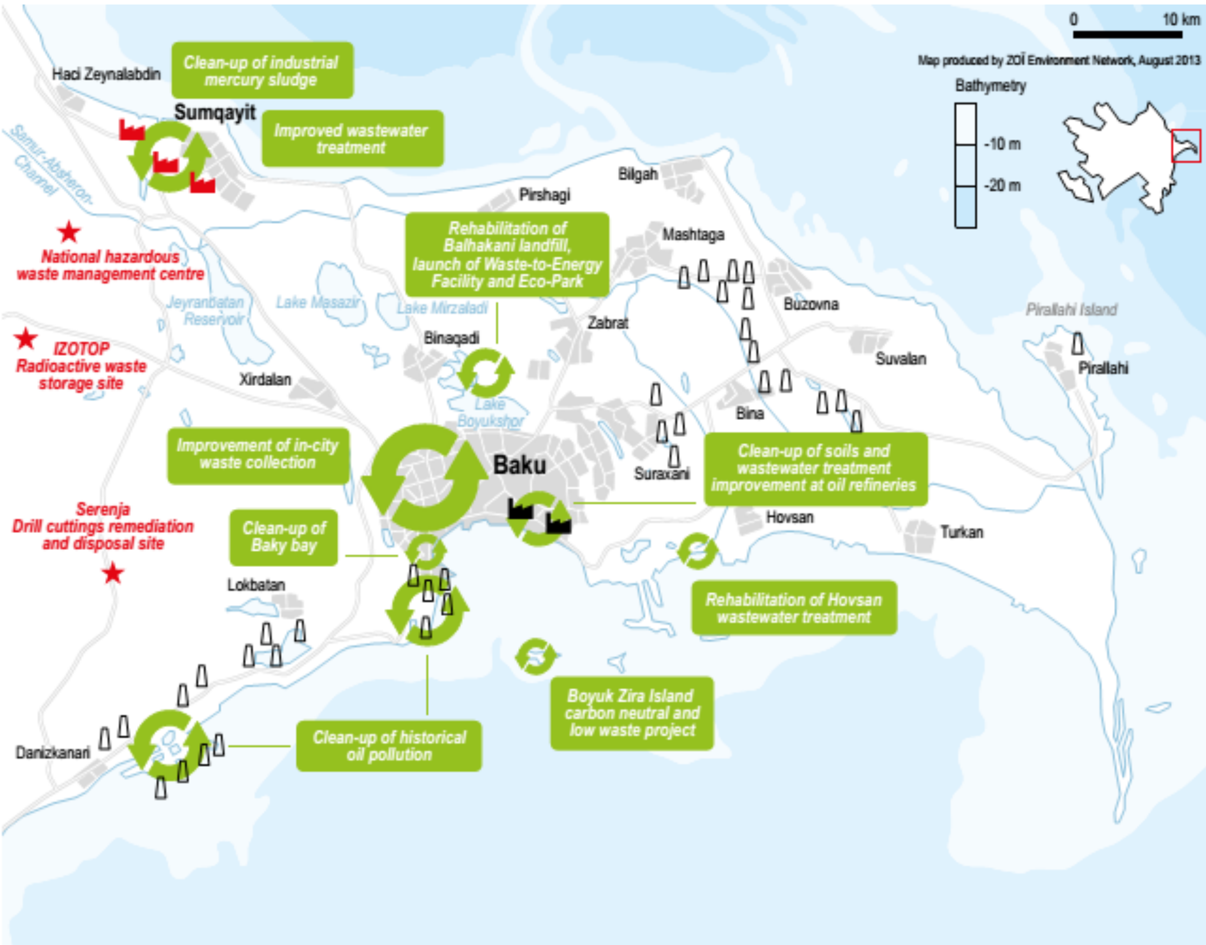
An estimated 10 000 ha on the Absheron Peninsula and surrounding areas are affected by oil and chemicals and the contamination of about 2 000 ha polluted during Soviet-era oil production is a notorious legacy that required priority clean-up. Mechanical methods are used for the clean-up of highly polluted soil, while bioremediation is used for less polluted soil. Between 2009 and 2011, over 800 ha were remediated using one or the other of these methods, notably at the Bibi Heybat and Binaqadi oil extraction and storage areas close to Baku. Once a pollution hotspot, the area is now a park. The large-scale clean-up of the Baku Bay targeting sunk vessels and obsolete infrastructure resulted in removal of more than 4 500 tonnes of scrap metal and 500 tonnes of other waste from the seashore and seabed.

The State Oil Company of the Azerbaijan Republic (SOCAR) has accepted responsibility for past oil pollution in other parts of the country and is scaling up the clean-up efforts, setting priorities on the basis of the economic potential of the polluted areas. The Baku and Azerneftyag refineries' wastewater facilities have been upgraded and nearly 35 million tonnes of oil-contaminated soils and sludge have been reprocessed. Both refineries are likely to be moved out of densely populated areas to minimize environmental and industrial impacts.

Part of the Absheron rehabilitation programme includes a low-level radioactive waste disposal project that helps to reduce health risks by lowering the population's exposure to the radioactive contamination resulting from oil extraction and iodine production. The planned decontamination of former iodine production plants will involve the removal, repackaging and transport of contaminated low-level radioactive waste and the disposal of this material at an upgraded radioactive waste storage facility "Izotop", which currently handles radioactive waste generated by medical, research and industrial applications. A survey programme has mapped the sites of low- and medium-level radioactive contamination in the country and has helped to determine priorities for remediation or containment.



Absheron peninsula: situation 20 years ago



Absheron peninsula: present situation

- Notorious historical pollution from industrial development
- Other industrial waste and chemical issues raising public concern
- Poorly managed waste collection or landfill practices
- Municipal and industrial discharge sources
- Oil wells


Balakhani Waste-to-Energy Facility and Sorting Plant


Clean-up action, Absheron Peninsula

The Absheron Environmental Programme also created the Tamiz Shahar (Clean City) Joint Stock Company, which is responsible for the transport, sorting and disposal of municipal waste from the Baku metropolitan area. Tamiz Shahar started its activities with public campaigns, then improved the waste management system and upgraded the Balakhani disposal site, which was selected as the central site for urban waste disposal for Baku and, in the long run, for the entire Absheron Peninsula. Tamiz Shahar is working to control the environmental impact of waste and to increase the efficiency of an existing landfill by installing up-to-date equipment and technology such as weighbridges, bulldozers and waste-sorting machines.

The separation and recycling of municipal solid waste by citizens is not yet common but business is improving its practices for paper, plastic and metal waste. The rehabilitation of the Balakhani disposal site led to the elimination of the fires that often blanketed Baku and its surroundings. Waste is now covered and fenced and incoming vehicles are controlled and monitored. As part of the project numerous informal smaller waste dumps in and around Baku were closed and the sites cleaned up.

The government of Azerbaijan has invested USD 350 million in a Waste-to-Energy Facility and a Sorting Plant located next to the Balakhani landfill. The government's medium- to long-term strategy is to develop the Balakhani site as an eco-industrial park hosting numerous recycling and green energy industries, including the principal recycling, recovery and waste management centre for greater Baku.

A project area of 120 ha at the Balakhani landfill will be rehabilitated and designed for long-term disposal of waste from the greater Baku region for the next 20 years at least. A highly efficient methane gas capture system will also be installed at the landfill. The system will generate revenues from sales of 91 000 MWh of electricity and reduce greenhouse gas emissions by 670000 tonnes of CO_2-eqvivalent over a period of ten years.

The Balakhani eco-industrial park currently consists of the Material Recovery Facility, with a capacity of 200000 tonnes per year, and the Waste-to-Energy Plant, with the capacity to generate 230 million kWh of power from 500000 tonnes of waste per year. Both facilities operate in compliance with European Union and Azerbaijani environmental requirements. The Waste-to-Energy Facility at Balakhani was completed in 2012 and its pilot phase of operation commenced in 2013. The facility includes an incinerator designed to handle 10000 tonnes of medical waste per year. Industries specialising in recycling plastics, rubber and tyres, lead batteries, mercury-containing equipment, electronic waste and other materials are welcome at the eco-industrial park, which is by far the largest project of its kind not only in Azerbaijan, but also in the Caucasus and Central Asia.

Sumgait chemical industry legacy and recent initiatives

With a population of 310000, Sumgait is the third largest city in Azerbaijan and lies 30 km north of Baku. It was once the industrial hub of chemical and metal production and equipment manufacturing in the Soviet Union and had a dozen industrial plants and factories employing thousands of workers, who were housed just a few kilometres from these enterprises. Industrial facilities occupy up to one third of the city area. Ten years after the end of the Soviet Union, more than half of the population had some form of chemical-related illness. Children were particularly sensitive to the environmental stress.

The most critical problem – mercury sludge from chlor-alkali production – was solved by the development of the national hazardous waste management site built with financing from the World Bank in full compliance with European Union regulations. The landfill, which has been in operation since 2004, has a capacity of 250000 cubic metres; over 40000 cubic metres have already been used for the disposal of mercury soil and sludge, a major operation that was conducted in 2009. The remaining space is available for commercial waste disposal. Təhlükəli Tullantılarn (Hazardous Waste) LTD, which was established by the Ministry of Ecology and Natural Resources, operates the national hazardous waste management site in the best manner possible.


Balakhani landfill before...


...and after rehabilitation


Modern hazardous waste disposal site

Abandoned obsolete pesticides in neglected storage conditions

Improved storage facility for obsolete pesticides at Jangi

Sumgait continues to harbour a number of industrial pollution hotspots. However, encouragement may be drawn from the closure of many of its hazardous industries and from some positive clean-up measures that have been successfully completed.

Persistent organic pollutants: Pesticides and PCBs

The Sumgait Surfactants Plant produced DDT for applications in local and regional agriculture, particularly in cotton plantations and vineyards from 1958 to 1980. Cumulative production exceeded 480 000 tonnes of pesticide mixtures, and the industrial site is now contaminated with leftovers and local spills. Estimates of obsolete pesticides left in 80 locations across the country vary but the amount probably exceeds 8 000 tonnes. The central facility for obsolete pesticides storage at Jangi contains about half of this amount. This central site was restored and upgraded recently and almost 2 500 tonnes of pesticides were repacked and safely placed in concrete bunkers. Responsibility for obsolete pesticides storage sites and the Jangi site is assigned to the Phytosanitary Control Service.

Azerbaijan has never manufactured PCBs, a type of persistent organic pollutant that the parties to the Stockholm Convention are committed to reducing and, if possible, eliminating. The country has, however, imported PCB-containing equipment and oil from Russia and other countries and needs to build capacity to deal with the consequences. A GEF project focusing on the power sector is working to enable Azerbaijan to comply with its obligations under the Convention, and is creating a national inventory of non-electrical equipment and other articles containing more than 0.005 per cent of PCBs, as required by the Convention.

The project is helping to dispose of at least 500 tonnes of PCB oil, equipment and wastes and is providing training to owners of electrical equipment containing PCB oil. The global benefit of the project will be the reduction of ongoing threats to human health and the environment by preventing future releases of PCBs into the environment through the improper management of electrical equipment. Another task is to enhance the regulatory frameworks and strengthen institutional capacity for the monitoring, management and treatment of PCBs.

APPENDIX 3 HAZARDOUS WASTE TREATMENT TECHNOLOGIES ORGANIC + INORGANIC WASTE IN PILOT COUNTRY

					Annual waste arising	Vitrification	HTI	Gasification *	PLASMA ARC	SCWO	Cement kilns	Radical Planet Technology
LEVEL 1	LEVEL 2 - Major Waste Type		LEVEL 3 - Specific Waste Type		total							
	No	Name	No	Name								
HAZ WASTE	HW 01	Gaseous waste	01	Gases (excluding Greenhouse gases)								
			02	Obsolete ozone depleting gases						Applicable[1]	CFCs, HCFCs[1]	
	HW 02	Mercury containing waste	01	Liquid waste containing mercury	11636					Applicable[2]		
			02	Solid waste containing mercury						Applicable[3]		Applicable[1]
	HW 03	Batteries	01	Lead Acid Batteries								Applicable[2]
			02	Mercury batteries								Applicable[2]
			03	Ni/Cd batteries								Applicable[3]
			04	Manganese dioxide and alkali batteries								Applicable[3]
			05	Lithium & Lithium ion batteries								Applicable[3]
			06	Nickel-metal hydride batteries								Applicable[3]
			07	Mixed batteries								Applicable[2]
	HW 04	POP Waste	01	PCB containing waste (>50mg/kg)	2						timc[2]	Applicable®
			02	Other POP-containing waste	19406						timc[2]	Applicable*
	HW 05	Inorganic waste	01	Liquid and sludge inorganic waste	3741306			applicable*			applicable[3]	Applicable^
			02	Solid inorganic waste	337761			applicable*			applicable#	Applicable^
			03	Spent pot lining (inorganic)				applicable*			applicable®	Applicable^
	HW 06	Asbestos containing waste	01	Asbestos containing waste	525							Applicable™
	HW 07	Waste lubricating Oils	01	Waste lubricating oil	18546						applicable°	Applicable©
	HW 08	Organic halogenated and /or sulphur containing solvents	01	Solvents containing halogens and/or sulphur	3492			applicable*			applicable™	Applicable[1*]
	HW 09	Organic halogenated and/or sulphur containing waste	01	Liquids and sludges containing halogens and/or sulphur	9333			applicable*			applicable™	Applicable[1*]
			02	Solids containing halogens and/or sulphur	6000			applicable*		Applicable^	applicable™	Applicable[2*]
	HW 10	Organic solvents without halogens and sulphur	01	Solvents without halogens and sulphur	28299						applicable™	Applicable[1*]
	HW 11	Other organic waste without halogen or sulphur	01	Liquid and sludge organic waste	183660						applicable^	Applicable©
			02	Solid organic waste	21810					Applicable^	applicable^	Applicable©
			03	Spent pot lining (organic)						Applicable^	applicable^	Applicable©
	HW 12	Tarry and Bituminous waste	01	Tarry waste	12084					Aplicable™	applicable^	Applicable©
			02	Bituminous waste	1000					Aplicable™	applicable^	Applicable©
	HW 13	Brine	01	Brine	15660					Applicable[2*]	applicable™	
	HW 14	Fly ash and dust from air pollution control devices	01	Fly ash							applicable^[1]	Applicable[2*]
	HW 15	Bottom ash	01	Bottom ash							applicable^[2]	Applicable[2*]
	HW 16	Slag	01	Ferrous metal slag	2019400						applicable^[2]	Applicable[1^]
			02	Non-ferrous metal slag		Applicable[2]					applicable^[2]	Applicable[1®]
			03	Other		Applicable[2]						Applicable[1#]
	HW 17	Mineral waste	01	Foundry sand	720						applicable^[2]	Applicable[1#]
			02	Refractory waste	3009						applicable^[2]	Applicable[1^]
			03	Other (more detail needed before determination can be made)								Applicable[12]
	HW 18	Waste of Electric and Electronic Equipment (WEEE)	01	Large Household Appliances								Applicable[1#]
			02	Small Household Appliances								Applicable[1#]
			03	Office, information & Communication Equipment								Applicable[2]
			04	Entertainment & Consumer Electronics and toys, leisure, sports & recreational equipment and automatic issuing machines								Applicable[1#]
			05	Mercury containing lamps								Applicable[2]
			06	Lighting equipment								Applicable[2]
			07	Electric and Electronic tools								Applicable[22]
			08	Security & health care equipment								Applicable[°*]
			09	Mixed WEEE								Applicable[2©]
	HW 19	Metal scrap	01	Contaminated scrap metal waste								Applicable[2©]
	HW 20	Health Care Risk Waste	01	Health care risk waste						Applicable[2*]		Applicable[°*]
	HW 21	Sewage sludge	01	Sewage sludge							applicable^[3]	
	HW 99	Miscellaneous	01	Miscellaneous	21678	Applicable[1]						
For mixtures, report under the waste type which represents the largest fraction of the waste under consideration												
Report under a specific waste type e.g. mercury battery would be reported under mercury battery and not mercury containing					6455327							

	Legend
(green)	Commercial Experience
(orange)	Demonstration Experience
(yellow)	no Experience but considered applicable
(red)	not treatable
HTI	High Temperature Incineration

Explanatory notes to the Table used in Appendix 3: Page 1

Evaluation has been made for the example of South African Waste Streams	
Waste Management Methods	
Code	**Description**
Recovery, Recycling and Reuse	
R1	Direct recovery of energy from waste
R2	Direct recovery of raw material from waste
R3	Recovery of energy and raw material from waste
R4	Regeneration or rejuvenation of waste (solvents, carbons, acids & alkalis)
R5	Recycling of waste
R6	Reuse of waste
Treatment	
T1	Biological treatment (e.g. biodegradation, composting, biogas generation)
T2	Physical treatment
T3	Chemical treatment
T4	Thermal treatment (incineration, pyrolysis etc.)
Disposal	
D1	Disposal of waste to landfill (e.g. specially engineered landfill)
D2	Storage/disposal of waste in surface impoundments
	(e.g. placement of liquid or sludge discards into pits, ponds, lagoons etc.)
D3	Release of waste into water bodies (except seas/oceans)
D4	Permanent storage (stabilization, micro-encapsulation, macro-encapsulation)
Notes on technologies and providers:	
Notes on Vitrification by technology by provider Geomelt	
Applicable[1]	Virification has been used on a variety
	of misc wastes streams
Applicable[2]	depend on contaminant/material type
Note: Gasification example Schwarze Pumpe commerical experience*	
* Evaluation by Dr. Buttker	
applicable*:	up to max allowable concentrations
Notes on SCWO, provided by General Atomics	
Competitively Treatable with SCWO	
Applicable[1]	if in liquefied form
Applicable[2]	if organic, Mercury in effluents must be scrubbed
Applicable[3]	if organic and slurried, Mercury in effluents must be scrubbed
Applicable[2]*	if organic
Applicable[3]*	if organic and slurried
Applicable^	if slurried
Apllicable™	if can be cut it with a solvent

Explanatory notes to the Table used in Appendix 3: Page 2

Notes on Radical Planet Technology (RPT), by Kaoru Shimme	
Applicable[1]	Activation & Insolubilization, Recycle as Rare Metal, with some conditions, Yttrium & Hafnium
Applicable[1ª]	Activation & Insolubilization, Recycle as Rare Metal, with some conditions
Applicable[1^]	Activation & Insolubilization, Reuse of Material, with some conditions, Inorganic Material
Applicable[1®]	Activation & Insolubilization, Recycle as Rare Metal, with some conditions
Applicable[12]	Activation & Insolubilization, Reuse of Material
Applicable[2]	Activation, Recycle of Metal, with some conditions
Applicable[2]©	Activation, Recycle as Rare Metal, with some conditions, Indium recovery
Applicable[22]	Activation, Recycle as Rare Metal, with some conditions, Indium & Yttrium
Applicable[3]	Activation, Recycle for Metal
Applicable[®]	Destruction, Stockholm Convention, PCB
Applicable[*]	Destruction, Stockholm Convention, POPs
Applicable[^]	Activation & Insolubilization, Reuse of Material
Applicable™	Destructon & Activation, Reuse of Material, Asbestos
Applicable©	Mechanical Cracking, Reuse of Material
Applicable[1*]	Destruction & Mechanical Cracking, Re-use of Material
Applicable[2*]	Destruction & Mechanical Cracking, Re-use of Material, PVC
Applicable[3*]	Destruction, Stockholm Convention, Dioxin
Applicable[°*]	Destruction & Bio-harmless, Easy to Landfill, with some conditions
Notes on Cement kilns, provided by Kåre Helge Karstensen	
CFCs, HCFCs[1]:	CFCs, HCFCs, Halons etc. are destroyed on routine
	basis in several countries : Japan,
	Indonesia, Norway etc.
timc[2]:	treated in many countries
applicable[3]	possible in small % of feed rate
applicable[ª]	if compatible with cement raw material chemistry.
	Raw material recycling
applicable[®]	both carbon and refractory
applicable[°]	as energy recovery
applicable™	but limited amounts
applicable[^]	as energy recovery
applicable[^1]	as raw material recycling. Control with
	heavy metals, chlorine and dioxins
applicable[^2]	as raw material recycling.
applicable[^3]	both raw sludge and dried
HTI Information has been provided by SAVA Germany	

APPENDIX 4 HAZARDOUS WASTE TREATMENT TECHNOLOGIES ORGANIC WASTE IN PILOT COUNTRY

LEVEL 1	LEVEL 2 - Major Waste Type		LEVEL 3 - Specific Waste Type		Annual waste arising total	GCPR	TPT	BCD	CTH Process	PLASCON	Alkali metal
	No	Name	No	Name							
HAZ WASTE	HW 01	.	01	Gases (excluding Greenhouse gases)			Applicable[TM]		HW 01°	Applicable°	
			02	Obsolete ozone depleting gases						Applicable°	
	HW 02	Mercury containing waste	01	Liquid waste containing mercury	11636		Applicable[1]	HW 02[1]*			
			02	Solid waste containing mercury			Applicable[1]	HW 02[1]**			
	HW 03	Batteries	01	Lead Acid Batteries							
			02	Mercury batteries							
			03	Ni/Cd batteries							
			04	Manganese dioxide and alkali batteries							
			05	Lithium & Lithium ion batteries							
			06	Nickel-metal hydride batteries							
			07	Mixed batteries							
	HW 04	POP Waste	01	PCB containing waste (>50mg/kg)	2			HW 04[2]		Applicable[1]	
			02	Other POP-containing waste	19406			HW 04[2]	HW 04-01[1]	Applicable[2]	
	HW 05	Inorganic waste	01	Liquid and sludge inorganic waste	3741306						
			02	Solid inorganic waste	337761						
			03	Spent pot lining (inorganic)							
	HW 06	Asbestos containing waste	01	Asbestos containing waste	525						
	HW 07	Waste lubricating Oils	01	Waste lubricating oil	18546			HW 07[3]	HW07[2]		
	HW 08	Organic halogenated and /or sulphur containing	01	Solvents containing halogens and/or sulphur	3492				HW08[3]	Applicable[3]	
	HW 09	Organic halogenated and/or sulphur containing waste	01	Liquids and sludges containing halogens and/or sulphur	9333			HW 09°		Applicable[TM]	
			02	Solids containing halogens and/or sulphur	6000			HW 09°			
	HW 10	Organic solvents without halogens and sulphur	01	Solvents without halogens and sulphur	28299				HW10*		
	HW 11	Other organic waste without halogen or sulphur	01	Liquid and sludge organic waste	183660						
			02	Solid organic waste	21810				HW11[TM]		
			03	Spent pot lining (organic)		?					
	HW 12	Tarry and Bituminous waste	01	Tarry waste	12084				HW12^		
			02	Bituminous waste	1000						
	HW 13	Brine	01	Brine	15660						
	HW 14	Fly ash and dust from air pollution control devices	01	Fly ash							
	HW 15	Bottom ash	01	Bottom ash							
	HW 16	Slag	01	Ferrous metal slag	2019400						
			02	Non-ferrous metal slag							
			03	Other							
	HW 17	Mineral waste	01	Foundry sand	720						
			02	Refractory waste	3009						
			03	Other							
	HW 18	Waste of Electric and Electronic Equipment (WEEE)	01	Large Household Appliances							
			02	Small Household Appliances							
			03	Office, information & Communication Equipment							
			04	Entertainment & Consumer Electronics and toys, leisure, sports & recreational equipment and automatic issuing							
			05	Mercury containing lamps							
			06	Lighting equipment							
			07	Electric and Electronic tools							
			08	Security & health care equipment							
			09	Mixed WEEE							
	HW 19	Metal scrap	01	Contaminated scrap metal waste			Applicable[2]				
	HW 20	Health Care Risk Waste	01	Health care risk waste			Applicable[3]		HW20®		
	HW 21	Sewage sludge	01	Sewage sludge							
	HW 99	Miscellaneous	01	Miscellaneous	21678						

For mixtures, report under the waste type which represents the largest fraction of the waste under consideration

Report under a specific waste type e.g. mercury battery would be reported under mercury battery and not mercury contain waste — 6455327

Legend

- Commercial Experience
- Demonstration Experience
- Not tested
- Not commercially viable
- Not applicable

Waste Management Methods	
Code	**Description**
Recovery, Recycling and Reuse	
R1	Direct recovery of energy from waste
R2	Direct recovery of raw material from waste
R3	Recovery of energy and raw material from waste
R4	Regeneration or rejuvenation of waste (solvents, carbons, acids & alkalis)
R5	Recycling of waste
R6	Reuse of waste
Treatment	
T1	Biological treatment (e.g. biodegradation, composting, biogas generation)
T2	Physical treatment
T3	Chemical treatment
T4	Thermal treatment (incineration, pyrolysis etc.)
Disposal	
D1	Disposal of waste to landfill (e.g. specially engineered landfill)
D2	Storage/disposal of waste in surface impoundments (e.g. placement of liquid or sludge discards into pits, ponds, lagoons etc.)

Notes on TPT	
Applicable[1]	Based on the expected volumes of mercury waste TPT are considering increasing the capacity of critical equipment that will be used for mercury treatment.
Applicable[2]	can de-contaminated scrap metal that may be contaminated with the hazardous classes that are highlighted in green
Applicable[3]	only treat pharmaceutical waste material
Applicable™	Gases must be in line with other cateogories highlighted in green

Notes on BCD	
HW 02[1]*	in cases where the waste contains POPs
	and Hg it can be treated in the BCD
	reactor if, in the solid form, ground into a
	moderately fine powder. The mercury is
	recovered as a separate relatively pure
	stream in the overhead condensate.
HW 02[1]**	In case of solids such as Hg contaminated
	soil it can be treated in the indirect fired
	rotary kiln.
HW 04[2]	almost all POPs waste except for volatile
	liquids
HW 07 [3]	the waste lube oils make an excellent
	processing oil in the BCD reactors.
	If they contain low concentrations of
	PCBs, < 50 mg/kg we can treat other POPs
	in combination and the oil is treated for
	free.
HW 09 °	many of these compounds, including
	those with organic bonded sulphur can
	be treated
Prelim T	Preliminary results strongly support the
	destruction of these materials at 200 C
	with CTH
HW22^	For CTH successfull tests PCP 50% + Endosulfan
Notes on CTH: Pilot testing	
HW 01°	GHS and ODS are destroyed in autoclave treatment system
HW04[1]	decompose other POPs to carbon residues
HW07[2]	CTH deontaminates oil for reuse
HW08[3]	solvents destroyed
HW10*	hetero atomic solvents destroyed, aromatics and aliphatics are not affected
HW11™	solid organics converted to carbon residue
HW12^	converts waste to carbon residue
HW20®	affects destruction of infectious agents ,biological specimens in waste stream without

Notes on PLASCON

Applicable°	Plascon has been utilised for the Destruction of Halogenated gases including fire extinguishing gases, CFCs, HCFCs, HFCs and SF6 on a commercial basis in Australia, USA, Mexico and the UK.
Applicable[1]	PCB containing waste has been commercially destroyed by Plascon in Australia and Japan
Applicable[2]	Other POPs containing waste have been destroyed by Plascon in Australia on a commercial basis. These include PFOS, DDT, DIeldrin, Chlordane, HCB, 2,4,5-T, organophosphate and organochlorine pesticides
Applicable[3]	Plascon has commercially destroyed halogenated solvents in Australia and the USA. Solvents processed include perchloroethylene, trichlorobenzene, bromoform and trichlorotrifluoroethane.
Applicable™	Liquids containing halogenated organics have been destroyed on a commercial basis in Australia. Plascon cannot process sludges.

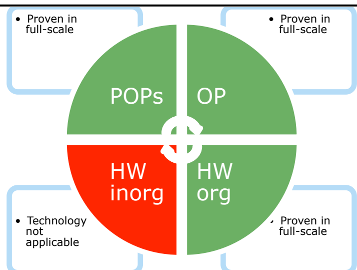
APPENDIX 5 TECHNOLOGIES: OVERVIEW OF FACT SHEETS

No.2 BASE-CATALYSED DECOMPOSITION (BCD) - SUMMARY INFO

Base-Catalyzed Decomposition (BCD) is a chemical process that destroys POPs in liquid and solid matrices, inside autoclave reactors or in reactors under no pressurized conditions. It involves treatment of liquid and solid wastes in the presence of a reagent mixture; when heated to about 300° C, the reagent produces highly reactive atomic hydrogen, which cleaves chemical bonds by the catalytic hydrogenation and dehydrogenation which results in removal of elements that confer toxicity to compounds.

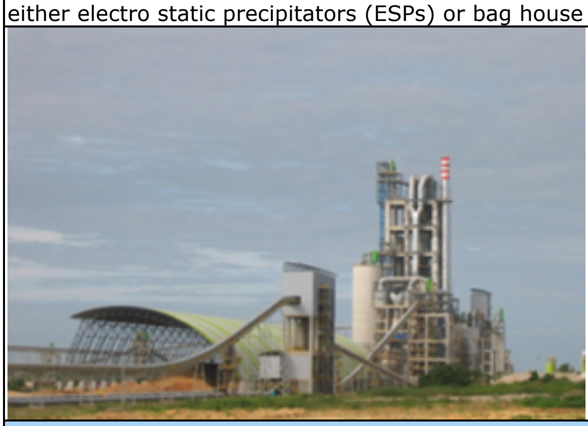
Commercial operations: Over 18 years on the market in Australia, Mexico. Systems used for short-term projects in Australia, Spain (2 years) and in US many soils/waste remediation projects. Long term project Spolana, Czech Republic 47,000 tons, PCCD-and PCDF, HCHs, HCBs.
In Australia, the process has been used at two commercial operations in Australia, one of which is still operating. Over 6 years, one license treated approximately 8-10,000 t of PCB and PCB contaminated oil, 25 tons of pesticide chemicals and pesticide waste, and 15 tons of pesticide concentrates collected from soil remediation. In US over 93,000 tons of soil contaminated with PCB and PCCD/PCDF and in Spain 3,500 tons of Pure HCH-waste.

Photo: BCD plant at Homebush Bay in Australia (ref new SBC BCD Fact Sheet)

STRENGTHS	WEAKNESSES
Original BCD process is based on bringing contaminants into a solvent and the process is favored for treating large volumes. The modified BCD process is capable of destroying POPs in aqueous medium, wet sludge or oils	Direct treatment of capacitors containing PCB is not possible as aluminum in capacitors interacts with the process.
Large experiences in combined soil-waste treatment in combination with thermal desorption. Little space needed	Large number of repeated extractions (e.g. 30 sequences) is required to obtain residual PCB concentrations which are suitable for landfill disposal (e.g. less than 50 mg/kg)
Proven track record for many high strength POPs waste like pure PCB and over 50% up to 1,000 t/y of high chlorine content PCB or pesticides (50%) have been treated in a single line	***Not suitable for inorganic waste***
Last POPs project Spolana Neratovice, on site, more than 47,000 t of POP wastes were treated with 2 X 10m³ reactors	
Simple proces, flexible, as capacity can be increased by increasing number of single reactors, mobile and fixed plants	
Widepread experiences on POPs treatment for all pesticides POPs and industrial chemicals/by-products	
No ash is produced	
High public acceptance	
Suitability rating 2014	

No 4 CEMENT KILN CO-INCINERATION – SUMMARY INFO

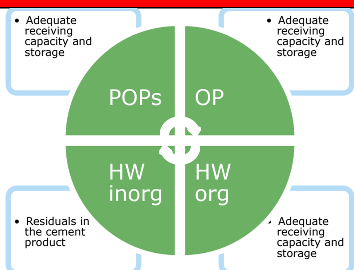
Portland cement is made by heating a mixture of limestone, silica, alumina, limestone, shale, marl and iron materials to a temperature of about 1450 °C. Fuel and wastes fed through the main burner of a cement kiln will be decomposed under oxidising conditions in the primary flame burning zone at temperatures up to 2,000 °C and a retention time up to 8 seconds. Fuel and waste fed to the secondary burner, kiln inlet or precalciner will be burnt at temperatures between 900 °C and 1,200 °C. Cement kilns are equipped with either electro static precipitators (ESPs) or bag house fabric filters, or both, for particulate matter control.



Commercial operations: Testing of cement kiln emissions and cement products for the presence of organic chemicals during the burning of hazardous materials has been undertaken since the 1970s, when the practice of co-processing hazardous wastes in cement kilns was first considered.

Cement kiln operators in the US began recovering energy from organic waste materials, incl. hazardous chlorinated compounds, as early as 1974. That practice became commonplace by 1987 and since 1991 US cement kilns have used roughly 1,000,000 tons per year of hazardous waste as fuel (IHPA,2009)

Photo: Report Ed Verhamme

STRENGTHS	WEAKNESSES
Cement manufacturing facilities and infrastructure are already in place in many of the countries information on worldwide co-processing (co-incineration) data: *1. **Holcim** co-incinerates world-wide about 6 – 7 Mill tons of waste per year, of which about 20% can be classified as hazardous waste, meaning that they alone co-incinerate, under business as usual conditions, about 1.2 – 1.4 Million tons/year Geocycle (waste management arm of Holcim) is present in approx 40 countries throughout the world www.geocycle.vn/en/tool-pages/world-wide* *2.**United Kingdom**:Co-processing (of co-incineration) in cement kilns approx 250.000 tons/y and of hazardous waste approx 135.000 tons/y (Source DEFRA).* *3.USA: Cement kilns (so called BIF (– boiler & industrial furnaces) facilities) co-process approx 1.000.000 tons/year over the last 15 years Source: CKRC (Cement Kiln Recycling Coalition*	Cement plants need adequate infrastructure to deal with waste management and co-processing
Potential recovery of energy and resources	Cement manufacture is an energy intensive process
Lower costs compared with dedicated technology or export of hazardous waste	*Pre-treatment and pre-processing of wastes may imply "dilution" of hazardous substances and is less acceptable among stakeholders*
Cement plants co-processing wastes usually need more stringent permits on emissions compared to non-co-processing plants	Cement plants emit large volumes of exit gas
The assessment of application of wide range of organic and inorganic hazardous waste the cement kiln scored highest	***Still Low public acceptance in many countries in spite of global application***
Suitability rating 2014	

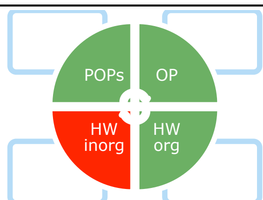
No 5 GAS PHASE REDUCTION (GPCR) – SUMMARY INFO

GPCR involves the reduction of organic compounds by hydrogen and some steam (which acts as a heat transfer agent and another source of hydrogen) at temperatures of 850°C or greater. Organic compounds are ultimately reduced to methane, hydrogen chloride (if the waste is chlorinated), and minor amounts of low molecular weight hydrocarbons (benzene and ethylene). The hydrochloric acid is neutralized by addition of caustic soda during initial cooling of the process gas, or can be taken off in acid form for reuse, if desired. Cooled, scrubbed gas from the reactor ("Product Gas") is compressed and analyzed. Product gas can then be reused as a fuel for plant components, or consumed in a burner.

Commercial operations: A commercial GPR system operated in Australia for more than 5 years, treating more than 2,500 t of PCBs DDT and other POPs. In 1999 a full-scale test on HCB was conducted using the commercial plant. GPR technology licensees in Japan have built and operated a semi-mobile GPR plant for the treatment of PCB wastes. A trial run for PCB treatment was performed in October 2006. The technology was tested as part of the ACWA (Assembled Chemical Weapons Assessment) Program for the destruction of chemical warfare agents. Through this testing the GPR technology was proven to be effective for treatment of chemical warfare agents.

The GPR technology has been permitted for the destruction of hazardous wastes in Canada, the United States, Australia, and Japan.

Photo:

STRENGHTS	WEAKNESSES
Successfully demonstrated for the destruction of a wide variety of organic wastes and POPs and OPs including PAHs, and chemical warfare agents including mustard, and VX and GB nerve agents	***Last 10 years little activities and experiences been made.***
Very low probability of PCDD/PCDF formation and release because there is no free oxygen in the system.	
Safe clean alternative to incineration with a reduction in greenhouse gas emissions and elimination of hazardous emissions associated with comparable incinerator. No ash and tar are produced.	
Designed to be modular therefore flexibility to add additional process capacity at the same site. Can be designed to process multiple feedstocks in a blended manner. Readily scalable. Can be designed to be transportable.	
High public acceptance	**Suitability rating 2014**

No. 6 HAZARDOUS WASTE INCINERATION – SUMMARY INFO

The most common combustion technology in hazardous waste incineration is the rotary kiln. Facilities in the merchant sector range in size from 82 to 270 tons per day waste throughput (European Commission 2006). Incinerators are usually designed for full oxidative combustion within a temperature range of 850 °C – 1,400 °C. Certain hazardous wastes, particularly spent solvents, are also burnt as fuel in cement kilns. This latter application is covered under section V.B. of the present guidelines.

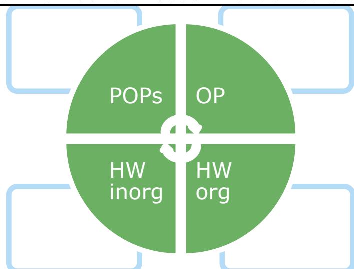
Similar to the incineration of municipal solid waste, hazardous waste incineration offers the benefits of destruction of organic (including toxic) materials, of volume reduction and concentration of pollutants into relatively small quantities of ashes, and, less frequently**,** energy recovery.

Commercial operations:Eurits, the European Union for Responsible Incineration and Treatment of Special Waste, representing more than 90% of the EU's specialist waste incineration sector, 26 members operate 36 plants in 12 countries with atotal capacity of 2.5 million tonnes per year (Eurits).

Photo: Photo: Hazardous waste treatment plant, HIM GmbH, Germany

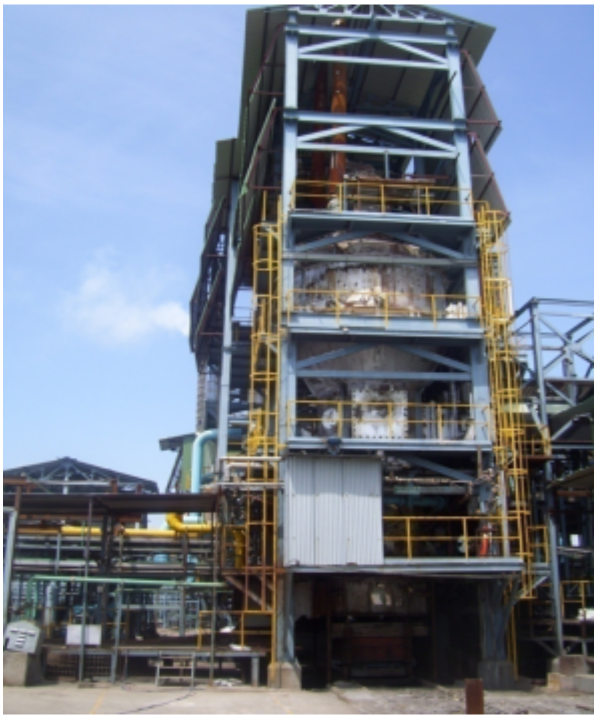
STRENGHTS	WEAKNESSES
Enable recovery of the energy, mineral or chemical content from waste	Frequently necessity of pre-treatment of waste
Plants can be fixed or portable units	Process gases released need treatment
Large variety of wastes treated (organic substances, minerals, metals, water), but also inorganic waste	Possible POPs release during the incineration (depending on the waste composition)
Assessment of application of wide range of hazardous waste the incinerator scored second highest	***Large quantities of residuals like slags up to 30% that needs to be disposed***
High capacity of waste treated	High concentrated POPs and OPs have to be diluted with other waste in order to treat them

Suitability rating 2014



NO. 7 PLASMA ARC–SUMMARY INFO

Plasma arc is a waste treatment method that utilizes high temperatures and high electrical energy to destroy a range of wastes. The process consists of either a plasma arc torch, which uses gas or steam and metal electrodes, or a graphite electrode, to ionize the gas (= plasma). The temperature of the plasma arc is from 2,000 °C to 15,000 °C, where molecular bonds of chemicals break down into atoms by injecting the waste into the plasma, or by using the plasma arc as a heat source for combustion or pyrolysis. The process converts the organic components of the waste into a high-calorific synthesis gas consisting of carbon monoxide (CO), hydrogen (H_2), and short-chain hydrocarbons (such as methane). Depending on the chemical composition of the waste, gaseous pollutants such as hydrogen chloride (HCl), hydrogen sulfide (H_2S) are formed. Non-flammable inorganic constituents end up as metals or in slags. Torch power ranges from 100 kW to 200 MW produce high energy densities. The torch operates with most gases.

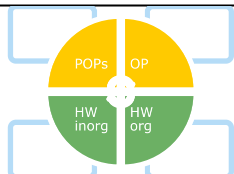


Commercial operations (of the various plasma technologies): The 2 world's largest waste to energy conversion facilities for hazardous waste Plasma Gasification Vitrification Reactors (PGVR) for the treatment of hazardous waste, are now operating in India. A 72 tons/d Plasma Gasification at Pune and the other 72 tons/d TPD Plasma Gasification plant at Nagpur (SMS ENVOCARE LTD .INDIA). Both plants receive together hazardous waste from more than 1800 industries. Dow Corning in Midland, Michigan, US. The Plasma Enhanced Melter® (PEM®) started-up in late 2009, and recycles hazardous chemical residuals into reusable process chemicals and clean syngas used as fuel for steam. More than 6,600 tons per year of hazardous chlorinated organic liquid waste are converted into 5500 tons per year of aqueous hydrochloric acid and 875 tons of clean synthesis gas. Argon plasma arc ("in-flight" plasma arc technology) is operative commercially since 1992. Till February 2014, 13 commercial plants have been operating in Australia, UK, USA, Mexico and Japan and destroyed more than 7000 tons of agriculture waste incl. POPs pesticides, 3000 tons of concentrated PCBs and halons and freons. All plants are standard-size and can be used as fixed plants, but also can be easily transported in standard containers.

Photo: Plasma Reactor at the SMS plant, India

STRENGHTS	WEAKNESSES
Distinct advantages of the treatment of incinerator residues	***POPs and OPs being treated at pilot scale but full scale experiences are lacking***
Rapid heating and reactor start-up and high heat and reactant transfer rates	Large amount of electricity as energy source
Melting of high temperature materials	Process economics
Plants can be fixed or portable units	
Can be used for the treatment of a wide range of wastes (liquids, solids and gases). Top performance for metal slags	
Smaller installation size for a given waste throughput	

Suitability rating 2014



No. 9 SUPER CRITICAL WATER OXIDATION (SCWO)–SUMMARY INFO

Supercritical water oxidation (SCWO), has been developed as a means of waste destruction for aqueous organic wastes. While the unique properties of near-critical and supercritical water have been utilized in an increasing number of applications ranging from power cycles to synthesis reactions to biofuels formation, SCWO is the application which has been studied the longest and is furthest along in commercial development (Marrone 2013)

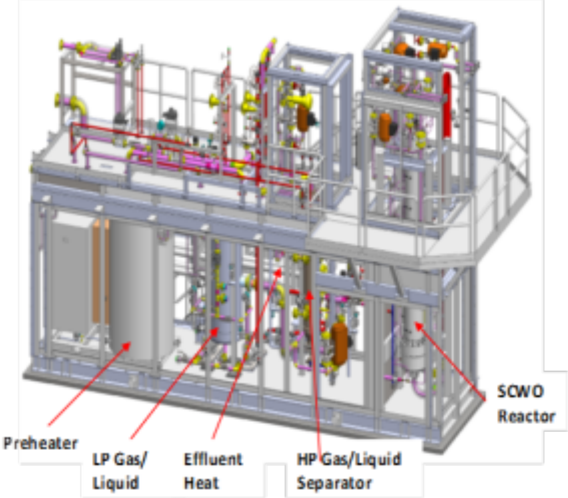


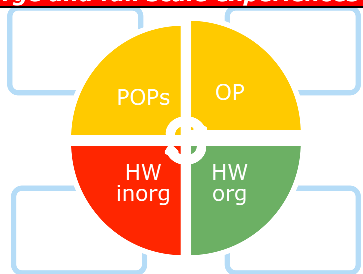
Photo: GA ACWA SCWO System Reactor Module Detail

<u>Commercial operations:</u>

January 2012, there are six companies active in commercializing SCWO technology: General Atomics (GA) SRI International, Hanwha Chemical, SuperWater Solutions, SuperCritical Fluids International (SCFI), and Innoveox.GA SCWO systems made over 20,000 hours of operation since 1981 processing numerous aqueous based and organic based waste materials. Majority of GA's SCWO systems designed, constructed and tested under contract to the US Government for treatment of military generated waste materials. Majority of systems would be considered pilot/demonstration scale. GA recently completed approx 800 h acceptance testing on one of three 687 kg/h SCWO systems built for US military under Assembled Chemical Weapons Alternatives program (ACWA). Systems will be installed at Blue Grass Army Depot in Richmond, Kentucky as part of overall ACWA program. Three identical units were built to meet requirements of processing caustic hydrolysates of agents and energetics derived from disassembly of chemical agent containing weaponry. Units were relocated to the Blue Grass site in 2013 and are currently being integrated into the overall BGCAPP facility**.**

STRENGHTS	WEAKNESSES
Complete oxidation (no products of incomplete combustion, e.g. CO)	Corrosion and Salt precipitation/accumulation, but has been dealt with nowadays
99.99% destruction efficiency for wide range of organic compounds	Feeds must be in form that can be pumped (i.e liquid, slurry, solution) therefore solid wastes need to be brought in to liquid phase (pre-treatment)
Liquid effluents discharged without further treatment and Gaseous effluents be discharged to the atmosphere	Potentially expensive materials of construction for high temperature components
Relatively small reactor volume	High energy consumption in pressurizing and preheating of reactants
High public acceptance	***POPs and OPs being treated at pilot scale but lack of large and full scale experiences***

Suitability rating 2014



No. 10 WASTE TO GAS – SUMMARY INFO

Gasification is a partial oxidation process. The term partial oxidation is a relative term which simply means that less oxygen is used in gasification than would be required for combustion (i.e. burning or complete oxidation) of the same amount of fuel. Gasification typically uses only 25 % - 40 % of the stoichiometric oxidant (either pure oxygen or air) to generate enough heat to gasify the remaining fuel into synthethis gas (syngas). The major products of gasification are carbon monoxide (CO) and hydrogen (H2), with only a minor amount of the carbon completely oxidized to carbon dioxide (CO2) and water (H2O). The heat released by partial oxidation provides most of the energy needed to break up the chemical bonds in the feedstock, to drive the other endothermic gasification reactions, and to increase the temperature of the final gasification products.

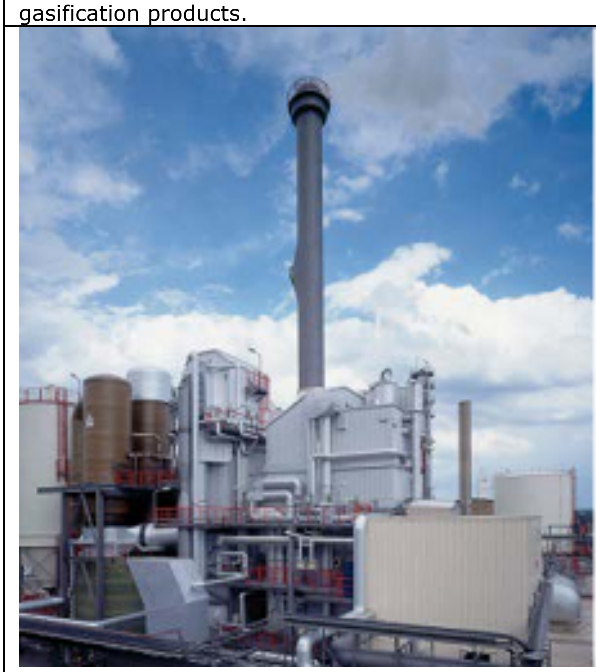


Photo : SVZ Schwarze Pumpe, Germany (Ref Baumgarte)

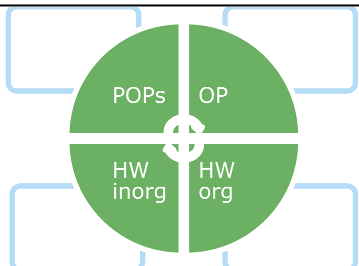
Commercial operations:

Sekundärrohstoff-Verwertungszentrum Schwarze Pumpe GmbH (SVZ): Commercial scale waste gasification was operated in Germany since 1992 in SVZ. In total about 3.6 million tonnes of waste has been treated in the gasification process. From 2000 to 2006, approximately 300,000 tons of solid waste and 60,000 tons of fluid waste have been processed to synthesis gas, gypsum, methanol, power and steam per year at SVZ. In 2006, the production stopped.

Texaco Gasification Process (TGP) is an entrained-bed, non-catalytic, partial oxidation process in which carbonaceous substances react at elevated temperatures and pressures, producing a gas containing mainly carbon monoxide and hydrogen. This product, called syngas, can be used to produce other chemicals or can be burned as fuel. Inorganic materials in the feed melt are removed as a glass-like slag. Technology has been operating commercially for over 40 years with feedstocks such as natural gas, heavy oil, coal, and petroleum coke. The TGP processes waste feedstocks at pressures above 20 atmospheres and temperatures of 1,200 °C - 1,540 °C. The TGP can treat contaminated soils, sludges, and sediments that contain both organic and inorganic constituents, chemical Contaminated soils, sludges, and sediments that contain both organic and inorganic constituents
wastes, petroleum residues.

STRENGTHS	WEAKNESSES
It uses only 25 - 40% of the theoretical oxidant to generate enough heat	***SVZ Plant stopped activities in 2006, although all technology is available on the market***
Valuable disposal of residues	Process gases generated have to undergo further treatment
No water effluents generated	
Feasible for large industrial facilities or in combination with large industries and large quantities of hazardous waste. Only stationary plants	Not economically feasible for small quantities and no mobile facilities

Suitability rating 2014



No. 13 PERMANENT STORAGE IN UNDERGROUND MINES AND FORMATIONS – SUMMARY INFO

This option is presently used in the EU, mainly in Germany, since 1972 and also in the United Kingdom since 2007 and large quantities of predominantly wastes from thermal treatment facilities (such as Air Pollution Control Residue (APC), but also PCB-containing construction and demolition waste, PCB-containing soil and building rubble, PCB-contaminated absorbents and PCB-contaminated abrasives are disposed of here. The conditions and requirements of ESM management are extremely high and can only be implemented with great experience. Export to such locations can be compared with export to all other EU dedicated hazardous waste treatment facilities, and therefore for the present assessment it is looked into the availability of such options in the region. A literature review on the Russian situation gave following information:

Radioactive waste storage and disposal facilities (Ref 1)

There are three underground facilities (under continuous monitoring) operated in Russia for disposal of low- and intermediate-level LRW (Low Radioactive Waste) generated during operation of the following enterprises:

- the Mining Chemical Combine (GKhK), Krasnoyarsk region;
- the Siberian Chemical Combine (SKhK), Tomsk region;
- the Research Institute for Nuclear Reactors (NIIAR), Ulyanovsk region.

The major part (89%) of all accumulated intermediate-level LRW of the industry is isolated from the environment in these disposal facilities in deep geological formations. According to Federal law on RW (Radioactive Waste) management, new enterprise was established in Russia in 2012 – the National operator for RW management (NO RAO), which is responsible for RW disposal, including construction and operation of facilities for final disposal of RW.

Currently, the activities are conducted under the leadership or with the involvement of NO RAO to select potentially suitable sites and to justify the proposed design solutions (the population and public organizations are informed of these activities), to create the infrastructure for RW disposal, and to develop respective projects and programmes.   Based on the data on accumulated RW (including "nuclear legacy" RW) and forecast for expected RW generation, the assessment is being carried out of the required RW disposal facilities to be provided. According to the NO RAO's investment programme titled "Construction of first disposal facilities", it is scheduled to create a system of RW disposal facilities of all classes until 2025, including construction of an underground laboratory as the first stage of a geological repository. It should be noted of the problems arising in the process of selecting sites for RW disposal facilities. Most recent was collected from the Atomexpo 2014, where it was mentioned that an underground research lab located in Shampane region where specificities pertaining to a deep-earth disposal of high- and mid-active long-living waste is investigated (Oleg Kryukov, 2014), Director for the State Policy in the Field of Radioactive Waste, Spent Nuclear Fuel and Nuclear Decommissioning, State Atomic Energy Corporation "Rosatom.

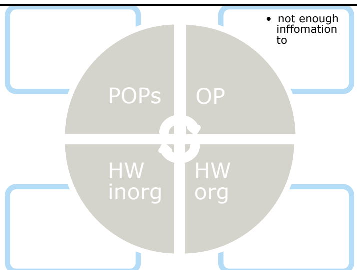
Recommendation: At this stage, it is not possible to make any conclusions based on the limited information available, but It would be good to examine if Russia has approved or is planning to approve the disposal of other hazardous wastes that RW in similar facilities. It is also important to examine the exact conditions of Environmental Sound Management ESM) that then are applied and if this is conform the concerned EU Directives.

Commercial operations in EU:

Mainly in Germany, since 1972 and also in the United Kingdom since 2007 and large quantities of predominantly wastes from thermal treatment facilities (such as Air Pollution Control Residue (APC), but also PCB-containing construction and demolition waste, PCB-containing soil and building rubble, PCB-contaminated absorbents and PCB-contaminated abrasives are disposed off here.

STRENGTHS	WEAKNESSES

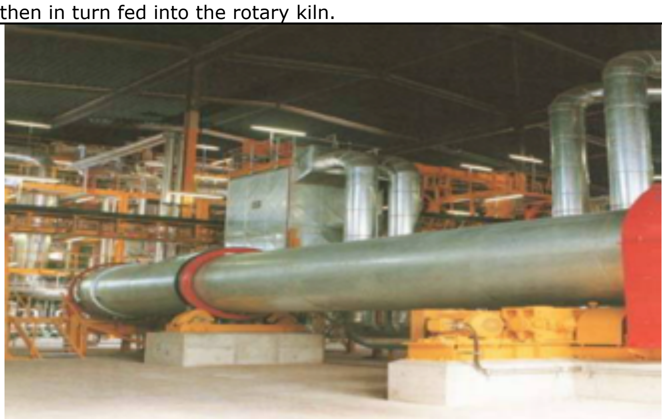
Suitability rating 2014



There is not sufficient information to give any Suitability rating 2014 for the application in the EECCA region. This method is ESM applied in the EU. See Basel Fact Sheets

AD 15a.
THERMAL DESORPTION Thermal Desorption followed by final destruction – SUMMARY INFO

Thermal desorption is a physical separation process and is not designed to destroy organics. Lower concentrated wastes are heated to volatilize water and organic contaminants. A carrier gas or vacuum system transports volatilized water and organic/soils to the gas treatment system. The off-gas is then treated separately to recover or destroy the contaminants. For treatment of the in the off-gas collected waste products any combination with one of the other listed waste technology is possible. In South Africa, A-Thermal Retort Technologies (Pty) Ltd. uses thermal desorption in combination with a thermal oxidizer/afterburner makes the process suitable for the treatment high concentrated pesticide waste. Initially the pesticides are prepared and separated based on its physical state (liquids, solids, etc) before its introduction into the process plant. Additionally, the waste in the form of liquid is fed to the kiln through an enclosed injection system, and equipped with various grades of pump configurations which are based on the flow characteristics and solid compositions of the liquid waste feed. Solid waste is fed by means of a conveyer which transfers the waste into a feed hopper and then in turn fed into the rotary kiln.



Indirect Thermal Desorption (ITD) working with BCD at Spolana Project, with capacity up to 7.5 t/h (Source: Fairweather J., 2003)

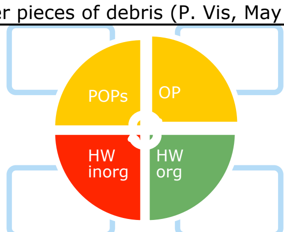
Commercial operations:

Globally large experiences with following examples: Summary the Netherlands (P. Vis, May 2014 and NATO CCMS). Thermal desorption plant Utrecht (175,000 t/y) operated from 1984-2005, no treatment of POPs, but soils mainly contaminated with PAH, oils BTEX and Cyanide and tar containing asphalt granulate. Thermal desorption plant Rotterdam-Botlek (225,000 t/y), operating from 1986-2006, treatment of POPs and other contaminations In total, last plant treated between 500,000 and 1,000,000 ton soil with chlorinated compounds among, others POPs. About 40,000 tons of soil contaminated with PCDD/F has been treated over a large number of years.

SITA in Germany indicate for their Thermal Desorption plant in Herne that more than 117,000 tons of POPS contaminated soils have been treated (P. Vis, May 2014)US: quantities of over 800,000 tons have been treated.
For the waste treatment plant in South Africa, at present several thousand tonnes of soils contaminated with pesticides and more than 4,000 tonnes of PCB waste or other similar waste has been treated.

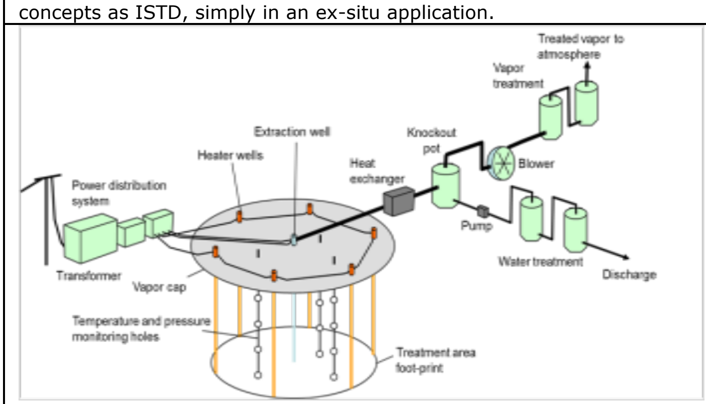
STRENGTHS	WEAKNESSES
Readily available for on-site and off-site treatment. Both stationary and mobile are standard.	Requires excavation of soils; generally limited to 60 cm below land surface
Cost competitive for large volumes of soils	On site treatment will require significant area (>1/2 acre)
Easily combinable with other technologies	Off-site treatment will require costly transportation of soils and possibly manifesting
Soil treated is not dead, as the normal organic substances such as humic acids are not destroyed and has **excellent value for re-use** (return to same location) for multi purposes like in gardens, and broad agricultural uses	Soils excavated from below the groundwater table require deterring prior to treatment due to high moisture content (US EPA, 1995). High moisture content increases heating costs
Volume reduction of wastes	Contaminant toxicity is not addressed by this treatment, although volume is reduced
Process can be extremely fast. Depending on soil and contaminant conditions, throughputs from 20 to 160 tons/hour have been achievable (NFESC,1998b). Because of the speed achievable by thermal desorption, it is often used for time sensitive projects (I. McCreery and L. Vander Linden)	Less effective in tightly aggregated soils or those containing rock fragments or particles greater than 4 cm. This is actually not a problem for larger materials when feeding in, as they fall apart in the drum and contaminations can be removed from larger pieces of debris (P. Vis, May 2014).

Suitability rating 2014



AD 15b. IN SITU THERMAL DESORPTION (ISTD) FOLLOWED BY FINAL DESTRUCTION – SUMMARY INFO

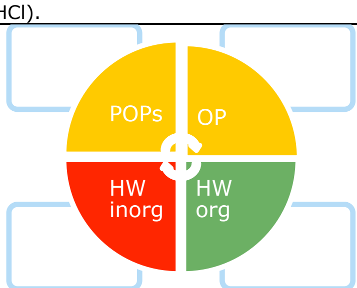
Soil remediation process in which heat and vacuum are applied simultaneously to subsurface soils with an array of heater and extraction wells. No excavation of subsurface soil is necessary. Thermal conduction accounts for majority of heat flow from high temperature (~800 °C) electrically powered heaters. As soil is heated to target temperatures above the boiling point of water that are applicable to treatment of POPs, volatile and semi-volatile contaminants in the soil are vaporized and treated by a number of mechanisms, including: (1) evaporation into subsurface air stream with application of vacuum, (2) steam distillation into the water vapor stream, (3) boiling, (4) oxidation, and (5) pyrolysis. The vaporized water and contaminants are drawn by the vacuum into the extraction wells. Additionally, In-Pile Thermal Desorption® (IPTD®) is a soil remediation process is applied utilizing the same general concepts as ISTD, simply in an ex-situ application.



Conceptual sketch of ISTD process (from ISTD SBC fact Sheet)

Commercial operations:
Full-scale ISTD/IPTD® projects treating SVOCs include: US Army Corps of Engineers,Saipan, W. Pacific(PCBs), US Navy - Centerville Beach, Ferndale, CA (PCB and PCDD/PCDF), Southern California Edison, Alhambra, CA (PCDD/PCDF, PAHs, and PCP, National Grid, N. Adams, MA (PAHs associated with MGP wastes),
USAID, Danang, Vietnam (TCDD associated with Agent Orange herbicide)
Demonstration-scale ISTD/IPTD® projects treating high-boiling contaminants include: Missouri Electric Works Superfund Site, Cape Girardeau, MO (PCBs and PCDD/PCDF),
US Navy BADCAT, Vallejo, CA (PCBs)(Conley and Jenkins 1998; NFESC 1998),
Japanese Ministry of the Environment, Yamaguchi, Japan (PCDD/PCDF)

STRENGTHS	**WEAKNESSES**
Thermal Conductive Heating (TCH), as utilized in ISTD/IPTD®, is the only commonly available heating method capable of achieving soil / sediment temperatures well above the boiling point of water, which are necessary for treatment of POPs such as PCBs and PCDD/PCDF	Treatment of POPs using ISTD/IPTD® requires attainment of soil/sediment temperatures above boiling point of water; thus, with ISTD, excessive recharge of groundwater into the treatment zone may prevent water from being boiled off cost-effectively and retard achievement of target temperatures
ISTD/IPTD® heating is highly predictable due to simplicity and robustness of conductive heat transfer in soil, sediment and rock of all types	Control of groundwater recharge into thermal treatment zone, using groundwater pumping or hydraulic barriers (steel sheeting, slurry walls, freeze walls, etc.) may therefore be necessary in such cases. This does not apply to IPTD® in above-ground piles or treatment cells
ISTD/IPTD® results in uniform heat distribution and treatment even under heterogeneous conditions, in the presence of metal, concrete or debris, and in fractured bedrock.	Heating of highly concentrated, heavily chlorinated pesticide liquids can result in decomposition / hydrolysis with resulting production of highly corrosive hydrochloric acid (HCl).
ISTD has no practical limitation on treatment depth or area	
The benefits of on-site IPTD® treatment are: no off-site transport costs, elimination of neighborhood impacts incl. potential vehicular accidents associated with offsite transport and disposal, and no long term liability	
ISTD/IPTD® boasts shorter treatment duration when compared with many other remedial alternatives. In some situations, ISTD/IPTD® programs can be accelerated such that all phases of work (design, construction, operation, demobilization) are completed within 18 months	
After IPTD® treatment, material is clean of contaminants, and yet still has properties of soil or sediment. It remains a porous medium, and once cool, treated material can be returned to its place of origin, or beneficially re-used for other purposes.	
When conducting a life cycle analysis (LCA), IPTD® was selected due to being the only treatment option that met remedial goals, had the lowest environmental impact, and had a competitive cost (Sorenson 2011).	



Suitability rating 2014

AD 16. VITRIFICATION – SUMMARY INFO

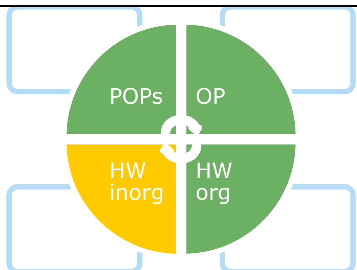
GeoMelt® is a commercially established remediation process that destroys organic contaminants and permanently immobilizes inorganic and radioactive contaminants within a high-integrity vitrified (glass) product. Process uses electricity to melt soil, sludges, debris and other waste material and can be used for either in-situ site remediation via its proprietary Sub-Planar Vitrification (SPV)™ configuration, or in an aboveground batch plant using its proprietary In-Container Vitrification (ICV)™ configuration. Last two decades, more than 25,000 metric tons of contaminated soil and waste materials have been successfully treated with mobile and fixed facilities. Organic compounds are pyrolyzed and reduced to simple gases which are collected under a treatment hood and processed prior to their emission to atmosphere.

10,000 kg Commercial GeoMelt System in Japan (Courtesy Keith Witwer, Kurion, Inc)

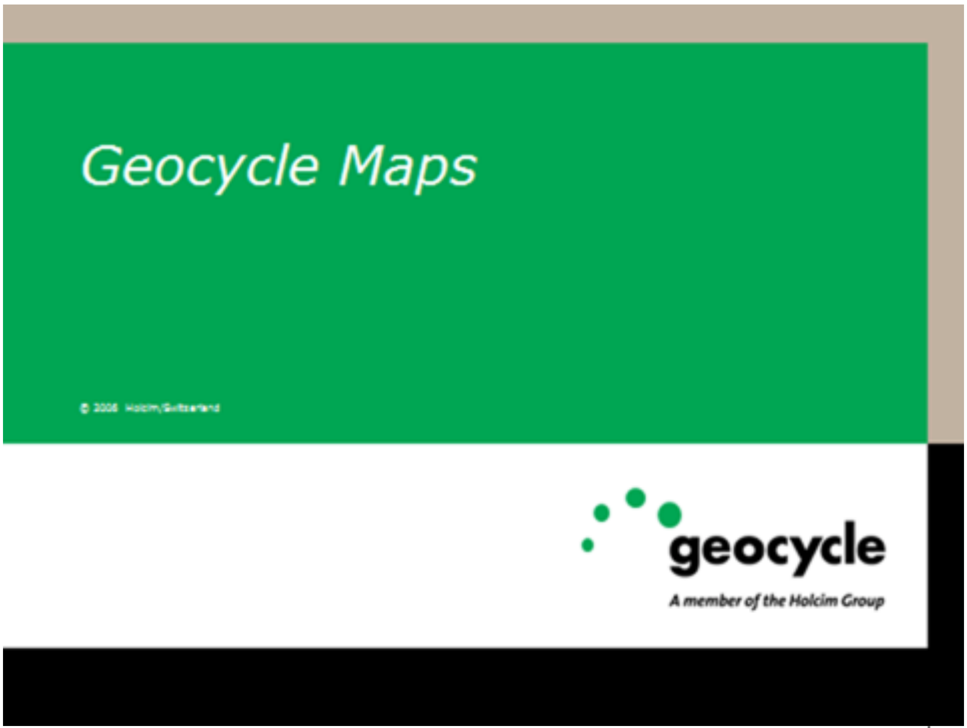
Commercial operations:
Kurion's GeoMelt system is in use commercially since early 1990's, in the USA, Australia and Japan.
Fixed plants: A 5-acre R&D facility, Horn Rapids Test Site, under continuous operation in Richland, Washington, USA. Facility has multiple scale (100 kg to 50,000 kg capacity) fixed and mobile systems available for use. R&D support for domestic and international work is coordinated through this facility. Dedicated demonstration facility, containing an engineering scale (500 kg capacity) system is located near Manchester, UK. System supports demonstration and validation testing for customers outside North America and the Far East. A 10-tonne batch fixed commercial GeoMelt ICV system is licensed and operating near Osaka, Japan, treating POPs, asbestos, and other hazardous chemical wastes. Portable plants: Originally designed with portability as primary consideration, and two different capacity systems are used where on-site treatment is needed. An intermediate-scale system with a treatment capacity of 10,000 tonnes per batch, and a large-scale system with a treatment capacity of several hundred tons per batch are currently operational.

STRENGTHS	WEAKNESSES
Significant commercial experience treating hazardous wastes, organic, asbestos, nuclear, heavy metal, withover 25,000 tonnes of glass product produced todate	A suitable power source is needed to treat the waste, depending on the size of the melter used.
Extremely insensitive to physical size, shape, or condition of the waste. Liquid wastes, slurries, buried wastes, metal debris (e.g., pumps, drums), mine tailings, wood, tires, soil, etc. has been treated. Only container opening size limits physical size/shape of waste. System has successfully mitigated wastes incl. soils, sludges, sediments, mine tailings, debris, and various radioactive contaminated materials containing organic and inorganic compounds	Larger mobile treatment system, used at full power, requires access to 13kV, 3-phase utility supply or provision of several large diesel generators; Intermediate scale (~10 tonne) system can be powered by standard 480V 3-phase utility supply or a 125 KVA generator.
Ability to treat in-situ and leave in place: Specially interesting for polygon treatment in the FSU region!	
Resultant glass product is completely non-hazardous and can be left in ground, similar to a large basalt formation, with the naturally volume reduced treatment zone covered over with local topsoil. This produces a green field site upon completion of the project, with no other remediation steps needed.	

Suitability rating 2014



APPENDIX 6 CO-INCINERATION CEMENT KILNS GEOCYCLE MAPS



European Waste Co-Processing Network

APPENDIX 7 CO-INCINERATION CEMENT KILNS: DEFRA 2008

Operational incineration facilities that accepted waste in England and Wales during 2008: Permitted capacity and tonnage incinerated

This list only includes incineration facilities that accept waste from off-site sources. It does not include facilities that burn waste from their own in-house processes.

Original Permit Number	Operator Name	Installation Name	Planning Region	Planning Sub-Region	Type	Permitted Capacity	Tonnage Incinerated in 2006	Tonnage Incinerated in 2007	Tonnage Incinerated in 2008	Further Details
BL7272IB	Castle Cement Limited	Ribblesdale	North West	Lancashire	Co-Incin of haz waste	175.428	47.475	58.030	44.654	
BK0973IK	Cemex UK Cement Ltd	Cambridge	East of England	Cambridgeshire	Co-Incin of haz waste	42.748	22.500	34.900	55.200	
BK9571IU	Lhoist UK	Hindlow Quarry	East Midlands	Derbyshire	Co-Incin of haz waste	14.000	238	1.225	471	
BL1029IP	Cemex UK Cement Ltd	Barton on Humber	Yorkshire & the Humber	Former Humberside	Co-Incin of haz waste	87.600	24.860	24.986	25.535	
BL1096IB	Castle Cement Limited	Mold	Wales	North Wales	Co-Incin of haz waste	181.368	4.334	7.970	12.846	
BL3269IH	Steetley Dolomite Limited	Worksop	East Midlands	Nottinghamshire	Co-Incin of haz waste	40.000	28.032	30.220	22.213	
BM0486IT	Castle Cement Limited	Stamford	East Midlands	Lincolnshire	Co-Incin of haz waste	460.943	66.552	101.275	92.269	
BM0699ID	Steetley Dolomite Limited	Durham	North East	Durham	Co-Incin of haz waste	50.000	21.025	22.493	21, 211	
					Co-Incin of haz waste	1.052.087	215.016	281.099	253.188	
BJ9509IC	Blue Circle Industries PLC	Stoke-on-Trent	West Midlands	Staffordshire	Co-Incin of haz waste	120.000	50.950	52.316	54.547	
BK9539IW	Lafarge Cement UK	Hope Derbyshire	East Midlands	Derbyshire	Co-Incin of haz waste	105.000	18.036	25.400	60.890	
BL3986ID	Lafarge Cement UK	Aberthaw, South Glamorgan	Wales	South East Wales	Co-Incin of haz waste	25.000	9.722	11.477	11, 080	
BL7248IH	Rugby Group Ltd	Rugby, Warwickshire	West Midlands	Warwickshire	Co-Incin of haz waste	87.600	0	18.136	91.607	
BL7752IT	Blue Circle	Westbury, Wiltshire	South West	Wiltshire	Co-Incin of haz	35.000	15.500	12.691	13.070	

	Industries PLC				waste					
CP3031SX	Slough Heat and Power Ltd	Slough	South East	Berkshire	Co-Incin of haz waste	547.500	No data for 2006	207.877	173.872	
VP3533LK	BLC Tunstead	Tunstead Quarry	East Midlands	Derbyshire	Co-Incin of haz waste	52.560	5.776	19.810	30.296	
					Co-Incineration of non hazardous waste Total	**972.660**	**99.984**	**347.707**	**424.282**	

note:
Co-Incin of haz waste: Co-Incineration of hazardous waste

APPENDIX 8 KYRGYZSTAN: PRODUCTION OF HAZ WASTE 2012

ANNEX I	**tons**
CATEGORIES OF WASTES TO BE CONTROLLED	
Waste Streams	
Y1 Clinical wastes from medical care in hospitals, medical centers and clinics	14820,589
Y2 Wastes from the production and preparation of pharmaceutical products	1848
Y3 Waste pharmaceuticals, drugs and medicines	
Y4 Wastes from the production, formulation and use of biocides and phytopharmaceuticals	
Y5 Wastes from the manufacture, formulation and use of wood preserving chemicals	
Y6 Wastes from the production, formulation and use of organic solvents	
Y7 Wastes from heat treatment and tempering operations containing cyanides	4749656
Y8 Waste mineral oils unfit for their originally intended use	1789
Y9 Waste oils/water, hydrocarbons/water mixtures, emulsions	
Y10 Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)	100
Y11 Waste tarry residues arising from refining, distillation and any pyrolytic treatment	95
Y12 Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish	
Y13 Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives	
Y14 Waste chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on man and/or the environment are not known	
Y15 Wastes of an explosive nature not subject to other legislation	
Y16 Wastes from production, formulation and use of photographic chemicals and processing materials	
Y17 Wastes resulting from surface treatment of metals and plastics	1467
Y18 Residues arising from industrial waste disposal operations	96
Wastes having as constituents: (2010 y)	
Y19 Metal carbonyls	
Y20 Beryllium; beryllium compounds	
Y21 Hexavalent chromium compounds	
Y22 Copper compounds	7,200
Y23 Zinc compounds	
Y24 Arsenic; arsenic compounds	1260,000
Y25 Selenium, selenium compounds	
Y26 Cadmium; cadmium compounds	
Y27 Antimony; antimony compounds	
Y28 Tellurium; tellurium compounds	
Y29 Mercury; mercury compounds	2,300
Y30 Thallium; thallium compounds	
Y31 Lead, lead compounds	
Y32 Inorganic fluorine compounds excluding calcium fluoride	5191,700
Y33 Inorganic cyanides	842,000
Y34 Acidic solutions or acids in solid form	145
Y35 Basic solutions or bases in solid form	
Y36 Asbestos (dust and fibres)	6594
Y37 Organic phosphorous compounds	113
Y38 Organic cyanides	
Y39 Phenols; phenol compounds including chlorophenols	
Y40 Ethers	
Y41 Halogenated organic solvents	
Y42 Organic solvents excluding halogenated solvents	
Y43 Any congenor of polychlorinated dibenzo-furan	
Y44 Any congenor of polychlorinated dibenzo-p-dioxin	

Y45 Organohalogen compounds other than substances referred to in this Annex (e.g. Y39, Y41, Y42, Y43, Y44).	
ANNEX II	
CATEGORIES OF WASTES REQUIRING SPECIAL CONSIDERATION (2012 y)	
Y46 Wastes collected from households	980400
Y47 Residues arising from the incineration of household	

APPENDIX 9 GEORGIA: WASTE REPORT 2007

WASTE REPORT 2007, PRODUCED BY MINISTRY OF ENVIRONMENT WITH SUPPORT FROM UNITAR

There is the table showing wastes from all regions.

Region	Number of sites covered by inventory	**1.** Oil production and refining wastes, **t**	2. Ferrous and non-ferrous, t metal scrap, **t**	**3.**Chemical industry and processing waste, **t**	**4**. Polyethylene and plastic waste, **t**	**5.**Glass sliver, **t**	**6**. Fluorescent lamps, **pcs.**	**7.** Mining and mineral processing waste, **t**	**8.**Const.mater.prod. waste, **t**	**9**Timber processing waste, **t**	**10.** Alcohol and non-alcohol beverages production waste,[3]	**11.**Other organic and non-organic wastes, **t**	**12** Hazardous waste among these, **t, pcs.**
Achara AR	52	22 354	119	62	_	_	_	_	5 000	4 200	60	_	**22 520**
Guria	10	_	_	_	_	10	_	_	400	130	81	_	**_**
Samegrelo-Zemo Svaneti	30	4 515	10	_	_	15	_	_	20	210	30	1 310	**4 520**
Imereti Barite;	30	3	3	768 008	_	110	_	8 144 500	20	950	28	3	**768 010**
Racha-Lechkhumi and Kvemo Svaneti.	--	_	_	_	_	_	_	_	_	100 000	_	_	**100 000**
Shida Kartli	16	_	60	_	_	_	_	_	2 460	250	100	_	**_**
Mtskheta-Mtianeti	16	_	_	_	_	_	_	_	55	370	_	_	**_**
Samtskhe-Javakheti	--	_	_	_	_	_	_	_	_	50	_	_	**_**
Kvemo Kartli	53	5	52	13 034	_	_	_	3 631 400	19 710	470	_	140	**13 040**
Kakheti	74	_	_	_	_	14	_	400 t	7 500	2 910	43 300	14	**_**
Tbilisi Rustavi	132 36	641	1 474	15	12,2	55	68 100	_	510	40	1 400	25	**660 t, 68100 pcs.**
Total[2]	**449**	**27 520**	**1 720**	**781120**	**12**	**200**	**68 100**	**11 776**	**35 700**	**19 600**	**45 000**	**1 490**	**908 740 t**

									300					**68100pcs**

Data which is in the table shows 11 categories of waste, which was assessed during the inventory. During the meeting with head of division waste and chemical substances was defined that inventory data were not specifying type of waste. In the list there is category - Chemical industry and processing waste with huge amount 781120 t and it is not defining what kind of waste is that as it may include inorganic, organic and other type of waste. According our observation we find waste streams which were shown in the category of ***Chemical industry and processing waste: (extracting info from inventory documents).***

APPENDIX 10 KYRGYZSTAN: SUMMARY OF OBSOLETE PESTICIDES

Inventory of Obsolete Pesticides Chui; Isyk-Kul; Narin; Talas and Batken Oblasts, Khatuna Akhalaia (Obsolete Pesticides Management Specialist), March 2012

12. EXECUTIVE SUMMARY

In the frame of Project - Initiative for Pesticides and Pest Management in Central Asia and Turkey - FAO has facilitated local stakeholders in Kyrgyzstan to conduct a field inventory of Obsolete Pesticides in Chui Oblast, Kyrgyzstan. This *fieldinventory* has taken place during the months March-May 2012

Preparation and execution of this field inventory were according to international standards making use of FAO standard field forms and instruction materials.

In total 121 sites have been discovered but after observation was find Obsolete Pesticides and other contaminated materials in 24 sites and total amounts are

35 720 kg - Obsolete Pesticides and Contaminated soil.

71 161 L - Liquid Obsolete pesticides

321 M^3- Obsolete Pesticides and Contaminated soil and other contaminated materials.

491 pieces-units of contaminated pallets.

Most sites were in very bad condition causing risk for human health and the environment. Most former pesticide storages are used for cattle and food for them.

Roughly half of the quantity of observed Obsolete Pesticides consists of contaminated soil and used packing materials.

As preparation for future collection and storage, some of the storages can be used for *Intermediate Collection Center.*

A detailed list of materials, equipment and manpower (including budget) for future cleaning up of the priority sites should be elaborated.

Recommendations include phyto remediation for contaminated soils.

15th of March – attended meeting in the Agricultural faculty plant protection division of Kyrgyz-Turkish Manas University - where students organized round table and different institutions (MoE and MoA) where invited to discuss the most active topics with students. Students re very active and they are really good partners for future.

APPENDIX 11 RECOMMENDATIONS FOR IMPROVEMENT OF LEGISLATION

The legal assessments have identified the following issues that are common to many of the countries in the region. These assessments were re-confirmed by the participants of the Workshop held from 27 to 30 October 2014 in Belarus and are listed below:

- *The establishment of clear policy objectives to avoid reoccurrence of obsolete pesticides (OPs) is recommended*.
  Many of the countries have not yet started developing the necessary hazardous waste management infrastructure and are looking into first planning of investments. It is therefore essential to establish clear policy objectives in order to avoid new stocks of hazardous waste. It should also be noted that the elimination of OPs alone is not sufficient to solve the problem.This can only be achieved in combination with a strategy that avoids the re-occurrence of new OPs.
- *In order to enable enforcement of waste legislation it is advised that statistical waste datawill be recorded.*
  Data on quantities, quality and treatment methods are essential evidence for the authorities to demonstrate the real enforcement and effectiveness of waste legislation. The introduction of a single entry point for all waste data will eliminate all previous reporting requirements. The quality and reliability of statistics will be improved by benchmarking, accompanied by third party verification of data and data quality.
- *It is recommended to give the public access to waste information.*
  An example is the website of the Russian Ministry of Environment. Other possible solution is to create an e-register, good examples can already be found in the EECCA region in Kazakhstan and Moldova where the mechanism of E-Government is under development.
- *Producer Responsibility schemes* are required for end of life cycle analysis in order to reduce generation of hazardous waste and to include sustainable management of waste in the price of products
- *Hazardous waste management can be further developed by using EU Directives as an example as well as other international frameworks and application of principles as BAT/BEP and ESM*
- *Strong control measures, combined with strict legislation and severe sanctions as a preventive set of precautions to avoid illegal practices*
  Experiences in other industrialized countries have shown that strong control measures, combined with strict legislation and severe sanctions are best to preventillegal dumping. It is advised therefore to include these "lessons learned" in the design of future legislation
- *The national legislation on obsolete pesticides waste and other hazardous waste in almost all countries is old and often complicated in consequences of numerous modifications.*
  In order to enable proper hazardous waste management it is proposed to improve and newly develop legislation in accordance with international acts and directives
- *The legislation on hazardous waste treatment on incineration and other methods is missing in the countries*
  In order to enable practical implementation of hazardous waste management it is proposed to include incineration and other "proven" technologies in the legislation. For example, Moldova has elaborated the draft of a by-law on incineration
- *Definitions of hazardous waste* should be included in the national legislation, by preference by harmonizing with other countries in the region.
- *Definitions e.g. when materials turn to waste or pesticides become obsolete lack clear definitions.*

The detailed reports are available at IHPA

APPENDIX 12 WORKSHOP BELARUS

WORKSHOP ON PROJECT OUTCOME 3.2 ACTIVITIES "THE ROAD MAP TO SUSTAINABLE ELIMINATION OF OBSOLETE PESTICIDES IN THE FORMER SOVIET UNION"

PART I: Brief explanations

Project: EC FAO Partnership Project GCP/RER/040/EC: Improving capacities to eliminate and prevent recurrence of obsolete pesticides as a model for tackling unused hazardous chemicals in the former Soviet Union

Project Outcome 3.2.Assessment of Capacity for Environmentally Sound Disposal of POPs and Obsolete Pesticide Wastes

Workshop on Project Outcome 3.2 Activities

"The Road Map to sustainable Elimination of Obsolete Pesticides in the Former Soviet Union"

27-29 October 2014

Green Cross Education and Rehabilitation Centre, Smolevitche and Minsk, Belarus

Introduction and explanation:

In 2013 and 2014, IHPA has together with its international and national legal consultants and national waste management consultants made an *assessment of the capacity for Environmentally Sound Disposal of POPs and Obsolete Pesticides Wastes in the Republics of the Former Soviet Union (FSU).* Input has been given by the concerned national authorities and the summary of the results will be presented during this workshop on the *first day*.

The Blacksmith Institute has been *working on the assessment and remediation of toxic contaminated sites in the Republics of FSU* and organizes a specific seminar on Pesticides Land Contamination with the goal to increase attendees' ability to effectively manage and direct programs to address pesticide contaminated sites on the *second day*. This issue is new and is therefore briefly explained on the 3rd page of this leaflet.

When the first results of the study came forward, FAO requested directly 2 international consultants to implement feasibility studies that could directly satisfy the needs reported in the study. *John Vijgen of IHPA* will report the *results a Feasibility Study and Conceptual Design for a 'multi-platform' destruction and decontamination facility for the environmentally sound management of Obsolete POPs pesticides.* The *results of the Feasibility Study for environmentally sound destruction and decontamination of Obsolete and POPs pesticides in cement kilns in Azerbaijan, Kazakhstan, Kyrgyzstan and Tajikista*n in order to find solutions within these countries will be reported by *Ed Verhamme*. This all will be presented on the *3rd day*. Finally, at the end of the 3rd day all these results, being prepared by the various Working Groups will then presented as "Road Map to sustainable Elimination of Obsolete Pesticides in the Former Soviet Union" as a draft of the proposed strategy for the future

Concept of the Workshop:

Day 1: Outcome of IHPA Legal and Waste Management Assessment of 12 FSU countries (IHPA)
Day 2: Pesticide Land Contamination Workshop and Road Map Development (Blacksmith)
Day 3: Follow-up of Waste Management Assessment achievements
Section: Summary Feasibility Study and Conceptual Design for a 'multi-platform' destruction and decontamination facility for the environmentally sound management of Obsolete POPs pesticides (John Vijgen, IHPA)
Section: Summary Feasibility Study for environmentally sound destruction and decontamination of Obsolete and POPs pesticides in cement kilns in Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan (Ed Verhamme)
Section: Group Exercise: Road Map to sustainable Elimination of Obsolete Pesticides in the Former Soviet Union

Organizer: IHPA

09:00 – 09:30 Registration
09:30 – 09:40 Welcome & Introduction of Participants –

- Mr. Igor Kachanovsky, Deputy Minister of Environment
- Mr. Richard Thompson, Pesticides Risk Reduction Team FAO

- Mr. John Vijgen, IHPA
- Mr. Vladimir Shevtsov, Green Cross Belarus

09:40 – 09:50 **Adoption of the Agenda** (Chairs: John Vijgen & Rodica Iordanova)

09:50 – 10:00 Introduction of all participants

10:00 – 10:20 Brief outline of the implementation status of Outcome 3.2 activities under the EC project GCP/RER/040/EC Workshop – (Chair John Vijgen, IHPA)

Section 1: Review and assessment of waste management legislation and regulatory framework

10:20 – 11:00 **Brief introduction to the Workshop** (Chairs Ms. Rodica Iordanova & Ms. Irina Kireeva)

i. Methodological approach and FAO Format to the Country specific Concept Notes

ii. Major outcomes and recommendations of the legal assessment of the national pesticide waste management legislation and regulatory frameworks in the EECCA countries How pesticide waste management legislation can be harmonized in the EECCA countries and what are the benefits of this legal process?

iii. EU Policy and Legal Framework and other International agreement (Ms. Irina Kireeva)

a) Waste Management Law – International and Regional dimension (applicable conventions and regional / bilateral Agreements relevant to the EECCA countries)

b) EU Policy and Legal Framework in relation to pesticides waste management – example of solid and risk based approach

11:00 – 11:20 Coffee break

11:20 – 12:30 **Output 2.1: Presentation of Summaries and Recommendations (6 countries)** (10 minutes each);

Chairs: Irina Kireeva & Rodica Iordanova

i. **Azerbaijan** Summary and Recommendations (Mr. Shamil B. Huseynov)

ii. **Belarus** Summary and Recommendations (Mr. Aleksander Gnedov)

iii. **Kazakhstan** Summary and Recommendations (Mr. Aigerim Daumenova)

iv. **Kyrgyzstan** Summary and Recommendations (Ms. Nadejda Prigoda)

v. **Ukraine** Summary and Recommendations (Ms. Irina Kireeva)

vi. **Uzbekistan** Summary and Recommendations (Mr. Alisher Mukhamedov)

Questions

12:30 – 13:30 Lunch break

Section 2: Waste Management Assessment

13:30 – 14:50 **Output 2.2 & 2.3: Presentation of Summaries (8 countries)** (10 minutes each);

Chair: John Vijgen & Andrei Isac

vii. **Armenia** Summary and Recommendations (Mr. Albert Haroyan)

viii. **Azerbaijan** Summary and Recommendations (Mr. Islam Mustafaya)

ix. **Belarus** Summary and Recommendations (Ms. Marina Belous)

x. **Georgia** Summary and Recommendations (Khatuna Akhalaia

xi. **Kazakhstan** Summary and Recommendations (Ms. Zulfira Zikrina)

xii. **Moldova** Summary and Recommendations (Mr. Andrei Isac)

xiii. **Tajikistan** Summary and Recommendations (Mr. Timur Yunusov)

xiv. **Ukraine** Summary and Recommendations (Mr. Mikhail Malkov)

Questions

14:50 – 15:10 Coffee break

15:10 – 16:40 Group work:

Group I: work out Draft Legal Roadmap per country /region - common issues and individual issues per country (facilitators Rodica Iordanova –Irina Kireeva)

Reporter Sandra Molenkamp

Group II: work out Draft Waste Management Roadmap per country/region - common issues and individual issues per country (facilitators John Vijgen – Andrei Isac)

Reporter Stephan Robinson

16:40 – 17:10 Group Presentation: Draft Legal Road map by Group I

Group Presentation: Draft Waste Management Road Map by Group II

18:30 – 20:30 Joint Dinner

Day 2: Tuesday 28 October 2014 :

Pesticide Land Contamination Workshop and Road Map Development

(See also Annex 1: explanatory note)

Organizer: Blacksmith Institute

08:30 – 08:45 Introduction

a. Purpose and goals
b. Focus of program: developing roadmaps to address contaminated sites
c. Review of program outline and schedule
d. Introduction of presenters and facilitators

Moldovan story 10 years of efforts from Obsolete Pesticides to contaminated land –Valentin Plesca-

08:45 – 09:15 Characteristics of pesticide land contamination

a. Types of pesticides (classes) and related health concerns
b. Volumes and concentrations
c. Migration routes – how pesticides get to where people are – dust, surface water, ground water, people present at site
d. Exposure routes for people – inhalation, ingestion, dermal, food-
e. Comparison to and differences from other types of pesticide waste

09:15 – 09:45 Review of current knowledge about pesticide land contamination sites

a. Blacksmith, PSMS and other data bases – estimates of number of sites
b. Preliminary analysis of the types and numbers of sites, extent of contamination and public health risk
c. Implications regarding volume of contaminated material to manage

09:45 – 10:30 Review of process for environmental assessment of contaminated sites

a. Types of Assessment
   I. Rapid environmental assessment to determine the severity of the problem sufficient for prioritization of action
   II. Preliminary assessment to determine the extent and impact of contamination
   III. Detailed assessment upon which risk management and remediation plans can be developed
b. Assessment and creating the site model – source, pathway, receptor
   I. Information and expertise needs
   II. Estimating and evaluating: amounts released at source, migration routes, degradation and natural attenuation, exposure levels (dose to people)
   III. Estimating risks, determining acceptable risk
   IV. Handling information gaps
   V. Sampling and analysis – purpose, strategy, number, type of samples, laboratory needs
   VI. Documentation and quality assurance

10:30 – 10:45 Coffee break

10:45 – 11.00 Stakeholder Engagement

a. Identifying stakeholders – community, workers, governments, etc.
b. When to engage - communication methods
c. Creating trust and managing fears about health concerns, loss of livelihood, adverse publicity, negative views towards officials or site owners

11:00 – 11:45 Methods to address risks and manage wastes

a. On-site strategies
   I. Permanent disposal – encapsulation, secure landfill, stabilization
   II. Enhanced degradation – biological, phytoremediation, chemical oxidation, others
   III. Long-term site management needs for on-site disposal strategies- security, ground and surface water protection, future use restriction and enforcement
b. Off-site strategies
   I. Incineration, cement kilns and ex-situ oxidation technologies
   II. Off-site disposal in landfills
   III. Transport considerations, international shipment
c. Advantages and disadvantages in terms of risk reduction, sustainability, public and political acceptance, technical difficulty, logistics and cost
d. Decision processes, considering both risk and public/political factors - what to: send off-site, treat on-site, allow to naturally attenuate, not address

11:45 – 12:15 Government organization to oversee contaminated sites

a. Regulatory and organizational framework - what has to be in place

b. Technical competency requirements
c. Differences with other waste management functions
d. Examples of organization in other countries

12:15 – 13:15 Lunch

13:15 – 15:15 Workshop – Developing country specific frameworks (Attendees divide into groups by country or region)

a. Review current regulatory/government status and structure
b. Discuss current knowledge of contaminated sites and need for further inventory and investigation work
c. Discuss current, needed and likely available resources
   I. Personnel – number, expertise
   II. Funds for oversight, assessment and risk abatement
d. Discuss political factors
e. Develop framework/roadmap to move forward on the issue

15:15 – 15.30 Coffee Break

15:30 – 16:30 Presentation of roadmaps and discussion

a. Summary presentation by country (10 min each)
b. Common themes and needs
c. How to integration with other work on pesticide waste management needs and plans

16:30 – 16:45 Conclusions, final comments

18:30 – 20:00 Joint Dinner (to be decided)

Day 3: Wednesday 29 October 2014:

1. Overview of day
2. Section: Results of Feasibility Study and Conceptual Design for a destruction and decontamination facility for the environmentally sound management of Obsolete POPs pesticides (John Vijgen)
3. Section: Results of Feasibility Study for environmentally sound destruction and decontamination of Obsolete and POPs pesticides in cement kilns in Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan (Ed Verhamme)
4. Section: Group Exercise: Road Map to sustainable Elimination of Obsolete Pesticides in the Former Soviet Union
5. Section: Wrapping up and summarizing Road Map strategy "The Road Map to sustainable Elimination of Obsolete Pesticides in the Former Soviet Union"

for the environmentally sound management of Obsolete POPs pesticide
Organizer John Vijgen IHPA

08:30 – 09:10 First Results of Feasibility Study

1. Introduction and study context
2. Status for disposal activities of obsolete pesticides and POPs in the region today
3. Hazardous waste management in the European Union
4. Quantities of obsolete pesticides, POPs and other hazardous waste in the countries
5. Assessment of Options
6. Technology assessment

09:10 -- 09:30 Presentation of Chechersk facility for treatment and disposal of hazardous industrial wastes Alexander Trestian – Director

90:30 – 09.45 Questions and answers

Section 2:

Feasibility Study for cement kiln destruction in the region: part I Desk Study

Results, conclusions and action plans for Azerbaijan, Kazakhstan, Kyrgyzstan and Tajikistan
Organizer Ed Verhamme

09.45 – 10.25 Results desk study for Azerbaijan, Kazakhstan Kyrgyzstan and Tajikistan

1. Definition/Requirements of suitable POPs;
2. Identification of suitable cement plants;
3. Technical and logistical issues associated with use of cement kilns for co-incineration of suitable POPs (pure or blended);
4. High level estimated costs in terms of investment in the disposal technology itself and the development of possible pre-treatment options such as fuel blending;
5. Possible health impacts at the point of disposal, pre-treatment and post disposal due to harmful emissions to land water or air;
6. Infrastructure requirements and
7. Environmental and human health monitoring requirements;
8. Training and coaching requirements for all stakeholders (Local and country authorities involved in project, cement plant organization, etc.);
9. Main conclusions

10:25 – 10.35 Questions and answers

10:35- 10:55 Coffee break

Section 3:

10:55 – 13:00 Group Exercise: Group Exercise: Road Map to sustainable Elimination of Obsolete Pesticides in the Former Soviet Union

13:00 – 13:40 Lunch

Section 4:

14:10 – 16:10 Wrap up and finalization of all Group Work: Formulation of Road map to sustainable Elimination of Obsolete Pesticides in the Former Soviet Union (all group leaders incl.
Richard Thompson and Wouter Pronk)
Reporters Sandra Molenkamp and Stephan Robinson

- From Legal Working Group (Group Leader: Rodica Iordanova)
- From Waste Management Group (Group Leaders John Vijgen, IHPA, Richard Thompson, FAO)
- From Contaminated Land Breakout Sessions (John Keith) –Eastern Europe –Caucasus-Central Asia
- SWOT disposal strategy for Obsolete Pesticides in the region

16:10 – 16:30 Final Presentation of results

16:30 -- 16:50 Coffee break

17:30 Official Closure of the workshop

19:00 – 20:30 Joint Dinner

Annex 1: Explanatory note on Pesticide Land Contamination Workshop and Road Map Development

Date: 28 October, 2014 - second day of FAO Conference to develop "The Road Map to Sustainable Elimination of Obsolete Pesticides in the Former Soviet Union"

Purpose and Content:

The purpose of the workshop is to develop roadmaps for each participating country to address pesticide contaminated land sites. To do this, information will be presented about the current knowledge about such sites, based on the work of Blacksmith and others. Then, to assure a common background knowledge for all attendees, there will be a review of the issues related to making decisions about contaminated sites, including discussion of:

- How such sites and their contaminated materials are different from obsolete pesticides and other pesticide waste issues
- The process of assessing and making risk abatement decisions for sites

- Options for reducing risk from contaminated sites, including advantages and disadvantages in terms of risk reduction, public acceptance, logistics and cost
- How the process and risk abatement decisions are managed in other countries
- Resource needs including expertise, regulatory structure and funding

Finally, there will be facilitated breakout groups to develop roadmaps for participating countries to move forward on the issue of contaminated site management and risk abatement. The results of the roadmap development work will be reported back to the larger group, and integrated into the roadmaps for obsolete pesticides and other pesticide waste disposal issues.

Level of program: This program will provide information to understand factors related to contaminated site investigation, assessment and remediation. The focus is on developing realistic roadmaps to move forward to address contaminated sites and their wastes. It is assumed that attendees will have knowledge of: basic environmental science; types of pesticides; pesticide public health and environmental risks; and the requirements for obsolete pesticides under international treaties.

Faculty: The workshop will be led by Blacksmith Institute, an NGO based in the USA that focuses on assessment and remediation of toxic contamination sites. The seminar leader will be John Keith, Lead Technical Adviser for Blacksmith, and formerly Vice President of Environment, Health and Safety for Pfizer (a global pharmaceutical manufacturing company) and Assistant Commissioner of the New Jersey, USA, Department of Environmental Protection. Mr. Keith has led investigation and remediation of over 25 toxic contamination sites in countries throughout the world.

Contact List of participants

Technical Workshop

"The Road Map To Sustainable Elimination Of Obsolete Pesticides In The Eastern Europe, Caucasus And Central Asia"
27-29 October 2014

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