



REQUEST FOR CEO ENDORSEMENT

PROJECT TYPE: Full-sized Project

TYPE OF TRUST FUND: GEF Trust Fund

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PART I: PROJECT INFORMATION

Project Title: Regional Demonstration Project for Coordinated Management of ODS and POPs Disposal in Ukraine, Belarus, Kazakhstan and Armenia			
Country(ies):	Armenia, Belarus, Kazakhstan and Ukraine	GEF Project ID: ¹	5300
GEF Agency(ies):	UNIDO	GEF Agency Project ID:	150105
Other Executing Partner(s):	Ministry of Environment in the 4 target countries	Submission Date: Re-submission Date:	12-02-2015 06-24-2016 01-11-2017
GEF Focal Area (s):	Multi-Focal Area	Project Duration(Months)	60
Name of Parent Program (if applicable): ➤ For SFM/REDD+ <input type="checkbox"/> ➤ For SGP <input type="checkbox"/> ➤ For PPP <input type="checkbox"/>		Project Agency Fee (\$):	1,620,000

A. FOCAL AREA STRATEGY FRAMEWORK²

Focal Area Objectives	Expected FA Outcomes	Expected FA Outputs	Trust Fund	Grant Amount (\$)	Co-financing (\$)
Chem-1: Phase out POPs and reduce POPs releases	1.3. POPs releases to the environment reduced.	1.3 Amount of un-intentionally produced POPs releases avoided or reduced from industrial and non-industrial sectors; measured in grams TEQ against baseline as recorded through the POPs tracking tool. The project aims to destroy 11,700 MT of POPs waste	GEFTF	2,000,000	32,500,000
Chem-2: Phase out ODS and reduce ODS releases	2.2. ODS phased out and their releases reduced in a sustainable manner.	2.2. Amount of HCFCs phased out from consumption or production, measured as ODP tons against baseline. The project aims to destroy 418MT of ODS (4MM of CO2)	GEFTF	16,000,000	42,000,000
Total project costs				18,000,000	74,500,000

¹Project ID number will be assigned by GEFSEC.

²Refer to the [Focal Area Results Framework and LDCF/SCCF Framework](#) when completing Table A.

B. PROJECT FRAMEWORK

Project Objective: The project will demonstrate environmentally sound collection and destruction of Persistent Organic Pollutants (POPs) stocks and Ozone Depleting Substances (ODS). This demonstration project will assist the countries involved in meeting their obligations under the Stockholm Convention and the Montreal Protocol and establish local capacities for destruction of ODS and some POPs substances. Through the demonstration activities the project aims to destroy a minimum of 11,700 MT of PCB/ODS containing waste and 4.14 MM of CO₂e. It will introduce regulatory reforms in Armenia, Belarus, Ukraine and Kazakhstan and strengthen national capacity in identifying, assessing, managing, and treating such wastes in an environmentally sustainable manner. It will also maximize opportunities for public-private partnership through development of appropriate policies and regulations. If the project is successful, it has the potential to become a pilot programme for other parts of CEITs, and reduce the cost of POPs destruction.

Project Component	Grant Type	Expected Outcomes	Expected Outputs	Trust Fund	Grant Amount (\$)	Confirmed Co-financing (\$)
1. National regulatory framework for ODS and PCB/POPs management and disposal	TA	1.1 Relevant regulations and instructions in each country developed to allow enforcement of POPs and ODS waste disposal in order to meet relevant obligations	<p>1.1.1. Revised national policies, regulations and guidelines on PCB/POPs and ODS waste disposal developed.</p> <p>1.1.2. A new regulatory mechanism on various aspects of ODS/PCB/POPs disposal in the project target countries developed</p> <p>1.1.3. Adequate financial models to ensure long-term sustainability of the sub-regional centers developed</p> <p>1.1.4. Qualified sampling and analytical capability in the region for characterizing PCB and POPs wastes and assessment of PCB and POPs content strengthened</p>	GEFTF	200,000	5,000,000
2. Waste management and disposal sub-networks in the project target countries including ODS and POPs waste collection, storage, transportation and final destruction linked into the regional network	TA	2.1. In country capability in identifying, collecting, and transporting POPs and ODS waste (refrigeration appliances) to specified recycling and destruction locations	<p>2.1.1 ODS, POPs and OPs waste for disposal at the sub-regional disposal centers assessed</p> <p>2.1.2 National ODS and POPs disposal plans developed</p> <p>2.1.3 Three national ODS and POPs collection, transportation and disposal centers</p>	GEFTF	300,000	7,100,000

		2.2 Potential for coordinated management of refrigerator recycling and ODS and POPs waste disposal among the countries within the region	<p>including infrastructure, control and reporting systems established</p> <p>2.2.1 A regional ODS and POPs pesticide waste stocks database designed</p> <p>2.2.2 A framework for regional cooperation for ODS appliances recycling, ODS and POPs disposal among the project target countries developed</p>			
3. ODS extraction during refrigeration appliances recycling, and subsequent destruction of ODS at the established national facilities	Inv	3.1 In country capacity in establishing refrigeration appliances recycling facilities for ODS extraction and their consequent destruction	<p>3.1.1 Advanced technology options for refrigeration appliances recycling and ODS destruction</p> <p>3.1.2 Construction, installation and commission of a refrigeration appliances recycling facilities for ODS extraction in the project target countries performed</p> <p>3.1.3 An estimated 400,000 units of EOL refrigerators and air-conditioners collected and recycled</p> <p>3.1.4 An estimated 418 tons of extracted ODS destroyed</p>	GEFTF	9,500,000	33,000,000
4. Environmentally Sound Management and destruction of PCB contaminated equipment and POPs-pesticide waste stockpiles	Inv	4.1 In country capacity for destroying PCB containing equipment and POPs contaminated pesticide waste at the established national ODS, PCB/POPs destruction facilities	<p>4.1.1 Advanced technology options for treatment and disposal methods of PCB and POPs destruction assessed</p> <p>4.1.2 A national plan for PCB-containing transformer oil decontaminated and pure PCB destruction in the project target countries developed</p>	GEFTF	7,000,000	27,500,000

			4.1.3 A national facility for ODS and POPs contaminated pesticides destruction in the project target countries established			
			4.1.4 11,700 tonnes of PCB-containing waste, other POPs and pesticides destroyed			
5 Project monitoring and Evaluation	TA	5.1 Project results monitored and evaluated effectively and “best practices” in the region and “lessons learned” during the project implementation disseminated	5.1.1 Country level and regional monitoring and evaluation plans developed and implemented, reports published 5.1.2 Mid-term and final evaluation constructed	GEFTF	100,000	900,000
Subtotal					17,100,000	73,500,000
Project management Cost (PMC) ³					900,000	1,000,000
Total project costs					18,000,000	74,500,000

C. SOURCES OF CONFIRMED CO-FINANCING FOR THE PROJECT BY SOURCE AND BY NAME (\$)

Please include letters confirming co-financing for the project with this form

Sources of Co-financing	Name of Co-financier (source)	Type of Co-financing	Co-financing Amount (\$)
GEF Agency	UNIDO	Cash	300,000
GEF Agency	UNIDO	In-kind	300,000
Recipient Government	Ministry of Nature Protection of the Republic of Armenia	In-kind	500,000
Recipient Government	Ministry of Ecology and Natural Resources of Ukraine	In-kind	500,000
Private sector	Counterpart as national ODS/PCB/POPs disposal center “Ecological Investments LLC”	Cash	5,000,000
Private sector	Counterpart as national ODS/PCB/POPs disposal center “Promtechnoresource”	Cash	1,900,000
Private sector	Counterpart as national ODS/PCB/POPs disposal center “BelVTI”	Cash	10,000,000
Private sector	Counterpart as national ODS/PCB/POPs disposal center “Ravis”	Cash	20,000,000

³PMC should be charged proportionately to focal areas based on focal area project grant amount in Table D below.

Private sector	Counterparts as national ODS/PCB/POPs disposal center "Waste Management System"	Cash	5,000,000
Private sector	Counterparts as national ODS/PCB/POPs disposal center "Group Nord"	Cash	5,000,000
Private sector	Counterparts as national ODS/PCB/POPs disposal center "Ecologiya Ukraina"	Cash	5,000,000
Private sector	Counterparts as national ODS/PCB/POPs disposal center in Ukraine "Krok-TC"	Cash	17,000,000
Private sector	Counterparts as national ODS/PCB/POPs disposal center in Ukraine "Tarkom Ekoservis"	Cash	4,000,000
Total Co-financing			74,500,000

D. TRUST FUND RESOURCES REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY¹

GEF Agency	Type of Trust Fund	Focal Area	Country Name/ Global	(in \$)		
				Grant Amount (a)	Agency Fee (b) ²	Total c=a+b
UNIDO	GEFTF	Chem-2	Ukraine	6,120,000	550,800	6,670,800
UNIDO	GEFTF	Chem-1	Ukraine	400,000	36,000	436,000
UNIDO	GEFTF	Chem-2	Belarus	4,170,000	375,300	4,545,300
UNIDO	GEFTF	Chem-1	Belarus	400,000	36,000	436,000
UNIDO	GEFTF	Chem-2	Kazakhstan	6,120,000	550,800	6,670,800
UNIDO	GEFTF	Chem-1	Kazakhstan	400,000	36,000	436,000
UNIDO	GEFTF	Chem-1	Armenia	390,000	35,100	425,100
Total Grant Resources				18,000,000	1,620,000	19,620,000

¹ In case of a single focal area, single country, single GEF Agency project, and single trust fund project, no need to provide information for this table. PMC amount from Table B should be included proportionately to the focal area amount in this table.

² Indicate fees related to this project.

F. CONSULTANTS WORKING FOR TECHNICAL ASSISTANCE COMPONENTS:

Component	Grant Amount (\$)	Co-financing (\$)	Project Total (\$)
International Consultants	432,000	518,400	950,400
National/Local Consultants	410,800	821,600	1,232,400

G. DOES THE PROJECT INCLUDE A "NON-GRANT" INSTRUMENT? No

(If non-grant instruments are used, provide in Annex D an indicative calendar of expected reflows to your Agency and to the GEF/LDCF/SCCF/NPIF Trust Fund).

PART II: PROJECT JUSTIFICATION

A. DESCRIBE ANY CHANGES IN ALIGNMENT WITH THE PROJECT DESIGN OF THE ORIGINAL PIF⁴

1. After approval of the PIF and during the project preparation the project has experienced some changes from the geographical point of view (the exemption of the Russian Federation). Due to the central geographical location and the size of Russian Federation (40% of Europe), this change has led to the necessity of transforming some elements of the regional project. The process of transition from 5 to 4 countries has been smoothly implemented jointly with stakeholders. Based on these changes, the project has been adopted to the new design. The priority is given to the main objective of the project and the total budget approved.
2. The original concept was targeting 5 countries in 2 steps, 18 Mio under GEF5 and 14 Mio under GEF6. Considering project transformation, instead of two steps, it has been decided to focus on “one step” approach under approved GEF5 budget, for 3 countries: Ukraine, Belarus and Kazakhstan. As far as Armenia is concerned, the country has decided not to host any PCBs treatment facilities at present and would like to finalize the “non-investment” activities before taking a final decision.
3. Taking into account the budget limitation and specification of the geographic location of the countries, a revised concept has been developed and that would allow meeting the target without the mandatory follow up project for Belarus, Ukraine and Kazakhstan. The updated project is slightly different from the initial one, but meets all the main objectives of the original concept for a smaller number of countries.
4. While preparing the project, the main attention was paid to the identification of potential stakeholders, counterparts and companies that meet all the requirements including technical and financial capacities to host the destruction facility for the project implementation at various sites.
5. A number of consultations with Governments of relevant countries have been held in order to coordinate their integration process on the national level, taking into account optimum technical solutions. As the result of this, the project now reflects the integration of the countries in the process of future project implementation. The Project Steering Committee (PSC) will be established by the Ministries for Ecology and will include The Ministries of Energy, the Ministries of Health, key project partners and stakeholders from the Government, Academia, PCB owners, NGOs and UNIDO. The Ministries for Ecology will chair the PSC meetings alternatively. UNIDO will assist in establishing a Regional Network Management Unit (PMU) in Belarus.
6. Despite these modifications to the project, it still addresses all of the objectives set out in the previous versions. Moreover additional technical meetings with potential counterparts for best technology selection have been successfully organized during the stage of the formatting the latest concept and it is now clear that certain technical challenges in dealing with destruction of different waste types and formats can be overcome and suitable technology for co-destruction of POPs, OP, PCB oils and ODS is commercially available.

A.1 National strategies and plans or reports and assessments under relevant conventions, if applicable, i.e. NAPAS, NAPs, NBSAPs, national communications, TNAs, NCSA, NIPs, PRSPs, NPFE, Biennial Update Reports, etc.:

7. The countries included in this programme have specific obligations for dealing with POPs and PCBs, addressed at the policy level through various programs and activities resulting from National Action Plans (NAPs) and National Implementation Plans (NIPs), including the assignment of staff to monitor the implementation of the Conventions and assess the extent of the problems in each country. There are 24 persistent organic pollutants currently within the scope of the Stockholm Convention including 14 pesticides and 10 industrial chemicals or

⁴For questions A.1 –A.7 in Part II, if there are no changes since PIF and if not specifically requested in the review sheet at PIF stage, then no need to respond, please enter “NA” after the respective question.

by-products. The absence of adequate capacity and infrastructure for environmentally sound management and disposal of POPs poses significant risks to human health and the environment. The project countries have encountered problems in establishing viable models for environmentally sound collection and destruction of POPs including the most appropriate technical options for the destruction processes, especially PCB management and destruction.

8. Having ratified the Montreal Protocol The control of ODS production and consumption in the target countries has been integrated into national environmental legislation. However, none of the countries have properly developed policies to deal with obsolete ODS and no legislation pertaining to ODS waste has been implemented.
9. There are well developed mechanisms in the EU for dealing with ODS banks contained in refrigeration and air-conditioning equipment through recycling processes, and for the management and destruction of POPs and it is feasible to develop waste handling legislation for ODS/POPs banks in the project target countries using available methods and technology.
10. This programme has therefore been developed at the request of the countries involved to address these issues which will support the national strategies currently in place.

A.2. GEF focal area and/or fund(s) strategies, eligibility criteria and priorities

11. The project supports the GEF-5 strategy for chemicals, the aim of which is to consolidate the persistent organic pollutants and ozone layer depletion focal areas, as well as to broaden the scope of GEF's engagement with the sound management of chemicals. Specifically it addresses GEF Chemicals Strategy Objectives 1 and 2, "Phase Out POPs and Reduce POPs Releases" and "Phase Out ODS and Reduce ODS Releases"

Focal area	Outcome
Chem-1: Phase out POPs and reduce POPs releases	Quantifiable and verifiable tons of POPs eliminated or reduced The Project aims to destroy a minimum of 11,700 MT of PCBs.
Chem-2: Phase out ODS and reduce ODS releases	Outcome 5.1: Countries have phased out Ozone Depleting Substances and replace them with zero ODP, low GWP alternatives The Project aims to destroy 418 MT of ODS (4.14 MM of CO ₂)

12. The prevention of ODS emissions from the ODS banks is also in line with priorities to reduce GHG emissions from ODS release into the atmosphere.

Country	Stockholm Convention on POP			NIP	
	Signed	Ratified	Entry into force	Approved	Submitted
Armenia	23/05/01	26/11/03	17/5/04	18/1/05	29/4/06
Belarus	26/12/03	5/3/04	5/3/04	17/5/06	17/1/07
Kazakhstan	22/5/01	7/6/07	2/7/08	8/12/09	2/8/10
Ukraine	23/5/01	18/4/07	17/5/04	2006	12/2015

Country	National Legislation on POPs			
	Environment law entered into force	Law on chemicals	Law on waste	Law on POPs management
Armenia	2008	2002	2004	-
Belarus	2002	-	1993	-
Kazakhstan	2003	-	1998	2003
Ukraine	1991	1995	1998	1996

A.3 The GEF Agency's comparative advantage:

13. UNIDO is within the comparative advantage matrix set out in GEF/C.31/5 rev.1.
14. UNIDO has considerable experience in developing and implementing projects the POPs focal area of GEF, in particular, it has implemented environmentally sound management of PCBs in Asia and other regions and has accumulated sufficient knowledge and experiences in implementing GEF projects. UNIDO is one of the leading implementation agencies of the Montreal Protocol and has established a number of ODS destruction programmes. The 63rd ExCom of the MLF approved the first project for Mexico on ODS destruction including a carbon trading offset programme based on Voluntary Carbon Market with the CAR and VCS and continued with formulation of national ODS destruction projects in Algeria, China, and Turkey.
15. UNIDO can involve the industrial sector in GEF projects in the following areas: industrial energy efficiency, renewable energy services, water management, and chemicals management (including POPs and ODS), and biotechnology. UNIDO also has extensive knowledge of small and medium enterprises (SME's) in developing and transition economy countries.
16. UNIDO has significant experience with environmentally sound waste management projects in developing countries. The municipal solid waste management project that resulted in the formulation of a nationwide municipal solid waste management strategy was of particular significance. The accumulated lessons learned provided valuable knowledge base for the formulation of this project proposal.
17. Recently UNIDO took the lead in implementing BAT/BEP measures in several industrial source categories (iron and steel industry, medical waste incineration and production of pulp and paper) of the potential for comparatively high formation and release of OP-POPs to the environment. Based on the favorable experience gained, developing countries jointly with UNIDO formulated and submitted for GEF funding a full sized BAT/BEP project on environmentally sustainable medical waste management in China. This project was approved and its Inception Workshop was held in Beijing in March 2008.

A.4. The baseline project and the problem that it seeks to address:

A.4.1. Context / background information

18. This project will be implemented in Ukraine, Kazakhstan, Belarus and Armenia at the country level.
19. The project has been requested by the governments of these countries to support their ongoing efforts and international obligations to deal with ozone depleting substances (ODS) and persistent organic pollutants (POPs). The project will enable environmentally sound collection and destruction of targeted POPs and ODS in Ukraine, Belarus, and Kazakhstan and the treatment of PCBs in Armenia. GEF funds to

new applicant countries will also assist in developing targeted ODS/POPs and Obsolete Pesticide (OP) elimination activities in these countries.

20. The regional concept is designed to provide the recipient countries an opportunity to address a number of common issues and barriers in implementation of similar obligations under international agreements. This approach aims to provide more efficient implementation for the GEF by grouping similar countries together where the same technical and logistical solutions are likely to work. This has two main advantages, a) it creates savings in the preparatory work, feasibility studies and systems design, that can be shared by each country rather than being done four times in different projects and it gives rise to potential economies of scale in the procurement of equipment and services; b) it creates a regional momentum that is more effective in incentivizing and demonstrating solutions to other countries in the region and at the same time creates a large enough regional network to be able to assess the issues of cross-boundary waste movement and regional cooperation.
21. The countries in the project represent a good cross-section of the region in terms of size and industrial capacity, whilst sharing the same environmental issues and socio-economic backgrounds. The project therefore aims to develop new approaches that overcome the difficulties faced by CEIT countries in general in the safe management of ODS and POPs banks.
22. The regional project allows the creation of three mutually independent but linked ODS/POPs co-destruction centers.

The exact locations of the centres cannot be established until the project is initiated however there will be one centre in three countries as follows:

Country	Facility to be created	Location
Belarus	1 x Plasma ODS/POPs co-destruction centre	
Kazakhstan	1 x Plasma ODS/POPs co-destruction centre	Several options indicated
	1 x Recycling centre for recovery of ODS refrigerants and foam blowing agents	Several options indicated
Ukraine	1 x Plasma ODS/POPs co-destruction centre	Several options
	1 x Recycling centre for recovery of ODS refrigerants and foam blowing agents	Several options indicated

**Armenia has decided not to host any PCBs treatment facilities at present and would like to finalize the “non-investment” activities before taking a final decision.*

This provides the opportunity for cooperation and load sharing. If a particular centre were overloaded, it would be possible to shift some of the load to another centre, particularly within the free trade zone. In addition to load sharing, knowledge sharing between centers will ensure that solutions to any problems encountered can quickly be shared to avoid similar issues in other centers. The regional concept will also provide efficiencies in staff training by organizing training programmes in one centre that will also support networking activities.

23. It is also important to note that as well as recovering refrigerant from the appliances, the project aims to recover (for destruction) the majority of the blowing agent contained in the insulation foam of a refrigerator. This is considered extremely important in the region due to the very large banks of equipment and the relatively large volume of ODS in the foam compared to the refrigerant.
24. Given the nature and timescales of the many ongoing projects, both in the baseline and sponsored by various international agencies, it is not feasible to predict every possible scenario and outcome from other activities. However we believe that by the time this project is initiated and in a position to be coordinated directly with other projects, the status of those projects will be accommodated. The project management structure will allow to respond and react to changes in the baseline project, the external landscape or outcomes of other projects.

A 4.2 Baseline Scenario

25. The countries have signed the international agreements and have in place high level legislation to control the use and movement of both ODS and POPs, currently focusing on streamlining and harmonizing legislative frameworks for chemicals, to be in compliance with the respective International Agreements, however they lack the detailed regulatory frameworks required at a local or provincial level to drive the implementation of waste management plans and access to detailed technical analysis of the optimum waste management model for ODS and POPs including their disposal.
26. The four countries are actively engaged in activities to meet the agreed phase-out benchmarks of production and consumption of the CFCs and HCFCs under the Montreal Protocol. However to date these have been focused on the phase out of consumption of ODS in manufacturing and service sectors. There are no activities addressing the management of ODS banks and the recovery collection and destruction of ODS from end of life equipment. The countries do not have a suitable system in place for the collection and storage of end-of-life refrigerant gases, or equipment containing ODS and deliberate venting of refrigerants is commonplace due to lack of awareness of or ineffective regulations and controls or insignificant penalties. Considerable work has been done in establishing the extent of the ODS bank problem in each country. However the countries have encountered problems in establishing models for environmentally sound collection and destruction or the most appropriate technical options for the destruction process.
27. In relation to the control of POPs; the NIPs of the target countries were approved by the GEF and their ministries (National GEF Focal Points) who have prepared internal action plans to adjust the national environmental legislation to the requirements of the Stockholm Convention (SC) on Persistent Organic Pollutants (POPs) and assigned staff responsible for monitoring the implementation of the Convention. The principle POPs activities so far have been to draw up inventories of PCBs and POPs pesticides and in all the target countries these indicate that considerable action is required for the countries to meet the requirements of the Stockholm Convention.

28. Therefore despite the ongoing efforts under the Stockholm Convention and the Montreal Protocol, in all the target countries refrigerators and other equipment are sent to landfill and POPs are simply abandoned in inappropriate storage conditions or burned in poorly controlled incinerators creating pollution and human health risks.

A.4.3. Baseline project

A.4.3.1 Armenia

29. In Armenia, all relevant regulations are in place. The implementation of the Stockholm Convention was planned and is progressing in close coordination with the “national strategies on development and environment”. Armenia has made significant progress in the development of a number of environmental strategies including: National Environmental Action Plan 2009–2012; as well as programmes for; updating a National Chemicals Management Profile and National SAICM capacity Assessment. A revision of the National Profile provided data for the period of 2003-2008 which was used to update the NIP.
30. The Governmental Action Plan prioritizes issues related to sound management of PCB containing wastes. The NIP also identified existing policy and regulations regarding the production, use, import and export, environmental monitoring for pesticide POPs and PCBs, and addresses stockpiles of waste and contaminated sites in Armenia. There are no specific policies or regulations regarding POPs management. Instead, stipulations related to POPs management are implied through different laws and regulations are hard to coordinate. These regulations sometimes contain overlaps and gaps. It is recognized that the framework would benefit from increased incentive-based measures to promote self-regulation and monitoring rather than through local enforcement of complex regulations. At local levels, where capacity is weak, regulations are poorly understood, inconsistently applied and subject to varying interpretations.

A.4.3.2 Belarus

31. In Belarus POPs are controlled by legislation such as the Law of the Republic of Belarus “On Environmental Protection” of 26 November 1992 (amended in 2002), the Edict of the President of the Republic of Belarus No. 594 “On Accession of the Republic of Belarus to the Stockholm Convention on Persistent Organic Pollutants” of December 26, 2003; and the Law of the Republic of Belarus “On Waste Management” on July 20, 2007 (amended in 2015). This legislation is supported by more specific laws and regulations covering the basic aspects of POPs management including; hazardous waste management, environmental monitoring, transportation of dangerous goods, registration of chemicals and pesticides, specific bans on substances, control of soil, water and air degradation, and protection of health. Jointly with research and scientific institutes the Government has developed a methodology and guidelines for compiling an inventory of the POPs, obsolete pesticides and equipment, PCBs waste.
32. The Government strongly supports the implementation of this legislation and the Ministry of Natural Resources and Environmental Protection has been designated as the National Focal Point for the exchange of information on POPs issues and the Specialized Inspectorate for Waste Management Control has been directly authorized to organize the work for the implementation of the provisions of the Stockholm Convention. This will provide the opportunity for great cooperation and support during the project implementation.
33. The Inventory undertaken within National Implementation Plan (2011-2015) of the Republic of Belarus identified the obsolete pesticides stockpiles of 7,281.5 tons. 2,006 tons of the repacked POPs from the Slonim landfill were destroyed at Sawa GmbH, Germany in 2012. As a result of the elimination of POP pesticides extracted from the Slonim landfill within the frame of the WB project “Integrated Solid Waste Management Project”, the quantity of obsolete pesticides in the country was reduced by 25% and it went down from 7,281.5 to 5,660 tons, 2,757 tons of which are mixtures and liquids potentially containing POPs pesticides. These stockpiles are located throughout the country in approximately 146 storehouses of variable quality and security (2,876 tons), seven obsolete pesticides landfills (2,482 tons) and one

hazardous waste storage facility (302 tons). There were about 2,400 tons repackaged according to EU standards for secure consolidated storage pending destruction.

A.4.3.3 Ukraine

34. In Ukraine the Framework Law on Environmental Protection was adopted in 1991, at the time of Soviet Union. It was updated in 2001 and the Water Code of 1995 and the Law on Waste (1998) were subsequently enacted to create regulatory frameworks for each area of environmental protection. In September 2003 Ukraine implemented a project called "Ensuring the Development of a National Action Plan for Implementation of the Stockholm Convention on POPs". The project was implemented by UNEP with GEF support.
35. The Ministry of Environmental Protection has overall responsibility for the legal framework, but local authorities have some responsibility for administration of environmental law. Law enforcement bodies, such as the Ministry of Internal Affairs and the General Prosecutor's Office, which includes a specialized environmental prosecutor's department, have significant authority to enforce actions against violations of environmental laws.
36. The Ukraine has a significant POPs inventory associated with well-developed agriculture, power generation/distribution and metallurgy sectors. However, the highest priority tasks are associated with management of accumulated stockpiles of banned and obsolete pesticides.
37. In 2009/10 around 2,000 tons of obsolete pesticides were exported from Ukraine to Germany for destruction. In 2010 a single mining site was identified which contained more than 20,000 tons of HCB. To date 8,500 tons of HCB have been excavated, repackaged and transported by ship to the United Kingdom for destruction.

A.4.3.4 Kazakhstan

38. Kazakhstan has strengthened and modernized the legal and policy framework for environmental protection management. In 2003 the Government adopted the "Concept of ecological safety for 2004–2015". In 2006 Kazakhstan published "the Concept of transition to sustainable development for the period 2007–2024", which includes increased emphasis on sustainable development. Various legislative measures have also been adopted to reduce and phase out ODS, including a requirement for businesses to obtain licenses to import or export ODS and ODS-containing products, and licenses to assemble or repair ODS-containing equipment.
39. In addition the import of most types of ODS and ODS-containing products has been banned. A programme on POPs control, management and monitoring was developed in accordance with the "Concept on Environment Protection of the Republic of Kazakhstan for 2004-2015". The POPs issue is reflected in "the Environment Code of the Republic of Kazakhstan". Legislation adopted in 2005 banned the disposal of unwanted refrigerators in a landfill and required municipalities and companies to put in place procedures to manage the environmentally safe recovery of ODS. Some used refrigerators are sent to the metal recycling facility, however only the refrigerant is removed from the compressor circuit, CFCs/HCFCs are not recovered from the insulation foam. There is an ongoing project on PCB oils and project on POPs that could be used as potential baseline project.
40. The Government is actively involved in implementing policies and is increasing number of additional MoE staff and budget, by creating of National Sustainable Development Council, Inspectorate and Inter-Agency body on ESD to provide support and develop strong cooperation with relevant stakeholders. One of the priorities is to address the sound management of ODS and POPs and waste.

41. Kazakhstan is the second among the CEIT countries with PCB-containing oils and PCBs contaminated soils (the Russian Federation ranks first). In late 2007, the MEP endorsed a UNDP submission for GEF funding of a program to enhance technical capacity for the management, safeguarding and disposal of PCBs.
42. Since then 80 tons of electrical transformers and 169 tons of electrical capacitors were incinerated in France and 10,052 electrical capacitors were disposed of in Germany in 2007. About 56,000 condensers are still in different areas, 15,000 of which were buried in the Semipalatinsk nuclear facility. More than 23,000 capacitors and 78 capacitor installations contain trichlorodiphenyl. There are six “hotspots” contaminated with PCB waste in Kazakhstan. Therefore, a part of incinerators is needed at the moment. If the project on “Elimination of POPs Wastes in Kazakhstan” will be implemented, the part on incineration of POPs is integrated and fulfilled in the framework of this project. The project financing will be invested in the modification of the central facility in the territory of Kazakhstan for safe destruction to make it operational.
43. There is no PCB transformer oil decontamination practice used in the country yet. A destruction unit is planned to be installed in the country for final disposal for the majority of stockpiles of PCB-waste, PCB-equipment and POPs-containing pesticides.

A 4.4.Barrier analysis

44. A key issue is the general lack of direct responsibility for systematic disposal of the ODS and POPs in the CEIT countries. Responsibility rests mainly on those organizations, which have applied for international funding. For example, the National Plan in Belarus provides for procurement of equipment for decontamination of obsolete pesticides and polychlorinated biphenyl-containing waste through high-temperature incineration, with a capacity of 1,000-1,500 tons/year, however no such equipment is in place.
45. To date disposal of POPs from CEIT countries has been done by shipping to other countries with suitable destruction facilities, mainly in Europe. For example Belarus sent POPs to Germany and PCB to France for high temperature incineration in dedicated facilities. However this practice is not cost effective it also fails to stimulate development of local disposal strategies and long term capacity and involves higher costs and increased risks of transportation accidents and spills.
46. For both POPs, ODS and OPs there are currently no approved storage or destruction facilities for pure or mixed chemicals and large amounts of obsolete POPs pesticides are often stored in unsuitable conditions. There are no efficient recycling facilities capable of dismantling refrigerators freezers and air-conditioners to remove and separate ODS and other waste material. There are no market mechanisms in place to drive effective recycling schemes and no coordinated mechanisms for the collection transport and storage of the POPs identified in the NIPs.
47. There is a general lack of technical understanding of suitable destruction technologies for POPs and ODS equipment as well as uncertainty over the costs related to destruction and potential funding mechanisms by which destruction could be supported. Whilst the target countries have been able to determine the extent of the problem in each country in terms of the banks and stocks of POPs/ODS to be destroyed, they have encountered problems in establishing suitable models for environmentally sound collection, transportation and destruction nor have they been able to determine the feasibility and viability of the available destruction technologies and processes. The following common problems are encountered in the region:

- Venting of unwanted refrigerant gases is common as operators are unaware of or unconcerned by legal requirements and penalties;
 - Lack of infrastructure or systems for the collection and storage of end-of-life (EOL) refrigeration and air-conditioning equipment and refrigerant gases;
 - Lack of infrastructure or systems for the collection and storage of end-of-life PCB containing equipment or recovered oils;
 - Lack of knowledge and or incentives for environmentally sound processing and recycling of the EOL, including the recovery and destruction of ODS/POPs;
 - No environmentally sound destruction facilities for either ODS or POPs;
 - No long term strategy for future POPs/ODS destruction and reliance on further GEF funding requests for POPs destruction in the EU;
 - Rapid filling of the existing municipal landfills such that disposal of POPs/EOL equipment will likely require increased landfill capacity and further environmental degradation;
48. All the countries in the region have several contaminated sites and equipment and large stockpiles of POPs pesticides stored in inappropriate conditions. There are many operational transformers, capacitors, switch gear and other electrical equipment containing PCBs and when this equipment is decommissioned it will add to the bank of PCB waste. Despite several common issues and technology barriers, there has been little or no cooperation or coordination between the countries. Large volumes of CFC-12, CFC-11, HCFC-22 and HCFC-141b are contained in the refrigeration circuits and insulation foams of domestic refrigerators and freezers, commercial cooling equipment and air-conditioning units.
49. The countries included in the project are considering or already in the process of updating their legislation on POPs and PCBs to bring it in line with European Union (EU) regulations, but for the time being landfill disposal is still being used, posing significant contamination risks.
50. The national requirements of the countries in respect of incineration of hazardous wastes mainly are based on the regulations existed in Former Soviet Union which present some differences comparing with the requirements adopted for example in the European Union.
51. Maximum-permissible concentration of dangerous and harmful substances in production installations, including in high-temperature burning sites.

Substances	FSU requirements
PCB	1 mg/ nm ³
Dioxin and furan	not regulated, recommended limit 0,1 ng/ nm ³
CO	20 mg/ nm ³
HC1	5 mg/ nm ³
Dust	4 mg/ nm ³
SO2	10 mg/ nm ³
Organic carbon	4 mg/ nm ³
Dioxin and furan in sewage	not regulated

52. Unlike POPs which are generally stored in their original form, ODS are contained mostly in refrigeration circuits and in the insulation foams of refrigerator and freezers. Given the very large numbers of obsolete

and near end of life equipment the recovery and recycling/reclamation or destruction of ODS banks creates a very difficult technical and logistical challenge.

53. Institutional strengthening is therefore a priority for initial technical assistance of the programme.

54. Refrigerators and other equipment containing ODS usually sent to landfill and POPs are often simply abandoned in inappropriate storage conditions or burned in poorly controlled incinerators creating pollution and human health risks. There is no storage facilities specifically designed for obsolete pesticides and large amounts of obsolete POPs are stored in unsuitable conditions.

55. The project therefore aims to develop new approaches that overcome the difficulties faced by CEIT countries in the safe management of ODS banks and POPs waste.

56. The UNIDO regional demonstration project for coordinated management of ODS and POPs disposal is therefore aimed at strengthening the national capacity building in the region and in the project target countries by provision of necessary equipment for ODS and POP destruction and developing national waste disposal plans.

**Projects previously funded by GEF relevant to baseline scenario for activities under
Stockholm Convention and POPs elimination**

Project number	Country	Project budget		GEF projects on POPs			
		GEF, US\$, m	Co-financing UD\$, m	Project objective (tons to be disposed of)	POPs stockpile to dispose of	Project status	IA
4737	Armenia	4.70	19.42	OPs and POPs contaminated soil disposal	POPs 8,150 MT	CEO Endorsement on 18.12.2014 Under implementation	UNDP
5038	Armenia	0.85	4.13	<i>Reduce UP-POPs releases in open burning sources</i>	UP-POPs	PIF on 17.07.2013 Project formulation	UNIDO
4961	Armenia	0.14	0.41	<i>Enabling activities</i>	POPs	9.08.2012	UNIDO
3571	Armenia	0.81	1.85	Management	PCB	Approved 10.07.2008 Completed	UNIDO
1479	Armenia	0.48	0.00	<i>Enabling activities</i>	POPs	Approved 06.02.2002 Completed 2006	UNIDO
2519	Belarus	0.50	0.07	<i>Enabling activities</i>	POPs	15.07.2004 completed	WB
3281	Belarus	5.5	21.75	<i>Management</i>	POPs	Approved 19.02.08 Completed 23.09.13	WB
1586	Kazakhstan	0.5	0.05	<i>Enabling activities</i>	POPs	Completed	UNDP

2816	Kazakhstan	3.3	10.6	<i>Management</i>	PCB	01.2009 Under implementation	UNDP
3982	Kazakhstan	10.35	59.05	OPs - 8,000 MT + capacitors - 28,000 MT	OP/capacitors	Approved in 2012 Under implementation	WB
4442	Kazakhstan	3.40	16.01	NIP update	POPs	21.11.2011 Completed	UNDP
1478	Ukraine	0.50	0.00	Enabling activities	POPs	18.06.2003 Completed	UNEP
4386	Ukraine	5.25	21.00	PCB disposal	PCB 3,000	17.07.2014 Under implementation	UNIDO

A.4.5. Relevant Data & PPG findings

A.4.5.1 ODS Banks

57. The environmentally sound disposal of ODS banks is becoming an urgent matter. Since ODS are also greenhouse gases, ODS banks left untreated over an extended period are serious environmental risk in terms of climate change and ozone layer protection. Technologies for destruction of ODS wastes are available but not currently in CEIT. The same technologies are can also be used for the destruction of POPs.
58. Large quantities of ODS (CFCs, HCFCs and halons) are still installed in equipment, in so-called “banks” of refrigerators, air-conditioning units, fire protection systems and foam products. The ODS are released to the atmosphere when leaks arise, when equipment is serviced, and when a product reaches the end of its useful life. Some ODS are emitted rapidly, while others are emitted very slowly, over many years. The MP has encouraged countries to take voluntary steps to reduce emissions. There is no infrastructure in place in the target countries for collection, storage, transportation of ODS recovered from the end-of-life appliances (refrigerators, freezers and air-conditioners) and this is the primary issue to be addressed in this project.
59. The CEIT countries have consumed about 17% of the global baseline of ODS. Assuming that CEIT therefore hold about 17% of the global ODS banks, there could be up to 642,400 ODP-tonnes in CEIT by 2002 and 358,700 ODP-tonnes by 2015, which is equivalent to about 3,400 and 2,300 million tonnes CO₂eq, respectively. Taking the mid-point of 2002 and 2015, this gives rise to an estimated 500,500 ODP-tonnes of ODS currently installed, or about 2,850 million tonnes CO₂eq from ODS alone. However, to provide more reliable estimates it would be necessary to carry out surveys and compile an inventory of the existing equipment and foam products in CEIT.
60. A number of CEIT countries have stockpiles of unwanted ODS in both equipment/products and storage cylinders, some of which are contaminated. The quantities of ODS already collected (recovered) are very low, due to the absence of destruction facilities, legislation or any other incentives for recovery and collection. If concerted efforts are made to establish a collection network and to collect ODS and ODS equipment, the resulting quantity of unwanted ODS would be very large, although a well-organized programme would be required to carry out destruction using environmentally-safe methods and avoid emissions.
61. Based on an average life expectancy of refrigerators, freezers and air conditioners of approximately 15 years it is estimated that current ODS bank in the countries covered by the project represents 10,478 ODP tons or 112.36 million tons of CO₂e:

Country	Estimated ODS Bank ODP tons	CO ₂ e MMT
Belarus	1,308	14.03
Ukraine	8,160	87.50
Kazakhstan	1,010	10.83
Total	10,478	112.36

62. Furthermore the bank of equipment containing ODS is growing in the project target countries by approximately 2.0 million refrigerators and freezers and about 0.5 million air conditioners per year. The recycling centres are not established yet. Only Belarus has a refrigeration appliances recycling facility. Which is currently not fully operating due to the missing ODS destruction facilities. The exact location of the recycling centres will be determined when the project is initiated. Although it is likely that these will be in the vicinity of major cities such as Minsk, Astana and Kiev.
63. The project therefore includes the development of pilot facilities for recycling materials and the environmentally sound destruction of ODS banks. CFC-12, CFC-11, HCFC-22 and HCFC-141b are contained in the refrigeration circuits and insulation foams in domestic refrigerators and freezers, commercial cooling equipment and air-conditioning units. Whilst the amount of CFC or HCFC in an individual piece of equipment is relatively small, the abundance of these items creates a large bank of contained substances. Given the very large numbers of obsolete and near end of life equipment the recovery and recycling/reclamation or destruction of ODS banks creates a very difficult technical and logistical challenge.
64. All the target countries have many contaminated sites and equipment and large stockpiles of POPs pesticides stored in inappropriate conditions. Many operational transformers, capacitors, switch gear and other electrical equipment still contain PCBs. When this equipment is decommissioned it will add to the bank of PCB waste. At present landfill disposal is still being used posing significant contamination risks.
65. Assessment of ODS banks has been made in the three countries (Belarus, Ukraine and Kazakhstan). Due to low cost-effectiveness of old refrigeration appliances recycling and ODS extraction in Armenia, this program has not been included in the current project.

A.4.5.2 POPs Stockpiles

66. The CEIT region is typically characterized by having relatively large stocks of obsolete pesticides, minor stocks of "pure" POPs and extensive, mostly site specific (hotspots) of polluted soil and industrial produced hazardous waste. It is estimated that in Central and Eastern Europe more than 100,000 tons of obsolete pesticides are stored in uncontrolled conditions. The Central and Eastern European region is therefore one of the most severely polluted regions.
67. Parties to the Stockholm Convention under Article 6 are obliged to provide for the environmentally sound disposal of POPs stockpiles and wastes. Such disposal is fundamental in achieving the Convention's objective of protecting human health and the environment by permanently eliminating persistent organic pollutants that might otherwise be distributed into the global ecosystem. As a consequence, the disposal of POPs stockpiles and waste is a priority component of National Implementation Plans (NIPs) developed by Parties to the Convention
68. The inventory exercises undertaken during the NIP development in the four countries provided general and preliminary information on POP quantities, PCB oil and PCB-containing equipment and waste. The information has been collected through assignment of local consultants and conduction of desk studies/consultations with respective Ministries.

Belarus

69. The National Plan in Belarus foresees the procurement of equipment for destruction of POPs and PCB-containing waste and other hazardous waste through high temperature incineration, with a capacity of 1,000-1,500 tons/year. Such an incinerator will enable the entire PCB/POPs phase out in the country during the certain period of time. It is recommended to install the equipment at the Gomel Toxic Industrial Waste Treatment and Burial Complex, wherefore it was advisable to establish a capacity for storing decommissioned PCB equipment and waste. It is important to set up in Belarus a long-term capacity for PCB/POPs disposal, which has also to incorporate PCB equipment de-commissioning targets and OD Annually in Belarus approx.
70. The major task of the regional project is to provide for a modern PCB/POPs destruction facility such as a stationary incinerator, which would enter into service in 2017. This destruction facility should also destroy ODS recovered from refrigerator recycling to be established at Minsk Regional Technopark (state owned). Destruction of POPs and PCB containing waste at the burial site in Gomel using a stationery facility will be linked with a supply of the repacked POPs/OPs and PCB containing equipment from six other landfills in the country.
71. 30 MT of ODS, subject to successful collection of 100,000 pieces of EOL refrigerators every year can be extracted in the new fridge recycling facility. This quantity can be further planned for destruction in the new incinerator together with PCB and POPs. If the fridge recycling plant is installed in the first year, there could be 60 MT of CFCs extracted from the old refrigerators in two subsequent years providing for 0.52 million tons in CO_{2eq} reduction.
72. There is a stock of approximately 1,850 MT of PCB/POPs to be destroyed in the new destruction facility in Belarus in the first year of operation of the plant. It is anticipated that 3,720 tons of PCB/POPs waste can be destroyed in two years, equivalent to all PCB wastes and PCB-containing equipment and 50% POPs in the country. The project will therefore provide for an incinerator with a capacity of about 2,000 MT of waste per year.

Ukraine

73. Approximately 150,000 refrigerators are expected to be collected annually in Ukraine, out which 47 tons ODS can be extracted per annum in a new refrigerator recycling facility (94 MT or 0.81 million tons in reduction of CO_{2e} in two years). These 94MT ODS will be then destroyed in the new PCB/POP destruction facility of the GEF/UNIDO project entitled "Environmentally Sound Management and Final Disposal of Polychlorinated Biphenyls", under which a PCB destruction plant is expected to be installed.
74. The plant should be capable of 3,200 tons of PCB/POPs waste over two years representing 50% of all PCB waste and PCB-containing equipment and 60% of POPs in the country. The project on ODS/PCB and POPs disposal will further monitor ODS, PCB and POPs quantities to be destroyed after completion of the project.
75. During the project preparation several commercial companies already working in this sector were identified and have expressed interest in co-financing and hosting the destruction /recycling facilities. For example SZRM Ltd., Kiev, the company, which has been involved in processing different toxic waste in territory of Ukraine can be a national center for ODS/PCB/POPs waste disposal.

Kazakhstan

76. There are also 150,000 refrigerators expected to be collected annually in Kazakhstan and 47 tons ODS will be extracted per annum in the new fridge recycling facility (94 MT in the two last years of Phase I) equivalent to 0.81 million tons in CO_{2eq} reduction. These 94 MT ODS are to be destroyed in the new PCB/POP destruction facility of the GEF/WB "Elimination of POPs wastes" Project, under which a POPs

centralized and permanent disposal facility foreseen to be provided. This new disposal facility will be used for disposal of POPs and obsolete pesticide and the stockpiles of PCB - contaminating oil from transformers and electrical capacitors.

77. A hazardous waste recycling plant worth \$40 million will be built in Pavlodar in Kazakhstan's north with the financial support from the WB. The new plant will dispose of all the industrial wastes including oil, oil sludge and contaminated soil. It is also assumed that POPs and OPs will be destroyed in this plant. The new plant will be the first of its kind in Kazakhstan. It will be capable of recycling the hazardous wastes both produced now and stored by industrial enterprises. The PIF was approved in 2009. If the WB project P114829 will be prepared and approved, the Kazakhstan's subcomponent can be integrated without changes in expected outcomes.
78. Approximately 1,000 MT of PCB and 2,000 MT of POPs will be destroyed in the new facility in Kazakhstan. 4,500 tons of PCB/POPs waste can be to be destroyed in case of up scaling. The operating entity expected to destroy 100% of pure PCB waste and PCB-containing equipment and 60% of all POPs in the country over a two year period.
79. JSC "Zhasyl damu" was identified in Kazakhstan as potential partner for hosting the incineration and recycling facility. The enterprise was created by converting the Republican State Enterprise "Kazakh Research Institute of Ecology and Climate" of the Ministry of Environmental Protection. Currently the company is create a network of branches in the regions of Kazakhstan to create production facilities for centralized waste collection and preparing them for onward transmission to the disposal (destruction) and has also experience with PCB waste.

A.4.5.3 ODS/POPs Destruction Technology

80. During the PPG stage all technologies indicated in the PIF where evaluated. The preferred and recommended technology for co-destruction of POPs/PCB/ODS/OP for this project is plasma arc. A plasma arc operates on principles similar to an arc-welding machine, where an electrical arc is struck between two electrodes. The arc creates temperatures ranging from 3,000 degrees to 15,000 degrees Celsius in a chamber into which waste is fed. The intense heat of the plasma breaks down organic molecules into their elemental atoms. In a carefully controlled process, these atoms recombine into harmless gases such as carbon dioxide and solids such as glass and metals are melted to form materials, similar to hardened lava, in which toxic metals are encapsulated. There is no burning or incineration and no formation of ash.
81. Plasma is an intense clean heat source with a growing number of applications in the context of waste management including the destruction of hazardous and chemically challenging materials. Plasma can be used to destroy the pure organic chemicals as gas, liquid or solid or as a more common solution a mixture of pure chemicals and materials contaminated with POPs.
82. Destruction of wastes, including those containing or contaminated with POPs and ODS, using plasma technology, offers a commercially advantage solution to existing waste management problems while conserving natural resources.
83. The process chemistry is designed to separate and destroy the hazardous components leaving the non-hazardous material. The intense temperature and light applied in the plasma process results in an extremely high Destruction and Reduction Efficiency (DREs) with levels of 99.9999% typically achieved. The non-hazardous material is then converted into a re-useable aggregate that can be employed in a range of building applications, enabling operators to extract value from waste. The key benefits of this technology are:

- I. Intense source of light and heat, capable of permanently destroying varied waste streams in an omnivorous ways.
- II. Proven, through practical experience and measurement, to deliver the desired temperature versus time histories that lead to the assured destruction and removal efficiencies (DREs).
- III. High intensity of operation, i.e. small plant foot print for a given throughput.
- IV. Plasma devices tolerant of aggressive halogen chemistry.
- V. Plasma power input independent of process chemistry and therefore tolerance to feed variations.
- VI. A high-intensity, clean processing solution with minimal environmental impact.
- VII. proven technology that is simple to operate and maintain, and that has high destruction and reduction efficiencies (DREs).
- VIII. suction pressure control enables ease of sealing of the furnace against possible fugitive emissions.
- IX. Rapid heat up and cool down period enables a flexible operating regime in response to waste material availability fluctuations
- X. Ability to closely control the process chemistry independently of the electrical power input and therefore achieve tight chemical and environmental control in response to waste stream variations

84. A system has been identified which is capable of treating any of the waste types covered by the project with no pre-treatment and producing a stable waste forms. The key technical challenge in the use of plasma destruction in this type of project is in the handling and loading of different forms of waste including liquids, solids and gases. This will require some additional engineering in the proposed plants but this technology is now available and demonstrable in Europe and commercial suppliers are available. The Environmental Benefits of Plasma Treatment are:

- High temperature and UV intensity ensures the rapid and effective destruction of persistent organics pollutants (POPs) such as dioxins and furans, i.e. high destruction and reduction efficiencies (DREs).
- The vitrified product will be non-hazardous with respect to the EU Hazardous Waste Directive, EWC number 190401 due to the characteristics of the processing technology.
- The vitrified material has the potential to be used as a secondary recovered aggregate in a range of applications.
- Off-gases generated are low in volume allowing for decreased physical size and lower costs for the off-gas handling system.
- Technology fits intermediately within the waste management hierarchy and should be considered a recovery, as opposed to disposal, process.

85. The waste material will be fed into the furnace in a safe, sealed and controlled manner the exact design is dependent on whether the waste material is solid, liquid or gaseous, or as in this case, a mixture of all phases. The plasma furnace environment will achieve effective cracking of organic species and vitrification/melting of inorganic species through the application of high temperature (1600 °C typical furnace temperature) and intense light (including UV) radiation.

86. The point of material entry into the furnace will be diametrically opposed to the exhaust port ensuring adequate gas phase residence time for reactions within the furnace. The plasma furnace will be powered by a DC electrical power supply. The plasma power input is regulated per unit weight of blended waste to give the correct gross energy input for the operational feed rate; to achieve the intended processing temperature and reaction regime. The furnace operation will be thermally and electrically monitored, in addition it will have a port for a camera.

87. The plasma furnace will have a cylindrical mild steel shell internally coated with a corrosion resistant barrier. It will be lined with high grade refractory, which will exhibit high resistance to slag attack and thermal spalling.

88. Further indirect slag line cooling will be employed for enhanced refractory life, by freezing slag to the hot face of the refractory. The water-cooled furnace roof section shall be sealed to prevent air ingress into the furnace and to prevent process gas egress, mitigating fire and explosion hazards. The nitrogen-stabilized plasma arc will be transferred from a single vertical plasma torch to the furnace melt, which will be electrically conductive at temperature giving rise to a path for the electrical current and joule heating of the melt phases
89. The exhaust gas could be analyzed and reported in accordance local standards, to ensure compliance prior to being vented to atmosphere.
90. A discharge to foul sewer of the neutralized effluent from the final wet scrubber is required.
91. The key operating concern is in the running costs of such technology; however the project aims to demonstrate that efficient high load operation of a relatively small number of such plants provides a clean, cost effective, and sustainable and capacity building solution than either shipping for destruction in other countries or building multiple combustion facilities.
92. For further details on country data and destruction technology, please see annex E and annex G.

A. 5. Incremental /Additional cost reasoning: describe the incremental (GEF Trust Fund/NPIF) or additional (LDCF/SCCF) activities requested for GEF/LDCF/SCCF/NPIF financing and the associated global environmental benefits (GEF Trust Fund) or associated adaptation benefits (LDCF/SCCF) to be delivered by the project:

93. This project seeks to support a key aspect of the GEF's strategy to bring together various chemical topics for increased coherence. It deals specifically with the GEF priority for funding integrated waste management projects dealing with multiple chemicals, in this case POPs and ODSs.
94. The project is a multi-focal programme with complementary parallel activities, which are designed to generate a robust regulatory framework and methodology for dealing with POPs and ODS disposal on a regional basis and at the same time demonstrate the operation of pilot recycling and destruction facilities.
95. The project is aims to process 800,000 obsolete refrigeration and air-conditioning appliances in the target countries during the project lifecycle (2 years) by establishing pilot recycling facilities which will recover ODS form refrigerant circuits and insulation foam and recycle metals and plastics on a commercial basis. ODS destruction should account for an emissions reduction of 418 ODP tons or 4 million tons of CO₂eq.
96. Recovered ODS and POPs/OP will be collected and transported to an appropriate facility capable of destroying:
 - Liquid and gas phase CFCs and HCFCs
 - Contaminated PCB oils
 - Mixtures of liquids containing POPs including but not limited to: DDT, Aldrin, Heptachlor, Hexachlorobenzene, Hexaclorcyclohexan
97. The project will provide for the environmentally sound disposal of PCB containing equipment and waste, the facilities will however continue to operate after the completion of the GEF project, and will be available to treat any remaining POPs /ODS waste.
98. The pre-project feasibility study has shown that these requirements can be met using plasma conversion technology and at the time of writing this is the preferred solution.

99. The project considered the technical feasibility of combined PCB/POPs destruction in cement kilns. As cement production is energy and carbon-intensive process there is also an opportunity, subject to the feasibility of the destruction efficacy, to address potential energy efficiency improvements in the cement kiln at the same time as modifying the kiln for waste destruction. For example coal fired kilns could be converted to natural gas firing, resulting in improved energy efficiency and reduced carbon emissions. However, during the PPG stage no potential partners (cement kilns) could be identified.

Incremental / Additional Activities Requested

Component 1: National regulatory framework for ODS and PCB/POPs management and disposal

100. A regulatory system for control of ODS and PCB/POPs shall be put in place, this shall cover sites where ODS and PCB/POPs stockpiles and waste are located or sites that are contaminated with PCB/POPs. The regulatory system shall include registration/labeling/status reporting of PCB/POPs-containing equipment and products in use, provisions for enforcement of such controls supported by local legislation, at least potentially consistent with international practice and guidance. This will include demonstrated government oversight and enforcement, whether disposal is taking place inside or outside the beneficiary countries.
101. POPs wastes above the low content level shall be classified as hazardous waste for purposes of regulatory control. Regulations will require operators and owners to ensure the proper identification, labeling, registration and status reporting of PCB/POPs containing equipment and to specify the types of containers, storage areas, transportation practice, sampling, analytical methods and safety procedures in place for each type of waste. An environmental assessment and permitting system shall be established on this basis.
102. National regulatory systems are not yet sufficiently established in participating countries (except Belarus) and some project network activity will be implemented in this regard.
103. This component ensures that the current, creditable national inventory of ODS/PCB/POPs stockpiles are properly registered including quantity, general analytical characterization, location, owner, and assessment of current storage and containment status. It will also develop a work plan for the capture and removal from service of PCB-containing products in accordance with national phase out objectives and those required under the Stockholm Convention including a formal inventory of potential POPs contaminated sites with preliminary assessment of impact and risk.
104. Assessment of existing legislation in participating countries shall be made and new or revised national policies, relevant regulations and instructions in each country will be developed to allow enforcement of POPs and ODS waste disposal in order to meet relevant obligations regulations and guidelines on ODS and PCB/POPs waste disposal.
105. Adequate financial models (take-back operating mechanism) will be developed to ensure long-term sustainability of the sub-regional centers. Under the current market situation, however, the Carbon Market cannot significantly contribute to the project's sustainability. Nevertheless, the development of the carbon market will monitored during project implementation, as an additional potential source of co-financing.

Component 2: Waste management and disposal sub-networks in the project target countries including; ODS and POPs waste collection, storage, transportation and final destruction linked into the regional network and Eurasian Economic Union.

106. The project will establish the regional network for the exchange of information and experience on all aspects of ODS extraction from obsolete refrigeration appliances, and ODS/PCB/POPs waste management

and disposal. The network will also promote the adoption of best practice waste management and environmental protection. The national capacity for identifying, collecting and transporting ODS waste (refrigeration appliances) and PCB/POPs to specified recycling and destruction locations will be strengthened. The project will develop a framework for regional cooperation in ODS appliances recycling and ODS/POPs disposal and create a potential for coordinated management of refrigerator recycling and ODS/PCB/POPs waste disposal between four countries and within two regions.

107. The project aims to establish destruction sub-centres in the project countries linked into the network; improved cooperation amongst the project countries in Europe and in the countries of the Central Asia region; facilitation of information collection and exchange in order to achieve effective communication among national focal points; regular regional meetings and other related activities as a basis for strengthening cooperation amongst the participating countries; and sharing of experiences relating to implementation of ODS and POPs disposal activities by countries within the region.
108. All aspects of ODS and PCB/POPs waste, PCB-containing equipment identification and collection, labeling, storage, transportation and final waste destruction will be considered at the national level and corresponding disposal plans formulated. A possible cooperation on the regional level (transfer of waste for disposal to other countries) on ODS, PCB/POPs and later on OPs waste disposal will be assessed. The establishment of the regional network will be supported by four national sub-networks for ODS and PCB/POPs waste processing including infrastructure, control and reporting systems. A coordinator in each of these will be responsible for maintaining contacts with the other countries.
109. The national networks will benefit from cooperation at the regional level, which includes opportunities to work with regional and international experts on urgent matters. Building up an ecologically, organizationally and financially sustainable ODS and PCB/POPs waste management and disposal national networks calls for creative, local and country-specific solutions. Existing expertise in the area will be used to ensure a sensible balance between costs and benefits. To ensure long-term sustainability of the national centers adequate financial mechanisms will be elaborated.

Component 3: ODS recovery from refrigeration appliances during recycling, and ODS destruction at the established national facilities

110. The project will assist in procuring and commissioning refrigeration appliance recycling plants for ODS extraction and material recycling from obsolete refrigerators, freezers and air-conditioners. ODS will be recovered, stored and transported to the destruction centre.
111. Refrigerator recycling plants capture refrigerants from the refrigerator compressor circuitry and blowing agents from refrigerator insulation foam panels and recover and sort materials, such as the plastic liner, aluminium, copper, steel, and insulating foam. ODS gas in foam is subsequently recovered during a grinding process under negative pressure, and then condensed to a liquid and collected in storage tanks. The degassed foam is compressed into pellets which can be used as fuel for other processes. Captured materials can be sold in the national markets for reuse and contribute to the economic sustainability of the project.
112. The targeted refrigerator recycling systems to be procured by the project should be able process approximately 40 refrigerators or freezers per hour and with a target annual throughput of 100 -150 thousand units each project country.
113. Refrigerator recycling plants can recover approximately 95% of the insulating foam contained in refrigerators and freezers and is estimated to reduce typical refrigerator landfill waste by 85% (by weight). By ensuring a high recovery rate for materials and increasing the volume of units that can be processed, this system allows for significant reductions of GHG and ODS emissions.

114. Experience in EU countries over the last few years has clearly shown that mandatory compliance with quality assurance standards is essential, if recycling companies are to be able to guarantee the maximum possible recovery of CFCs from waste refrigeration equipment and the project will assist in this respect.
115. The project has further positive impact on greenhouse gas (GHG) emissions due to the high GWP of CFC-12 (10,720) and CFC-11 (4,750) accordingly. This will reduce the CO₂ equivalent GHG emission of the GEF project by 2.14 million tons.

Component 4: Environmentally sound management and destruction of PCB contaminated equipment and POP-pesticide waste stockpiles

116. The project will address the priority actions identified in the National Implementation Plans of the SC, namely the capture and secure containment of existing PCB, DDT, and POPs containing pesticide mixture stockpiles including establishing the physical and technical capacity to manage these stockpiles for ultimate destruction, and in the longer term POPs contaminated sites, OPs and unintentional POPs releases by establishing a national long term capacity in waste destruction. It also included technical assistance and institutional strengthening of the sub-regional centers required in participating countries hence supporting the countries' capability to meet their current and future obligations under the Stockholm Convention.
117. The GEF project will secure currently accessible POPs stockpiles of POPs pesticides and PCBs and to the degree practical eliminate them by supporting the development of the required technical, administrative and regulatory disposal tools required to sustain effective POPs destruction into the future. It is an integral part of the countries' ongoing activities programs following the Action Plans contained in their NIPs and specifically those priority activities associated with management of POPs stockpiles and building a sustaining long term capacity in PCB/POPs management and disposal.
118. The project will assist in building in-country capacity for destruction of POPs, PCB Oils, PCB contaminated equipment, obsolete pesticides and ODS in a single facility in each country
119. A feasibility study on the use of cement kiln for ODS and POPs destruction and test burn of waste at a suitable cement kiln will be conducted in order to take a final solution on the use of cement kilns for ODS and POPs disposal in participating countries in the future.

Component 5: Project Monitoring and Evaluation

120. This component addresses project management, oversee and appraisal, as outlined in Part II section C.

A6. Risks

121. Main project risks have been assessed with the national counterparts during project preparation and the corresponding mitigation measures have been designed and will be ready to be implemented. The following table contains the details risk analysis for this project:

Risk	Level	Mitigation Measures
Government at national, provincial, and local levels, as appropriate,	Medium	Ensure laws, regulations, standards, guidelines and specifications are practical and enforceable and support with institutional capacity building and training

would not endorse and adopt the required standards, guidelines and specifications according to the project timeline		
Co-financing will not reach the target level	Medium	<p>Seeking additional funds/donors or lowering the targeted amount of old refrigeration appliances for recycling, targeted amounts of extracted ODS and POPs/PCB contaminated waste for their disposal. While there will be safe storage available, the final decisions will be met by the Project Steering Committee.</p> <p>Policy incentives to be provided for potential investors</p>
Disposal technology not meeting performance requirements, resulting in unacceptably high emissions of dioxin/furan and other toxic chemicals	Low	Selection of proven technology and equipment from recognized suppliers, provision of adequate training, and active supervision of the operation of disposal facilities will mitigate this risk
Delays in project implementation and low quality performance	Low	Carefully selected success indicators and the adaptive monitoring practice will enable timely implementation and high quality results
Public opposition to the disposal project	Low	Public awareness raising and inclusion of all stakeholders in project implementation will minimize the likelihood of this occurring
Owners of old refrigerators and air conditioners and POPs contaminated waste might not be willing to actively participate	Low	Focus on stakeholder awareness raising as a priority; introduction of financial incentives for collection of old refrigeration appliances and their transportation to the recycling centers and a producer responsibility programme; coverage of IOC at the time of the project for PCB and POPs contaminated waste disposal including their transportation to the incineration centers
Vendors, owners of old refrigerators and air conditioners and POPs waste and other parties might not be willing to cooperate	Medium	A policy for POPs disposal fee will be issued and a proper price mechanism will be introduced to allow suitable revenue for the contractors
Engagement of PCB owners, complex or slow in the relevant countries or owners will not declare their PCB inventory	Low	Clear communications and open guidance with explanation of recovery and treatment process and benefits for users
Climate change risk	Low	No activities are planned in the area of possible risks, resulted by the climate change processes
Political imbalances hinder project implementation	Medium	The political imbalances and security issues in Ukraine have been recognized during the formulation of the project document. The implementation activities planned to be undertaken in the territories which are not part of the conflict. The possibility of collecting old refrigerators for recycling from the Eastern Ukrainian part can be considered,

		if the situation does not deteriorate. The geographical scope of the project including its work plan and timeline could be always readjusted
Delays in project implementation and week project coordination	Low	Carefully selected national institutions specialized in waste destruction, project personnel, success indicators and adaptive monitoring practice will enable timely implementation. UNIDO, as a GEF agency responsible for the project, will use the experience accumulated through other similar projects to facilitate accelerated and efficient implementation of the project
The national destruction centres established by the project are not sustainable	Medium	Project design seeks to provide a viable business model over a 10 years period and planned financial incentives will continue to refine this model and provide sustainable technical, administrative and financial mechanisms. The provision, by the sub-regional treatment centers, of treatment services to other owners of electrical equipment with PCB will render the business model more sustainable; this support will be leveraged during project implementation.

A.7. Coordination with other relevant GEF financed initiatives

122. There is a number of PCB management projects, approved by the GEF, but none of these projects is covering obsolete pesticide destruction. Therefore, this project is innovative in terms of establishing a network of national destruction centres, with fully equipment needed for ODS extraction and POP destruction. GEF is implementing no similar project at the moment.
123. As it is proposed in this project, the Steering Committee will be established in Belarus. Therefore the coordination with other GEF-5/6 on-going projects in Belarus is a matter of high importance. There could be no duplication with the GEF-6 project proposed in Belarus through UNDP due to the different approaches to the technology of waste management. Still this project will be coordinated with the project in Belarus to the extent possible.

B. ADDITIONAL INFORMATION NOT ADDRESSED AT PIF STAGE:

B.1 Describe how the stakeholders will be engaged in project implementation.

124. Stakeholder engagement is crucial in terms of getting commitment and approval, as well as of the opportunities to address one of the main priority areas concerning environment. The new status will be sustained through the regulatory and policy enforcement of POPs and ODS waste management and institutional capacity building at central government and provincial level in selected provinces that will be part of the project.
125. Building the structure during the project life cycle, establishing of POPs/ODS destruction Network and close collaborations among the targeted countries will provide sustainability and opportunities for scaling up of this Regional project.
126. The project is innovative in its character because it will demonstrate co-destruction of ODS and POPs waste simultaneously and because it will bring ODS extraction and destruction technologies not presently available in the CEIT countries. It is also innovative in that the project focuses on coordinated action between some

selected countries rather than on policy agreement.

127. The project sustainability is secured by the recovery of metal, copper, aluminum and plastic as scrap materials from the refrigerators and air conditioners units processed in the shredder with their further re-sell on the recycled metals markets available in the project beneficiary countries or even abroad. Also PCB containers, capacitors, etc. can be processed in the same equipment.
128. The rough calculations show that it can be possible to achieve the profit of about US\$ 10.0 per one unit. If 150,000 units are annually collected at one center, then the income can reach the value of US\$ 1.5m per year to cover operating cost. Any other ODS destruction projects without introduction of the shredding operation are non-sustainable. However, the ODS destruction sub-component has two major costs i.e., the cost associated with destruction of 1.0 kg of ODS (US\$ 3.0-10.0) and the cost of one EOL refrigerator or air-conditioner (US\$ 30-50) to be obtained from dumping places, if they are not collected using incentives indicated in Para 7. Therefore, we have a sole solution as introducing the recycling fee as described in the Para 7. A subsidiary price for 1.0 kg of POPs also needs to be discussed with the Governments, in case the profit from re-selling metals appears to be not sufficient. The project is also innovative in this way, that one project component (ODS) monetary supports the destruction of another project component (POPs). These aspects are seen as key factors for engaging stakeholders.

B.1.1. Institutional arrangements for project implementation

129. UNIDO will be the implementing agency (IA) of the project. In order to have direct control on the implementation process UNIDO will be a member of the Project Steering Committee. The above Ministries will be the national executing partners of the project. The Ministries will be involved in developing/modification of the ODS, POP/PCB-related regulations, relevant standards and norms on ODS and POPs management, ESM systems and to make them compatible with the requirements of the MP and SC on POPs. It will be responsible for establishing the requirements and stimulus for national industries to implement the MP and SC compliance measures, for the in-depth inventory of EOL refrigerators and air-conditioners in stocks, PCB-contaminated equipment as well as for capacity building for POPs/PCB and ODS in banks management.
130. All project activities will be coordinated and adjusted with other GEF project in respective countries in order to avoid duplications. Representatives from other IAs will be invited to participate in the work of the Steering Committee.
131. The Ministries of Energy (ME) in the relevant countries will participate in developing technical standards and administrative guidelines and procedures for PCB-contaminated equipment and the Ministries of Health (MoH) in the relevant countries will monitor the influence of the existing and new technologies on the health of workers at companies of PCB-containing equipment and POP-contaminated wastes as well as the health of the population of the country. Representatives from both ministries will be invited to the Project Steering Committee.
132. The Project Steering Committee (PSC) will be established by the Ministries for Ecology and will include ME, MoH, key project partners, other stakeholders from the Government, Academia, PCB owners, NGOs and UNIDO. The Ministries for Ecology will chair the PSC meetings alternatively. Any changes to the work programme will be done in accordance with approved project document and GEF document C 39 Inf. 04.
133. UNIDO will assist in establishing a Regional Network Management Unit (PMU) in Belarus. The PMU will consist of a National Project Coordinator, project assistant, legal, technical and other relevant experts. Over the life of the project, the PMU will provide the key technical backup for all project related activities such as legislation updating and technical guidelines development, inventory, labelling and database compilation,

assessment and selection of technologies. Other ad-hoc groups will be formed, if required. Upon completion of the project enforcement and monitoring activities will be transferred to relevant departments of the Ministries for Ecology in the project target countries and other enforcement agencies. The updated/improved regulations will be organically integrated into the legal framework of the relevant countries. The procured technologies will continue to operate on self-sustainable basis and will be available to at the cost recovering basis.

134. Private sector stakeholders and other potential project participants will be actively approached and integrated into the project. Waste owners of old refrigerators and air-conditioners and obsolete POPs waste will be provided with technical advice in treating existing stocks of obsolete POPs pesticides and associated wastes and electrical appliances in the dumping places of landfills.

135. The following illustration summarizes the overall project structure and implementation arrangements.



B.2 Describe the socioeconomic benefits to be delivered by the Project at the national and local levels, including consideration of gender dimensions, and how these will support the achievement of global environment benefits (GEF Trust Fund/NPIF) or adaptation benefits (LDCF/SCCF):

Socio-economic benefits:

136. ODS not only damage stratospheric ozone, but are also powerful greenhouse gases (GHGs,) with global warming potentials up to 11,000 times greater than carbon dioxide (CO₂). ODS from banks in the CEIT countries are continuously released into the atmosphere until they are properly disposed of. By legislating for the removal and destruction of refrigerants and foam-blowing agents from the refrigeration appliances, and the provision of pilot facilities in the selected four countries, which is not covered under existing national regulations, the GEF project will minimize the emissions of ODS and GHGs from the ODS banks. In addition, the project saves landfill space through avoidance of illegal

refrigerator dumping; conserves energy through the premature removal of working refrigeration appliances and the recycling of durable materials (e.g., metals, plastics, glass); and prevents the release of used oil.

137. The management of hazardous obsolete POPs pesticides and associated wastes has not yet been achieved in the CEITs. Most obsolete POPs pesticides are dumped untreated on pesticide manufacturer property or in the surrounding area, or mixed with municipal wastes. Many of sites are currently impacting soil and groundwater. The given GEF project will reduce the risk to the health of Communities living and working close to obsolete pesticides stores and the wider community that is indirectly exposed to contamination through food and water. The most important socio-economic benefits of the proposed project will be the reduced amount of ODS and PCB releases in the environment and consequently the reduction of human exposures. The economically and environmentally efficient management of PCB and POPs wastes at the national and regional levels will contribute towards the mitigation of global environmental problems associated with ODS and POPs environment pollution. The project will lay the groundwork for the total POPs and PCB elimination in the project participating countries, develop the annual plans for ODS extraction from the refrigeration appliances and gradual transfer to the destruction of and POP/PCB contaminated soil and OPs in general available in the countries.
138. The main reason behind the removal of all hazardous waste stockpiles in the countries of the two regions is high public concern. The proposed project is in line with this movement and creates an enabling environment for local communities to learn and follow the POPs and PCB disposal actions. The inclusion of environmental NGOs in the project demonstration activities is expected to reduce the environmental and health risks and will assure the support of the local communities. The project will create an enabling environment for local communities to participate in the project, such as selection of priority actions and demonstration areas, selection and approval of technologies for local use and subsequent stages of project implementation.
139. The project will partner with technology providers to evaluate and to transfer to the country the best alternatives for decontamination and disposal of equipment with low and high concentration of PCBs and POPs contaminated pesticides waste. The local production of the disposal equipment based on BAT/BETs will be encouraged. The project envisages transfer of non-combustion technology to the region for the destruction of ODS and POPs and this is in line with the advocacy of the GEF in promoting the transfer of environmentally sound technologies. The demonstration project will help to determine the technical, economical and environmental requirements for the application of disposal technologies that will fit the countries' requirements. The project also foresees the creation of at least 30 new working places at refrigerator appliances recycling facilities and ODS/POPs/PCB destruction facilities in the countries.

Gender inclusion:

140. The project design also takes into consideration the GEF's and UNIDO's guidance on gender mainstreaming (based on UNIDO's gender policy), through the whole project cycle. While the degree of relevance of gender dimensions vary depending on the GEF focal area or type of engagement, accounting for gender equity and equality is an important consideration when financing projects that address global environmental issues, because gender relations, roles and responsibilities exercise important influence on women's and men's access to and control over environmental resources and the goods and services they provide. These human resource development initiatives are open for all genders and would encourage the participation of women. As women and children are the most vulnerable group with regard to exposure to POPs, the project shall strive to involve women organizations to work on awareness raising campaigns on the health and environmental impacts of these chemicals. Gender issues will be measured at baseline i.e. project inception, such as the gender ratio of participants at the workshops and awareness programs. During the implementation then Project Steering Committee and PMU will facilitate the improvement of the baseline gender ratio, while at project closure these values will be reassessed and analyzed.

Global Environmental Benefits:

141. The project will deliver annual emissions reductions from the ODS banks of CFC-12, CFC-11, and HCFC-22 extracted from end-of-life refrigerators and air-conditioners. The estimated GHG emission reduction is 2.14 million tons CO₂ equivalent. In this respect it is also consistent with GEF-5/6 linkages to other focal areas in Climate Change Mitigation.
142. The outputs of the project will serve as knowledge base for other programmes in the CEITs as well as providing insights into the development of global strategies.
143. It is also in line with Montreal Protocol's appeal to "International funding agencies including GEF to enable practical solutions for the purpose of gaining better knowledge on mitigating ODS emissions and destroying ODS banks".
144. All the countries are party to the Basel Convention on the Control of Trans-boundary Movement of Hazardous Waste and their Disposal, hence the proposed project is consistent and in line with global environmental policies and political commitments of the countries.
145. Availability of GEF funding would also provide the leverage necessary to secure additional funds from the Governments of the project target countries. PCBs waste and equipment disposal approaches and facilities require a wide spectrum of expertise. CEIT countries lack sufficient financial resources and standards for effective PCBs and POPs destruction. Plus additional problems associated with the recycling of old refrigerators and disposal of extracted ODS require additional expertise. Without this proposed project, innovative approaches - recovery and promotion of sustainable industrial practices, and other activities to remediate polluted sites - would be considerably limited if not non-existent. GEF funding, however, would provide the necessary incentive and international expertise and skills to establish an environmentally sound ODS/POPs/PCBs disposal systems in the project target countries.
146. PCB/POPs management is costly and disposal facilities that meet the requirements of the SC are not available in Eastern Europe and Central Asia. Solutions identified for the project target countries as the most feasible and cost-effective for PCBs/POPs disposal could be replicated in other countries in the two regions (Eastern Europe and Central Asia) and would therefore help reduce the trans-boundary movement of PCBs/POPs regionally and globally, which in turn would reduce the negative impacts on the environment and public health in the regions. In summary, GEF incremental support would assist the Governments in protecting the population's health and the environment at local and regional levels. Co-operation with the regional projects in CEIT countries will be also developed to share project results.
147. Environmental benefits of the given project are as follows:
- Establishment of a national and regional logistical networks for ODS/POPs waste collection;
 - Environmentally safe disposal ODS and some POPs contaminated waste;
 - Experience in management and disposal of ODS and PCB/POPs in an environmentally sound manner that will be used to facilitate the elimination of these waste in the countries as per the SC and MP;
 - Saving natural resources through recycling; water contamination will go down; creation of additional working and employment opportunities in the hazardous waste management and disposal sectors;
 - Introduction/demonstration of plasma technologies, if possible, which will reduce the generation of GHG; and
 - Prevention of cross-contamination and daily leakages from the operational equipment and storage of contaminated wastes; mercury release from refrigeration devices will be avoided.

B.3.Explain how cost-effectiveness is reflected in the project design:

148.ODS /POPs destruction will require a significant programme plan and programme of activity in line with the relevant protocols and conventions governing the control of hazardous substances. Having reviewed the inputs and activities required for these programmes with a view to developing wherever possible innovative integrated mechanisms, it is clear that there are synergies between the two objectives and that there is a benefit in developing a combined programme. The project concept assumes that since both objectives must be achieved whether jointly or separately, any cost or logistical benefits that can be gained by combining activities will result in an overall a cost benefit improvement when considering the climate impact and costs associated with the two objectives undertaken separately.

ODS Recycling and Destruction Calculation					
Material	Mass per unit	Recycling efficiency	Mass Recovered	units per year	Total recycled or destroyed Mt
Metal	45.00	90%	40.50	400,000	16,200
Plastic	11.36	90%	10.23	400,000	4,091
Glass	1.36	85%	1.16	400,000	464
Refrigerant	0.23	70%	0.16	400,000	64
Foam Blowing agent	0.45	80%	0.36	400,000	145
Oil	0.23	75%	0.17	400,000	68
Total	58.63				
Total ODS recovered/destroyed per facility per year of operation					209.09

Estimated Cost Effectiveness	
Recycling/Extracting Facilities in operation	3.0
ODS Destruction in project period MT	418.2
Grant cost US\$ Million	6.0
Cost Effectiveness \$/kg	209.1
Destruction facilities online	3.0
POPS destroyed during project MT	11,700.0
Grant US\$ Million	9.0
Cost Effectiveness \$/kg	0.77
Total Destroyed MT	12,118.2
Equipment grant cost US\$ million (GEF)	15.0
Combined Cost Eff \$/kg	0.81
CO₂eq	
Refrigerant destroyed MT	190.9
Foam blowing agent destroyed MT	436.4
CO ₂ eq tonnes Refrigerant MT	2,080,909
CO ₂ eq tonnes Foam Blowing agent MT	2,072,727
Total Project MMT in year	4.15

149. Whilst the technology required to destroy POPs differs from that required to destroy ODS, investing in plant capable of destroying both has an overall positive impact on the cost-benefit ratio of the combined outputs. Furthermore many aspects of the preparatory design and implementation of the two objectives require very similar assessment, planning and logistics. Moreover incremental investments in certain aspects of the programme such as the destruction plant will mean that both POPs and ODS can be handled at a single installation whereas separate projects would require two destruction plants and two supporting infrastructures at an overall higher cost and lower utilization

C. DESCRIBE THE BUDGETED M&E PLAN:

150. Project monitoring and evaluation (M&E) are conducted in accordance with established UNIDO and GEF procedures. The M&E activities are defined by Project component and the concrete activities for M&E that are specified and budgeted in the M&E plan. Monitoring will be based on indicators defined in the strategic results framework (which details the means of verification), and the annual work plans. Monitoring and Evaluation will make use of the GEF Tracking Tool, which will be submitted to the GEF Secretariat three times during the duration of the project: at CEO Endorsement, at mid-term review, and at project closure.

151. UNIDO as the Implementing Agency will involve the GEF Operational Focal Point and project stakeholders at all stages of the project monitoring and evaluation activities in order to ensure the use of the evaluation results for further planning and implementation. According to the Monitoring and Evaluation policy of the GEF and UNIDO, follow-up studies like Country portfolio evaluations and thematic evaluations can be initiated and conducted. All project partners and contractors are obliged to (i) make available studies, provide reports or other documentation related to the project and (ii) facilitate interviews with staff involved in the project activities.

152. The project implementation structure will be designed to optimize local implementation effectiveness in line with the Country National Ozone Offices and POPs NIPs. A project focal point will be established within UNIDO structure at each project target country to assist with this given project execution. These focal points will consist of dedicated core staff, supplemented by support from professional and support staff colleagues on a part-time as needed basis, including in particular senior staff engaged in the management and coordination of UNIDO's POPs and ODS destruction programme. The Project Management Units (PMUs) will be responsible for the day-to-day management and execution of the project, and will oversee local project management offices. A regional network management unit will be established in Belarus. UNIDO will make these services available as part of its in-kind contribution to the project and will work in close co-operation with the counterparts.

153. A Project Steering Committee (PSC) from related ministries will be established to provide the project team with political guidance and inter-ministerial coordination support. The project will be subject to GEF Monitoring and Evaluation rules and practices of the GEF and UNIDO.

154. For project monitoring the Project Steering Committee (PSC) will be established at the Regional Centre in Belarus which will include the representatives from all the Ministries for Environment and National Resources of the four countries (Belarus, Ukraine, Kazakhstan and Armenia), national directors of the four sub-regional centres, owners of the refrigeration appliances recycling units, PCB-containing equipment owners, representatives from POPs landfills, owners of waste destruction units and UNIDO.

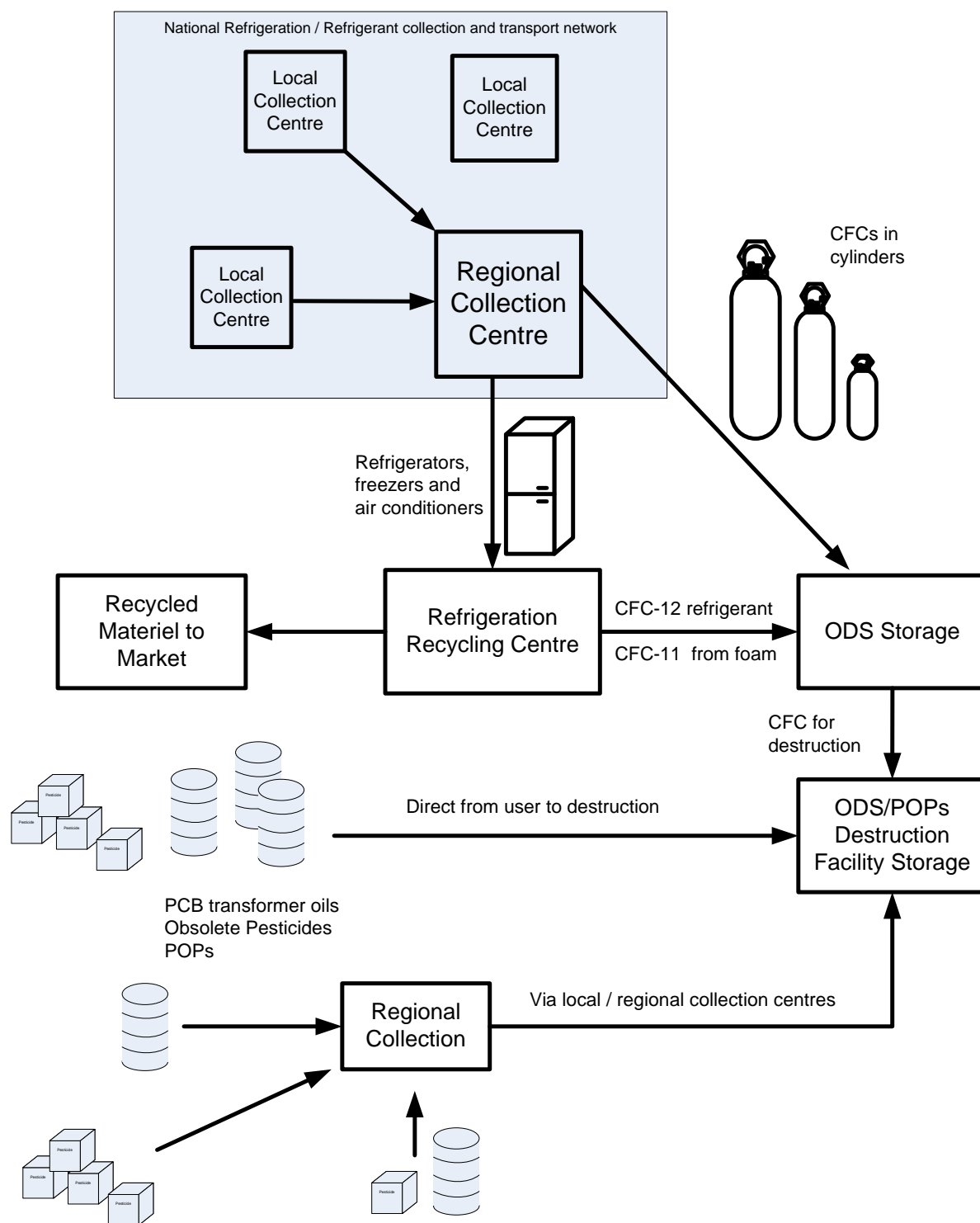
155. The sustainability of the project is ensured by the fact that the Ministries for Environment will be assuring a flow of POPs waste and PCBs-containing equipment for dismantling for by this demonstration project or/and by other on-going GEF projects. The recycling of refrigerators and other ODS containing equipment is economically sustainable (if the capital cost for the facility and supported by the GEF fund) Details of costs to be charged to the waste suppliers, introduction of financial regulations (take-back mechanism) will

be established later on based on the operating cost in each county and taking into account of the already established WEEE collection network in Belarus.

156. The project strategy is to provide a fridge recycling plant for Ukraine and Kazakhstan, in order to initiate refrigeration appliances recycling (not available in all the target countries) and ODS extraction for their subsequent disposal of, ODS/PCB/POPs destruction plant for Belarus and use of ODS/PCB/POPs destruction facilities in Ukraine and Kazakhstan to be provided under other on-going GEF projects. The main outcome of the project is the development of national disposal schemes for ODS and POPs collection and destruction, linked into a regional waste destruction infrastructure. The regional destruction project is also aimed at demonstrating a co-destruction technology (cement kiln), which is capable of handling both POPs and ODS in the volumes required to manage disposal of stockpiles and recovered waste over a reasonable time period.
157. The main potential adverse impacts are related to possible POPs pesticide leakages during excavation and repackaging at the burial sites; possible air pollution, soil and water contamination during OPs burial opening and OPs excavation, temporary storage prior to export shipment, remaining environmental pollution and contamination of former POPs sites without timely clean-up and rehabilitation.
158. It has become evident that for all potential adverse environmental impacts from the future project activities including prevention, minimization and mitigation measures, which are outlined in various national regulatory procedures and requirements, are to be addressed during the project implementation in all the target countries. The regional network will consist of a regional centre and National Centres for waste management. The Regional Network Coordinating Unit planned to be located in Belarus.
159. Within its terms of reference and under current legislation, the Regional Network Center in Belarus will be responsible among others for:
- Coordination of the project activities, organization of joint activities, preparation of technical specifications and the functions to project execution.
 - Collection of relevant information on the introduction of the program of regional monitoring of ODS and PCB/POPs waste and direct inputs in the project target countries.
 - Coordination of document processing related to project implementation (at the regional and country level) as relevant to all stages of the project cycle, updating the UNIDO project data base, follow-up on correspondence with project proponents, and processing documentation for submission, including final quality checks.
 - Monitoring of project delivery and submission of progress reports and budget revisions; identification of the reasons for shortfall in delivery and recommendations to correct the situation.
 - Maintaining of close contact with national sub-centres in varying stages of the project cycle, tracking project development and/or implementation progress against established time-frames for project maturation and/or the attainment of implementation milestones as indicated in project annual workplans, recommending courses of action as appropriate and bringing to UNIDO's attention all technical issues that require resolution.
 - Organization of Project Steering Committee Meetings and Focal Points meetings and project training programmes and workshops as appropriate, including logistics, communications with corresponding organizations, documentation requirements, etc.
160. Monitoring and evaluation will facilitate tracking implementation progress toward the outcomes and objectives. Likewise, it will facilitate learning, feedback, and knowledge sharing of results and lessons among the primary stakeholders to improve knowledge and performance. This section of the project document presents a concrete and fully budgeted monitoring and evaluation plan of the project.
161. Formal monitoring and evaluation (M&E) of the project will follow the principles, criteria and minimum requirements set out in the GEF Monitoring and Evaluation policy and the respective guidelines and

procedures issued by the GEF Evaluation Office and the GEF Secretariat. At the same time, M&E will comply with the rules and regulations governing the M&E of UNIDO technical cooperation projects, in particular the UNIDO Evaluation Policy and the Guidelines for Technical Cooperation. The overall objective of the monitoring and evaluation process is to ensure successful and quality implementation of the project.

Monitoring and Control of Collection, Recycling and Destruction



162. According to the Monitoring and Evaluation policy of the GEF and UNIDO, follow-up studies like Country Portfolio Evaluations and Thematic Evaluations can be initiated and conducted. All project partners and contractors are obliged to prepare studies, reports and other documentation related to the project, and facilitate interviews with staff involved in the project activities. A detailed monitoring plan for tracking and reporting on project time-bound milestones and accomplishments will be prepared by UNIDO in

collaboration with the Project Management Unit (PMU) and project partners at the beginning of project implementation and then periodically updated.

163.UNIDO through meetings with project counterparts as frequent as deemed necessary but not less than twice per year will undertake periodic monitoring of the project implementation progress. This will allow parties to troubleshoot any problems pertaining to the project in a timely fashion to ensure the smooth implementation of project activities.

164.The Project Implementation Review (PIR) is an annual monitoring process mandated by the GEF. It is an essential management and monitoring tool for project managers and offers the main vehicle for extracting lessons from ongoing projects. Once the project will be under implementation for a year, the project team shall complete the PIR. The PIR can be prepared any time over the year. The project will be also subjected to at least two external evaluations, i.e. mid-term review and final evaluation.

Monitoring and evaluation	GEF US\$	Co- financing US\$	Timing
Regular monitoring and the project analysis of performance indicators	10,000	40,000	Regularly, based on the logical framework to feed into project management and Annual Project Review
Annual Project Review to assess project progress and performance	20,000	80,000	Annually prior to the APR/PIR and to the definition of annual work plans
Mid-term Review	30,000	120,000	Mid-term of Project implementation
Terminal Project Evaluation	40,000	160,000	Evaluation at least one month before the end of the project; report at the end of project implementation
Total indicative cost	100,000	400,000	


PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)

A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT(S) ON BEHALF OF THE GOVERNMENT(S): (Please attach the [Operational Focal Point endorsement letter\(s\)](#) with this form. For SGP, use this [OFP endorsement letter](#)).

NAME	POSITION	MINISTRY	DATE(MM/dd/yyyy)
Mr. Vadym Pozharskyi	Head of Department, International Cooperation and European Integration GEF Operational Focal Point	MINISTRY OF ENVIRONMENTAL PROTECTION OF UKRAINE	03/12/2013
Mr. Vitaly Kulik	First Deputy Minister GEF Political/Operational Focal Point	MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT PROTECTION OF REPUBLIC OF BELARUS	28/06/2012
H.E. Nurlan Kapparov	Minister GEF Political Focal Point	MINISTRY OF ENVIRONMENT PROTECTION OF REPUBLIC OF KAZAKHSTAN	24/04/2013
H.E. Aram Harutyunyan	Minister- GEF Political/Operational Focal Point	MINISTRY OF NATURAL PROTECTION OF REPUBLIC OF ARMENIA	29/03/2013

B. GEF AGENCY(IES) CERTIFICATION

This request has been prepared in accordance with GEF/LDCF/SCCF/NPIF policies and procedures and meets the GEF/LDCF/SCCF/NPIF criteria for CEO endorsement/approval of project.

Agency Coordinator, Agency Name	Signature	Date (Month, day, year)	Project Contact Person	Telephone	Email Address
Philippe R. Scholtès Managing Director, Programme Development and Technical Cooperation (PTC) UNIDO GEF Focal Point		01/11/2017	Yury Sorokin	+43(1)26026- 3624	Y.Sorokin@unido.org

ANNEX A: PROJECT RESULTS FRAMEWORK (either copy and paste here the framework from the Agency document, or provide reference to the page in the project document where the framework could be found).

Project Objective: The project will demonstrate environmentally sound collection and destruction of Persistent Organic Pollutants (POPs) stocks and Ozone Depleting Substances (ODS) from the ODS banks in Ukraine, Belarus, Kazakhstan and Armenia and is aimed at to destroying a minimum of 1,950 MT of PCB, 5,500 MT of POPs pesticide waste and 248 MT of ODS (2.14 MM of CO₂e) over Phase I of the project life

Interventions	Indicators	Baseline	Target	Sources of Verification	Assumptions
Outcome 1: Relevant regulations and instructions in the project target countries developed to allow enforcement of PCB/POPs and ODS waste disposal in order to meet obligations	A new set of regulatory instruments adopted including legal measures or guidelines on enforcement of POPs and ODS waste disposal meeting the SC and MP requirements	No access control measures exist or in place. National legislation on ODS and POPs/ PCB –contaminated waste destruction in the project target countries is scattered and not in compliance with EU corresponding directives	Regulatory instruments, official guidance on ODS and POPs/ PCB – contaminated waste disposal adopted with gaps filled, conflicts resolved and consistent with relevant international requirements	Assistance in drafting of relevant regulation and instructions and policy enforcement strategy based on the EU directives	The Governments of the project target countries are committed to meet the requirements of ODS banks destruction under the MP and POPs/ PCB –contaminated waste disposal under the SC in managing waste in an environmental sound manner
Output 1.1.1: Assessment of existing legislation made and new or revised national policies, regulations and guidelines on PCB/POPs and ODS waste disposal developed	New or revised national policies, regulations and guidelines issued on: PCB/POPs contaminated sites management issues; and PCB/POPs monitoring and reporting, ODS-based refrigeration appliances collection	The absence of controls on PCB and POPs pesticides stockpiles and their potential disposal; no control on extracted ODS monitoring and reporting	Existing legislation in the project target countries on ODS and POPs disposal in comparison with EU directives analysed	Guidelines for the management and control of PCB and POPs waste developed; guidelines on ODS disposal developed	Demonstrate to the international community that the project target countries meet their obligations under the SC and MP
Output 1.1.2: Development of new regulatory mechanism on various aspects of ODS/PCB/POPs disposal in the project target countries	A modern regulatory system established for the management, control and disposal of ODS and PCB and POPs waste	Local legislation does not specifically mention ODS, PCB and POPs especially in terms of their destruction in the project target countries	A relevant policy enforcement strategy based on the EU directives in each country developed	Fully updated regulatory framework for waste disposal implemented	Harmonization of governments policies and regulatory management systems with that of their neighbors in the region

Interventions	Indicators	Baseline	Target	Sources of Verification	Assumptions
Output 1.1.3: Adequate financial models to ensure long-term sustainability of the sub-regional centres developed	Economic and market based incentives for collection, transportation, storage and final destruction of ODS and PCB/POP waste developed	<ul style="list-style-type: none"> i) No refrigerators collection fee is introduced; ii) No producer responsibility program except Belarus is introduced iii) Waste disposal fee is not introduced iv) No interest of cement kilns in ODS/PCB/POP destruction 	Within 12 months of the start-up of project implementation financial plans on ODS and PCB/POP disposal in the project target countries prepared	Reports on financial take-in systems for refrigerator collection, PCB electrical equipment collection and transportation to the collecting sites prepared	Regulations requiring holders of PCB contaminated equipment to inventory their holdings and register them with the relevant regulatory body and finally to transport them to the collection sites
Output 1.4: Qualified sampling and analytical capability in the region in characterizing PCB and POPs wastes and assessing PCB and POPs content strengthened	A set of measures for national laboratories in strengthening their capacity in PCB/POPs analyses developed	International standards are not applied in the project target countries	Availability of PCBs screening kits for detection of PCB levels in transformer oil and measuring devices for POPs assessment in the national laboratories analyzed and if necessary procured	Project reports on assessment of the sampling and analytical capability in the project target countries	Upgraded laboratories will apply the international standards and methods in the field of PCB and POPs detection and analyses, regional cooperation between the labs in the project target countries improved
Outcome 2.1: In country capability in identifying, collecting and transporting POPs and ODS (refrigeration appliances) waste to the specified recycling and destruction locations	National sub-regional centers established capable to handle refrigeration appliances recycling, PCB electrical equipment decontamination and POPs stocks disposal	No EOL refrigerators and air-conditioners are yet collected; there is no national capacity set up for POPs destruction; POPs stockpiles are destroyed only irregularly abroad, no assessment of the quantities of contaminated soil, etc.	In country capability in processing toxic waste under the SC and MP	Supervisory consultant technical reports	There could be national barriers preventing the export of ODS and POPs waste for destruction between the project target countries as per the Basel Convention on transboundary movement of hazardous waste; bilateral agreements might be likely additionally concluded.
Output 2.1.1: ODS, POPs and OPs waste for disposal at the sub-regional disposal centres assessed	The national reports on POPs and OPs waste revised, ODS banks analyzed to estimate the scope of disposal operations	No data is available on ODS banks in the project target countries. The inventory on POPs and OPs are permanently updated	Strengthening national waste management equipped with secure storage and basic infrastructure to allow introduction of new	National waste assessment reports	Secure storage of POPs pesticide waste and OPs stockpiles and potential treatment of POP pesticide contaminated soil

Interventions	Indicators	Baseline	Target	Sources of Verification	Assumptions
			technologies		
Output: 2.1.2: National ODS and POPs disposal plans developed	National plans with targeted figures of ODS and POPs quantities to be disposed of developed	No ODS disposal plans available. The NIPs on POPs phase-out based on the establishment of incineration facilities funded by IOs only	Long-term site management plans for remediation of the dumpsites and for refrigerator recycling and ODS destruction in the project target countries prepared	National disposal plans prepared	National commitment to achieve this task
Output 2.1.3: Three national ODS and POPs collection, transporation and disposal centers including infrastructure, control and reporting systems established	Sub-regional ODS and POPs collection, transporation and disposal centers in the project target countries established	No ODS or POPs autonomous destruction centers are available in the CEIT countries including the project target countries	Implementation of centers design, operational procedures and a conformance with national legislation	On-site visual and analytical screening reports; supervisory consultant reports	No unforeseen institutional or legal barriers exist to set up sub-regional disposal centers in the project target countries
Outcome 2.2: Potential for coordinated management of refrigerator recycling and ODS and POPs waste disposal among the project target countries and within the region	A regional network for cooperation on refrigerator recycling and ODS and POPs waste disposal at national potential sub-centers established	No inventory work consolidated for regional waste disposal network assessment made	Identification of priority autonomous sites for refrigeration appliances recycling, PCB decontamination and POPs pesticide waste destruction	Preliminary site assessment reports received from the Ministries for Ecology	Goodwill and commitment of the Governments in the project traget countries to support the regional coordinated management of ODS and POPs waste disposal. Acceptance of access and involvement of private sector owners.
Ouput 2.2.1 A regional ODS and POPs pesticide waste stocks database designed	Guidance documentation on the regional database on ODS and POPs pesticide stocks	No activities in the project target countries on regional disposal of ODS or PCB/POPs waste pesticides	The availability of the regional database would allow the regional network to plan the project waste disposal activities on the long-term basis	Database on disposal designed	Potential expansion of database for contaminated soils and OPs in the region
Ouput 2.2.2 A framework for regional cooperation	A new set of regulatory instruments for regional cooperation adopted	No regional cooperation on POPs disposal among the project target countries and in	Agreements among stakeholders on the content of the regional	A framework document on regional cooperation	A framework takes into consideration environmental, financial, and technical

Interventions	Indicators	Baseline	Target	Sources of Verification	Assumptions
for ODS appliances recycling, ODS and POPs disposal among the project target countries developed		the region in the past	framework cooperation made	signed by the stakeholders	aspects of regional cooperation
Outcome 3.1: In country capacity in establishing refrigeration appliances recycling facilities for ODS extraction and their destruction	Core national capacity in place in the project target countries relative to waste disposal management and risk assessment developed	No ODS-based refrigerator recycling and ODS destruction facilities are available in the project target countries	Refrigeration appliances recycling facilities for ODS recovery therein and their consequent destruction in incinerators or cement kilns established	Regulatory inspection reports	An opportunity to recycle refrigeration appliances from other countries; permanent measures to maintain the recycling facility
Output 3.1.1: Advanced technology options for refrigeration appliances recycling and ODS destruction assessed	Feasible local refrigerators and air-conditioners recycling and ODS destruction options	There exists manual cutting of refrigerator carcasses (ODS are evacuated into atmosphere); no recycling facilities in the project target countries available	A refrigerators and air-conditioners recycling facility selected including carcasses shredding and automatic ODS extraction and filtration	Consultant technical reports on selection of EOL refrigerators recycling technology	Assessment of recycling and ODS evacuated technology not known in the region, which meets the requirements of EU directives
Output 3.1.2: Construction, installation and commission of a refrigeration appliances recycling facility for ODS extraction in the project target countries performed	Refrigeration appliances recycling facility in the project target countries established. Site preparation arrangements for hosting the required technology completed	No ODS extraction from refrigerator appliances are made; no refrigerators and air-conditioners are recycled in the project target countries	National capacities in refrigeration appliances recycling	Supervisory consultant reports	Qualified and competitive facilities and supporting logistics (collection, transportation, storage) and introduction of EPR in the project target countries
Output 3.1.3: An estimated 800,000 pcs over Phase I of the project life of EOL refrigerators recycled and 248 ODS tons	800,000 pieces of refrigerators recycled, an estimate of 248 tons of ODS extracted and disposed of	No refrigerators and air-conditioners are recycled in the project target countries	A national capacity in place in the project target relative to EOL refrigerator and air-conditioners recycling	Inspection report	Preliminary site assessment and conceptual design sufficiently defines the scope of appliances recycled

Interventions	Indicators	Baseline	Target	Sources of Verification	Assumptions
extracted in the project target countries					
Output 3.1.4: An estimated 248 tones of extracted ODS destroyed	Annual quantities of ODS extracted from refrigerator appliances in the project target countries destroyed	No ODS extraction from the refrigeration appliances in the project target countries available	800,000 pieces of old refrigerators recycled and approx. 248 tons of ODS destroyed in Phase I	Supervisory inspection reports	Getting down to national practices of refrigeration appliances recycling and extracted ODS destruction
Outcome 4.1: In country capacity in destroying PCB containing equipment and POP contaminated pesticide waste at the established national PCB/POPs destruction facilities in the project target countries	Obsolete non-soil mixed POPs pesticides already packed or excavated and re-packaged to be transferred to the destruction facility.	Mixed POPs contaminated pesticides buried at the dumpsites in the project target countries; electrical transformers and capacitors containing PCB - contaminated oil stockpiled	Getting down to annual planning and disposal of PCB and POPs waste, PCB - contaminated soil dechlorination and finally getting down to OPs disposal of in the project target countries	Progress reports	Demonstration for other holders of obsolete capacitors and transformers containing PCB and for their eventual safe disposal. Raise awareness of dangers of POPs to human health and the environment and approve a way for the adoption of a modern system of toxic chemical disposal
Output 4.1.1: Advanced technology options for treatment and disposal methods of PCB and POP destruction assessed	Selection of feasible local PCB and POPs waste pesticide destruction technology meeting the EU requirements	No treatment and disposal of PCB and POPs waste pesticides techniques applied in the project target countries	Assessment of BAT technologies for PCB and POPs destruction and selection of appropriate one	Reports on advanced technologies to be used in selected countries	The four major tasks are to be solved. i) characterization of PCB waste; ii) PCB stocks to be decontaminated and oil re-used; iii) electrical transformers to be cleaned and re-used; and iv) PCB waste to be destroyed
Output 4.1.2: A national facility for PCB-containing transformer oil decontamination and pure PCB destruction in the project target countries established	A national facility for environmental sound disposal of PCB-containing equipment including their handling, disposal and occupational and environmental safety measures and transformer cases cleaning established in each country	No PCB decontamination or destruction facility is yet available in the project target countries; current transformer and capacitor management practices allow for further cross-contamination of PCB free equipment; no PCB-contaminated oil from transformer parts removed	Start-up of annual PCB destruction in the project target countries	Supervisory inspection report	In country long-term capacity for PCB destruction; after the project implementation the project facilities will be further used for OPs destruction

Interventions	Indicators	Baseline	Target	Sources of Verification	Assumptions
Output 4.1.3: A national facility for destruction of POPs contaminated pesticides in the project target countries established	A national facility for environmentally sound disposal of POP waste pesticides including their handling, disposal and occupational and environmental safety measures	Through the POPs waste management projects funded by the GEF a certain quantity of POPs waste is destroyed abroad; no long-term capacity in POPs waste disposal established in the project target countries	Annual POPs waste pesticides destruction and later on OPs waste in selected countries	Supervisory inspection report	Annual planned POPs and OPs waste destroyed at the sub-regional disposal centers
Output 4.1.4: PCB-containing waste and POPs disposed.	11,700 tonnes of PCB-containing waste, other POPs and pesticides destroyed	Not all electrical transformers and capacitors containing PCB - contaminated oil stockpiled. Not all POPs contaminated pesticides buried at the dumpsites in selected countries	Getting down to annual planning and disposal of PCB and POPs waste in selected countries	Supervisory inspection report	For disposal of POPs the waste stocks have to be re-packaged and transported to the sub-regional centers and residual site contamination cleaned up
Outcome 5.1: Project results monitored and evaluated effectively and "best practices" in the region and "lessons learned" over the project implementation disseminated	Project implementation follows the annual work plans and budget	Baseline indicators are assessed and documented at project start-up	Monitoring and evaluation team established in due time. Country level and regional monitoring and evaluation plans developed and implemented, reports published	All projects reports and mid-term and final reports effectively drafted and timely delivered	Evaluation reports will be timely drafted and their content properly communicated and used for an effective project management

ANNEX B: RESPONSES TO PROJECT REVIEWS (from GEF Secretariat and GEF Agencies, and Responses to Comments from Council at work program inclusion and the Convention Secretariat and STAP at PIF).

GEF Secretariat

Questions	Secretariat Comment at PIF (PFD)/Work Program Inclusion	UNIDO Response
25. Items to consider at CEO endorsement/ approval?	During PPG stage the appropriate incentives should be investigated and elaborated at the time of CEO endorsement. Fees at the time of disposal may result in improper disposal to avoid fees.	<p>The project foresees the introduction of some incentives subject of negotiations with the Governments of five countries during the project implementation cycle. They are:</p> <p><u>POPs</u></p> <p>Government disposal fee for national POP destruction centers to subsidy the destruction operations Expenses covered by the Governments for POP storage, packing and transportation to the destruction centres Transportation and destruction expenses supported by the Governments to transfer and destroy the POPs in other countries</p> <p><u>ODS</u></p> <p>Waste management and destruction local legislation in five project participating countries obliges manufacturers of home appliances to ensure the recovery and sound disposal of the refrigerant and foam insulator (i.e. CFC, HCFC, HFC) installed in the domestic refrigerators & air-conditioners. The incentives planned for ODS banks emission reduction are:</p> <ul style="list-style-type: none"> •Government or manufacturers collection fee for end users of EOL appliances to encourage them to transfer the EOL appliances for destruction •Government collection fee for quantity of recovered ODS collected by servicing operators (repair and servicing workshops) <p>US\$ 10-20 recycling fee is to be included in agreements with producers or distributors of electrical appliances including new refrigerators, freezers and air conditioners. This recycling fee will be collected in the shops and transferred to the Ministries of Environment. The Ministries will decide to which licensed recycling companies they will</p>

		<p>transfer the funds to subsidize the electrical appliances destruction in the country.</p> <p>Retailers' promotion sells of new appliances with reduction of their nominal price due to handover of EOL appliances by end users.</p> <p>Potential government subsidiary fee to monetary support the local ODS destruction centres' expenditures relating to EOL appliances collection, transportation and storage.</p>
	Carbon trading should be elaborated at the time of endorsement.	Under the current market situation, the carbon market cannot significantly contribute to the project sustainability. However, the development on the carbon market will monitored during project implementation.

Additional comments received at CEO Endorsement stage have been responded to in the Review Sheet.

Council Member:

Canada's Comments

Canada would like to congratulate UNIDO and all of the proponent countries for this project proposal, which aims to maximize synergies within the GEF's Chemicals and Waste focal area, and generate substantial co-benefits for other GEF focal areas, like Climate Change. We look forward to seeing similar project proposals in the future.

We request that this project be circulated to the GEF Council prior to CEO endorsement, to ensure the following concerns are addressed.

We note that there are various references to a "scale-up" project in the proposal (e.g., paragraph 1, page 10), which would increase investment activities in order to enable the destruction of additional ODS and POPs. The proposal should clarify if the proponents intend to submit a subsequent "scale-up" project, and its potential costs.

The proposal aims to establish new destruction facilities in three countries; however, it would likely be more cost-effective to export the waste to existing destruction facilities in nearby countries. Of note, the Multilateral Fund of the Montreal Protocol (MLF) has not financed the establishment of new destruction facilities, rather it has provided assistance for the destruction of the ODS in existing facilities in nearby countries, or in upgrading cement kilns or other facilities available in the country itself. In addition, we note that ODS disposal projects under MLF have cost effective levels around \$10/kg, with a ceiling for funding of \$13/kg. Conversely, the proposed project has an estimated cost effectiveness of \$50/kg. The data supporting the claim that more ODS and POPs would be destroyed in subsequent years needs to be strengthened. Overall, the justification for a more costly approach needs to be provided to ensure GEF funds are used in a cost-effective manner.

We note that under the MLF, proposals for ODS disposal must substantiate the quantities of ODS that will be destroyed by providing actual data collected in the country, which can be challenging to obtain. Currently, the project's estimates are based on assumptions of quantities that can be recovered from equipment; however, at least some of these recovered ODS could be re-used and are not available for destruction. The proposal should provide actual ODS data, or consider alternative approaches that would provide stronger estimates.

Originally an “Up-scale” project was considered for GEF-6 or 7. However, after approval of the PIF and during the PPG phase, it was realized that the project concept and objectives can be achieved under the current project. Technically, “scale-up” of the project is still possible and would be welcome in the region. In case additional funding would be available, it is still possible to increase the number of participating countries in the region, replicate and extend (type of waste) the project concept and/or just increase the project capacities.

The project is innovative in its character because it will demonstrate efficient co-destruction of ODS and POPs waste at the same facility. It is also innovative because it will bring ODS extraction and destruction technologies not presently available in the CEIT countries. It is highly innovative project focusing on coordinated action between some selected countries rather than on policy agreement could be implemented with the establishment of a Regional Destruction Center in the Belarus and two other sub-centers in the region.

The combined cost effectiveness for ODS destruction is estimated in para 148 and is under US \$ 1.00/kg, much under the MLF ceiling of US \$ 13.2/kg. This was established under available funding (“Funding window”) for already collected ODS waste to be destroyed outside of the project countries (transportation, destruction) not for establishment of a destruction facility. It referred to only a limited number of demonstration projects under specific conditions, financed by the Multilateral Fund only at the 59th ExCom meeting. Therefore, this ceiling is not applicable and not directly comparable due to the different approach and conditions. The current project is dealing with the establishment of destruction facilities.

Plasma is a tested technology, operating in private companies, for example in Saudi Arabia, Mexico, Australia, USA, UK, Japan, but not as a part of MLF demonstration projects. However, the available information from the operating facilities was considered during the project preparation and was used for cost calculations.

Detailed ODS data is provided in the Annexes E, country specific information. The quantities of obsolete equipment containing ODS are “available” and expected to “grow” in the next years, due to the increased quantities and decreased “life time” of the equipment.

The project sustainability is secured by the recovery of metal, copper, aluminum and plastic as scrap materials from the refrigerators and air conditioners units processed in the shredder with their further re-sell on the recycled metals markets available in the project beneficiary countries or even abroad. Also PCB containers, capacitors, etc. can be processed in the same equipment. The rough calculations show that it can be possible to achieve the profit of about US\$ 10.0 per one unit. If 150,000 units are annually collected at one center, then the profit can reach the value of US\$ 1.5m per year. Any other ODS destruction projects without introduction of the shredding operation are non-sustainable. However, the ODS destruction sub-component has two major costs i.e., the cost associated with destruction of 1.0 kg of ODS (US\$ 3.0-10.0) and the cost of one EOL refrigerator or air-conditioner (US\$ 30-50) to be obtained from dumping places, if they are not collected using incentives indicated in Para 7. Therefore, we have a sole solution as introducing the recycling fee as described in the Para 7. A subsidiary price for 1.0 kg of POPs also needs to be discussed with the Governments, in case the profit from re-selling metals appears to be not sufficient. The project is also innovative in this way, that one project component (ODS) monetary supports the destruction of another project component (POPs).

Germany's Comments

Germany approves the following PIF in the work program but asks that the following comments are taken into account:

Suggestions for improvement to be made during the drafting of the final project proposal:

Germany welcomes the PIF and generally supports the STAP comments, in particular the emphasis on networking with stakeholders. In the project region some projects are dealing with phase out of POPs. Experiences from existing networks, projects and stakeholder are to be taken into account. Germany would like to add the following:

- The PIF should take into account the role of the private sector to a more detailed extent. It is mentioned that the private sector is willing to contribute financially, but the role and input of the private sector is not clarified.

The stakeholder engagement is crucial in terms of getting their commitment and approval, as well as of the opportunities to address one of the main priority areas concerning environment. The new status will be sustained through the regulatory and policy enforcement of POPs and ODS waste management and institutional capacity building at central government and provincial level in selected provinces that will be part of the project.

The role of the private sector was identified and reflected in the current CEO Endorsement. The main role of the private partners is to “host” and operate the equipment. Therefore, potential private partners have been identified and preliminary selected during the PPG stage. Co-financing letter obtained. All information regarding private sector contribution is in Annex H and para 75, 79, 134 and others.

- Storage is a temporarily solution, but the main focus should be on recycling and destruction.

Fully agree with the comment. The project design is actually targeting this problem. Destruction technology is described in details in the Annex G. Recycling in Annex I. Further, building the structure during the project life cycle, establishing of POPs/ODS destruction Network and close collaborations among the targeted countries will provide sustainability and opportunities for scaling up of this Regional project. This project is innovative because it will demonstrate co-destruction of ODS and POPs waste. The project concept is designed on gaining maximum benefits from the available synergies.

ANNEX C: STATUS OF IMPLEMENTATION OF PROJECT PREPARATION ACTIVITIES AND THE USE OF FUNDS⁵

A. PROVIDE DETAILED FUNDING AMOUNT OF THE PPG ACTIVITIES FINANCING STATUS IN THE TABLE BELOW:

PPG Grant Approved at PIF: 275,000			
<i>Project Preparation Activities Implemented</i>	<i>GEF/LDCF/SCCF/NPIF Amount (\$)</i>		
	<i>Budgeted Amount</i>	<i>Amount Spent To date</i>	<i>Amount Committed</i>
International consultants	150,000	120,000	50,000
National consultants	80,000	60,000	25,000
Travel	40,000	5,000	15,000
Miscellaneous	5,000		
Total	275,000	185,000	90,000

⁵If at CEO Endorsement, the PPG activities have not been completed and there is a balance of unspent fund, Agencies can continue undertake the activities up to one year of project start. No later than one year from start of project implementation, Agencies should report this table to the GEF Secretariat on the completion of PPG activities and the amount spent for the activities.

ANNEX D: CALENDAR OF EXPECTED REFLOWS (if non-grant instrument is used)

Provide a calendar of expected reflows to the GEF/LDCF/SCCF/NPIF Trust Fund or to your Agency (and/or revolving fund that will be set up)

Not applicable

E.1 Armenia

Armenia signed the Stockholm Convention on Persistent Organic Pollutants in 2001, and ratified the convention in 2003. The Ministry of Nature Protection of the Republic of Armenia with the financial support obtained from Global Environmental Fund (GEF) prepared the National Programme “Enabling activities to facilitate early action on the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs) in the Republic of Armenia”. The main goal of the Project was to identify priority problems related to negative impact of POPs on environmental and human health, taking actions to eradicate these problems in order to fulfill the country's commitments to the Stockholm Convention. Some of the tasks undertaken were:

- Identification of main sources of contamination by persistent organic pollutants in industrial, energy, agricultural sectors and other branches of industry;
- Compilation of an inventory of PCB-containing equipment and oils in the above sectors
- Monitoring of contaminated areas of industrial entities and energy facilities;
- Identification of weaknesses in legislative basis and evaluation of institutional mechanisms for regulation of POPs issues (import, export, minimizing releases, disposal, decontamination, final disposal/ elimination);
- Development of specific actions to reduce and eliminate persistent organic pollutants in the Republic of Armenia.

The “National Implementation Plan” established the following priorities:

- Improvement of legislative/ regulatory background for regulation of POPs relevant issues;
- Setting up institutional capacities/ structures and strengthening the interaction amongst concerned Ministries and Agencies aimed at revealing main sources of POPs-related pollution, reducing their releases and eliminating the most hazardous ones, investigating environmental contamination by POPs and taking joint actions for prevention of their impact on human health;
- Inventory taking on PCB-containing oils and equipment in energy and industry sectors of the Republic of Armenia;
- Replacement of PCB-containing oils and equipment (with PCB-free oils and equipment) at entities in the energy and industrial sector in Armenia;
- Providing monitoring of POPs polluted/ contaminated sites, development of screening methods for POPs analyses with the purpose of initial/ preliminary assessment of local contaminations;
- Establishment of the Central Analytical Laboratory on POPs to ensure analyses and control on the environment;
- Environmentally sound elimination/disposal of PCB-containing oils and PCB-containing equipment, as well as existing stockpiles of obsolete pesticides;
- Implementation of sound/safe technologies, which exclude POPs generation, releases in industrial area/zones and the environment;
- Carrying-out wide information and awareness raising activities on POPs problem in order to develop and establish an information system embracing issues on prevention of POPs harmful impact, as well as their after-effects for human and environmental health;
- Ensuring implementation of actions aimed to meet the objectives of Stockholm Convention;

During assessment it was revealed that energy sector was one of the main sources of environmental pollution by POPs and, in particular polychlorinated biphenyls (PCBs), which are contained in oils used in electrical equipment of various types (power transformers, greasing/lubricating systems; rectifiers, high voltage switches and breakers, compressors, etc.).

In 2008-2011, due to financial support of the GEF, the project “Technical Assistance for Environmentally Sustainable Management of PCBs and other POPs Waste in the Republic of Armenia” was implemented jointly with UNIDO. The Inventory of PCB-containing equipment and oils was done in energy production/distribution and industrial sectors, oil analysis was done for probable PCB content, and equipment was labeled.

The Government has also requested assistance from NATO on “Inventory, Monitoring and Analysis of Obsolete Pesticides in Armenia for Environmentally Sound Disposal” (NATO Project ESP.EAP.SfPP 982812) which together with the assistance of the Brazilian Government has allowed the establishment of a POPs laboratory. This laboratory was used to provide analytical back-up of the PCB inventory exercise.

The detailed PCB inventory included the following stakeholders:

- Energy sector, including electricity production and distribution enterprises;
- Industrial sector, including companies with transformers capacitors and oil switches

The first step was to identify the amount of oil-containing equipment at each stakeholder. Table A1 presents the power generation sector stakeholders. In the power sector 9,867 transformers and 2,574 of switchgear have been identified. During the inventory exercise sampling was done on 1,833 transformers and 470 oil switches all of them belonging to the power generation, transmission and distribution sectors.

Table A1. Scope of inventory (oil containing equipment)

Energy sector	generation	Transformer s units	Oil switches (pcs)	Amounts of T- 1500 type transformer oils (ton)	Oil samples taken and Identification Forms filled out	
					from transformers	from oil switches
Energy generation and distribution (Power plants and High- Voltage Electric Network)		335	1,288	6,307	202	470
Electric Networks of Armenia CJSC		9,014	1,286	10,447	1,601	0
Provinces		518			30	
Total Power sector		9,867	2,574	16,754	1,833	470

Laboratory investigation of the samples was undertaken with DEXSIL L2000 DX Analyzer. As part of the inventory exercise labels with identification numbers have been attached to all the transformers, oil switches and other containers. After laboratory analysis all sampled equipment was labeled to provide information on PCB content. 1,521 samples have been analyzed of which 1,365 samples were found to contain less than 50 ppm PCBs, in 148 samples the PCB concentration was 50-500ppm, in 3 samples it was 500-2000ppm and in 5 samples the PCB concentration exceeded 2000ppm (Table 2.).

Table A2. Analytical result of the transformer and switch gear samples

	Analyzed Transformer & Switch Gear Samples				
PCB contamination, ppm	<50	50-500	500-2000	>2000	Total
Number of equipment	1365	148	3	5	1521

This means that 89.7% of the samples were PCB negative. Among the PCB positive samples 148 samples (94.8%) is in the range of 50-500 ppm, while the remaining part was approximately evenly distributed between the range of 500-2000 ppm and > 2000 ppm.

Among the 1,197 transformer samples 1,056 turned out to be PCB negative <50ppm, 135 were 50-500ppm, and 1 sample was in the range of 500-2000 ppm and 5 samples were 2000ppm.

Based on the number of transformers and the total weight of transformer oils in the electrical sector an extrapolation was made for the whole energy sector to map its PCB problem. According to this estimation approximately 89.7% of the transformers are free of PCBs which represents 15,028 tons of transformer oils. Approximately 1,636 tons of transformer oil is contaminated with PCBs in the range of 50-500ppm. For these transformers the replacement of the oils would probably solve the PCB contamination. Approximately 15 tons of transformer oil are contaminated with PCB between 500-2000ppm. For these transformers either several oil replacements are needed or the transformers need to be decontaminated. Finally approximately 75 tons of transformer oil is contaminated with PCBs above 2000 ppm. These transformers may need to be replaced.

The inventory analyzed 126 sets of switchgear and 3 containers. The result of analysis is presented in Table 4. In the case of oil containers none of the three containers were found to be PCB positive. This may be due to the dilution of PCBs in the containers. In the case of oil switches 117 equipment out of the 126 (94%) were found to be PCB negative (<50ppm).

Table A3. Analytical result of the switch gear and oil container samples

	PCB content of Analyzed oil switches (ppm)				
PCB contamination	<50	50-500	500-2000	>2000	Total
Number of equipment	117	7	2	0	126
Total weight (ton)	382	18	5	0	405
	PCB content of analyzed oil containers (ppm)				
PCB contamination	<50	50-500	500-2000	>2000	Total
Number of containers	3	0	0	0	3
Weight of oil (m3)	100				100

Seven switches with a total weight of 18 ton (4%) were found to contain 50-500ppm PCBs while 1%, 5 tons of the switches have been contaminated with PCBs in the range of 500-2000ppm. In the case of switches and containers extrapolation of the whole country has not been undertaken as the oil weight and carcass weight of the equipment could not always be recorded.

The scope of the inventory did not include capacitors because these are closed equipment mainly within the industrial sector.

In 2013-2015, “Enabling activities to review and update the National Implementation plan for the Stockholm Convention on Persistent Organic Pollutants (POPs)” UNIDO Project was carried out. In this project the national Implementation Plan (NIP) was revised and up-dated with new POPs, and the Action Plan for 2015-2020 was elaborated. Currently the Action Plan is under negotiation with the concerned parties and after endorsement by the Republic of Armenia Government it will be submitted to the Secretariat of the Stockholm Convention.

The following priority actions for environmentally sound disposal of PCB-containing liquids and equipment were identified.

- Development of the legislative bases for inventory, analysis, collection and storage of PCB-containing oils and equipment.
- Development of documents on obligatory self-accounting and registration of PCB-containing oils and equipment;
- Development of programme on treatment or disposal of PCB-containing oils and equipment, proceeding from conditions of contamination and the technical state of the specified equipment;
- Development of Guidelines for treatment and cleaning of the equipment with the unused resource and still applicable for operation or equipment containing PCBs low concentration. Overall aim: to re-fill equipment with PCB-containing.
- Elaboration of plan for stage-by-stage phasing-out of identified types of PCB-containing equipment, especially for those not subject to be further cleaned, re-filled, used.
- Selection of strategy, method and technology for treatment and/or destruction of PCB-containing equipment and oils.

In Armenia chemicals and waste management are regulated by: The Republic of Armenia Law “On Waste” and about 20-30 by-laws. Only some by-laws are relevant to POPs – PCB-containing wastes. After taking the in the energy sector the following problems were identified:

- Lack of resources (including lack of trained technical personnel) for the timely carrying out a detailed inventory;
- Unwillingness of the companies’ staff to cooperate.
- Not correctly or incompletely filled Inventory Forms presented the following difficulties;
- The Inventory Forms were lacking.
- Lack of Identification Labels on the equipment as a result of improper attachment or none-attachment at all.
- On some sample containers the identification numbers were erased;
- Screened samples were not GC analyzed (confirmed).
- Absence/lack of knowledge on environmentally sound handling (sampling, filling in Inventory Forms, labeling, etc.) of PCB-containing oils and equipment among stakeholders (technical staff).
- Insufficient number of trainings, training programs for technical staff and management personnel at the energy sector enterprises and the Inspection.
- Inappropriate choice of packaging, sampling markers, material for labels, as well as improper transportation conditions.
- The absence or lack of awareness in key management personnel of the energy sector in the area of PCBs.
- The absence of a binding legal framework to carry out inventory, identification of equipment potentially containing PCBs and oils.
- The absence of a binding legal framework to carry out reporting on amounts, location of PCB-containing oils and equipment; lacking requirements for appropriate storage conditions.

- The absence/ lack of technical guidelines for PCBs environmentally sound management (ESM) in energy sector.
- Lacking laboratory capacity/ resources for PCB identification.
- The lack of sanctions for non-compliance with PCB ESM.

The problems listed above created the following difficulties during inventory and identification:

- Impossibility of identifying samples and, as a result, inability to analyze samples which lead to a decrease in the total number of the tested equipment;
- Incomplete or not correctly filled Inventory Forms do not provide enough information or give false information about the equipment, which creates difficulties at the attempt to extrapolate data on PCB for the entire energy production/ distribution sector and at further choice of technical solutions for the treatment and/or disposal;
- Lack of identification labels /sheets on the equipment or oil containers does not allow complete identification (attaching a label with information about the PCBs content), which will lead to repeated inventory, sampling, analysis and labeling that will result in waste of financial, technical resources and time.
- Unwillingness to cooperate or grudging cooperation usually leads to a waste of time and other resources, as well as to impossibility of planning the project work flow and creates other problems (decrease in efficiency of Project implementation).
- Lack of awareness in the technical staff regarding PCBs can lead to secondary contamination of both oils and equipment and the environment by PCBs, which in turn becomes a source of risk towards the human health;
- Lack of awareness of in key management personnel of the energy sector enterprises on PCBs related issues leads, on the one hand, to the unwillingness to cooperate, on the other hand, – increases the risk of secondary pollution (thus increasing the amount of PCB contaminated equipment and oils).
- Imperfect legal framework, lack of knowledge on the issues related to PCB in state inspectors results in non-compliance with conditions of PCBs ESM in the energy sector of Armenia;

This project addresses these issues and brings the inventory and identification of PCBs-containing oils and equipment to a level that will allow for reliable extrapolation of data for the entire energy sector of Armenia. This is a prerequisite for the selection and further acquisition of technological solutions for cleaning and or destruction of PCB-containing oils and equipment and PCB-waste in the energy sector of Armenia.

E2. Belarus

The Republic of Belarus has not produced ODS, although like the majority of industrially developed countries it was an ODS consumer and still continues consuming HCFCs. As a result, the country's main efforts have and continue to be aimed at reducing and eliminating the use of such substances and replacing them with non-ODS alternatives. The main historical uses of ODS have been in the manufacture of refrigeration equipment, as a blowing agent in production of heat-insulating materials, as a solvent in metal parts and electronics cleaning during manufacturing processes, and in repair and maintenance of refrigeration and air conditioning equipment. Belarus carried out the ODS consumption reductions between 1996 and 2004. The CFC consumption reduction phase was completed between 1996 and 2004 and the total CFCs phase out in Belarus took place in 2004.

Belarus has never been a producer of POPs chemicals and had discontinued the import or use of POPs pesticides and PCBs in any new applications by the 1980s along with other countries in the FSU. However, POPs pesticides had been used historically. DDT was the principle POPs pesticide in common use at one time although Aldrin, Heptachlor, Hexachlorobenzene (HCB) and Hexachlorocyclohexan (HCH) or Lindane were also used to a limited extent. PCBs have and continue to be used in certain types of older electrical equipment remaining in service. This

has resulted in stockpiles of PCB and POPs pesticides, operation of equipment containing PCBs, and the presence of POPs contaminated sites. There is also unintentional release of other POPs from obsolete technological processes and various human activities, in particular dioxins and furans. As consequence of both local release and trans-boundary transfers from surrounding neighboring countries, there has also been accumulation of POPs chemicals in the broader environment and to some degree in biological receptors including humans.

Estimate of ODS bank in Belarus

The ODS banks are formed on the basis of the end-of life refrigeration equipment. Until 2004, CFC-12 based refrigerators were produced in Belarus. In 2009 Belarus adopted a state programme for 2009-2015 for collection and re-processing of e-waste, which confirmed an estimate of the annual volume of end-of-life refrigerators potentially ready for collection of 150,000 pieces. The annual refrigerators supply in Belarus was approx. 180,000 pieces per annum as per Table below. Taking into account the summary of CFC11 and CFC12 0.318 kg per unit the CFC bank quantities per annum are:

The table presents annual accumulation of CFC refrigerators in Belarus (Table B1).

Year	1999	2000	2001	2002	2003	2004
Units (million)	66.7	57.2	57.2	57.2	47.7	57.2
CFC (tonnes)	0.21	0.18	0.18	0.18	0.15	0.18

A refrigerator in Europe containing on average 125g of CFC-12 in its cooling circuit and about 312 g of CFC R11 in the insulation materials has a GWP equivalent to around 2.8 metric tons of CO₂. The RAL Quality Assurance Association for the De-manufacture of Refrigeration Equipment, RAL GZ-728 quality assurance and test specifications, which were last updated in September 2007, set out detailed specifications governing the quality requirements for all stages of the fridge de-manufacturing process. For stage I of the fridge de-manufacturing process (recovery of CFCs from the appliance cooling circuit), the RAL specifications stipulate that a minimum average of 115 g of CFC must be recovered per appliance. In stage II, a minimum average quantity of 283 g must be recovered per appliance from the insulation material. Expected minimum quantity of CFC recovered, if state-of-the-art processing assumed to be 90%, i.e. 115 g CFC-12 and 283 g CFC-11.

According to the Report entitled “Deficiencies in treatment of CFC-containing waste refrigeration equipment in Germany, 2007”, deduction of the 20% of appliances in the EU received for treatment that do not contain CFCs can be taken into consideration by making a total estimate of CFCs per unit. Therefore, we can assume 92 g CFC-12 and 226 g CFC-11 per unit.

The HCFC-22 volume where present would be similar to CFC-12, therefore for any commercial refrigerator load of comparable volume expansion, the HCFC-22 / CFC-1212 ratio of molecular weights would be a good estimate. The quantity of HCFC-22 in a split air-conditioner is assumed to be 900 g.

These minimum recovery levels can be considered for estimate of ODS banks in the target countries of the given project. All CFCs and if possible HCFCs recovered during the recycling operation must then be subjected to environmentally safe destruction.

The normative life span perspective (LSP) of refrigerators and freezers is estimated as 10 years. According to UNU (2003), Belgium the LSP is assumed as 14 years and 17.4 years for freezers. The LSP of air conditioners is 12.8 years. For the purpose of ODS bank estimate, the LSP of 15 years has been used.

Taking the last year of CFC refrigerator production/import as 2004, the quantity of refrigerators and air-conditioners manufactured in the 15 years up to 2004 (1990-2004) would give rise to 858.6 tons of ODS in refrigerators and 450 tons air-conditioners. (there is no statistics available on CFC-based air-conditioners imported into the country; therefore the mean quantity of 30,000 pieces per year is assumed, with a CFC charge of 900 g).

Using the approximate ratio of CFC-12 and CFC-11 in one refrigerator of 39.68% /60.32 % it is possible to make an estimate of the installed CFC banks in Belarus in of 10.93M CO₂eq tons. The HCFC- based refrigeration appliances have not yet reached end of life of 15 years and their quantities can be only considered later for estimation of the future HCFC bank.

Table B2: quantity of HCFC refrigeration equipment (future HCFC bank)*

Year	2010	2011	2012	2013
Production in Belarus	1,105,822	1,196,556	1,262,899	1,283,607
Export	844,620	808,994	835380	756,423
Net addition to bank	261202	387,562	427,519	527,184

* Source: Report of the Byelorussian Scientific Research Center “Ecology” Minsk, 2013 only data for four years is available

Table B3: quantity of HCFC A/C equipment (future HCFC bank)*

Year	2010	2011	2012	2013
Production in Belarus	0	1,225	7,061	1,187
Import	36,496	55,915	36,758	51,936
Net addition to bank	36,496	57,140	43,819	53,123

* Source: Report of the Byelorussian Scientific Research Center “Ecology” Minsk, 2013 Only data for four years is available

Table B4: potential banks of installed CFCs (tons and CO₂eq) in Belarus

Refrigeration appliances	CFC Equipment millions 15 years	CFC tons 1991-2004	CO ₂ eq million tons
Domestic refrigerators (CFC-12 and CFC-11)	2.7	858.6	6.11
Stationary air conditioners (CFC-12)	0.45	450.0	4.82
Total (estimate)	3.15	1,308.6	10.93

POPs situation in Belarus

The 2011-2015 National Implementation Plan (NIP) of the Republic of Belarus under the Stockholm Convention on POPs was approved by Edict of the President of the Republic of Belarus No. 271 on June 27, 2011 (amended by Edict of the President of the Republic of Belarus No. 153 of March 30, 2012). http://www.popsbelarus.by/en/pops_rb_en/national_implementation_plan.html

This is the second NIP since Belarus acceded to the Stockholm Convention on POPs in 2003 and since the approval in 2007 of the Belarus National Implementation Plan under the SC on POPs for 2007–2010 and for the period until 2028.

The NIP inventory identified the obsolete pesticides stockpiles of 7,281.5 tons. 2,006 tons of the repacked POPs from the Slonim landfill were destroyed at Sawa GmbH, Germany in 2012. As a result of the elimination of POP pesticides extracted from the Slonim landfill within the frame of the WB project “Integrated Solid Waste Management Project”, the quantity of obsolete pesticides in the country was reduced by 25% and it went down from 7,281.5 to 5,660 tons, 2,757 tons of which are mixtures and liquids potentially containing POPs pesticides. These stockpiles are located throughout the country in approximately 146 storehouses of variable quality and security (2,876 tons), seven obsolete pesticides landfills (2,482 tons) and one hazardous waste storage facility (302 tons). There were about 2,400 tons repackaged according to EU standards for secure consolidated storage pending destruction. Nevertheless, there were separate cases when repackaged pesticides spontaneously ignited causing destruction of containers and releases of chemicals to the environment.

Buried pesticides remain a specific concern, particularly at sites having transboundary impacts and/or those containing DDT. The country has seven obsolete pesticides landfills: three of them are located in the Vitebsk region (the Verkhnedvinsk, the Postavy and the Gorodok landfills), one is located in the Brest region (in the village of Gershony), one in the Gomel region (the Petrikov landfill), one in the Grodno region (the Slonim landfill) and one in the Mogilev region (the Dribin landfill). Communal Unitary Enterprise “Facility for processing and burial of hazardous industrial wastes of the Gomel region” located in the Chechersk district of the Gomel region is also classified as an obsolete pesticides landfill. The condition of the obsolete pesticides landfills is still not favorable as according to the results of local environmental monitoring; there were some cases of pesticides migration into the environment. The monitoring results at the Verkhnedvinsk site indicated a negative impact upon the Zapadnaya Dvina river basin due to pesticides migration to the environment.

PCB and PCBs-containing equipment in Belarus

Belarus has undertaken obligations to stop the use of PCB by 2025 and to dispose of PCB-containing waste by 2028. The international technical assistance plays an important role in achieving this goal. The Ministry for Ecology has developed a long term Program on the PCB management in Belarus. The strategy for the PCB management was determined by the NIP for the period of 2011-2015, and approved by Decree of the President of the Republic of Belarus #271, issued on June 27, 2011. A set of measures for handling equipment, materials and waste containing PCBs was determined by the NIP, which included measures on inventory and labeling, discontinuation of use and environmentally safe storage and elimination of PCB-containing equipment. The main elements of the long-term program of PCB management in Belarus are:

- Decommissioning of all the PCB-containing equipment available in Belarus by 2025,
- Environmentally-safe disposal all PCB-containing transformers in the country by 2025 and
- Disposal of all PCB-containing capacitors by 2028.

The national program deals with disposal of 307 transformers and over 54,000 capacitors that contain PCB. The total amount of liquid PCBs in the Republic of Belarus was around 1,561.6 tons available in electrical equipment. The largest quantity of PCBs is concentrated at enterprises which belong to the Ministry of Industry (MI) and to “Belneftekhim” Concern. They account for 38% and 26% of all the PCBs in the country respectively. An environmentally-safe transportation and elimination of 823,1 tons of PCB-containing waste products in France, (in compliance with the SC and BC within the frame of the GEF/WB project “Integrated Solid Waste Management Project”) was carried out in 2012 bringing the remaining balance of PCB in the country to 1,314 MT. *(The data was corrected because, according to the existing international experience, the volume of PCB-liquids inside the PCB-containing equipment comprises around 30% of the total weight of the PCB-containing equipment.)* It is recommendable to build a long-term capacity for PCB destruction in the country by installing a destruction facility at the Gomel Oblast Toxic Industrial Waste Treatment and Burial Complex, where has been planned to establish a facility for storing the decommissioned PCB equipment and waste.

E.3 Ukraine

Among the CEITs in the region, the Ukraine was considered among the largest consumers of ODS. In 1991, annual consumption of Annex A and B ODS in Ukraine was estimated to be 7,061 MT but by 1994, actual consumption dropped to 3,310 MT and was reported to be 1,470 MT ODP in 1996 and 1,780 MT ODP in 1997. This consumption occurred in the refrigeration, aerosol, solvent sectors and fire protection sectors.

Ukraine did not produce ODS; it was a CFC consumer and still continues consuming HCFCs after conversion to HCFCs in Dec. 2004. HCFC-21, HCFC-22, HCFC-141b and HCFC-142b are used in residential, commercial and industrial refrigeration and air conditioning equipment. The most common ODS is HCFC-22:

Table U5. HCFC consumption in the refrigerator producing Sector in Ukraine in 2010-2014

YEAR	HCFC-22, MT
2010	583.2
2011	997.4
2012	997.5
2013	585.0
2014	320.6

Estimate of ODS bank in Ukraine

The annual quantities of CFC-based refrigerators and ACs used in households (local production + import) in Ukraine before the year to the HCFC conversion, Dec. 2004 and of HCFC –based refrigerators are given in the following Tables:

Table U6: CFC Bank estimates

Year	Number of CFC refrigerators used in households (local production + import) prior to HCFC conversion	Number of CFC air-conditioners used in households (local production + import) prior to HCFC conversion
1991	15,272	201,685
1992	20,672	262,701
1993	22,369	537,361
1994	148,120	643,644
1995	151,321	990,262
1996	152,241	1,151,084
1997	252,600	1,818,926
1998	351,280	1,734,056
1999	418,220	953,186
2000	422,112	1,559,799
2001	398,200	1,494,266
2002	508,323	1,559,986
2003	622,321	1,362,712
2004	311,656	1,299,564

Year	Number of HCFC refrigerators consumed used in households (local production + import) after conversion	Number of HCFC air-conditioners consumed used in households (local production + import) after conversion
2005	590,262	151,321
2006	769,483	152,241
2007	520,253	252,600
2008	356,810	245,896
2009	568,965	125,466
2010	667,723	122,118
2011	747,930	119,467
2012	567,983	120,467
2013	443,378	134,453
2014	213,675	58,398

The same approach in calculating the volume of the CFC bank as in Belarus is applied hereto.

The U7: Potential ODS banks estimate of installed CFCs and HCFC (tons and CO₂eq) in Ukraine.

ODS refrigeration appliances - 15 years	Quantity million units	ODS tons (000s) 1991-2004	CO ₂ eq, million tons
Domestic refrigerators (CFC-12 & CFC-11)	14.9	4.37	18.59
Stationary air conditioners (CFC-12)	3.79	3.79	44.82
Total (estimate)	18.69	8.16	63.41

POPs situation in Ukraine

The Ukraine has a significant POPs inventory associated with well-developed agriculture, power generation/distribution and metallurgy sectors. However, the highest priority tasks are associated with management of accumulated stockpiles of banned and obsolete pesticides.

As of December 2003 Ukraine stored 20,900 tons of OPs, previously earlier delivered for agricultural applications. These pesticides are stored in 4,983 agriculture stores of different ownership throughout the country. Chemicals include around 2,000 tons of DDT (10%), 13.4 tons of heptachlor (0.07%), 1.0 ton of hexachlorobenzene (0.005%) and 1.1 tons of endrin (0.005%).

In 2009/10 around 2,000 tons of obsolete pesticides were exported from Ukraine to Germany for destruction. In 2010 a single mining site was identified which contained more than 20,000 tons of HCB. To date 8,500 tons of HCB have been excavated, repackaged and transported by ship to the United Kingdom for destruction.

Table U8.The POPs overview in Ukraine

Estimate of the POPs /OPs sector in Ukraine Metric Tons				
Quantity of POPs excluding PCB as per the last inventory	Quantity of POPs excluding PCB already disposed of	Remaining quantity of POPs, MT excluding PCB ready for disposal	Estimate of quantities of obsolete pesticides (OPs)	POP/OP contaminated soil ready for disposal,
8,442 + 11,088 HCB	7,136	5,000	31,689	8,106

PCB and PCBs-containing equipment in Ukraine

PCBs were never produced in Ukraine, but were broadly used in different industrial sectors. According to the preliminary inventory there is an estimated total amount of 4,240 MT of PCB containing equipment (transformers and capacitors) in Ukraine. This inventory was mainly based on the identification of equipment using PCBs as the dielectric fluid.

There is no certainty of the extent of contamination of the mineral oil transformers in Ukraine, it could be as low as 5 to 10% similar to countries where the proper management of PCBs has been in place since the late 1980's. However it could be 20 to 25% where there are no practices to identify, segregate and properly manage PCB contaminated equipment. In order to estimate the extent of contamination of transformers, the PCB on-going project of UNIDO will carry out sampling and testing of 10,000 units. Through the introduction of screening tests, 10,000 transformers will be tested for PCBs and those giving borderline results (range of 35 to 70 ppm). The result of this massive sampling and testing program will be used to identify mineral oil transformers with PCB level above the 50 ppm level and will require special maintenance programs and decontamination. This result will be used by the given regional project.

According to the preliminary inventory, a total amount of 4,994 tons of PCBs from 1,212 transformers of 27 different models and from 111,205 capacitors of 157 different models have been identified. Additionally 362 tons of PCB liquids have been recorded as stored in different owners. However, the total amount of PCB reported in the NIP could be much higher as indicated in the table U9.

Table U9 PCB quantities in Ukraine

Quantity of PCB as per the last inventory, MT	Quantity of PCB already disposed, MT	Quantity of PCB ready for disposal, MT	Quantity of PCB contaminating oil ready for dechlorination	Estimate of quantities of PCB-contaminated soil, hectare
4,994 transformers – 2,519 tons capacitors - 2,112 tons synthetic fluid cont. PCB – 362 tons	0	4,994 (no destruction technology available)	Not known (LSP till 2020)	~ 860 hectares
Quantity of PCB-containing transformers	Annual quantity of transformers to be recycled annually	Quantity of transformers to be decontaminated	Quantity of PCB –containing oil capacitors to be recycled	

1212	1212(LSP until 2020)	0	111,205
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Details on POPs overview in Ukraine are given in the UNEP report:
http://www.chem.unep.ch/pops/pdf/cpf/UkrainePCBProject_Report_Stage2.pdf

E.4 Kazakhstan

Kazakhstan did not produce any substances controlled by the MP. The total consumption of all ODS imported from the Russian Federation in 1998 into Kazakhstan was 1,356.12 metric tons, or 1,304.86 ODP tons, including Methyl Bromide and HCFCs. Of this amount, CFCs accounted for 1,079.87 ODP tons, or approximately 83% of the total consumption. Domestic refrigerators were either assembled in Kazakhstan, or imported from Russia, Belorussia and Latvia. The total CFC phase out in Kazakhstan took place in 2004. No production facilities for domestic refrigeration equipment exist at present in Kazakhstan.

ODS banks in Kazakhstan

Practically all enterprises and 4.8 million families in Kazakhstan run one or several refrigerators. That makes about 5 million domestic refrigerators in the country. The annual quantities of CFC refrigerators and air-conditioners before the year of CFC phase out are given in the tables K10.

The annual quantities of HCFC refrigerators and air-conditioners imported into Kazakhstan after the year of CFC phase out are shown in the tables K11. These quantities can be considered for estimation of HCFC bank in the country in 2020.

Table K11 CFC Bank Estimates

Year	Number of CFC refrigerators used in households (local production + import) prior to HCFC conversion	Number of CFC air-conditioners used in households (local production + import) prior to HCFC conversion
1991	276,345	188,352
1992	269,367	167,549
1993	315,398	219,348
1994	423,987	156,982
1995	363,286	198,567
1996	301,356	230,763
1997	249,569	176,430
1998	357,254	134,671
1999	286,590	178,432
2000	356,871	201,651
2001	299,732	164,358
2002	337,485	176,439
2003	328,854	211,529
2004	367,432	189,034

Year	Number of HCFC refrigerators consumed used in households (local production + import) after conversion	Number of HCFC air-conditioners consumed used in households (local production + import) after conversion
2005	192,754	141,955
2006	604,169	246,593
2007	667,600	246,819
2008	367,686	169,618
2009	363,586	126,520
2010	315,187	199,702
2011	141,900	296,049
2012	172,751	371,525
2013	200,346	388,730
2014	125,667	176,225

The same approach as applied above for CFC banks estimate is used for Kazakhstan. The last year of CFC refrigerator supply was 2004 according to the CFC-phase-out programme in Kazakhstan.

Table K12 potential ODS banks estimate of installed CFCs and HCFC MT and CO₂eq) in Kazakhstan.

ODS refrigeration appliances - 15 years	Quantity million units	ODS tons (000s) 1991-2004	CO ₂ eq, million tons
Domestic refrigerators (CFC-12 & CFC-11)	4.53	1.44	10.26
Stationary air conditioners (CFC-12)	2.59	2.59	27.76
Total (estimate)	7.12	1.01	38.02

POPs situation in Kazakhstan

In June 2007 Kazakhstan ratified the SC. The NIP was based on the results of the 2003 inventory. It highlighted the need for information, policies, legislation, and coordination among stakeholders, funding, and necessary investments to manage the problems in accordance with the SC. It covered an implementation program of roughly 20 years with a focus on four different areas: (i) obsolete and unwanted pesticides; (ii) PCB-containing operation equipment; (iii) PCB-containing waste (dioxin and furan releases); and (iv) other sources of POPs, such as POPs-polluted territories. There is no full picture on POPs quantities in the country. It was estimated that about 1,544 MT of POPs available in Kazakhstan included 15 MT of toxaphene in the North-Kazakhstan region and 0.5 MT of buried DDT and the total volume of POPs/OPs - containing waste was about 250,000 MT. However, the conducted inventory did not reflect the real situation in the country with obsolete pesticides volume, especially with the mixed quantities of unknown pesticides.

Table K13.PCB and PCBs-containing equipment in Kazakhstan

Quantities of POPs in MT excluding PCB	Quantities of POPs in MT already disposed	Quantities of POPs in MT excluding PCB ready for disposal	Estimate of quantities of obsolete pesticides (OPs) in MT	Estimate of POP/OP contaminated soil in MT
1544	In 2002 190 MT of obsolete pesticides and 0.5 MT of DDT were buried	1544	~250,000	No data available

Kazakhstan is the second among the CEIT countries with 980 MT PCB-containing oils and 255,000 MT PCBs contaminated soils (the Russian Federation ranks first). In late 2007, the MEP endorsed a UNDP submission for GEF funding of a program to enhance technical capacity for the management, safeguarding and disposal of PCBs. The GEF approved this program (FSP) for Work Program entry in December 2007.

Since then 80 tons of electrical transformers and 169 tons of electrical capacitors were incinerated in France and 10,052 electrical capacitors were disposed of in Germany in 2007. About 56,000 condensers are still in different areas, 15,000 of which were buried in the Semipalatinsk nuclear facility. More than 23,000 capacitors and 78 capacitor installations contain trichlorodiphenyl. There are six “hotspots” contaminated with PCB waste in Kazakhstan.

A reasonable estimate of the percentage of POPs in these pesticides is difficult to determine given that large volumes of pesticides are not properly labeled and only limited sampling has been carried out. The NIP provides a rough estimation of 15% POPs in pesticides based on the preliminary inventories referred to above. International representative sample analysis indicates that the average amount of POPs pesticides out of the total stock of obsolete pesticides is around 20 to 30%. An estimated 10,000 tons of obsolete pesticides are stored in warehouses all over the country. Many of these pesticides are stored in unsuitable, dilapidated structures with leaking roofs, which are several decades old, and other unsound storage conditions.

The table K14 presents the quantity of PCB and PCBs-containing equipment.

Quantity of PCB in tons as per the last inventory	Quantity of PCB in tons already disposed of and method of disposal	Remaining quantity of PCB in MT ready for disposal
116 electrical transformers 56,000 capacitors PCB - 980 MT PCB-containing waste ~250,000 MT	80 tons of electrical transformers 169 tons of electrical capacitors were incinerated 10,052 electrical capacitors were disposed of	~ 220 tons capacitors. No data on PCB quantity

Table K15: overview of the capacitors, transformers and pesticides present in the country and the status of safeguarding support provided by different actors.

POPs	Originally present	Exported by GoK in 2007-	Exported for disposal	for of	UNDP/GEF project	WB/GEF/Kazakhstan
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		2008	abroad		project
Capacitors, pc	56,000	5,000	10,052	2,000-3,000	40,000
Transformers, pc	116			116	
Pesticides, MT	~10,000				~10,000

The GEF grants played a catalytic role in the government's implementation of project activities to address POPs risks. For example, the UNDP-GEF project was focused on management, safeguarding and disposal of 116 transformers and 2,000 to 3,000 capacitors in Kazakhstan. There is no PCB transformer oil decontamination practice used in the country yet. A destruction unit is planned to be installed in the country for final disposal for the majority of stockpiles of PCB-waste, PCB-equipment and POP-containing pesticides.

ANNEX F: GEF BUDGET

Armenia GEF Budget	Unit	Cost	Total
National Experts	60	1400	84,000
International Experts	6	2000	72,000
Sampling, screening, analyses/consumables for analysis			144,500
Travel			50,000
Workshops/Trainings			20,000
Management			19,500
Total			390,000
Belarus GEF Budget	Unit	Cost	Total
National Experts	72	1,650	118,800
International Experts	10	12,000	120,000
Destruction equipment			3,000,000
Recycling equipment modifications/networking			1,055,000
Communications			47,200
Management			228,500
Total			4,570,000
Ukraine GEF Budget	Unit	Cost	Total
National Experts	70	1,485	104,000
International Experts	10	12,000	120,000
Destruction equipment			3,000,000
Recycling equipment			2,970,000
Management			326,000
Total			6,520,000
Kazakhstan GEF Budget	Unit	Cost	Total
National Experts	70	1,485	104,000
International Experts	10	12,000	120,000
Destruction equipment			3,000,000
Recycling equipment			2,970,000
Management			326,000
Total			6,520,000

ANNEX G: DESTRUCTION TECHNOLOGY

Stockholm Convention lists 21 particularly harmful and persistent chemicals (POPs) and gives timelines and other conditions for their disposal. Some chlorinated pesticides and polychlorinated biphenyls (PCB) are examples of the POPs.

Recommended POPs destruction efficiency– not less than 99,9999 %.

The Montreal Protocol determines conditions of ODS disposal and recommends ODS destruction efficiency– not less than 99.99%.

It means the technology should meet the following requirements:

- *Processing of POPs shall provide destruction of 99.9999% of the hazard compounds.*
- *Processing of ODS shall provide destruction of 99,99 %*
- *Production capacity of installation shall be not less than 400-500 kg/h.*
- *Operation of processing installations shouldn't not affect the environment or human being. It means that environment has to be protected as far as available technologies are able to afford it. The emission of flue gases of waste processing should not exceed the limits established by international and local directives.*
- *The safety of working conditions of personal involved in operating process and in contact with materials and waste to be treated should be provided.*
- *Safety of processing and disposal of waste should be provided constantly, regardless of time of day in which waste is delivered to the place of processing.*

Requirements for thermal methods of POP/ODS destruction

The high-temperature oxidation up to the moment have proved to be the most widely used, technically efficient and commercially acceptable method of destruction of hazardous wastes including PCB and chlorine-containing pesticides.

The world practice of hazard waste disposal proves that efficient destruction of 99,9999% of POPs and 99,99% in case of ODS could be ensured in case the following requirements being met:

- *processing temperature above 1200 °C;*
- *processing time in a gas phase not less than 2 seconds;*
- *ensuring turbulence and excess of oxygen not less than 5% ;*
- *obligatory use of an afterburner with an adjustable temperature;*
- *cleaning treatment of flue gases is obligatory;*
- *scrubber for neutralization of vapours of chloride of hydrogen and filters for cleaning of mineral dust are required.*

In certain conditions of high-temperature oxidation the dioxine the can be formed in the furnace. The concentration of dioxine in burning gases shouldn't exceed the accepted safe level of 0,1 ng/m³.

Description of methods of POP/ODS disposal

The thermal destruction technologies which are offered for POPs treatment and prove to ensure efficient destruction closed to the level recommended for POPs are based on the following methods:

- Pyrolysis
- Technology of chemical neutralization
- Gasification
- High-temperature oxidation in the cyclonic reactor
- High-temperature oxidation with use of the rocket engine
- Plasma chemical destruction
- Plasma arc destruction
- Cement kilns

High-temperature pyrolysis

The world practice of destruction of toxic organochlorine waste offer technology of multistage thermal oxidation with pyrolysis or incomplete oxidation of organochlorine compounds at the first stage. Among them the high-temperature pyrolysis is the most widely used up to now.

At the first stage of pyrolysis the thermal decomposition of organochlorine compounds is carried out, ensuring that in destruction products the maximum quantity of chlorine is present at a type of HCl. The catalysts are used in the process providing significantly increases of selectivity of pyrolysis and ensuring that decomposition of POPs takes place at much lowest temperatures enabling effective disposal of waste with low contents of POP. A negative factor of catalysts is their quite fast deactivation because of pyrolyzed carbon formation.

The second stage is a removal of chlorine-containing products from a gas phase. As a volume of gas emissions at pyrolysis is a 10 times less than combustion gases in the exit from an afterburner, the dimensions and weight of the equipment as well a quantity of the neutralized agent could be significantly reduced. As oxidizers usually use air, oxygen, water vapor (at indirect heating of wastes), products of combustion of auxiliary fuels (at direct heating).

The negative points of this method are high investments and complexity of multistage oxidation process due the fact that the process of destruction is divided into two stages.

Advantages:

- reduction of weight and volume
- possibility of destruction of big values of waste
- full sterilization of waste
- possibility of regeneration of energy in big incineration installations
- possibility of considerable automation of process of neutralization

Shortcomings:

- high cost of equipment and considerable operation cost of processing
- qualified personnel required
- consumption of electricity, fuel and chemicals for purification of furnace gas
- purification system of furnace gas is required.

Technology of pyrotechnic neutralization

In chemical neutralization process a burning-out of POPs waste is affected by explosion of the pyrotechnic material based on magnesium-aluminum powder. Technology is used for destruction of the crushed condensers, liquid PCB and PCB containing waste.

The process of destruction consists of the following stages:

- hydromechanical crushing of the polluted elements of condensers using a water stream crush system of ultrahigh pressure;
- preliminary neutralization of PCB containing in the crushed components using compound supplied by technology provider as technological "know-how";
- adding of neutralizing agents which provide formation of ecologically harmless products of combustion in explosion process.

The PCB quantity to be mixed with neutralizing agents shouldn't exceed 13% of the compound mass, i.e. for destruction of one ton of PCB requires 8 tons of the decontaminating substance and one tone of ethyl alcohol.

Destruction of PCB contained in particles of the crushed condensers occurs in explosion under pressure of 5700 MPa. High pressure and temperature created by explosion (thousands of Celsius degrees) ensure distraction

efficiency of 99.99%. According to declaration of technology providers no organochlorine compounds are present in the explosion products which mainly consist of NaCl, H₂O, N₂ and Al₂O₃.

The basic equipment includes:

- ultrahigh pressure system for crushing of the polluted elements;
- special chemical reactor;
- special pumps for aggressive, high-viscosity and explosive materials;
- gravitational mixer;
- dispensers of bulk, liquid and high-viscosity substances;
- hydroclone;
- independent electricity supply unit;
- bunker of the main oxidizer, capacity for liquid components;
- control units;
- technological transport;
- conveyor;
- installation for explosion mix preparing .

Production of mobile installation is from 200 up to 500 tons of PCB per year.

No information about the destruction efficiency and dioxine content tests carried out by specialized laboratories is available yet. Most probably the lack of information confirmed by independent laboratories occurs due to difficulties to get samples of gas emissions and substances of explosion.

The pyrotechnic technology wasn't widely adopted for destruction of PCB as it doesn't contain accurate recommendations for liquid waste treatment and there are no confirmed information of destruction efficiency and dioxine content in emissions.

Gasification

Process of gasification is similar to pyrolysis process, except the fact that small amounts of air or oxygen are added into the preprocessing camera. Additional air doesn't provide full oxidation, but it is enough to release more energy from waste in primary camera. Thus, temperature in primary camera increases to higher level (900–1100 °C) therefore waste is burned out to ashes.

Gasification process could synthesize gas from organic particles of waste. The demanded components are a monoxide of carbon and hydrogen (CO and H₂). Their formation from carbon in the loaded material is made in an endothermic way therefore it is necessary "to burn" part of carbon for receiving carbon dioxide (CO₂). However gasification of waste treatment with capacity of 500 kg/h doesn't produce enough gas capable to justify economically its further use.

Gasification generates mix of gases including toxic Cl, HCl, COCl₂, etc. which are quite difficult to separate from the mass of neutral products. The multicomponent gas mix in significant amounts has to be treated by multistage processing for allocation and neutralization of toxic components which reduce economic efficiency of POPs destruction.

High-temperature oxidation in rotary furnace

For burning out of waste with production capacity of 500 - 1000 kg/h and more, especially in cases of processing of toxic substances requiring high efficiency of destruction and appropriate purification of combustion gases, the two-stages high-temperature oxidation in rotary furnace could be considered.

Modern installations of such type are usually equipped with PLC monitoring systems which provide due quality of process of burning. The process is monitored from the moment of loading of materials in the burning camera up to purification of combustion gases.

The operating mode of the first camera of burning within high-temperature oxidation process can variate from full burning, when excess of air or oxygen is provided to the process when the content of oxygen intentionally decreases for pyrolysis or gasification of waste.

Combustion gases from the first camera are moving to the second camera where controlled temperature has to reach a desirable point of 850 or 1100 °C. This camera is equipped with a torch which guarantees required conditions of burning. The minimum time of processing in this camera according to requirements should be not less than 2 seconds. Mostly processing time considerably exceeds 2 seconds as loading in the first cameras is made not absolutely continuously.

In burning installations where the full burning in the first camera is carrying out, the second camera serves as safety volume for reaction in a gas phase to achieve desirable conditions of reaction of all components of combustion gases.

In case of production of combustion gases from the first camera working with smaller amount of oxygen than it is required for full burning, the secondary camera serves as a real camera of burning after air being added in the gas leaving the first camera. The gas from the first camera due to pyrolysis process occurred on the first stage has its own residual heat capacity which is used to achieve desirable temperature of some 1100 °C. Reaction of oxygen with the gas leaving the first camera facilitates appropriate mixture of gases in the secondary camera and guarantees increase of the temperature reducing at the same time the amount of the additional fuel used to achieve of require conditions in the secondary camera.

The design of the secondary camera should consider possible variations of the entering loading. It also concerns operation conditions of boiler, combustion gases purification and ventilation system. The more the productivity of installation, the less deviation of the entering loading will be. It means that, in general, the installations of bigger production capacity could provide more stable and continuous process of waste burning out and neutralization of toxic substances.

The installations of production capacity of 500 kg/h and more should be equipped with automatic extraction of remaining ashes. The moving grates are generally used to move of material within the camera of burning. Automatic systems of withdrawal of firm particles could differ from each other depending on the supplier. Both dry and damp systems are available. The damp system is recommended for big production installations with considerable ashes volume as it will work continuously without need to interrupt process for a devastation or replacement of a basket for ashes collection.

The gases leaving the secondary camera of burning have temperature of 1100 °C. The energy of combustion gases could be used in boiler for hot water and steam supply to local heating system. As combustion gases have to be cooled up to the temperature below 200 °C in summertime if it is impossible to use hot water, the additional cooling installations should be provided.

In purification process of combustion gases acid gases like dioxide of sulfur and hydrochloric acid are generally used. Normally it is carried out at dry process. The mix of solid additives (lime or bicarbonate of sodium) is added to combustion gases after cooling of in a cupper. Firm particles mix up with a gas stream for reaction with pollutants.

The additives and firm remains (dust, ashes) are separated in filters. The layer of additives which is formed in the filter, serves as an additional contact zone for combustion gases allowing to collect more pollutants.

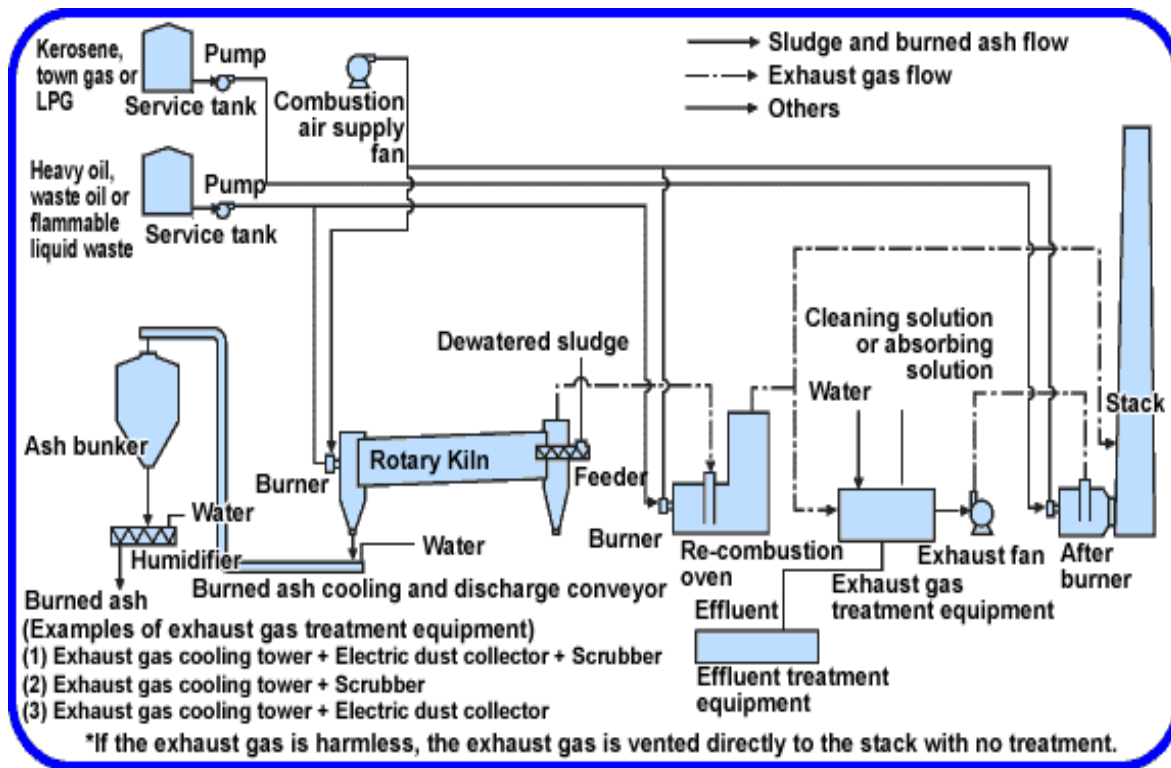
For large-scale processing of dangerous wastes the rotary furnace of High-temperature oxidation are widely used. The furnace of this type consists of the furnace and an afterburner and generally is used for burning of chemical waste.

The axis of the furnace is inclined at a small angle on a vertical (an inclination of 3-5%). The furnace rotates from 2 to 5 times a minute. Waste is loaded into its upper side. Ashes are removed from the lower part. The gases developed by the furnace heat up to high temperatures and burning out substances in an afterburner, processing time, as a rule, is 2 seconds.

Rotary furnaces work continuously and can operate with various types of waste loading devices. The units designed for processing of toxic waste, normally have to be operated by the specialized companies, which are engaged in recycling and have installations in industrial zones.

The combustion gases leaving an afterburner pass through a cooler for cooling and production of hot water or vapor, which in case of installations with capacity from 1 t/h to 4 t/h could be used to produce electricity by the steam turbine. The units of such production combined with additional burning power from liquid organic waste could justify installation of the turbine electricity generator. After cooling in a cooler combustion gases are treated in the purification system. In big size plants different purification technologies could be applied (dry, moist and damp processes). Dry systems of purification of combustion gases are used in installations of the smaller ones.

The technological flow sheet high-temperature oxidation in rotary furnace



High-temperature oxidation in the cyclonic reactor

The technology of POPs destruction in the cyclonic reactor had been tested in production scale and meets most ecological and production requirements. It is widely promoted for application of toxic liquid organochlorine waste with a production capacity of 200-250 kg/h.

Processing installation includes:

- Receptions and account capacities of liquid waste;
- Cleaning filters;
- Plunger pumps for waste supply;
- Vertical water-cooled cyclonic reactor;
- Gas flue to burn out products of chemical decomposition of residual concentration of nitrogen oxides;
- Scrubber - the evaporator and the fabric filter, which sleeve are made of fiber.

The tests carried out during more than 10 years of cyclonic reactor operation in Russia testified no dioxin in dust. Numerous measurements of dioxin content in combustion gases indicated then levels lower than 0,1 ng/nm³. Results of the test carried out showed that combustion gases emissions and mineral dust content meet the EU requirements.

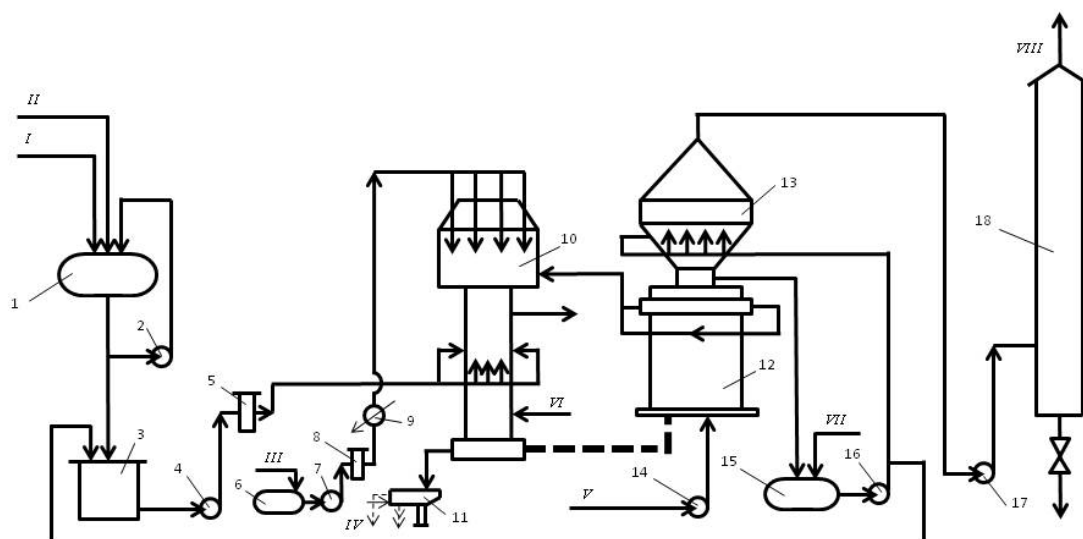
The process meets technological requirements for high-temperature POPs treatment:

- Temperature in a reaction zone - not less than 1200 °C;
- PCB processing time in a reaction zone - not less than 2 sec.;
- Ensuring turbulence of a gas stream in a reaction zone;
- 10% excess (on volume) of oxygen in relation to PCB;
- Efficiency of destruction and removal of PCB isn't lower than 99,9996%;
- Special attention to monitoring of level of CO concentration is paid. CO burning out proceed more slowly, than

burning of dioxine. The practice showed that in case the CO contents being lower than 5 mg/m³, the level of dioxine shall be lower than 0,1 ng/m³;

- Technological process provides obligatory stages as additional burning out stage with adjustable temperature,
stage of combustion gases treatment by vaporizing cooling in scrubber and filter of mineral dust.

The technological process do not provides separate unit of neutralization of chloride of hydrogen, this stage is carried out directly in the cyclonic reactor with formation of solid substances.



The technological process and flow sheet of POPs high-temperature oxidation in the cyclonic reactor

1 – neutralization unit; 2, 4, 7, 16 – pumps; 3 – homogenization tank unit; 5, 8 – filters; 6 – fuel oil collector; 9 – fuel oil heater; 10 – cyclonic reactor; 11 – crystallizer unit; 12 – air heater; 13 – dust collector; 14 – air fan; 15 – collector; 17 – exhaust fan; 18 – stack

I – alkali; II – juicy waters; III – fuel oil; IV – fusion of carbonates; V – air; VI – softened water; VII – caustic soda solution; VIII – combustion gases

High-temperature oxidation with use of the rocket engine

The technology is known as "Papusha-Rocket-Technology" (PRT) by the name of its provider Doctor of Engineering A. Papusha. The PRT process is developed on the rocket engine technology basis and was successfully tested at the trial production installations.

For this purpose the rocket engine of the standard sizes developed for orientation of space stations is used. The nozzle for mixing of fuel has length of 10 cm and the maximum diameter of 8 cm.

Control of ecological properties of installation at its commercial operation was carried out by independent laboratory certified by local authorities.

The carried-out analyses certified the following results:

- Concentration of dioxin in flue gases of installation from 3,5 to 14 ng/m³ (in the absence of the filter);
- Concentration of PCB in the used neutralizing solution - 52 mg/l. (additional filter system of water purification is required in this case).

Technological requirements:

- Temperature in a zone of reaction of 2000-3000 °C;
- PCB processing time in a reaction zone less than 0,1 sec. that is much less than the 2 seconds required;

- High speed of a gas stream in a reaction zone is provided;
- Excess of oxygen in relation to PHB makes not less than 13%;
- Efficiency of destruction of PCB is 99,9993% (according to technology providers);
- CO level of flue gases exceed value of 5 mg/m³ that can testify increased content of dioxine;
- *Technological process provides obligatory stages as additional burning out stage, stage of combustion gases treatment in scrubber and additional filter system of water purification.*

Shortcomings of the PRT method:

- *Periodical operation of installation require daily start-up and fine-tuning of technological process;*
- *Difficulty of control of reagent supply , especially oxygen;*
- *Lack of the filter in the exit of flue gases;*
- *Need of additional water treatment;*
- *High noise level;*
- *Short processing time of reagent in a reactionary zone.*

Plasma chemical destruction

Destruction process includes heating of the waste containing PCB/ODS, their pyrolysis and oxidation and is divided in two stages. The first preliminary stage is carried out outside of plasmatron at temperatures close to thermal decomposition of the destructed substances. Heating of PCB serves to decrease viscosity, disperse and evaporate the substances. PCB vapors are mixed up intensively with water vapor. Implementation of various preparatory processes at the first stage allows to reduce considerably reactor size, losses of heat and consequently to lower the operating costs of the reactor.

Mix of PCB and water vapors is heated up to 600 °C and then supplied by tangential channels to the reactor. An electric arch is used to heat plasma-forming gas (nitrogen) in plasmatron. The high-temperature vapor of nitrogen enter from plasmatron to reactor at a temperature of about 5000 °C and mixes up with composition of PCB and water vapor. Process of pyrolysis proceeds at a temperature of about 2000 °C. The processing time of reaction in a high-temperature zone is 6-7 msec.

Products of pyrolysis from the reactor enter the unit of their treatment and neutralization. They are cooled very rapidly, neutralized and directed to a separator in which are divided in liquid and solid phases.

As a water vapor is used as oxygen source the main products of reaction in flue gas are: nitrogen, CO₂, CO, H₂ and H₂O.

Solid waste in the form of paste consists mainly of NaCl, a small quantity of NaHCO₃ and water which represent same 10% of total weight of compound.

The analysis of special requirements for PCB/ODS destruction certify that conditions of plasma chemical treatment are as follows:

- Temperature in a reaction zone is about 5000 °C and is much higher than 1200 °C required;
- Processing time in a reaction zone is of 5-7 m/sec, much less than 2 seconds required;
- Design of the reactor and supplying speed of reagents provide turbulence of stream and reactionary mix;
- At plasma chemical destruction of PCB a source of oxygen is water in quantity of some 10-15%;
- Efficiency of PCB destruction is estimated at 99, 9999%;
- *Technological process provides stages of treatment and neutralization of reaction products, its division in gas, liquid and solid phases and the subsequent processing.*

The plasmatron of 200 kW power provides PCB destruction of 25-30 kg/h (135 tons/year) and is offered by supplier as a basic unit for application of Plasma chemical destruction.

The unit includes preliminary stage equipment, plasmatron, and reactionary camera and was successfully tested in trail production.

If bigger production is required, the parallel usage of several basic units is recommended. For example to ensure PCB destruction of 1000 tons/year, the installation of 8 basic units of 200 kW each with all stages technological equipment will be required. Only processing system of flue gases and paste like waste can be common for all units. Essential negative factor of this method is small productivity of the basic units (25-30 kg/h) as consequence high operation cost of the POPs treatment.

Plasma thermal destruction

Plasma destruction provides the temperature of waste treatment up to 1600 °C and considered to be quite adequate for neutralization of PCB and pesticides which have very high thermal stability and resistance to decomposition at high temperatures. The technology was successfully tested and implemented in various fixed installations of POP destruction with production capacity up to 500 kg/h and in mobile units for neutralization of environment pollution in case of emergency situation resulting flood of hazard substances.

The plasma thermal destruction installations include:

- reception warmed capacity,
- warmed reactor with a mixer,
- steam heater of the processed mix,
- pumps of supply of the warmed mix in reactor,
- the blower for air supply in reactor nozzles and on cooling of the reactor,
- plasma reactor,
- camera of neutralization of toxic products of plasma decomposition,
- the service equipment (preparation of hydroxide of sodium solution, capacity for technical water, pumps of supply of alkaline solution and water)

Processing conditions of POPs disposal provided by plasma destruction technology:

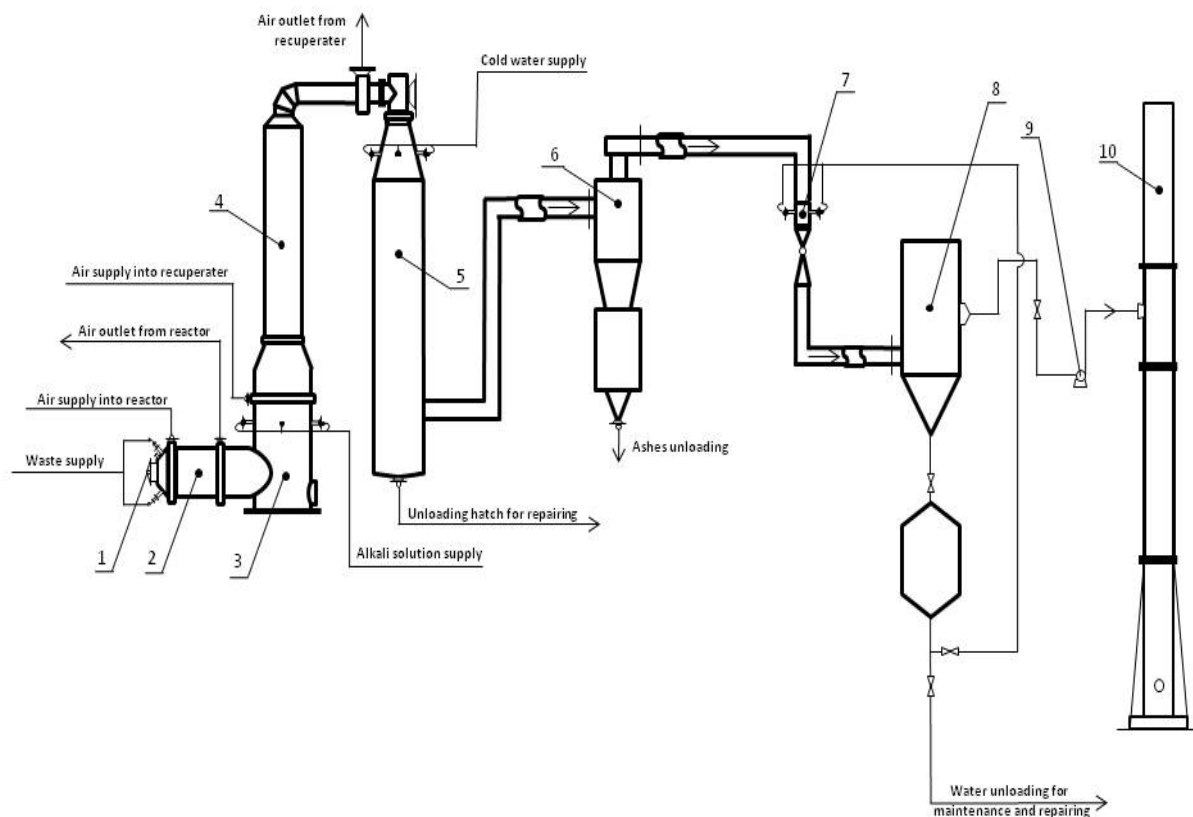
- temperature in a zone of reaction of 1100-1700 °C;
- processing time of POPs in a reaction zone less than 3-4 sec;
- high level of mixture of a fine stream of waste with a plasma torch in a reaction zone is ensured;
- excess of oxygen in relation to POP is not less than 13%;
- efficiency of destruction and removal of POP and ODS – 99.9999%;
- CO content in flue gases doesn't exceed 3 mg/m³.

From reception capacity liquid waste moves into the warmed reactor with a mixer. Viscous waste is warmed up for further transportation, the waste demanding mixture with other components, for example with diesel fuel, are mixed up. Waste with the increased viscosity (more than 0,03 Pa.s) is additionally warmed up in a steam heat exchanger and moves to nozzles of the plasma reactor. The waste which isn't demanding heating moves in the reactor without additional heating on the bypass line.

The plasma consists of the steam plasmatron of direct current which generates a high-temperature stream of plasma-forming gas and neutralization cameras. There are plasmatron constructions using air as plasma-forming gas. Liquid waste is dispersed in pneumatic nozzles and moves into plasma stream generated by a plasmatron, water overheats and evaporates, the organic components are oxidized to final gas products. In this option of the plasmothermal reactor operation the one-stage oxidation is carried out.

Oxidation proceeds in reaction with the air supplied by pneumatic nozzles and oxygen which is formed at steam conversion. Products of burning are cooled up in the neutralization camera supplied with alkali or water. Further steam-gas mix comes to a recuperator warming up the air supplied to the reactor. The corrosion and toxic substances containing in burning products are neutralized by the alkali solution supplied to the neutralization camera by mechanical nozzles. Gaseous products after a recuperator move to the scrubber where are irrigated by mix of water and solution of salts supplied by wet cleaning system. The cooled gases go to a cyclone dust collector for rough cleaning, and then to "Venturi's pipe" for cleaning of small fractions of mineral compounds.

The technological process of plasmothermal destruction of POP



1 – plasmotron; 2 – reactor; 3 – neutralization unit; 4 – recuperator; 5 – scrubber; 6 – cyclone unit;
7 – Venturi tube; 8 – centrifugal unit; 9 – combustion gases exhaust fan; 10 – stack

The technology of plasma processing of waste is indicated for disposal of the most difficult and toxic waste including PCB and chlorine-containing pesticides, when the cost of their storage is high and ecologically dangerous or the rigorous standards of distraction and emissions makes the traditional technologies of high-temperature burning insufficient.

Plasma neutralization of chlorine-containing waste offers the following advantages

- Total quantity of products of burning due to absence of organic fuel is reduced and consequently the dimensions of installations are considerably reduced as well;
- Due to increase of working temperature of process it is possible to reduce the burning camera;
- Application as plasma-forming gas produced from water vapor leads to its partial dissociation in a plasma stream, with the corresponding conversion into OH, which is additional oxidizer and allows to reduce concentration of O₂ in fuel – air mix ($\alpha \leq 1.5\%$) and correspondently increase a fuel component of system.
- Basing on technical and ecological requirement for POPs disposal, the results of comparative analysis of technologies of combustion and plasma technology are presented below.

Disposal technology	High-temperature oxidation in rotary furnace	High-temperature oxidation in cyclonic reactor	High-temperature oxidation in rocket engine reactor	Pyrotechnic neutralization	Plasma chemical destruction	Plasma destruction
Production capacity, kg/h	700	200	200	30-80	25-30	500
Excess of oxygen, %	10-13	10	13	13	10-15	8-12
Temperature in reaction zone, °C	850	1200	2000-3000	up to 2500	up to 5000	1200-1600
Processing time in reaction zone, seconds	2	2	0,1	explosion	0,005-0,007	3-4
Destruction efficiency, %	95,00	99,9996	99,9993	99,99	99,9999	99,9999
Concentration limits of dioxin and furan Hg/m3	50-120	0,1	45	55	0,1	0,1
Cost of equipment, US\$ thousands	4100	2300	3650	4250	Not available	2600
Operation cos of 1 tonn, US\$	240	860	2350	3370	2500	920

Capacity

Existing installations of POPs/ODS disposal based on Pyrotechnic neutralization and Plasma chemical destruction have production capacity of 30-80 kg/h and 25-30 kg/h respectively. Facilities of high-temperature oxidation in the cyclonic reactor and in rocket engines have average productivity of 200-250 kg/h. The technologies, which meet the production capacity requirements, are Plasma destruction of 500 kg/h and high-temperature oxidation in rotary furnace of 700 - 4000 kg/h .

Excess of oxygen

All the technologies considered meet excess of oxygen requirements. As to the rocket engines technology concerned it should be taken into consideration that a lack of uniform of oxygen supply could occur in this process affecting ecological characteristics of combustion gases.

Temperature in a reaction zone

All the technologies, except high-temperature oxidation in rotary furnace, meet the temperature requirements of 1200 °C. It should be noted that technologies of high-temperature oxidation in the cyclonic reactor and on technology of plasma destruction of 11200 °C and 1200-1600 °C respectively are most appropriated as they fulfill one of the most important POPS destruction requirement. At the same time they don't impose critical restrictions for the materials to be used for reactor's production, as it occurs in case of rocket engine reactor, pyrotechnic neutralization, plasma chemical technologies and affects the economic characteristics of the above processes.

The processing time in a reaction zone.

The technologies of plasma destruction, high-temperature oxidation in rotary furnace and in the cyclonic reactor meet the processing time requirements of 2 seconds. All other methods should be improved in this respect which could require technological and construction alterations of processing.

Destruction efficiency

The destruction efficiency is considered to be the most important requirement of POP disposal and is recommended by the Stockholm convention to be not less than 99.9999%. The plasma destruction is the only technology proved to meet this requirement. No other presented technology meet requirement of POP destruction efficiency. The high-temperature oxidation in rocket engine reactor and cyclonic reactor come very closed and prove to have efficiency of 99.9993% and 99.9996% respectively.

Dioxin and furan in remains

The only 3 presented technologies: high-temperature oxidation in the cyclonic reactor, plasma technology and plasma technologies meet the requirements of dioxin and furan concentration which should not exceed 0,1 ng/nm³.

Equipment and production costs

The estimated equipment cost of two technologies: plasma destruction and high-temperature oxidation in the cyclonic reactor, which meet or come very closed to fulfill the requirements of POPs disposal, are very similar. Nevertheless the differences of production capacity offered by two technologies should be taken in consideration. In case of plasma technology the production capacity is of 500 kg/h and is twice that 200 kg/h of high-temperature oxidation in the cyclonic reactor.

Substances	Plasma destruction	FSU requirements	EU requirements DEQ
PCB	< 1 mg/ nm ³	1 mg/ nm ³	not regulated
Dioxine and furana	0,1 ng/ nm ³	not regulated, recommended limit 0,1 ng/ nm ³	0,1 ng/ nm ³
CO	3 mg/ nm ³	20 mg/ nm ³	50 mg/ nm ³
HC1	5 mg/ nm ³	5 mg/ nm ³	10 mg/ nm ³
Dust	1 mg/ nm ³	4 mg/ nm ³	10 mg/ nm ³
SO2	10 mg/ nm ³	10 mg/ nm ³	50 mg/ nm ³
Organic carbon	2 mg/ nm ³	4 mg/ nm ³	10 mg/ nm ³

Dioxine and furana in sewage	1.1 pg/l	not regulated	0,3 mg/ l
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In case of plasma process the concentration of dangerous and harmful substances do not exceed the limits and meet both the FSU and EU requirements. The control is continually made in operating installations and confirmed by results of inspections of various production plants.

ANNEX H: Information on potential counterparts in Belarus, Ukraine and Kazakhstan.

➤Potential counterpart in Belarus

Republican Unitary Enterprise (RUE) “Gomel Oblast Complex for Toxic Industrial Waste Recycling and Burial” (further – Complex} is the unique for the former Soviet Union countries object for environmentally sound storage created in the Republic of Belarus.

The priority objective of construction of the Complex is to mitigate the negative impact of the hazardous waste existing in Belarus on the health of people and environment.

The main tasks implemented by the Complex are:

- the environmentally sound centralized collection, storage and disposal of hazardous wastes produced by the enterprises and organizations in Belarus;
- the receipt of valuable components from industrial waste for industrial and construction use, maximizing the economic use of recycled waste.

The total area allocated for construction of the Complex - 45,0865 hectares.

The Complex has the necessary legislative and institutional capacity on implementation of activities on consolidated collection and long – term environmentally storage of hazardous wastes both from the organizations of Belarus and other countries of the region.

Types and volumes of the hazardous wastes stored at the Complex

By October 1, 2015, the complex has accumulated the following types and volumes of the hazardous wastes:

- obsolete pesticides – 3 684, 93 tons;
- medical waste – 4,649 tons;
- sludges – 83,195;
- mercury – containing waste – 31,47 tons.

Investments and perspectives of the development of the Complex

In the period from 1995 till 2015 more than 19 million USD were invested from the national budget of the Republic of Belarus in construction of the Complex.

In the draft of the National Plan on implementation of the provisions of the Stockholm Convention for the period of 2016 – 2020 the budget line in amount of 9 million USD on financing of the development of the Complex is planned, including:

- development of the current complex infrastructure providing for environmentally sound waste disposal;
- construction of 2 storages for environmentally sound storage of PCB-containing wastes;

- carry out a package of operations to monitor the environment in the complex area for making an assessment of the efficiency of the proposed activities and ensuring control over the safety of POPs waste transportation and disposal operations.

One of the key priorities of the National Plan on implementation of the provisions of the Stockholm Convention for the period of 2016 – 2020 to be approved by the Government is to set up the facility for environmentally sound disposal of hazardous wastes.

Main challenges for the further development of the Complex

- Absence of the free storage facilities for acceptance and environmentally sound storages of additional stocks of obsolete pesticides;
- Lack of the financial and technical resources for purchasing of the equipment for disposal of obsolete pesticides and other types of hazardous chemical waste;;
- No storage facilities designed for environmentally sound storage of PCB – containing wastes.

The attempts to purchase the equipment for disposal of the hazardous wastes were undertaken by the management of the Complex in the framework of implementation of the activities of the National Plan on implementation of the provisions of the Stockholm Convention for the period of 2011 – 2015. But these attempts failed because of the modest amount of financial resources planned for this activities (1,8 million USD) as well as lack of the technical expertise of the national stakeholders in choosing of the appropriate and effective technology of environmentally sound disposal of obsolete pesticides.

➤ *Potential counterpart in the Republic of Kazakhstan*

The company "Zhasyl Damu" was created by converting the Republican state enterprise on right of economic management "Kazakh research Institute of ecology and climate" of the Ministry of environment and water resources of Kazakhstan on the basis of Government decision No. 978 dated 26.07.2012.

The main task of "Zhasyl Damu" is to create conditions for the preservation, restoration and quality improvement of the environment.

Main objectives:

- Production management system and the management and disposal of hazardous wastes;
- Reducing greenhouse gas emissions through the establishment and smooth functioning of the regulatory system and trade quotas for greenhouse gas emissions in the Republic of Kazakhstan;
- Technical and consulting support of activities of the authorized body for the coordination and implementation of the Kyoto Protocol to the UN framework Convention on climate change
- Research work

By official decision of the Minister of energy of the Republic of Kazakhstan, "Zhasyl Damu" is assigned as the responsible organization for the implementation of the UNECE Convention on long range transboundary air pollution on long distances, the Stockholm, Basel and Rotterdam conventions.

Today "Zhasyl Damu" is a powerful infrastructure center, where it is possible to concentrate all support activities of the Ministry of energy of the Republic of Kazakhstan in the sphere of ecology and environment protection.

➤ *Potential counterpart in Ukraine*

A group of companies on hazardous waste disposal

The group has been established by Ukrainian businesses, engaged in services on collection, transport, storage and further disposal of waste of hazard classes I to IV, at corporate operational facilities.

Today they operate as a holding with integrated governance and development strategy.

The Group comprises:

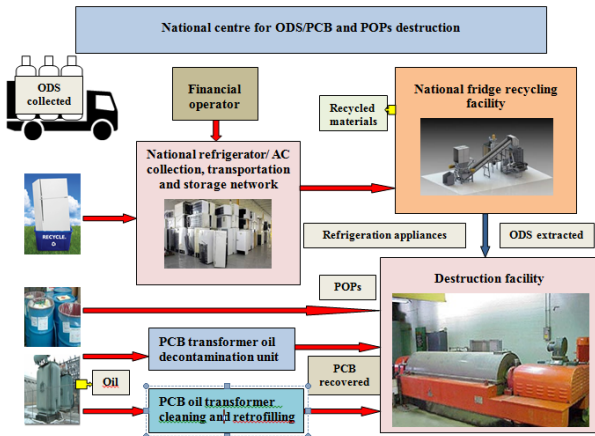
- ECOCENTR – research and development company, which includes the laboratory, complying with ISO 17025 standard. Was established in 2010.
- TARKOM ECOSERVICE –the leading company has two plants of hazardous waste disposal located in Kiev region and Odessa region. Was established in 2010.
- ECOSVIT – research and development enterprise, was established in 2011.

They are the reliable partner both for the government and businesses. They operate in full compliance with current regulations, have a complete licenses package for safe hazardous waste disposal and own advanced equipment/

The group has an exceptional capacity to perform actual disposal, confirmed by the required package of regulatory documents, stating the fact of their disposal.

Enterprises are fully equipped in compliance with current environmental, sanitary-epidemiological and fire safety regulations.

The group deals in recycling and disposal of waste, generated in various sectors: agriculture, pharmacology, chemical industry, petrochemical industry, fuel, transport, construction and etc. and provides a full range of services: collection, storage, transportation, treatment and disposal.



ANNEX I EOL EQUIPMENT – REFRIGERATOR RECYCLING PLANT / ODS RECOVERY

The refrigerator recycling plant includes everything from shredding to separation. The refrigerator recycling system is designed for processing refrigerators operating with CFC/pentane gasses to prevent harmful substances to evaporate into the atmosphere, and to the most efficient recycling of the solid materials.

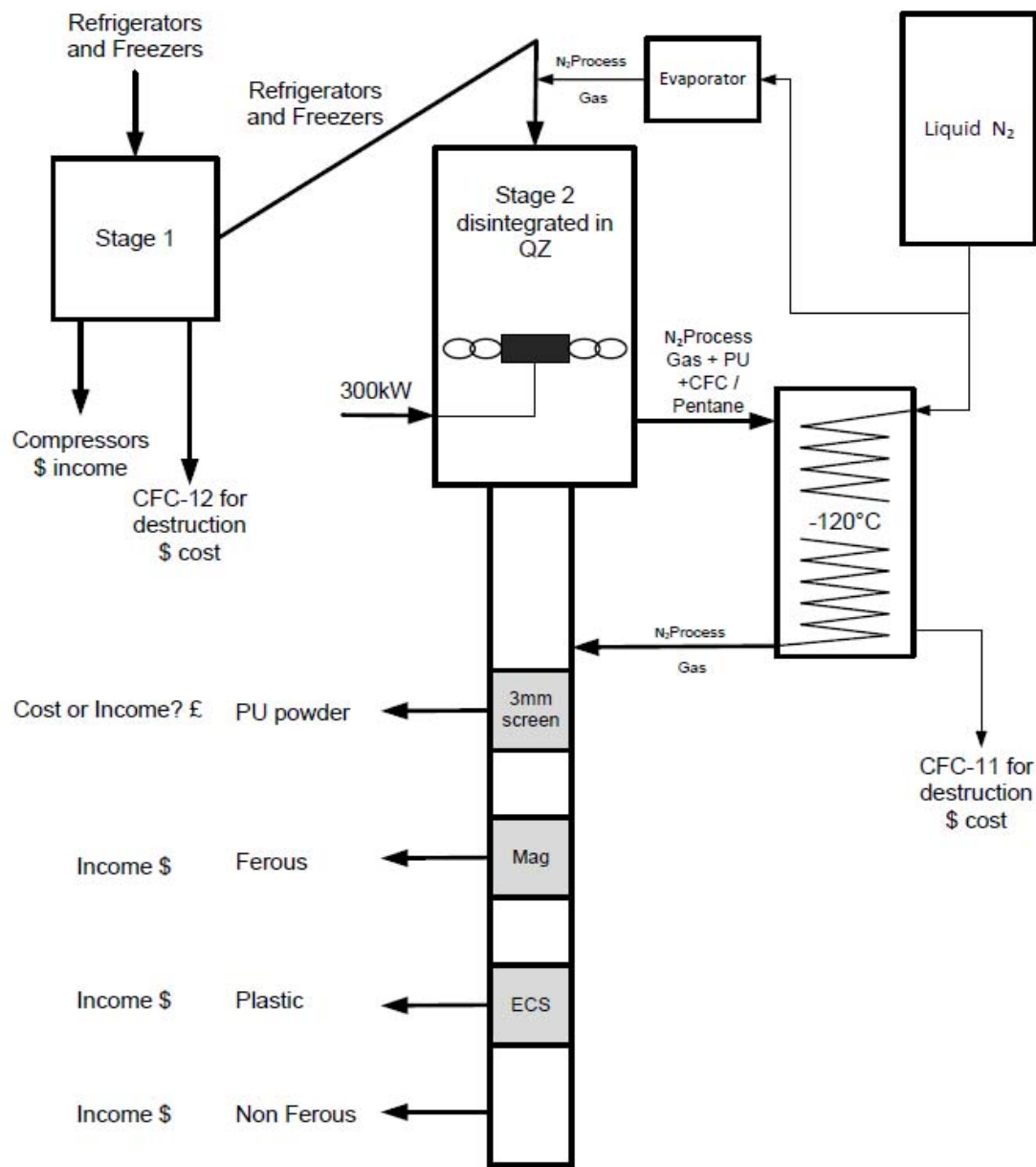
Refrigerator recycling plants capture refrigerants from the refrigerator compressor circuitry and blowing agents from refrigerator insulation foam panels and recovers and sorts materials, such as the plastic liner, aluminum, copper, steel, and insulating foam. ODS gas in foam is subsequently recovered during a grinding process under negative pressure, and then condensed to a liquid and collected in storage tanks. The degassed foam is compressed into pellets which can be used as fuel for other processes. Captured materials and substances can be sold in the national markets for reuse, recycled or properly destroyed.

This fully automated refrigerator recycling technology can recover approximately 95% of the insulating foam contained in refrigerators and freezers and is estimated to reduce typical refrigerator landfill waste by 85% (by weight). By ensuring a high recovery rate for materials and increasing the volume of units that can be processed, this system allows for significant reductions of GHG and ODS emissions.

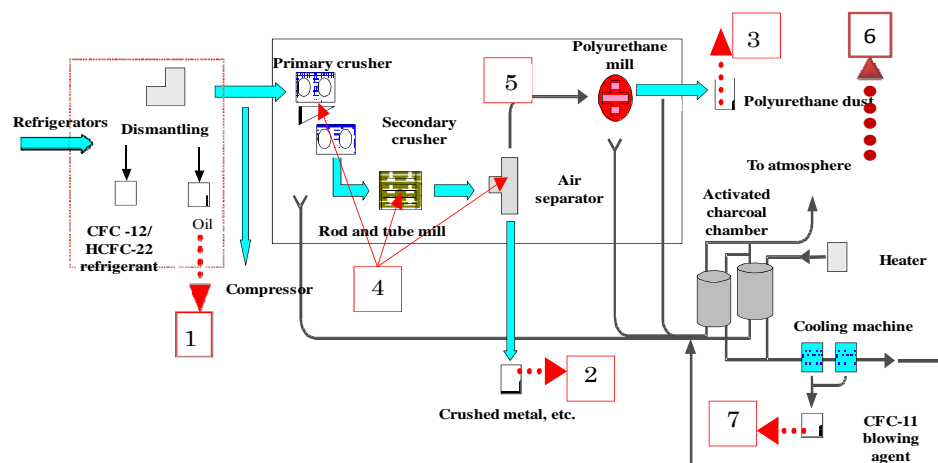
Complete fridge recycling plant includes everything from pre-chopping to separation and the whole process can be divided into the following stages: pre-handling - Step I, shredding and materials separation - Step II, degasification and finally ODS destruction. The fridge recycling takes place at one site and then recovered ODSs are to be transported to destruction place. The same can be applied to the refrigeration systems with HCFC- 22/pentane as a cooling agent and HCFC-141b/cyclopentane as a blowing agent in foams.

All work steps are to be designed to ensure that the ODS/pentane contained in the appliances is recovered with minimum losses and forwarded to controlled destruction, while the materials forming other constituent parts of the appliances are recycled. The design of the individual work steps should be taken into account the industrial health and safety requirements as well as the requirements for soil protection, fire protection, water protection and air pollution control. The Step II treatment plant is designed to shred cooling appliances and separate the different materials of the appliance casings while recovering to a large extent the CFC and cyclopentane blowing agent contained in the insulating foams. For this purpose, the appliance casings are input in a closed system and shredded there in a 2-stage shredding system; the resulting mixture of materials is then divided up into by means of an air separating system. The fraction consisting of scrap steel and iron, plastics and non-ferrous metals is discharged from the system and further divided up into its constituents by means of a magnetic separator and an eddy-current separator system, while the separated PUR foam is ground within the plant and heated up in order to drive out the CFC adhering to the PUR foam. Upon completion of this treatment step, the PUR powder is also discharged from the plant. The insulating gas/blowing agent (CFC-11 or R141b, etc) released during the process of shredding, grinding and heating is collected, adsorbed in activated carbon and, following desorption from the activated carbon, liquefied under pressure by means of compressors or using any other cryogenic methods. The fridges are transported to the Fridge Tower through a sluice. The Fridge Tower is a unit which combines a pre-chopper, a chopper, can be a granulator. This makes possible an inert cutting chamber eliminating the risk of fire and explosion. Next step is a unit where the PUR foam is separated out and transported to the Pelletizer. In the Pelletizer the PUR foam is pressed into pellets. At the same time the remaining gas is sucked out into the CFC Liquefaction system. The Fe-particles are separated out by the overband magnet. Aluminium and plastic fraction is passed over the Eddy Current Separator, where it is separated into plastic and aluminium/Cu fractions. In the CFC liquefaction system the nitrogen used to reduce the oxygen level in the cutting chamber of the Fridge Tower is recovered and recycled in a closed circuit system to minimize the consumption. The gases are collected in closed gas vessels.

Overview of Refrigerator / Frezer Recycling Plant



The schematic diagram of the refrigerator recycling and ODS extraction plant.



Sample of the operating facility in Belarus:

"Minsk Regional Technopark", a very large area that the Byelorussian Government has conceived as a centre of excellence for recycling of waste and for production of renewable energy. The plant, which is already fully operational has a processing capacity of 5 tons/h of tired tires.

The Bel-VTI has already supplied 19 of 10,000 obsolete refrigerators for their recycling to the Technopark. The pictures below show some parts of the pant under installation

The system, designed by Forrec, Italy consists of a double-shaft shredder TBH 2000, two single shafts grinders MR 2000 and two granulators FMS 2000, and all those components that complete the installation. The system allows to obtain rubber granules which, depending on the subsequent reuse, can vary from 0-1 mm, 1-2 mm and 2-4 mm. The granules obtained are to be used in the production of asphalt and some technical articles.



Material output after automatic sorting as expected



The final products: non-ferrous metals



The final products: ferrous metals



**The non-ferrous metals are transported to the densimetric separators for separation
pper from the aluminum**