

# Zdroje kontaminace prostředí na Ukrajině a důsledky válečného konfliktu

## Sources of environmental contamination in Ukraine and the consequences of the war

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<b>Chemical pollution of environment</b>	↪ <b>Science behind the war conflicts and environmental pollution</b>
<b>Stockholm Convention on Persistent Organic Pollutants (POPs)</b>	↪ <b>Implementation projects in Ukraine</b>
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<b>Future, co-operation</b>	↪ <b>Assessment of environmental impacts</b>

# Contents

**Chemical  
pollution of  
environment**

↳ **Science behind  
the war conflicts  
and  
environmental  
pollution**

# Chemical substances (ChS)

- Mixture of natural ChS
- Products of their transformation and degradation

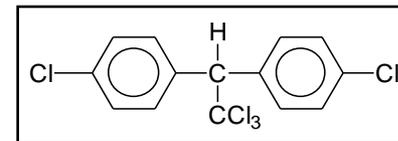
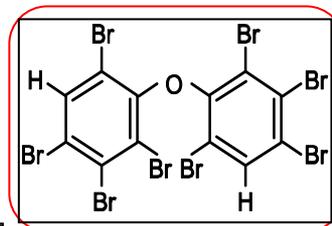
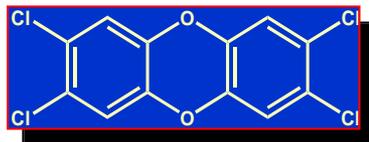
**Natural ChS**

**Anthropogenic ChS**

- Mixture of anthropogenic substances
- Products of their transformation and degradation

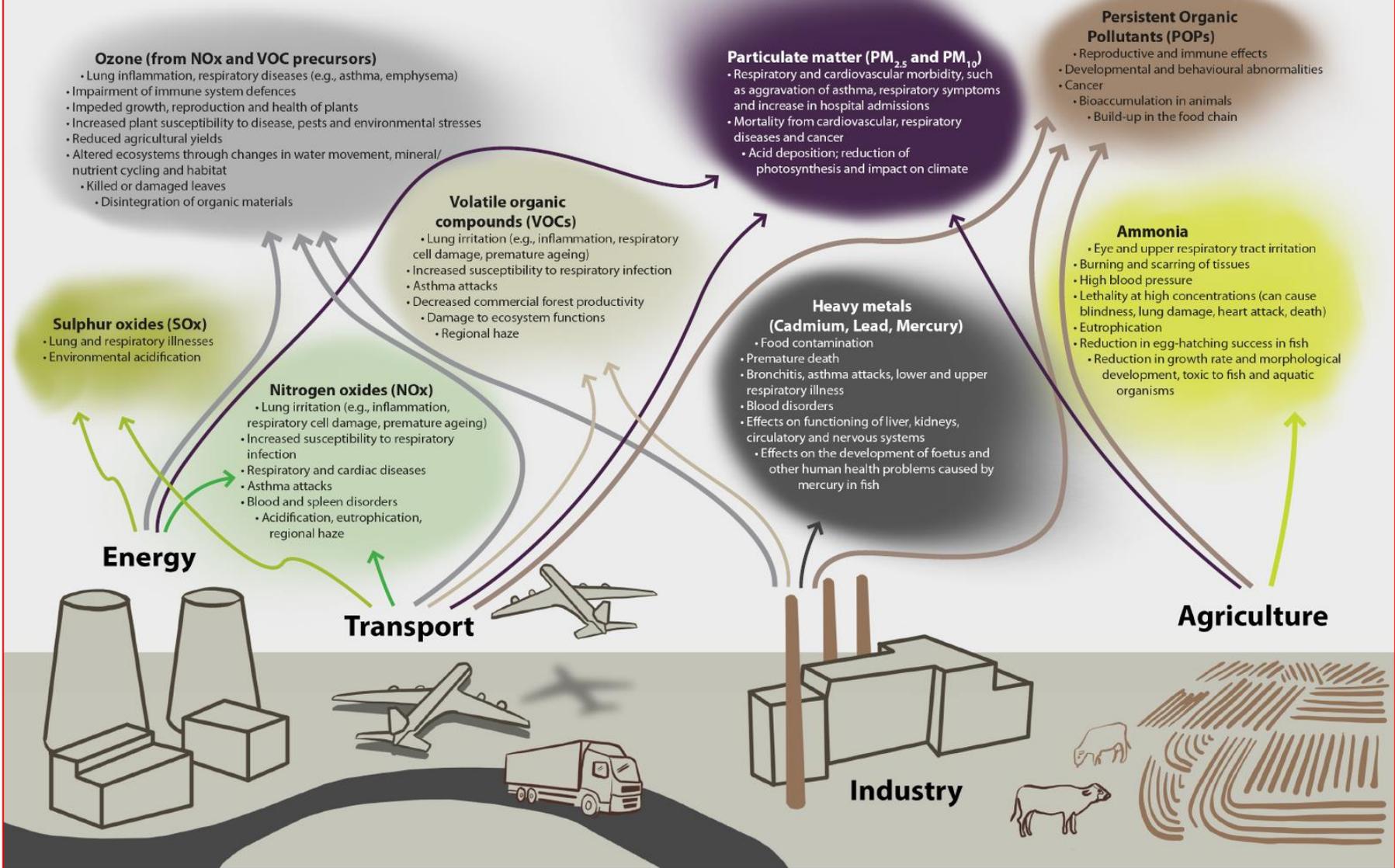
- Contaminants
- Products of their transformation and degradation

**Environmental mixtures**



# Sources of air pollution and impacts

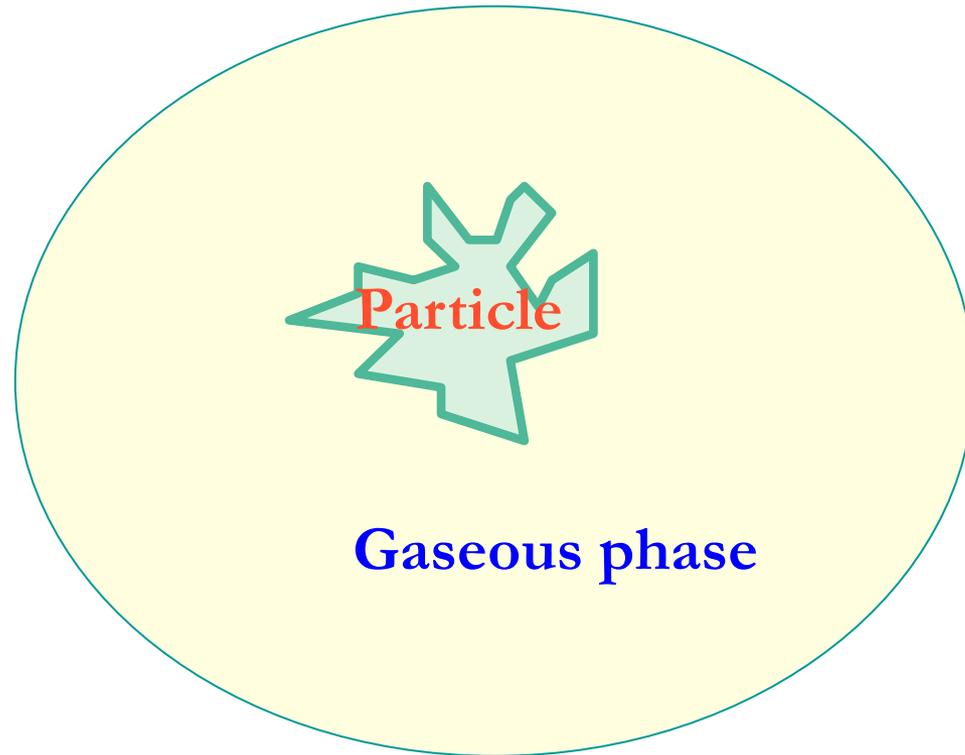
Figure 4: Air pollution sources and impacts



# War conflicts



# Atmospheric particles



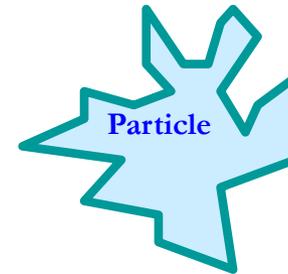
# 2 principle formation types

Formation in the GAS

~~'HOMOGENOUS' FORMATION~~

500 – 800°C

Homogenous formation  
not relevant (here)



Formation on  
particle surface



'HETEROGENOUS'  
FORMATION  
200 – 500°C

GAS

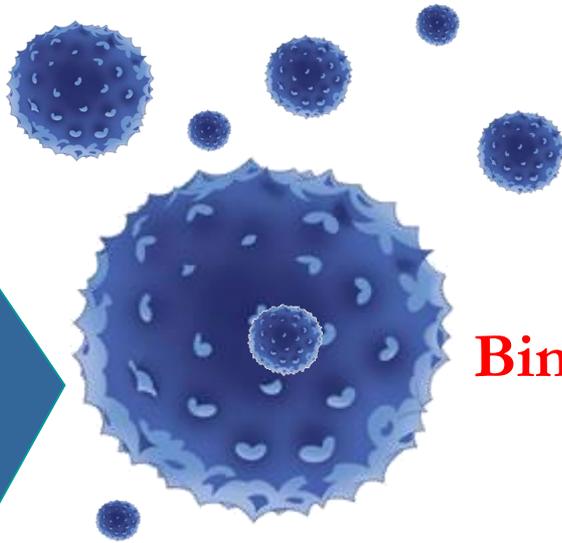
**PM 10**

**PM 2.5**

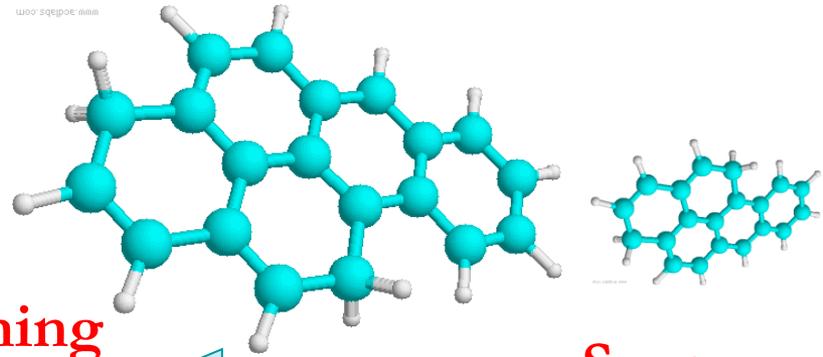
**PM 1.0**

.....

.....



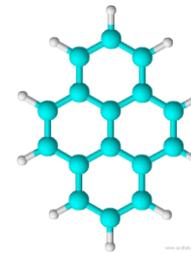
# Atmospheric particles



**Binding**



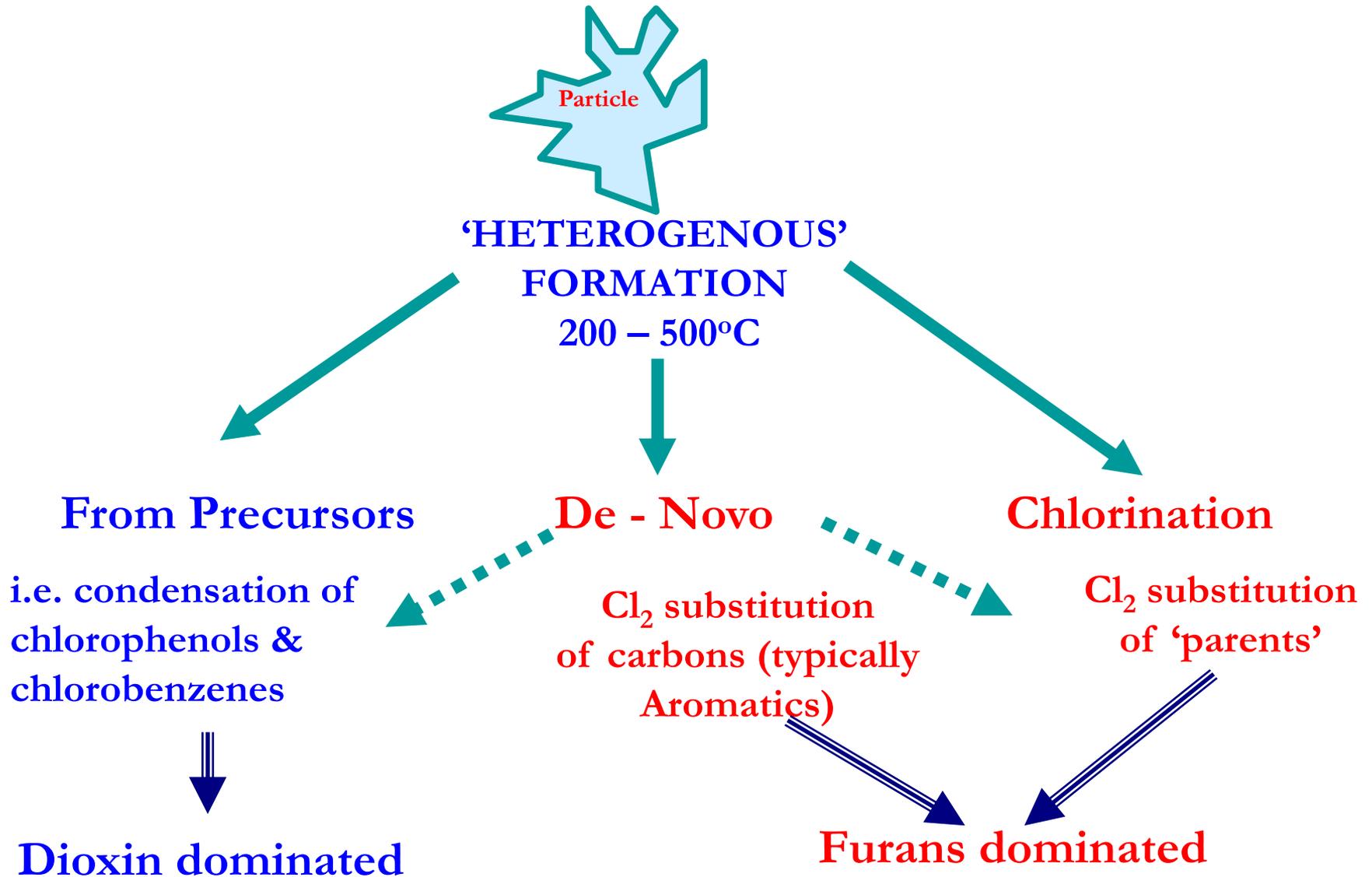
**Sources of  
toxic  
substances**



**Huge  
amount of  
particle  
sources**

- 1) Local furnace (source of particles and bound chemicals)
- 2) Secondary sources (contaminated soils, landfills - volatilization at higher temperatures in summer,...)
- 3) The parameters of particle size, material, quantity,... are decisive.

# Heterogeneous Formation (Dioxins/Furans)



# Formation of PCDDs/Fs from precursors for low temperature POPs/pesticide destruction technologies

## POPs

DxnPrecursor:

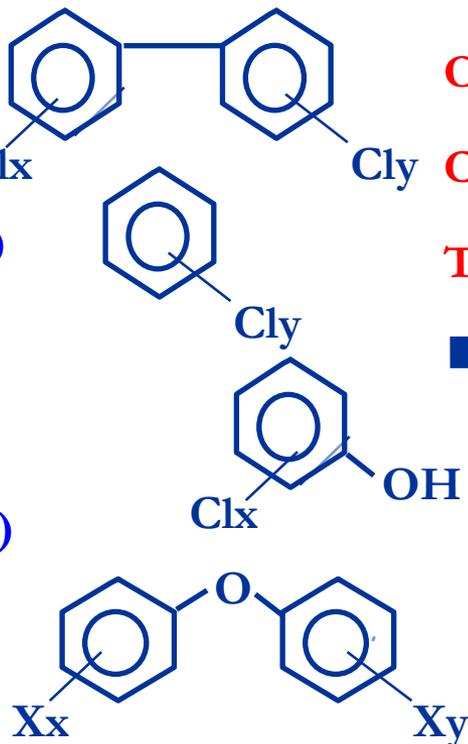
PCBs (Ox. or OH)

PCBz (Ox. + Cond.)

PxCP, PCP, 2,4,5-T  
(Ox., Cond.)

PXDE (Elimination)

HalAromatics



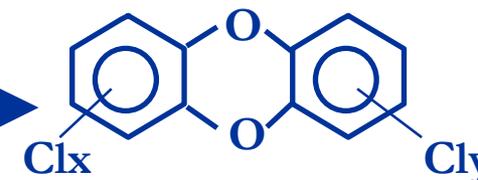
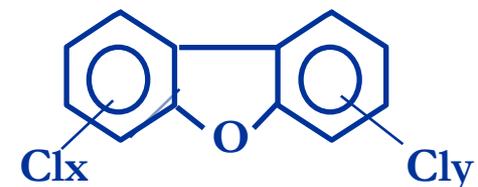
Oxidation, Hydroxylation,

Condensation reactions,

Thermal stress; Energy



PCDDs/PCDFs



Destruction:

Oxidation

Reduction

Photolytic technologies

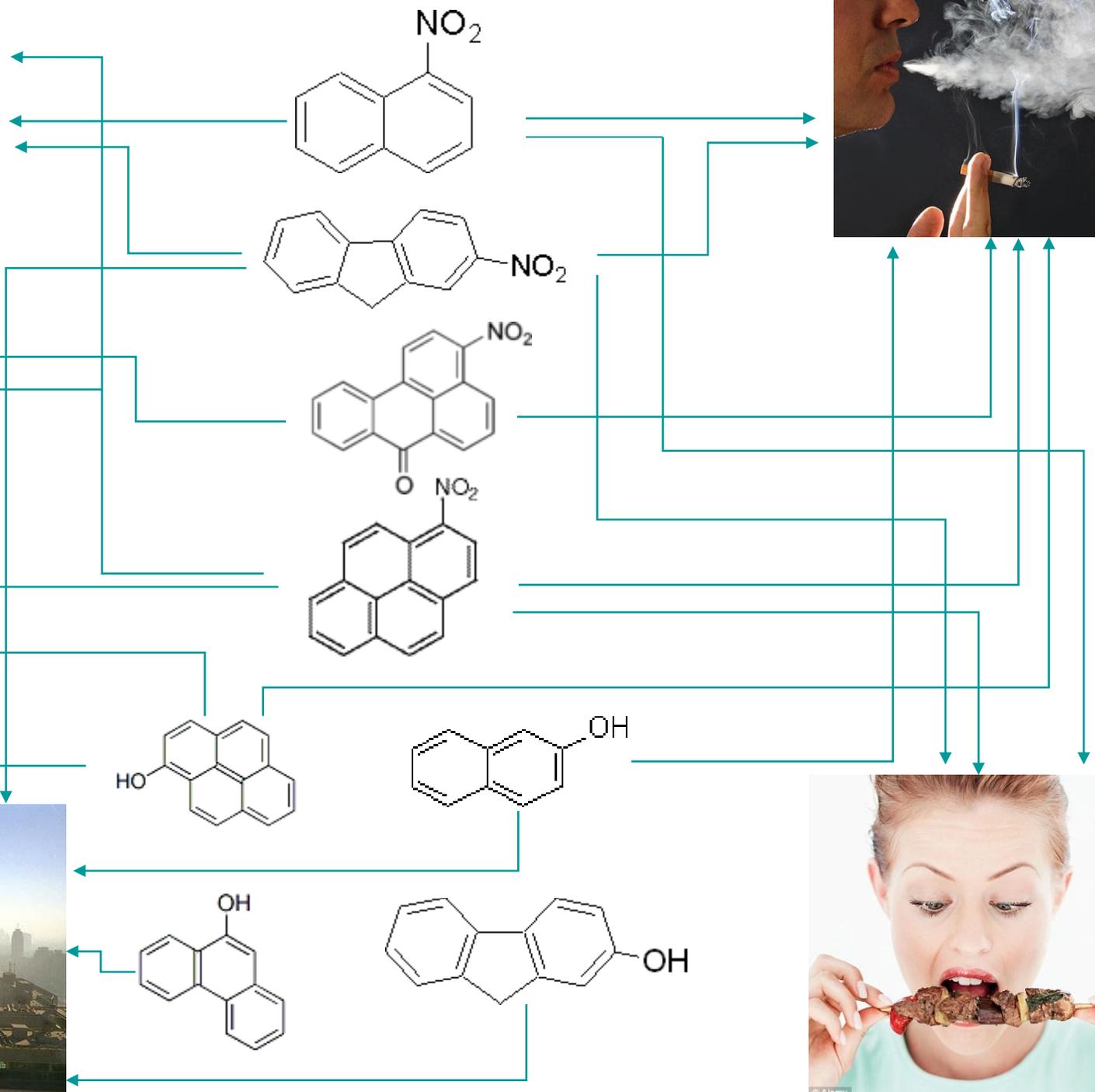
Biodegradation

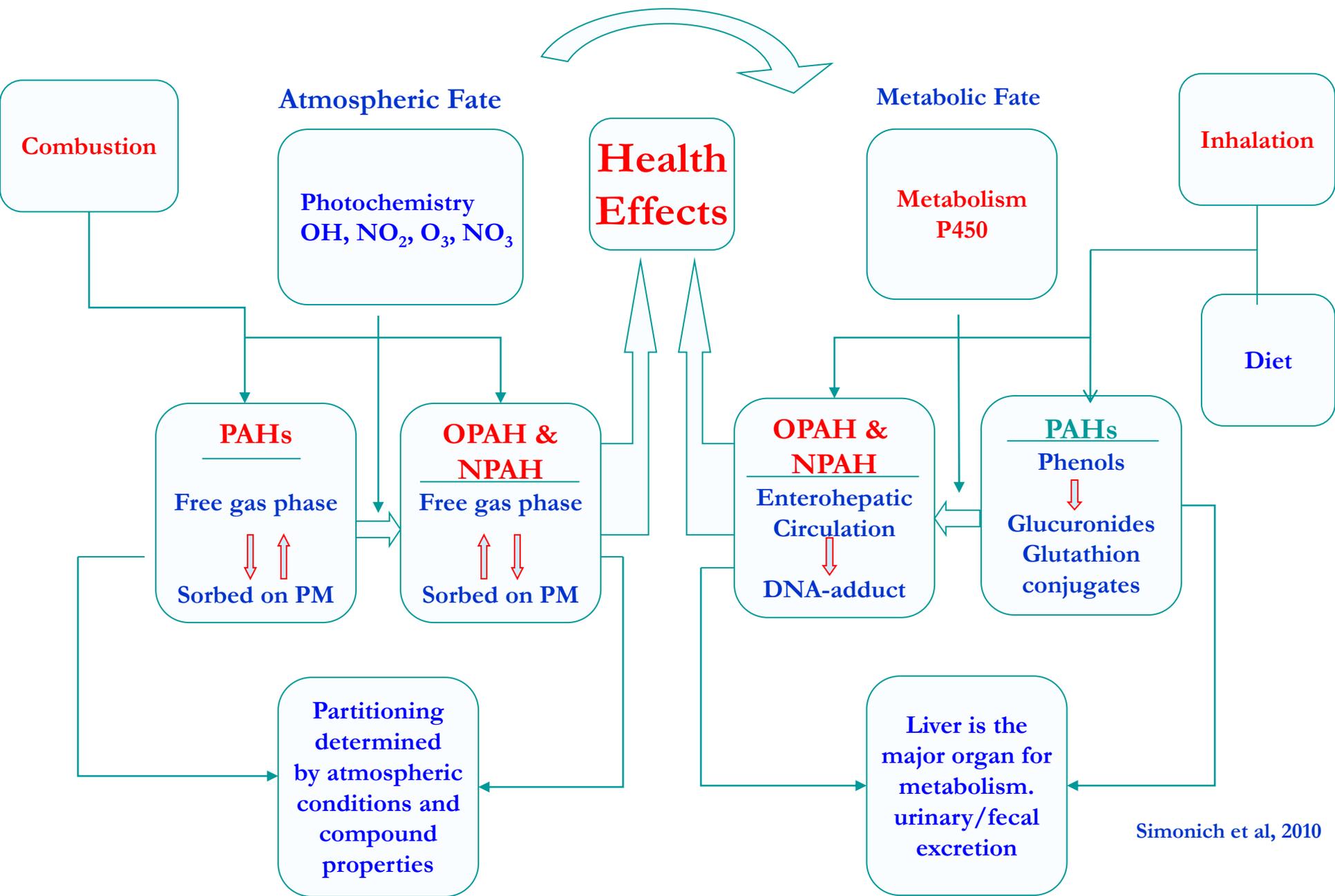
↑ Thermolysis  
T > ca. 300°C

NonPrecursors

DDT, Aldrin, Endrine, etc.

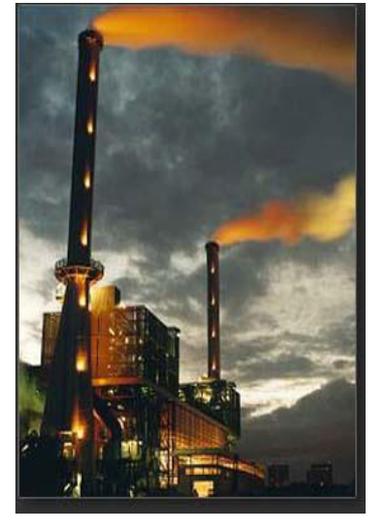
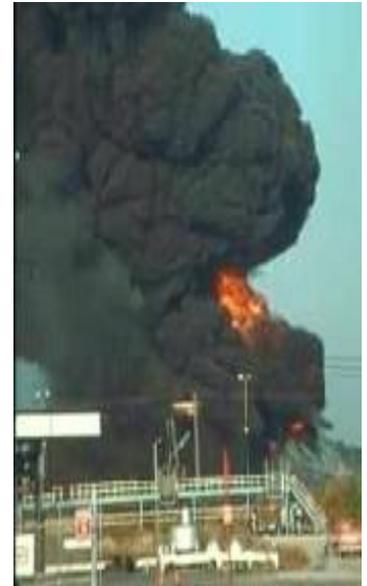
Cl/Br organics





# Sources of PCDDs/Fs

- ↪ Combustion
- ↪ Metal Smelting, Refining, and Processing
- ↪ Chemical Manufacturing
- ↪ Biological and Photochemical Processes
- ↪ Reservoir Sources
- ↪ Chemical Accidents



# Emission of dioxins from uncontrolled burnings

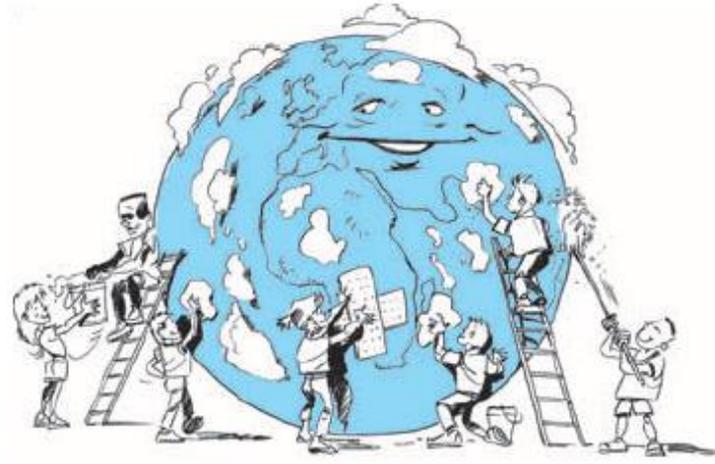


# War conflicts

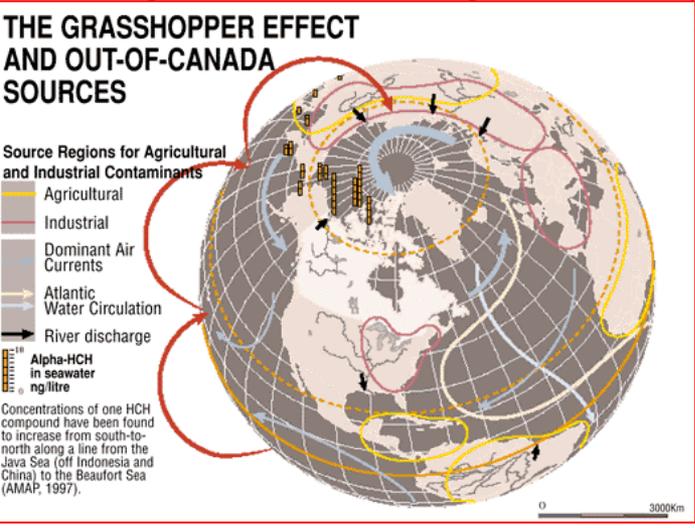


# Contents



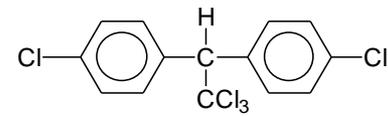


# POPs

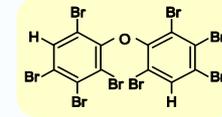


## International impacts

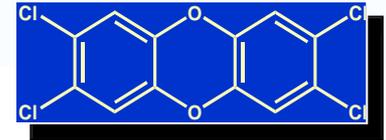
# IP and UP POPs



↪ **Intentionally produced (IP):** Chlorinated pesticides, transformer/capacitor oils (PCB), polybrominated flame retardants, ...



↪ **Unintentionally produced (UP):** Dioxins/furans (byproducts in thermal processes)



**Elimination of wastes (IP) -  
destruction (conservation)**

**Elimination of stockpiles (IP) -  
destruction (conservation)**

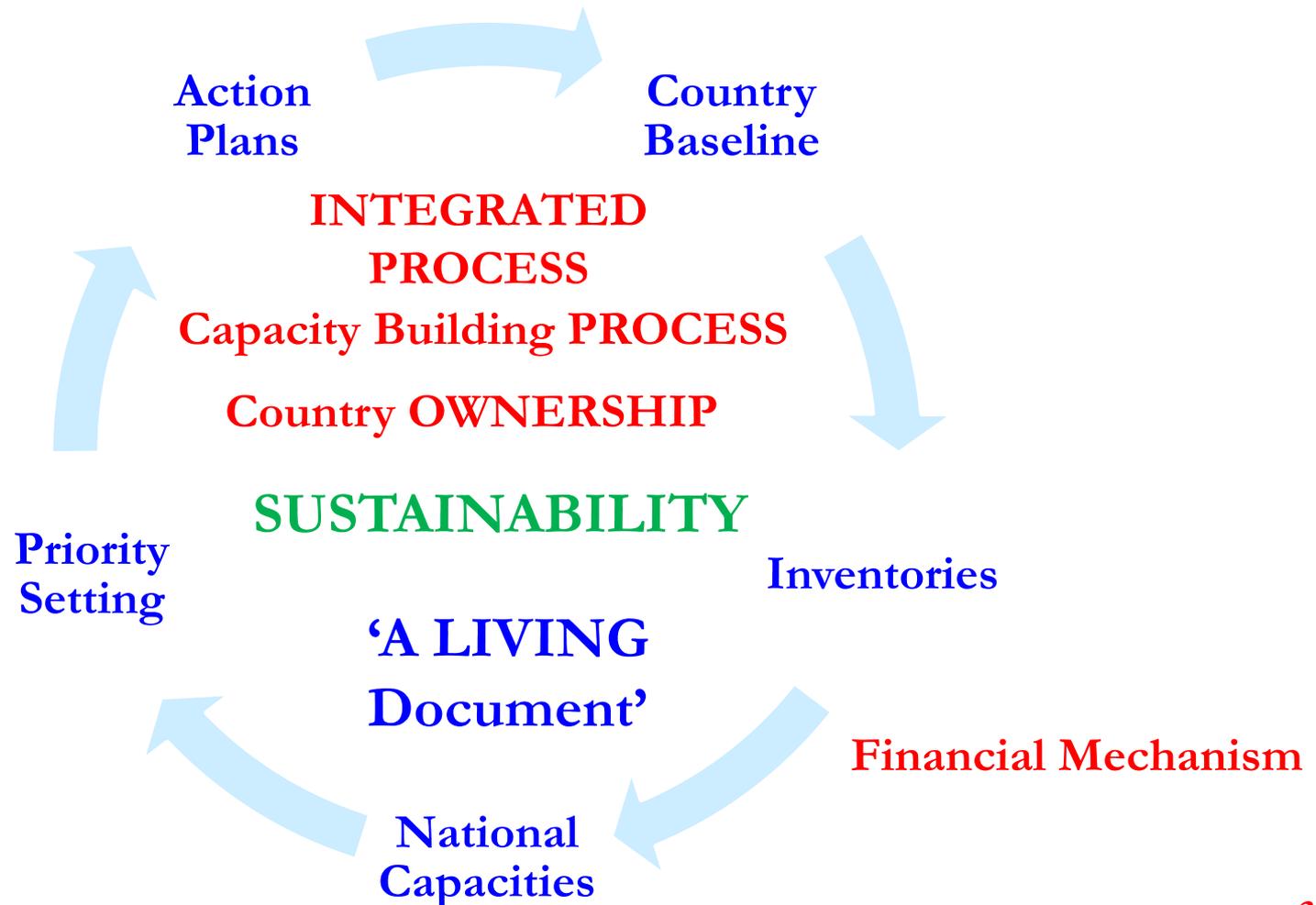
**Elimination of byproducts (UP) -  
prevention and destruction**

**Decontamination (IP + UP) - remediation of soils,  
sludges, water, sediments, ...**



# The NIP documents

UNEP/POPS/COP.1/INF/13: “Interim guidance for developing national implementation plans for the Stockholm Convention”



MINISTRY OF ENVIRONMENTAL PROTECTION OF UKRAINE

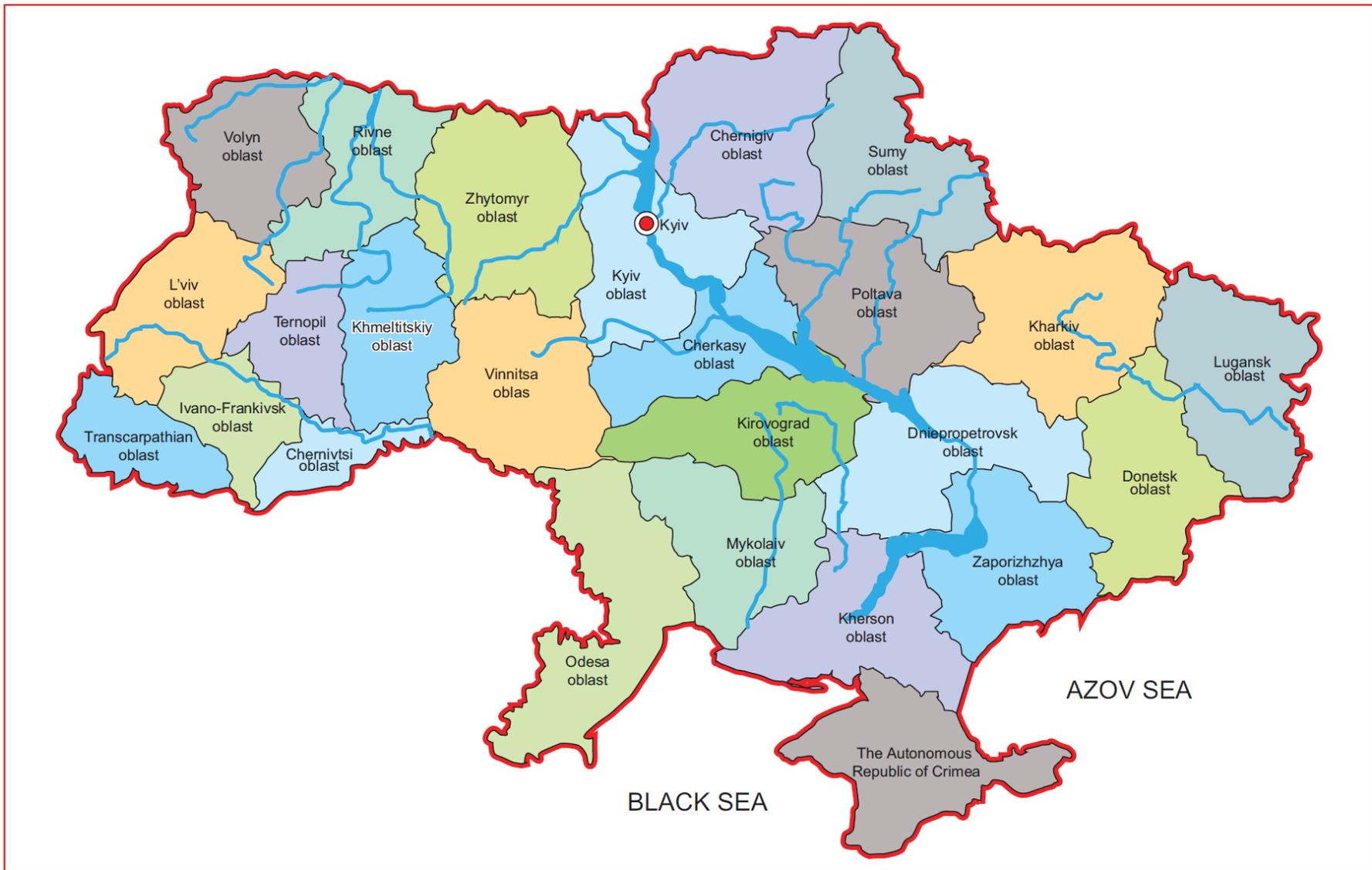
Project # GF/2732-03-4668

Enabling Activities for the Stockholm Convention on Persistent Organic  
Pollutants (POPs): National Implementation Plan for Ukraine

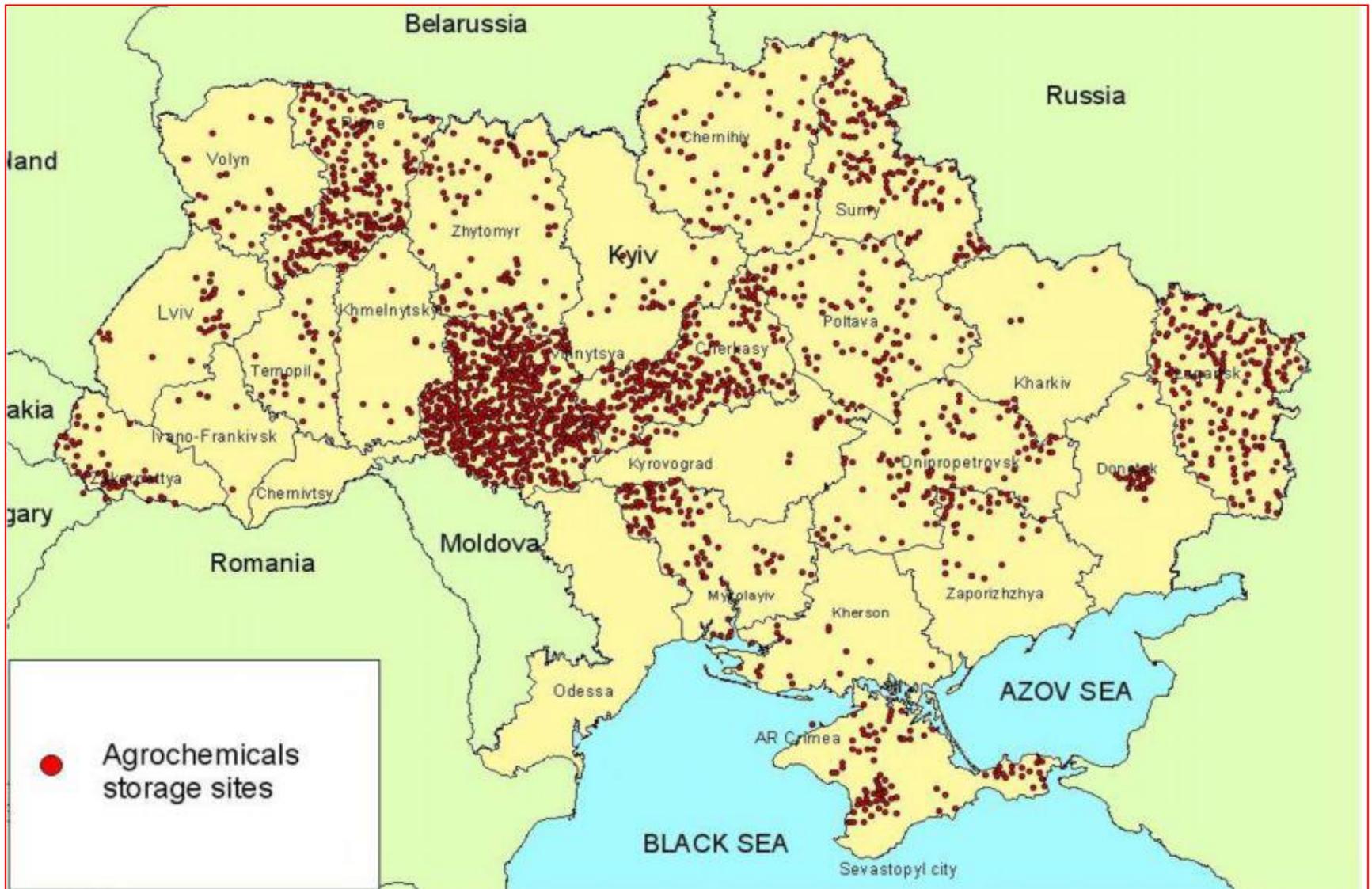
**NATIONAL  
IMPLEMENTATION PLAN  
FOR THE STOCKHOLM  
CONVENTION ON PERSISTENT  
ORGANIC POLLUTANTS**

**KYIV 2007**





# Agrochemical storage sites



# Ukraine, June 2003



# OCPs in Ukraine, 2007

The total amount of OCPs in Ukraine was over 22 thousand tons most of which are persistent organochlorinated compounds.

They were stockpiled in about 5 000 storehouses of various forms of property, of which 109 are owned by the state.

According to the latest inventory of 2006, the OCPs amount in every oblast varies from 130 to 2 500 tons; while every storage unit has from 0.1 to 500 tons.

## The hot spots:

The Autonomous Republic of Crimea - 1 180.0

Vinnitsa oblast - 1 073.9

Dniepropetrovsk oblast - 1,211.0

Zaporizhzhya oblast - 1 214.0

Kyiv oblast - 1 932.9

Kirovograd oblast - 1,210.5

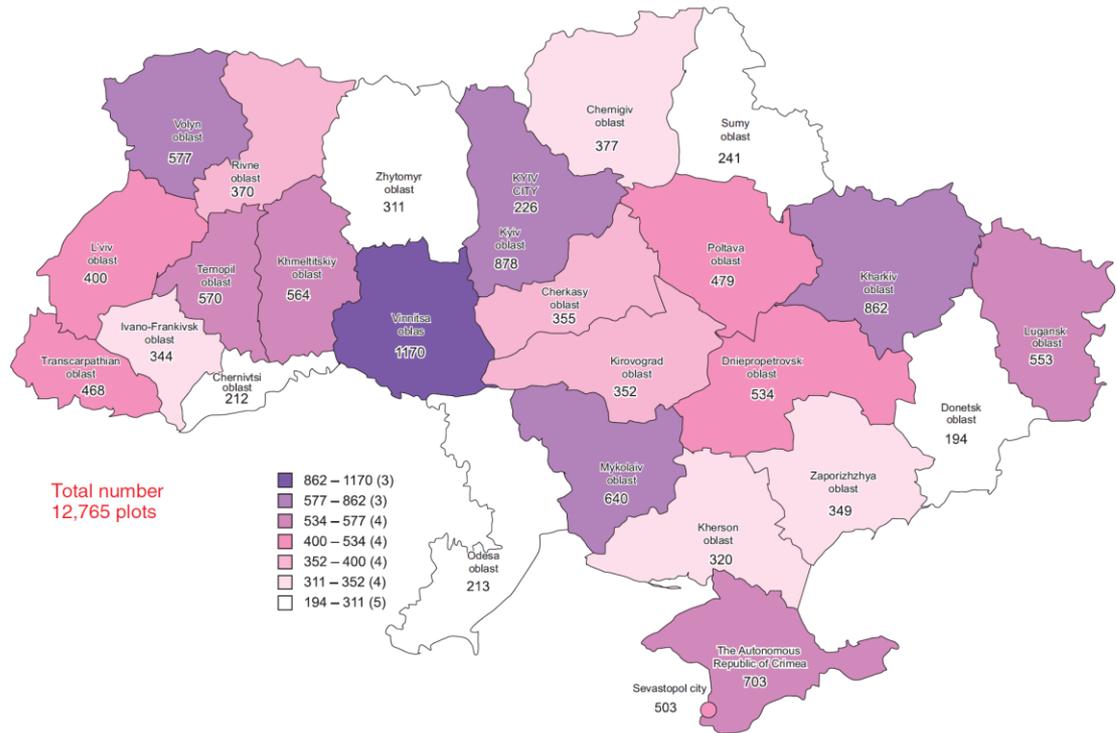
Odesa oblast - 1 867.6

Sumy oblast - 2 527.7

Kharkiv oblast - 1 193.1

# Number of contaminated and potentially contaminated sites according to the inventory results in administrative units (by to 2005-11-05)

Administrative units	Registered
ARC	703
Vinnitsa oblast	1170
Volyn oblast	577
Dniepropetrovsk oblast	534
Donetsk oblast	194
Zhytomyr oblast	311
Transcarpathian oblast	468
Zaporizhzhya oblast	349
Ivano-Frankivsk oblast	344
Kyiv oblast	878
Kirovograd oblast	352
Lugansk oblast	553
L'viv oblast	400
Mykolaiv oblast	640
Odesa oblast	213
Poltava oblast	479
Rivne oblast	370
Sumy oblast	241
Ternopil oblast	570
Kharkiv oblast	862
Kherson oblast	320
Khmeltitskiy oblast	564
Cherkasy oblast	355
Chernivtsi oblast	212
Chernigiv oblast	377
Kyiv city	226
Sevastopol city	503
<b>Total</b>	<b>12765</b>



# Transformers



# Transformers



# PCBs in Ukraine, 2007

**Analysis of PCB data** obtained from Ukrainian enterprises proved that the largest amounts of PCBs were used and/or located at the most power consuming enterprises of metallurgic and engineering sectors

Regarding various types of PCB-containing equipment the hot spot were:

## **a) transformers**

Donetsk oblast (25%);

Dniepropetrovsk oblast (11%);

Kyiv oblast (11%);

## **b) capacitors**

Zaporizhzhya oblast (18%);

the Autonomous Republic of Crimea (12%);

Dniepropetrovsk oblast (7%);

## **c) containing PCB liquids**

Donetsk oblast (27%);

Dniepropetrovsk oblast (26%);

Kyiv oblast (14%).

# PCBs in Ukraine, 2007

The inventory revealed a total of 1 002 transformers of 27 different models, and 102 032 capacitors of 157 different models as well as 250 048 kg of synthetic liquids of 8 various types.

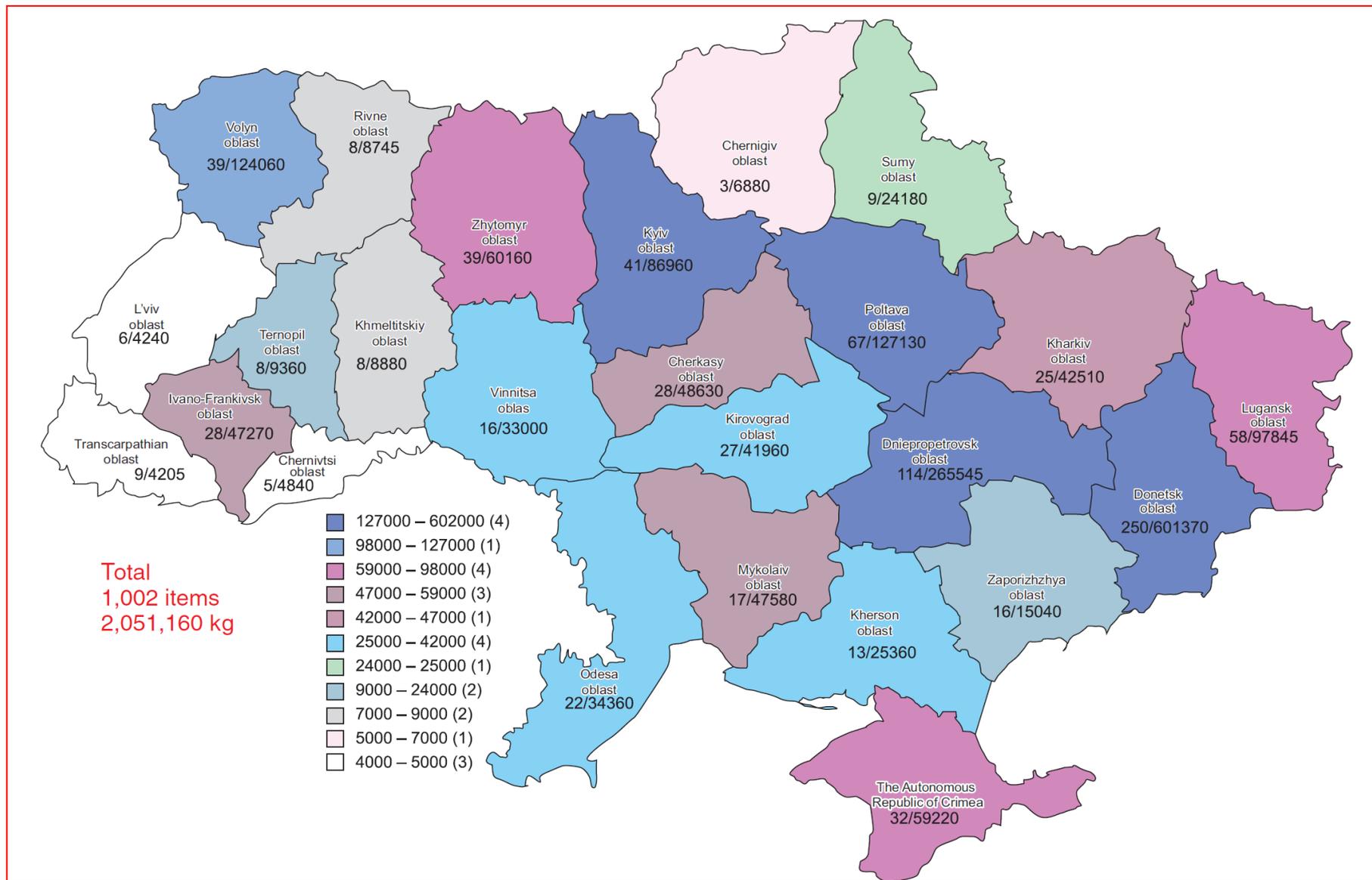
Each transformer weighs between 490 kg and 12 000 kg while the total weight of liquid dielectric in each one varies from 160 kg to 4 160 kg.

The total weight of all transformers is 5 746 540 kg, of which PCB makes up 2 051 160 kg.

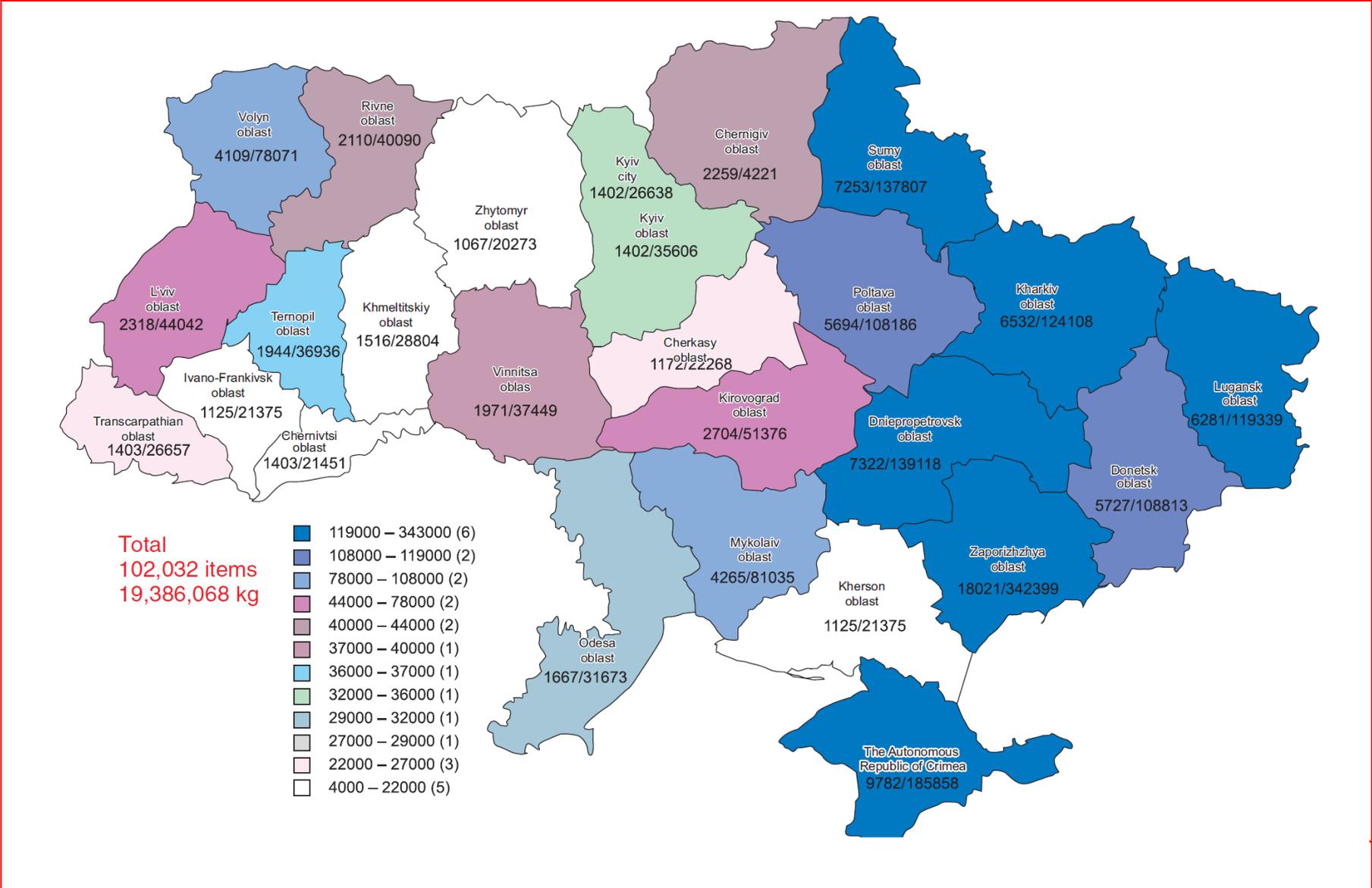
The total amount of PCB contained in the equipment and stored at Ukrainian enterprises, as estimated by the preliminary inventory, makes up about 4 240 tons.

It should be noted that experts' estimated the real amounts to be 1.5-3 times larger.

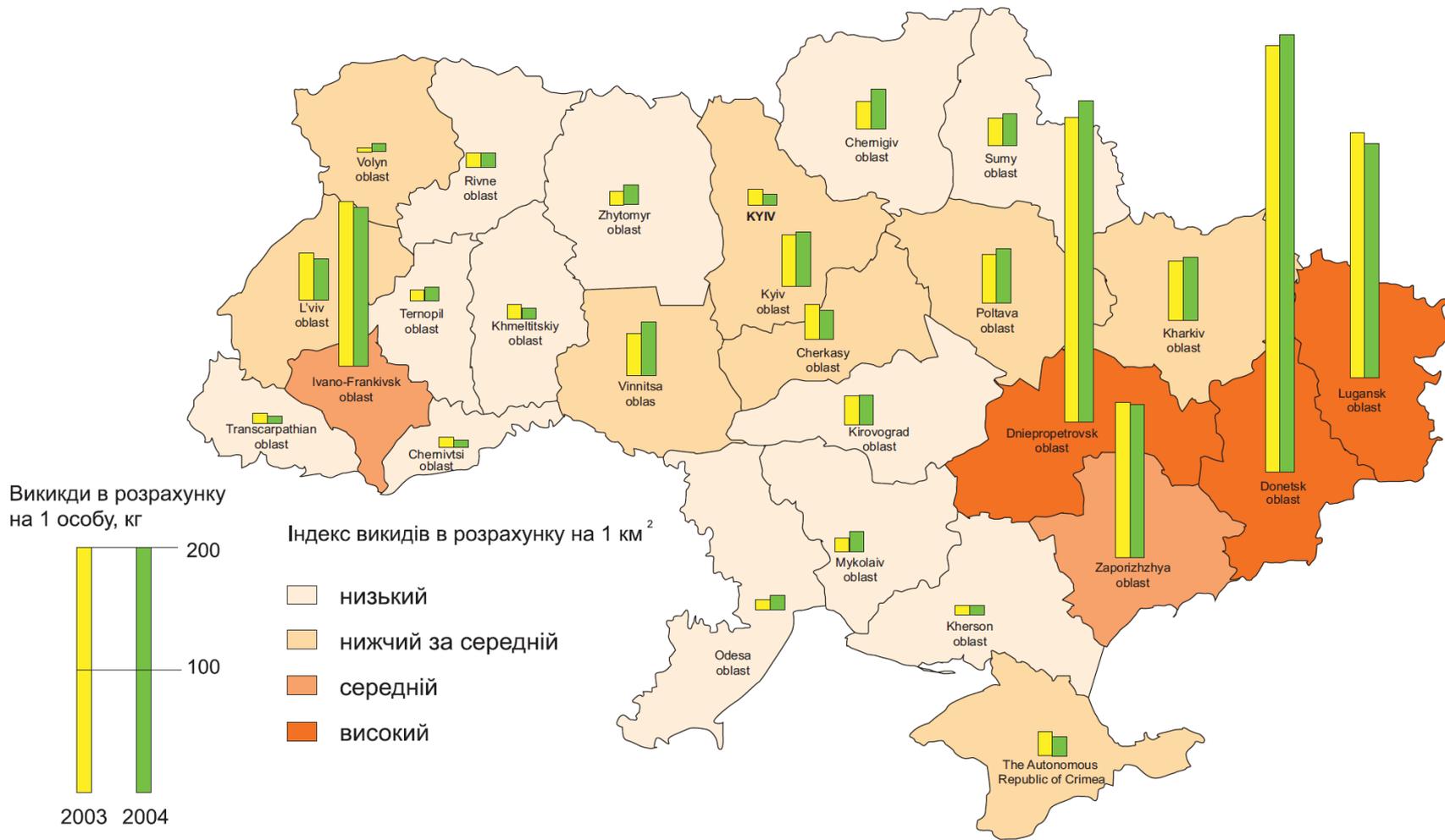
# Availability of transformers containing PCBs in accordance with administrative distribution obtained by inventory results, items/kg of PCBs (by the 1st quarter of 2006)



# Availability of capacitors containing PCBs in accordance with administrative distribution revealed by inventory results, items/kg of PCBs (by the 1st quarter of 2006)



# Release of harmful substances from stationary sources of pollution in the oblasts of Ukraine in 2004



**Stockholm Convention on Persistent Organic  
Pollutants (POPs)  
Elimination of polychlorinated biphenyls (PCBs)**

**GEF-UNIDO Project**

**Environmentally Sound Management and  
Final Disposal of Polychlorinated Biphenyls  
(PCBs) in Ukraine**



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION

# **THE CURRENT STATE OF THE ISSUE OF PERSISTENT ORGANIC POLLUTANTS (POPs) IN UKRAINE AND APPROACHES FOR ITS RESOLUTION**

**Chetverykov V.**, The Gas Institute of the National Academy of Sciences of Ukraine, Kyiv, Ukraine

**Holoubek I.**, RECETOX, Masaryk University, Brno, Czech Republic

**Pianykh K.**, The Gas Institute of the National Academy of Sciences of Ukraine, Kyiv, Ukraine

**As at March 31, 2006** - 21 615 tons of unusable or prohibited plant protection chemicals (PPC) were accumulated in Ukraine, 2 019 tons of them are pesticides classified as POPs, among which majority is DDT – 1 744 tons and hexachlorocyclohexane – 273 tons.

**January 01, 2019** – 8 193,3 tons

# PCBs problems

Total number of concentrated PCBs in 2003 was estimated to be 4 240 tons.

Similar to the case of pesticides, there have been significant changes in situation with PCBs in the time ahead.

Region	2003			2018		
	Number of enterprises, confirmed PCB presence	Transformers	Capacitors	Number of enterprises, confirmed PCB presence	Trans-formers	Capa-citors
Donetsk oblast		250	5 727	no information		
Total		970	91 990		322	29 502

# PCBs problems

Sample #	[CI]oil	[Sovtol]eq	Model of transformer	Company
1	2,33	< 2	ТРАН- 25000/35/10/10	KyivEnergo
1425	22,87	28,05	ТДТН-16000/110/3 5/10	KyivOblEnergo

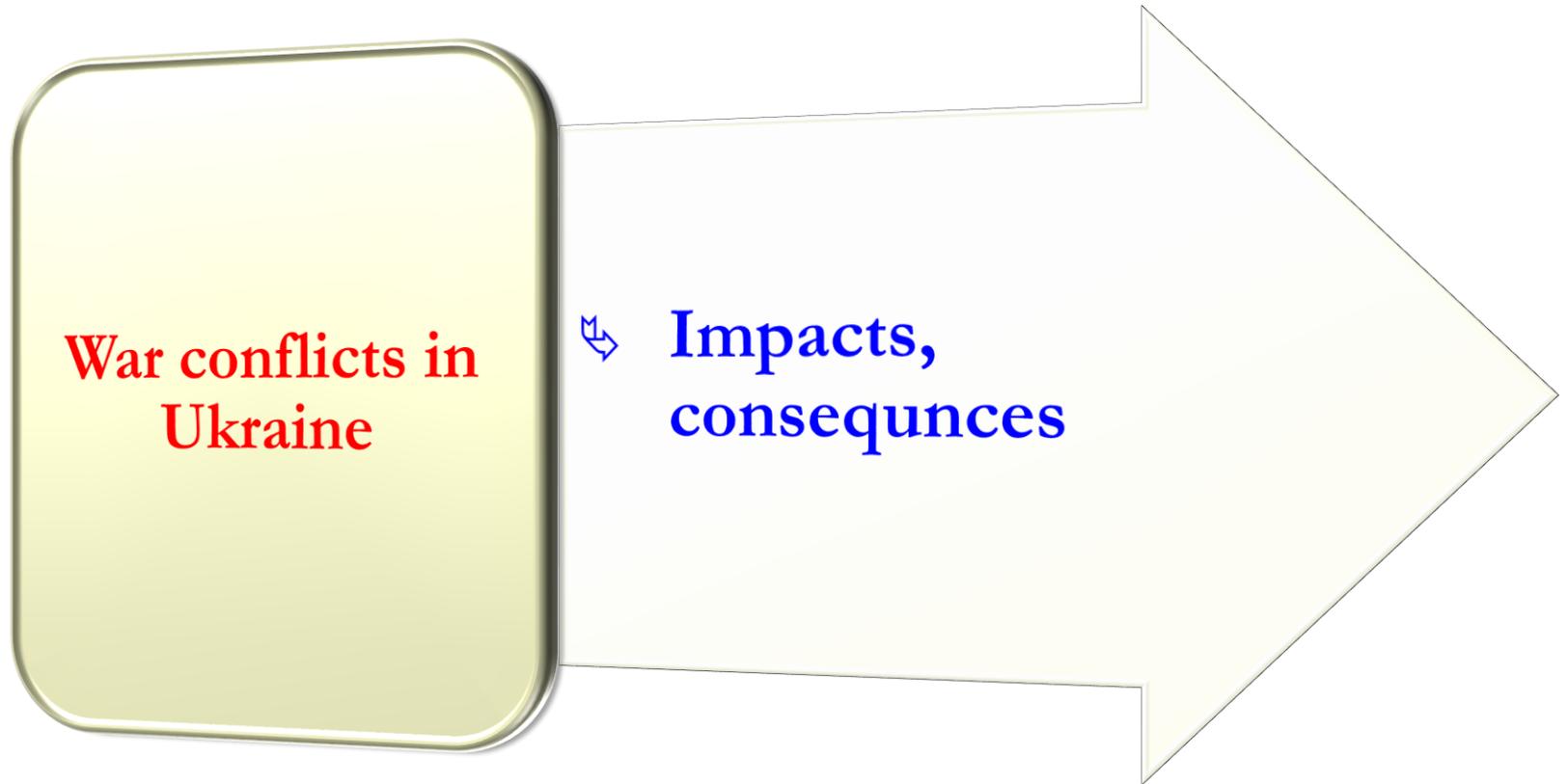
# PCBs problems



**THE PROJECT GEF ID 9732**

**REVIEW AND UPDATE OF THE  
NATIONAL IMPLEMENTATION PLAN  
FOR THE STOCKHOLM CONVENTION  
ON PERSISTENT ORGANIC  
POLLUTANTS IN UKRAINE**

# Contents



# War destruction and consequences

Among the facilities that were in the zone of hostilities or rocket attacks, the greatest potential risks of environmental pollution are chemical and metallurgical facilities and chemical and radioactive waste landfills.



# War destruction and consequences

## Chemical industry

The cities of Rubizhnoye, Severodonetsk and Lisichansk, which have been in the zone of military operations for several weeks, have undergone significant destruction.

Rubezhnoye - Several chemical enterprises are concentrated here, among which the Zorya enterprise produced the following products:

- a unit for raw benzene processing nitration facilities: for benzene to produce nitrobenzene, for benzoic acid to produce 3,5-DNBA
- a unit for production of weak nitric acid
- a unit for concentration of sulfuric acid
- production of industrial explosives
- production of chemical agents for plants protection
- production of isomers DNT and MNT
- production of carbamide formaldehyde and phenol formaldehyde resins
- production of polymer goods
- a unit for production of fluoroplastic equipment
- a unit for production of non-standard equipment
- a foundry



# War destruction and consequences

**Severodonetsk - Joint-stock Company “Azot”** - the third largest producer of ammonia in Ukraine and one of the largest enterprises in Europe of the chemical industry for the production of nitrogen fertilizers, methanol, acetic acid, vinyl acetate and its derivatives, acetylene, formaldehyde, catalysts, household chemicals and more chemical products.

On May 31, 2022, the aggressor's troops carried out an air strike on the enterprise and destroyed a tank with nitric acid in it.

On June 1, 2022, Russian troops again shelled the territory of the enterprise, hit one of the administrative buildings of the enterprise and the warehouse where methanol was stored.

On June 11, 2022, the Russian invaders once again shelled the territory of the azot chemical plant transport shop, where fuel and lubricants were ignited.



# War destruction and consequences

**Lysychansk - Pjsc "Lysychansk Oil Investment Company"—**  
Ukraine's second largest oil refinery, capable of refining 16 million tons of oil per year. As a result of the shelling, a fire broke out in the place of storage of oil sludge, covering 5 000 square meters.



# War destruction and consequences

## Metallurgy

In Ukraine, in metallurgical enterprises, transformers filled with PCB were widely used.

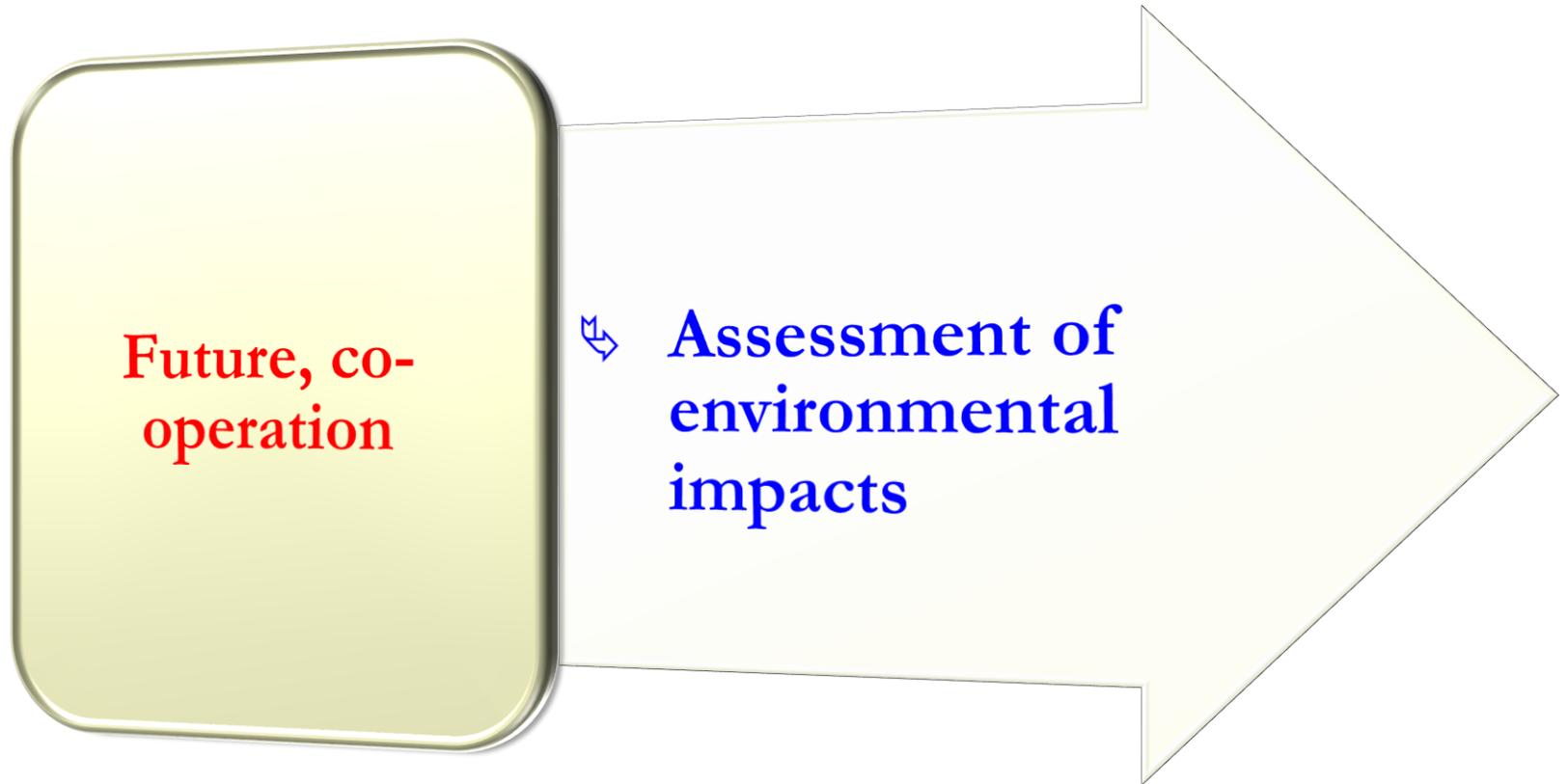
According to the 2004 inventory, there were 94 transformers at the Azovstal plant, and 96 transformers at the Ilyich plant.

Each transformer contains 2.5-3.5 tons of PCBs.

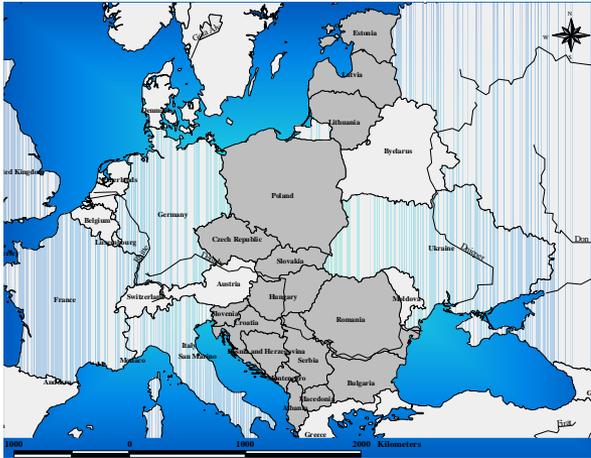
Today, Azovstal plant looks like this:



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# Regional war conflicts

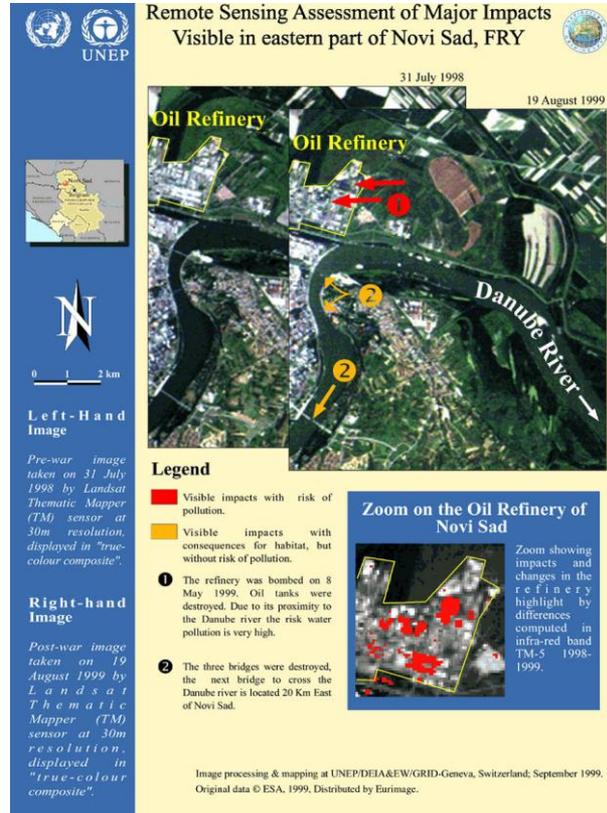
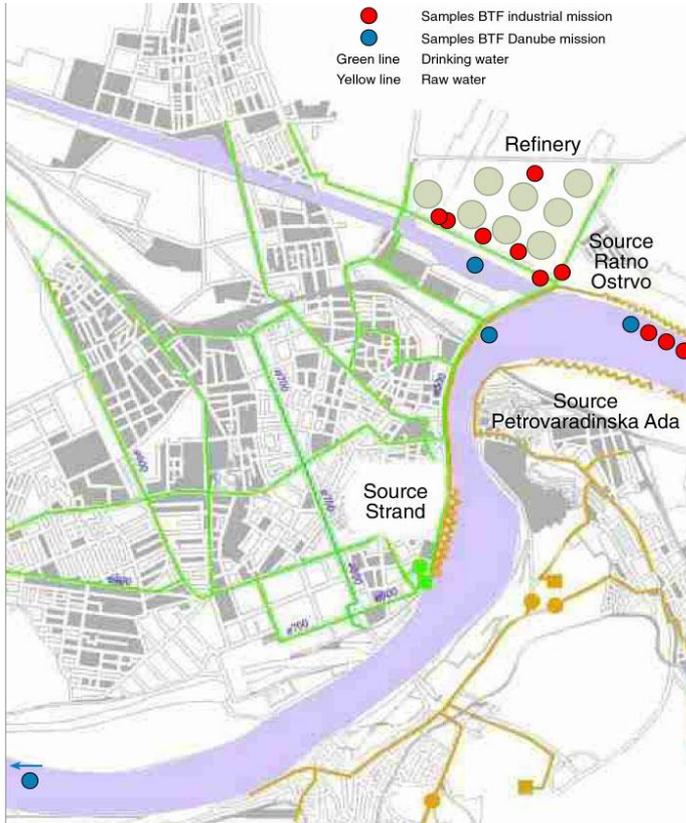


Balkan – BiH, Croatia, Serbia

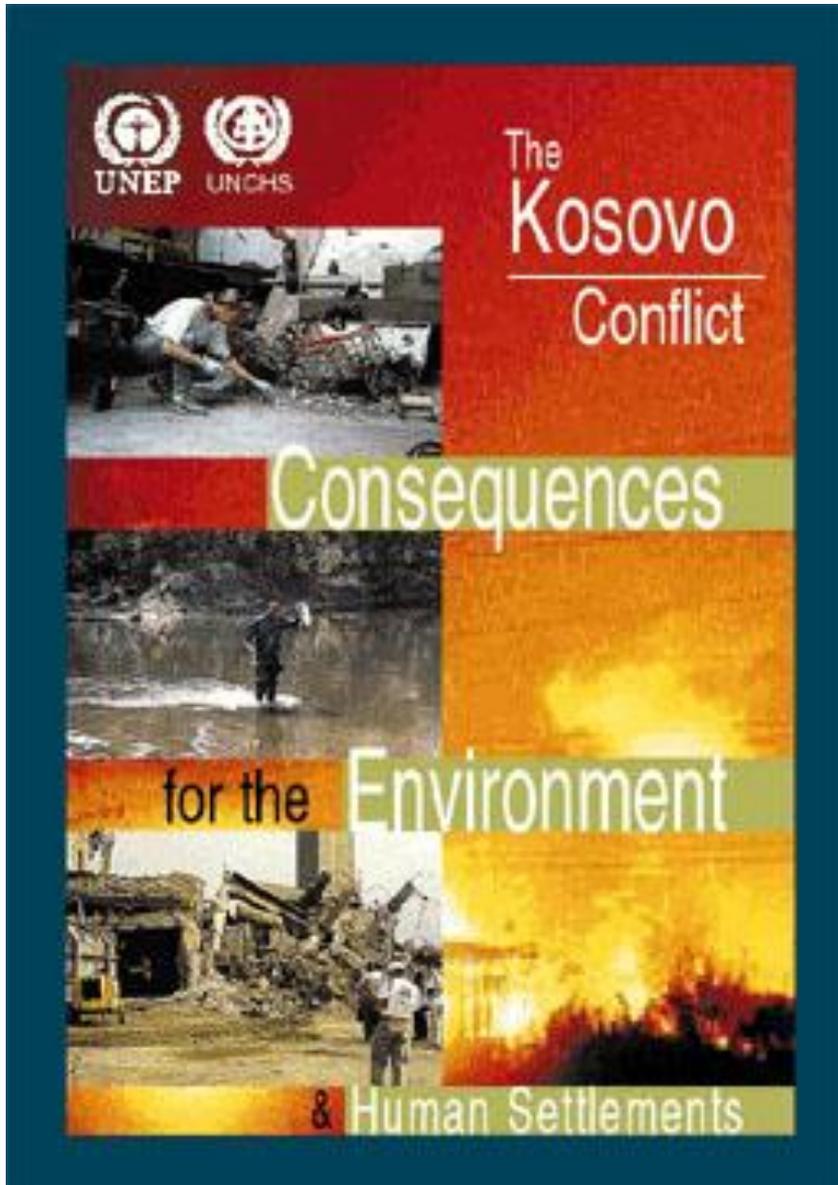
Caucas – Armenia, Chechnia



# Serbia



# The Kosovo conflict



# APOPSBAL

Assessment of the selected POPs (PCBs, PCDDs/Fs, OCPs) in the atmosphere and water ecosystems from waste materials generated by warfare in former Yugoslavia



# Proposal of common activity

**Title:** Preliminary assessment of the environmental impacts of the war in Ukraine

**Objective:** The objective of the draft proposal of environmental impacts assessment of the war in Ukraine is to gather as complete information as possible on the environmental consequences of the Russian invasion of Ukraine.

**The proposal was prepared by:**

**Prof. RNDr. Ivan Holoubek, CSc.**, RECETOX/CzechGlobe, Brno, Czech Republic in the co-operation with prof. **Dr. Olexander Bondar, Natalia Ryzhenko, Anna Vygovska, Pirtro Myliejin, Vanda Baranovska** (State Ecological Academy of Postgraduate Education and Management under the Ministry of Environmental Protection and Natural Resources of Ukraine), Kyiv, Ukraine, **Volodymyr Chetverykov**, The Gas Institute of the National Academy of Sciences of Ukraine (NASU), Kyiv, Ukraine

# Proposal of common activity

## Impact inventory

The effects of armed conflicts vary depending on the intensity and duration of the conflict, the type of terrain and the warring parties' intention to use the environment as a weapon. It is too early to make comprehensive estimates based on incomplete information from combat operations on the effects of the current conflict on the environment, but even from this information it can be clearly concluded that it will be considerable.

The following phases of the inventory project seem to be optimal:

- **First** - collection of historical information - from before the conflict - an overview of possible sources of environmental pollution and possible impacts on the environment in the event of an accident or war
- **Second** - gathering information from the course of the conflict - what was destroyed during the invasion - preparation of an interactive map (s) locating places with risk to the environment and humans - see the proposal of Ukrainian experts - Annex I
- **Third** - monitoring of environmental contamination in places posing the greatest risks to the environment, biota and humans based on the evaluation of hot spots from the second phase.

# Proposal of common activity

**CONCEPT** of creating an interactive map to monitor the parameters and objects of the natural environment that have suffered as a result of military operations of the Russian Federation on the territory of Ukraine



**Děkuji Vám za Vaší pozornost**

