Systems for environmental quality assurance and condition assessment

Environmental engineering MSc

Lecturer: Dr. Edit Kaszab PhD

Department of Environmental Safety

Outline

- The course covers basic knowledge of **environmental quality assurance and condition assessment**. The aim of this course is to serve knowledge
  - to **prepare the technical documentation** of environmental protection;
  - to **understand the operation** and objects of environmental facilities and to recognize the opportunities for further development;
  - to **plan, conduct and control** the environmental impact assessment procedure;
  - to design and operate **Environmental Management Systems** (EMS)

Project works - condition assessment

- 10-15 min individual ppt presentations following the recommended structure of thesis presentations (Introduction, Problem statement, Analysis, Discussion, Conclusions, References)
- Project:
  - Chosen country or area
  - Chosen topic

List of condition assessment project topics:

- Environmental condition assessment of
  - Water (supply, usage, condition)
  - Soil and geological medium (sensitivity, vulnerability)
  - Climate change and its effects on a region (water balance, extreme weather)
  - Industrial emissions (energy, production, transport)
  - Agricultural emissions
  - Renewable energy
  - Waste and sewage treatment
  - Air quality and pollution
  - Biological contamination, pandemy, biological weapons

Environmental Quality Assurance and Condition Assessment

- **First we will repeat what is:**
- Environment
- Environmental impact
- Environmental use
- Environmental protection
- Pollution

Environment

The surroundings or conditions in which we live and operate (organic, inorganic i.e., artificial)

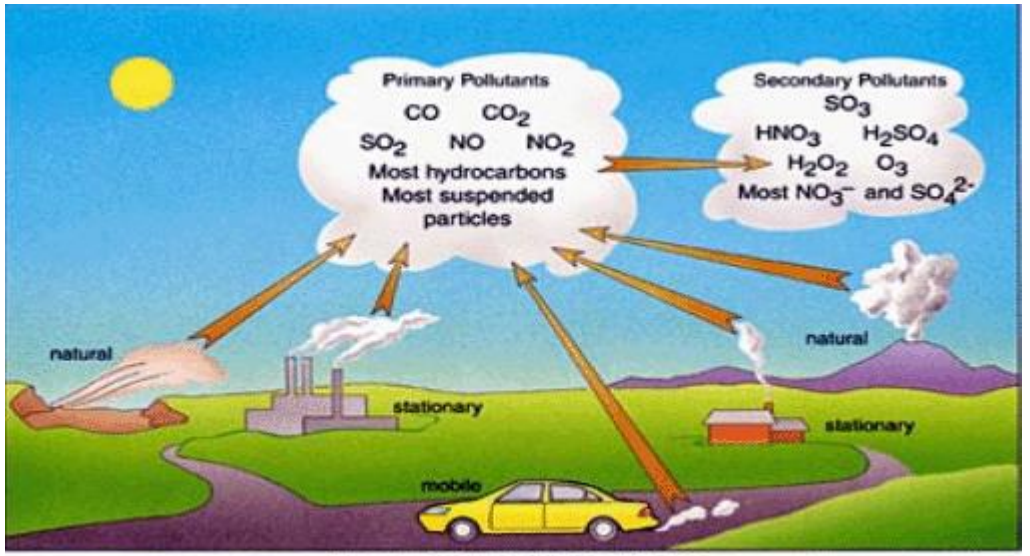
Environmental elements

- Natural environmental elements
  - Soil and geological medium (bedrock, minerals, sediments)
  - Water (surface and subsurface)
  - Air
  - Biosphere (plants, animals, microorganisms)
- Artificial (built) environment (settlements, road networks, etc.)

Environmental Pollutant

Substances or mixtures of substances, their degradation products, which, if released into the environment, may adversely affect the condition of environmental elements or harmful to human health or have a negative effect on environmental use.

Primary and secondary pollutants ??????



Types and sources of air pollutants

reminder

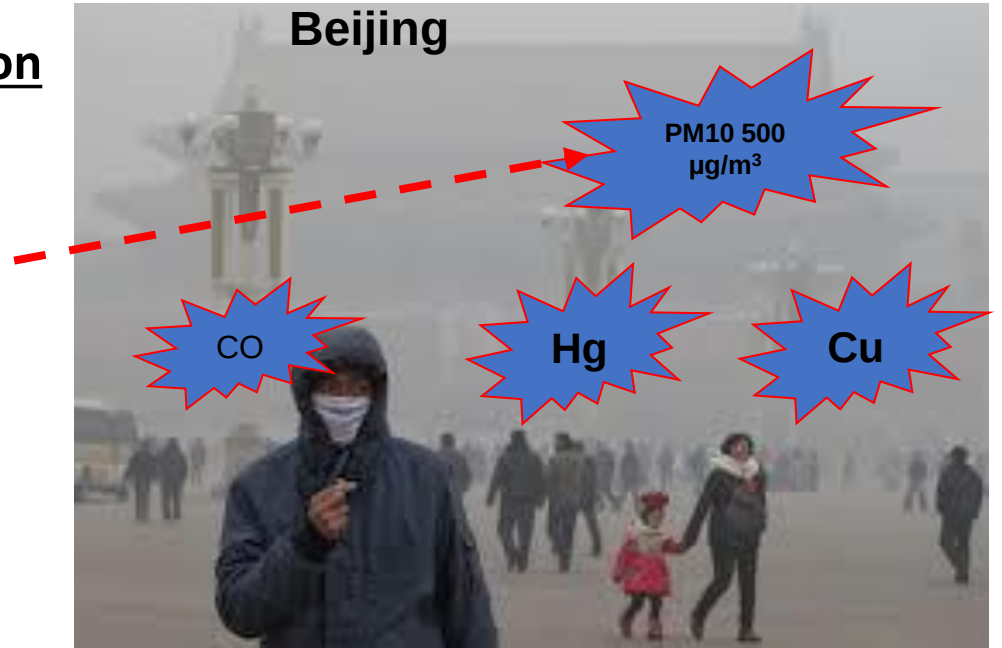
- **Source of pollutants:** place of origin
- **Pollution/Contamination:** discharge of contaminants (PROCESS!)
- **Pollution/Contamintion:**

  the result of the contamination characterized by the level of contamination (STATUS!)

reminder

- **Emission is the release of primary pollutants from a source. Further contaminants formed from a primary contaminated are referred to as secondary contaminats (SECONDARY POLLUTION)**

- **Immission is the measurable environmental concentration of pollutants released from emmission sources**



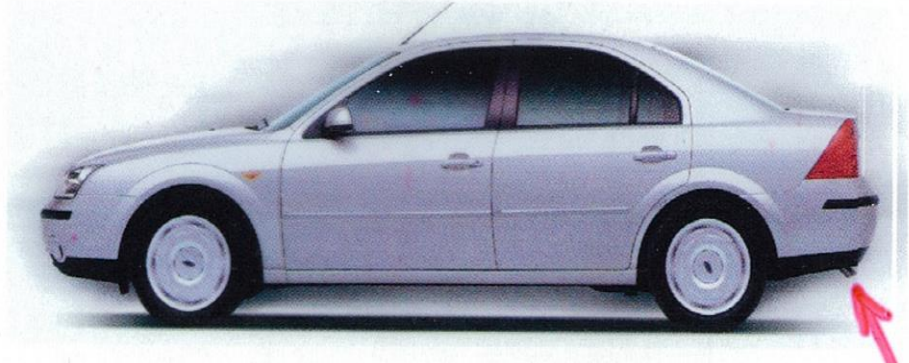
EMISSION AND IMMISSION LIMITS!

- **The source of contamination according to the spread of the pollutant**
- **<u>POINT SOURCE</u> (local pollution): the emission source delivers the pollutant to a given medium at a well-defined location (factory chimney, channel inlet to an open water receiver)**
- **<u>EXPANDED SOURCE</u> - Spatially distributed release of pollutants into the environmental element (surface, diffuse of non-point pollution): enters the medium over a large spatial extent (e.g. plant protection product, slurry, fertilizer use in agriculture and its leaching to surface water).**
- Surface source (air): any ambient air pollutant activity or material storage that is not a point or building source.

- **EXAMPLES for different sources of contamination**

LOCAL POINT SOURCE AND DIFFUSE SOURCE

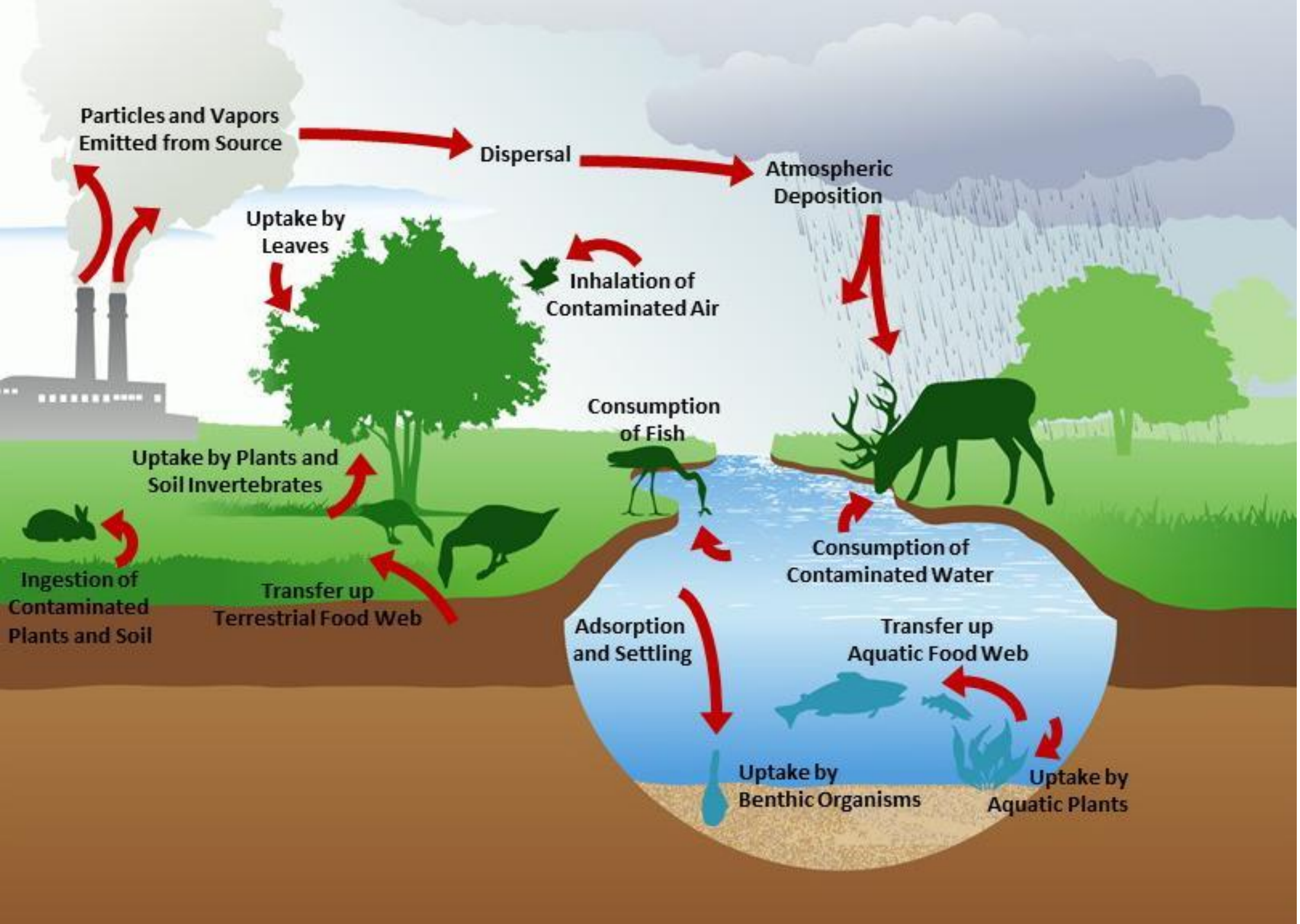
MOVING POINT SOURCE



?


ZUNHAMMER
ZUNHAMMER

DIFFUSE LOAD: this includes the amount of material washed away by rainfall from the immediate catchment area and the infiltration from groundwater


Particles and Vapors Emitted from Source
Dispersal
Atmospheric Deposition
Uptake by Leaves
Inhalation of Contaminated Air
Consumption of Fish
Uptake by Plants and Soil Invertebrates
Consumption of Contaminated Water
Ingestion of Contaminated Plants and Soil
Transfer up Terrestrial Food Web
Adsorption and Settling
Transfer up Aquatic Food Web
Uptake by Benthic Organisms
Uptake by Aquatic Plants


Loads occuring over a large area, in a difficult model distribution, at a particular location and time
?
infiltration
leaching

Environmental protection

- A system of activities and measures to protect, improve and prevent the deterioration of **natural environmental elements** (soil and geological medium, water, air, ecosystem, landscape) and **artificial environments** to

  ensure the health and survival of mankind and the ecosystem.

- The level of environmental protection is strongly connected to the stage of development (economic, technical, social, cultural, scientific, political and legal).

Environmental protection – Nature conservation

Nature conservation and landscape protection is an important PART OF ENVIRONMENTAL PROTECTION

NATURE CONSERVATION

- **Protection of some chosen conservation areas of natural environment (the hotspots of biodiversity)**
- **Tools of nature conservation are THE LIMITATION or COMPLETE TERMIATION OF HUMAN ECONOMIC AND OTHER ACTIVITI to ELIMINATE THE ANTHROPOGENIC EFFECT and to PRESERVE THE ORIGINAL STATE OF NATURAL ECOSYSTEM.**
- **AIM: to PRESERVE BIODIVERSITY**

ENVIRONMENTAL PROTECTION

THE PROTECTION OF NOT ONLY THE NATURAL ENVIRONMENT, BUT BUILT (I.E. ARTIFICIAL) ENVIRONMENT AS WELL.

AIM: TO ORGANIZE HUMAN ACTIVITIES (INDUSTRIAL, AGRICULTURAL, TRANSPORTATION, ETC.) IN A WAY TO PRESERVE THE NATURAL AND ARTIFICIAL ENVIRONMENT OF HUMANITY.

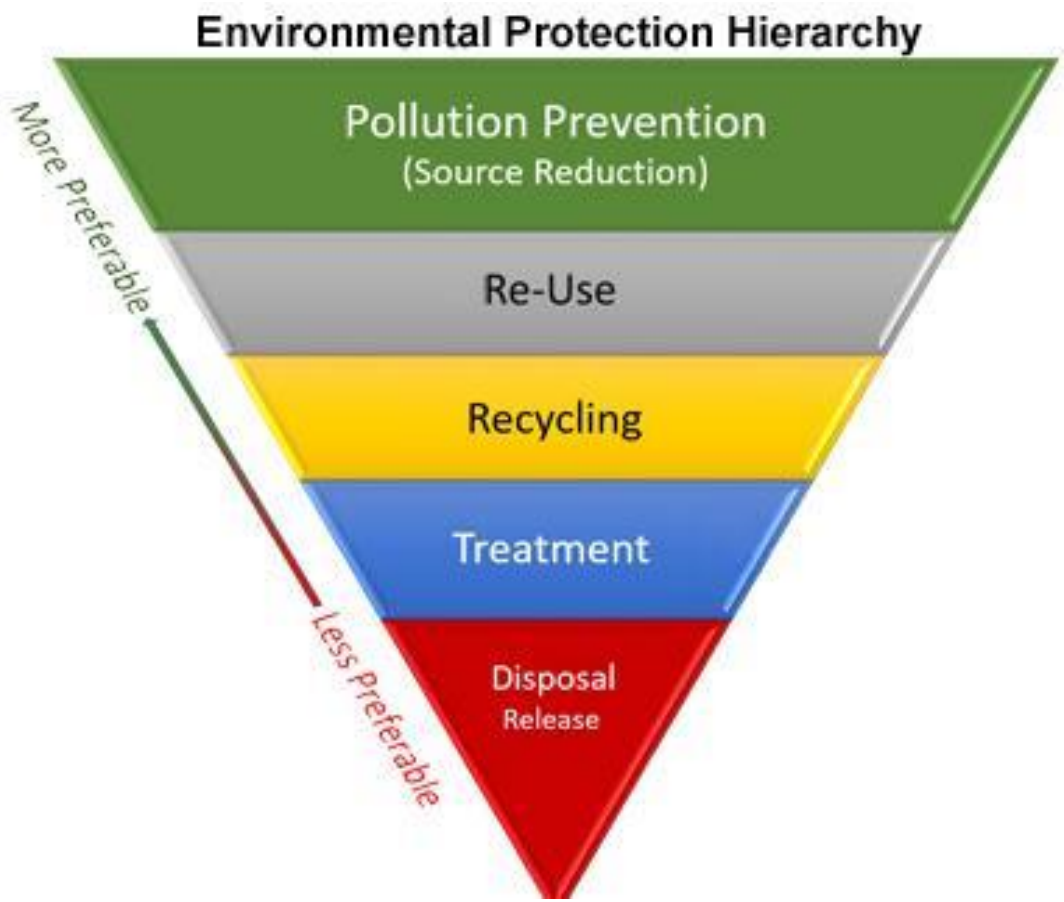
BALANCING – COMPROMISE SEARCH, BUT CONSERVATIVE ESTIMATION AND APPROACH!
(in environmental protection, a conservative risk/management approach is when the worst-case scenario is taken into account during planning or permitting environmental use)

In the long run, nature conservation areas can be only maintained with the elimination or reduction of harmful effects!

Environmental Protection Hierarchy (source: epa.gov)

Pollution prevention (P2) is any practice that reduces, eliminates, or prevents pollution at its source, also known as "source reduction."

- Source reduction is fundamentally different and more desirable than recycling, treatment and disposal.
- There are significant opportunities for industry to reduce or prevent pollution at the source through cost-effective changes in production, operation, and raw materials use.
- The opportunities for source reduction are often not realized because existing regulations focus upon treatment and disposal.



Environmental Pollution

Physical, chemical or biological changes in the properties of environmental elements which have an adverse effect on the health, survival or well-being of humans and/or other living organisms.

IN SHORT: SUCCEED ENVIRONMENTAL LIMIT VALUES OR THE ILLEGAL DISPOSAL OF WASTE

(BELOW LIMIT: ENVIRONMENTAL LOAD)

CAUTION: „DON'T BE ENCHANTED BY LIMIT VALUES" !!!

Threshold limit values (TLVs)

For physical, chemical, biochemical or biological parameters

Presence/absence: whether a component is found in the examined medium, or not (zero tolerance – e.g. Pseudomonas aeruginosa in drinking water – limit value 0/250 ml water)

Quantitative: a small concentration of the given parameter is permissible, so the purpose of test is to determine the exact quantity to see the extent of any deviation

Standards: preceded by thorough research (standardization, regulations)

~ 100 000 chemicals
on the market

~ 22 600 chemicals
with a use over
1 tonne per year

~ 4 700 chemicals
with a use over
100 tonnes per year
prioritised in
hazard characterisation
and evaluation

RISKS

HAZARDS

EXPOSURES

~ 500 chemicals
extensively characterised for
their hazards and exposures

~ 10 000 chemicals
fairly well characterised for
a subset of their hazards and exposures

~ 20 000 chemicals
with limited characterisation for
their hazards and exposures

~ 70 000 chemicals
with poor characterisation of
their hazards and exposures

MUTAGENIC

TOXIC

CARCINOGEN

BIOACCUMULATIVE

Fire and exposion

TERATOGENIC

INFECTIOUS

ENDOCRINE DISRUPTING

CORROSIVE

RADIOACTIVE

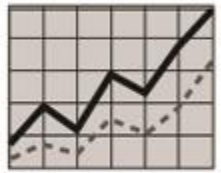
PERSISTANT

Data often used in developing an occupational exposure

PHYSICAL PROPERTIES
- Lipid solubility
- Water solubility
- Vapor pressure
- Odour threshold

ACUTE TOXICITY DATA
- Oral toxicity, LD50
- Dermal toxicity, LD50
- Dermal and eye irritation
- Inhalation toxicity, LC50

SUBACUTE AND SUBCHRONIC DATA (ORAL, DERMAL OR INHALATION)
- 14 day, NOEL
- 90 day. NOEL
- 6 month, NOEL



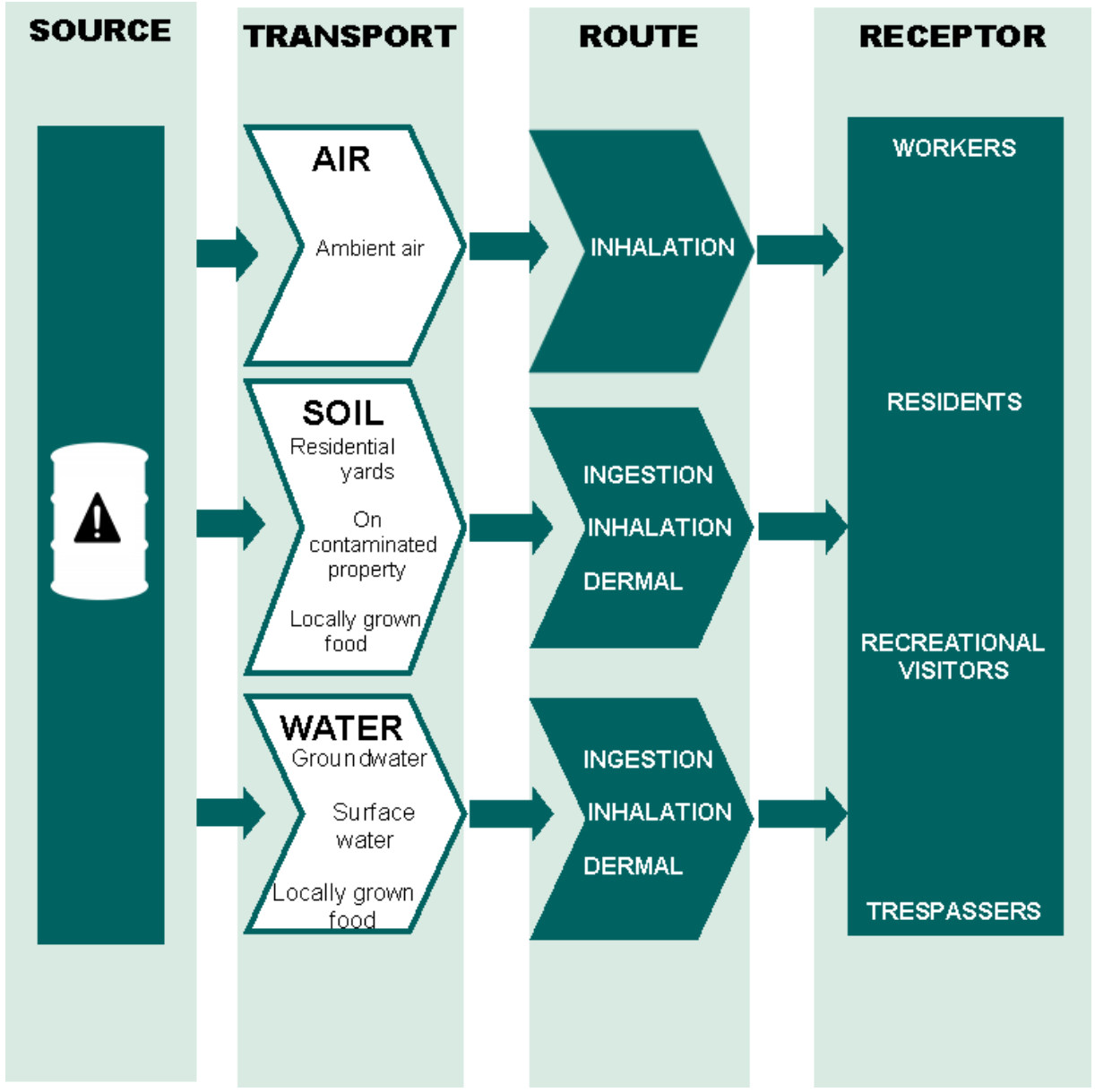
OTHER DATA
- Developmental (teratology and embryotoxicity)
- Mutagenicity (Ames test, Drosophila, etc.)
- Fertility
- Reproductive (3 generation)
- Reversability study
- Dermal absorption test
- Pharmacokinetics
- Cancer bioassay (2 year)

EPIDEMIOLOGICAL DATA
- Morbidity
- Mortality
- Base reports

INDUSTRIAL HYGIENE EXPOSURE DATA
- Area samples
- Personal samples

Source: April Weber, 2011

Exposure



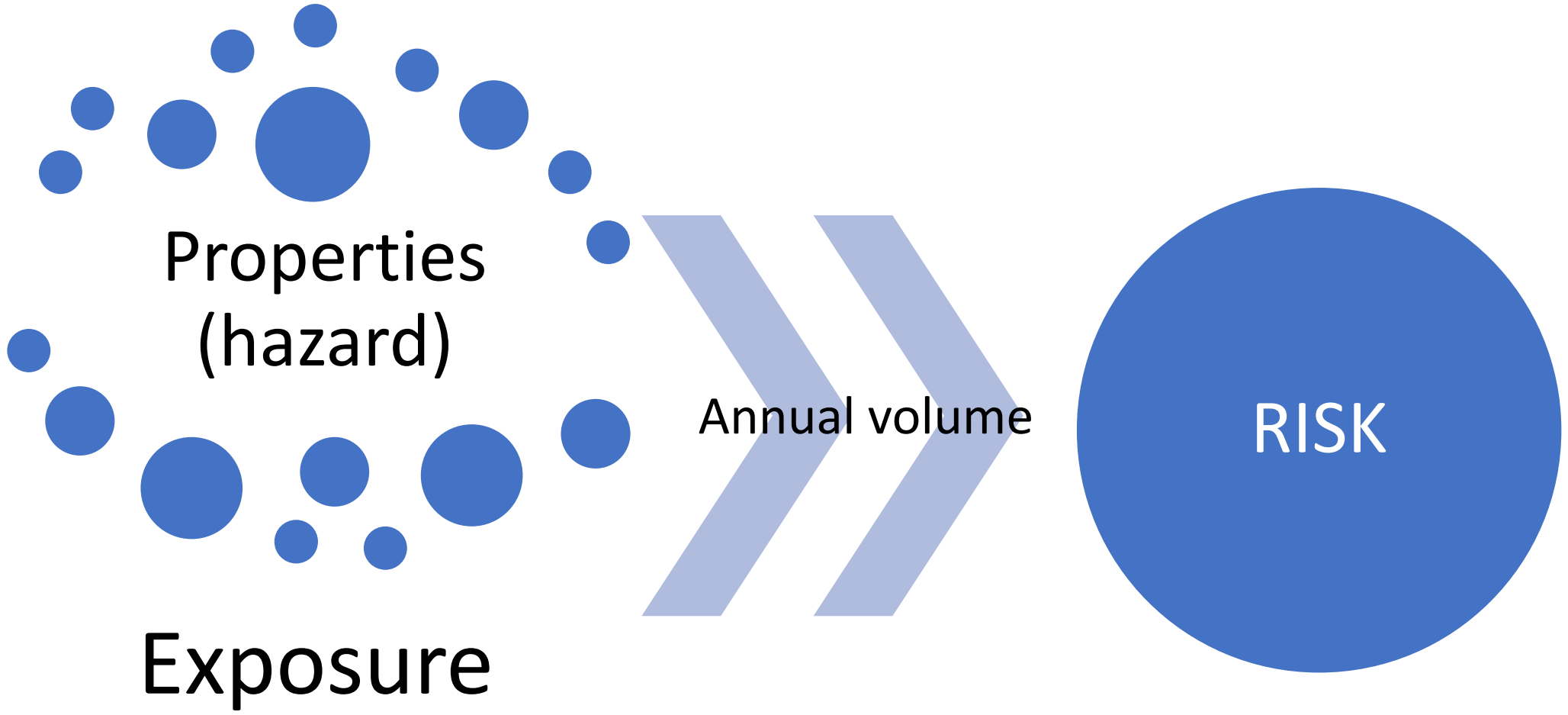
Source: https://matracking.ehs.state.ma.us/

Production and sale

- The annual global production of chemicals has risen from 1 million tonnes (1930) to over 400 million tonnes.
- On the community market, slightly more than 100 000 different substances are traded of which 30 000 succeed the annual volume of 1 tonne. Internationally, approx. 200-1000 new substances are introduced in a year.
- **According to World Wildlife Found (WWF) 80% of chamicals used in bulk have never been tested for human health (…what about ecological effects???)**

What is an environmental contamintant/pollutant to…

- **ambient air**
- **surface water**
- **soil and geological medium/subsurface water?**


Properties
(hazard)
Exposure
Annual volume
RISK

Carcinogen?

SAFETY SHEETS! → Hazard statements (H350 and H351)

Label elements for carcinogenicity

Classification	Category 1 (Category 1A, 1B)	Category 2
GHS Pictograms		
Signal Word	Danger	Warning
Hazard Statement	H350: May cause cancer (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard)	H351: Suspected of causing cancer (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard)
Precautionary Statement Prevention	P201 P202 P280	P201 P202 P280
Precautionary Statement Response	P308 + P313	P308 + P313
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SAFETY SHEETS! → Hazard statements (H350 and H351)

International Agency for Research on Cancer
World Health Organization

IARC (INTERNATIONAL AGENCY FOR RESEARCH ON CANCER)

Last update: 12 August 2022. 1035 substances

More than 40 years of data collection !!!

https://monographs.iarc.fr/agents-classified-by-the-iarc/

Agents Classified by the IARC Monographs, Volumes 1–132

Group 1	Carcinogenic to humans	122 agents
Group 2A	Probably carcinogenic to humans	93 agents
Group 2B	Possibly carcinogenic to humans	319 agents
Group 3	Not classifiable as to its carcinogenicity to humans	501 agents

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EPA USA (ENVIRONMENTAL PROTECTION AGENCY)

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REACH COMPLIANCE

European Union: REACH (in force: EC 1907/2006) Annex. XVII. Carcinogen substances are listed in Appendix 1, Entry 28. (Entry 29. is listing mutagens)

Carcinogens category 1A and 1B

WHAT IS REACH? → separate slide

What is REACH?

REACH (EC 1907/2006) aims to improve the protection of human health and the environment through the better and earlier identification of the intrinsic properties of chemical substances.

This is done by the four processes of REACH, namely the **R**egistration, **E**valuation, **A**uthorisation and restriction of **CH**emicals.

REACH also aims to enhance innovation and competitiveness of the EU chemicals industry.

„No data no market" phylosophy: the REACH Regulation places responsibility on industry to manage the risks from chemicals and to provide safety information on the substances.

The Regulation also calls for the progressive substitution of the most dangerous chemicals (referred to as "substances of very high concern") when suitable alternatives have been identified.

Annex XVII REACH

- The restricted substances (on their own, in a mixture or in an article) are substances for which manufacture, placing on the market or use is limited or banned in the European Union.

ANNEX XVII

RESTRICTIONS ON THE MANUFACTURE, PLACING ON THE MARKET AND USE OF CERTAIN DANGEROUS SUBSTANCES, MIXTURES AND ARTICLES

Column 1 **Designation of the substance, of the group of substances or of the mixture**	**Column 2** **Conditions of restriction**
1. Polychlorinated terphenyls (PCTs)	Shall not be placed on the market, or used: — as substances, — in mixtures, including waste oils, or in equipment, in concentrations greater than 50 mg/kg (0,005 % by weight).
2. Chloroethene (vinyl chloride) CAS No 75-01-4 EC No 200-831-0	Shall not be used as propellant in aerosols for any use. Aerosols dispensers containing the substance as propellant shall not be placed on the market.

ECHA (European Chemicals Agency) table

- A table has been prepared by the European Chemicals Agency (ECHA) to facilitate the searching of restricted substances in the Annex XVII of the REACH Regulation, and the table provides additional information related to the specific restriction entry.

Substance name kibontás/összecsukás	EC No.	CAS No.	Entry no.	Conditions	Appendices	
(3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl)silanetriol and any of its mono-, di- or tri-O-(alkyl) derivatives	-	-	73			
1,1,1,2-Tetrachloroethane	-	630-20-6	36			
1,1,2,2-Tetrachloroethane	201-197-8	79-34-5	35			
1,1,2-Trichloroethane	201-166-9	79-00-5	34			
1,1-Dichloroethene	200-864-0	75-35-4	38			
1,4-Dichlorobenzene	203-400-5	106-46-7	64			
1-methyl-2-pyrrolidone	212-828-1	872-50-4	71			
2-(2-butoxyethoxy)ethanol (DEGBE)	203-961-6	112-34-5	55			

Categories	Criteria
CATEGORY 1:	Known or presumed human carcinogens A substance is classified in Category 1 for carcinogenicity on the basis of epidemiological and/or animal data. A substance may be further distinguished as:
Category 1A:	Category 1A, known to have carcinogenic potential for humans, classification is largely based on human evidence, or
Category 1B:	Category 1B, presumed to have carcinogenic potential for humans, classification is largely based on animal evidence.
	The classification in Category 1A and 1B is based on strength of evidence together with additional considerations (see section 3.6.2.2). Such evidence may be derived from: •human studies that establish a causal relationship between human exposure to a substance and the development of cancer (known human carcinogen); or •animal experiments for which there is sufficient[a] evidence to demonstrate animal carcinogenicity (presumed human carcinogen).
	In addition, on a case-by-case basis, scientific judgement may warrant a decision of presumed human carcinogenicity derived from studies showing limited evidence of carcinogenicity in humans together with limited evidence of carcinogenicity in experimental animals.
CATEGORY 2:	Suspected human carcinogens The placing of a substance in Category 2 is done on the basis of evidence obtained from human and/or animal studies, but which is not sufficiently convincing to place the substance in Category 1A or 1B, based on strength of evidence together with additional considerations (see section 3.6.2.2). Such evidence may be derived either from limited[a] evidence of carcinogenicity in human studies or from limited evidence of carcinogenicity in animal studies.

Label elements for carcinogenicity

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Identification criteria for persistant (P) bioaccumulative (B), toxic (T), very persistant (vP) and very toxic (vT) substances

	Persistant (P) criteria, half life (days)	Very persistant (vP) criteria, half life (days)	Bioaccumulative (B) criteria, bioconcentration factor	Very bioaccumulative (vB) criteria, bioconcentration factor	Toxicity (T) Criteria
Seawater	> 60	> 60	Aquatic species > 2000	Aquatic species> 5000	a) NOEC or EC10 is lower than 0.01 mg/l; b) Based on the 1272/2008/EC directive, substance is classified as a carcinogen (category I and II), mutagen or reprotoxic agent c) There are other evidences for the chronic toxicity e.g. The substance is classified as a Specific Target Organ Toxicant (STOT) (it produces specific target organ toxicity/systemic effects that are not specifically addressed elsewhere in the GHS). All significant health effects that can impair function, both reversible and irreversible, following single exposure or repeated exposure, are included.
Freshwater or estuary	> 40				
Sea sediment	>180	> 180			
Freshwater or estuary sediment	> 120				
SOIL	> 120	> 180			

What is considered as environmental contaminant/pollutant (i.e. harmful substance/chemical?

Ambient air (Hungarian low):

4/2011. (I. 14.) VM decree: technological (general: 228 organic substance + 11 carcinogen and procedure-specific: 56 procedure (e.g. steel construction, fertilizer production, etc.) emission values; air load level exposure limits (20 substance with a special attention to air pollutants of major importance and carcinogen air pollutants immission values), air pollutants planning values (166 substances + sedimenting dust!), disclosure (information) and alert thresholds (sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter PM10, ozone) , critical air load levels set to protect ecosystems (sulfur dioxide, nitrogen oxides, ammonia, near-ground ozone, 9 types of aerosols including metal-containing ones)

AIR POLLUTANTS OF MAJOR IMPORTANCE

4/2011.(I.14.) VM DECREE

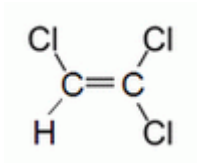
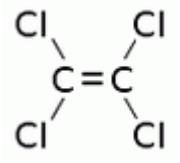
Sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter PM10, lead, mercury and benzene (carcinogen air pollutant),

ozone is in a separate section

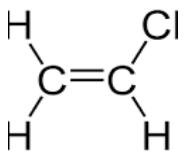
„CERTAIN CARINOGEN AIR POLLUTANTS”

Arsenic, Cadmium, Nickel, Benzo(a)pyrene, Chromium, Beryllium, 1,3-Butadiene, Dioxins and furans, Tetrachloroethylene, Trichlorethylene, Vinyl chloride,

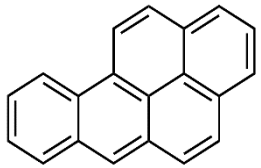
Special item: asbestos

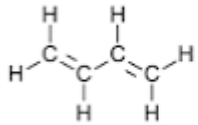
Trichlorethylene, Tetrachlorethylene



Vinyl chloride



Benzo(a)pyrene

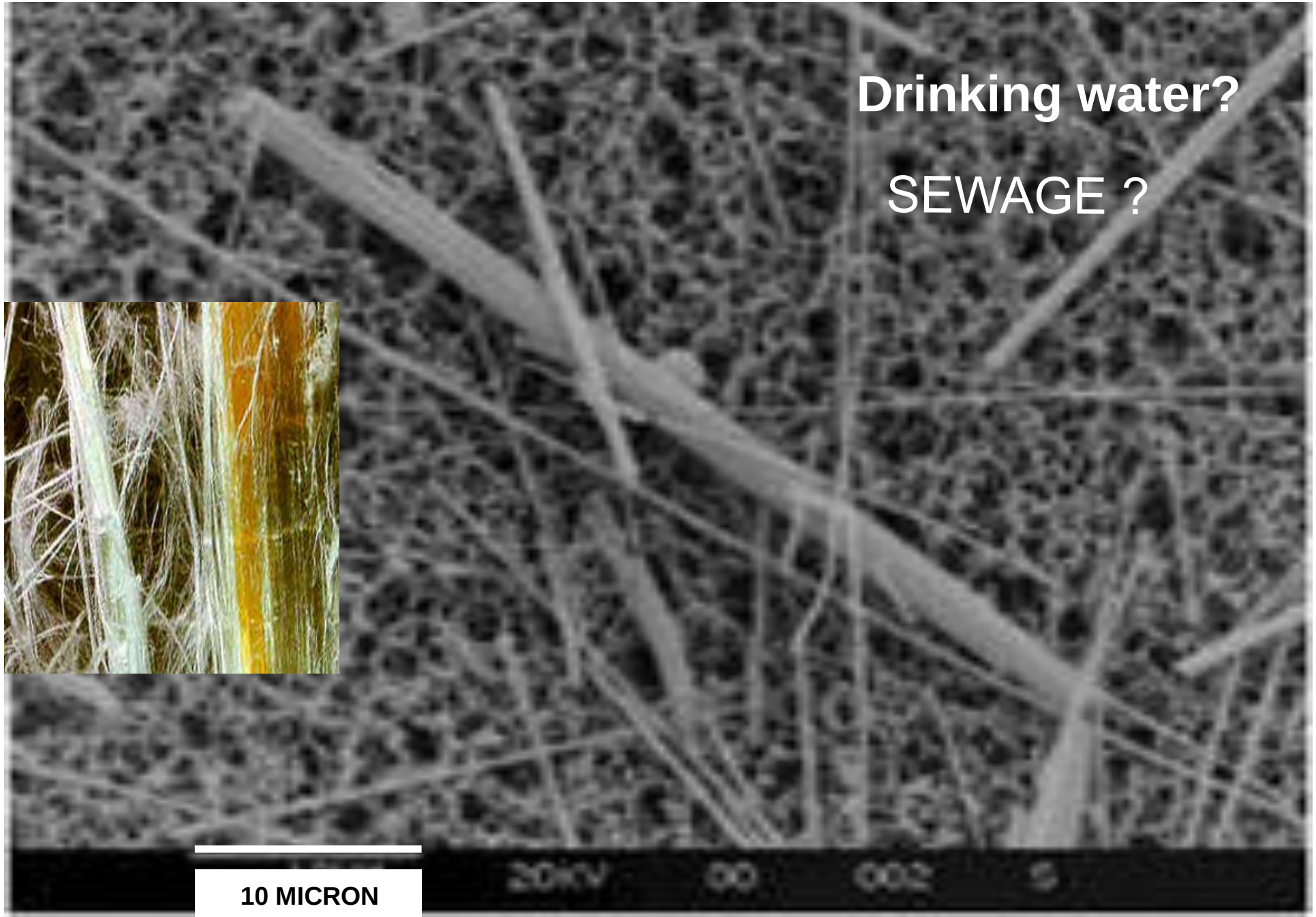


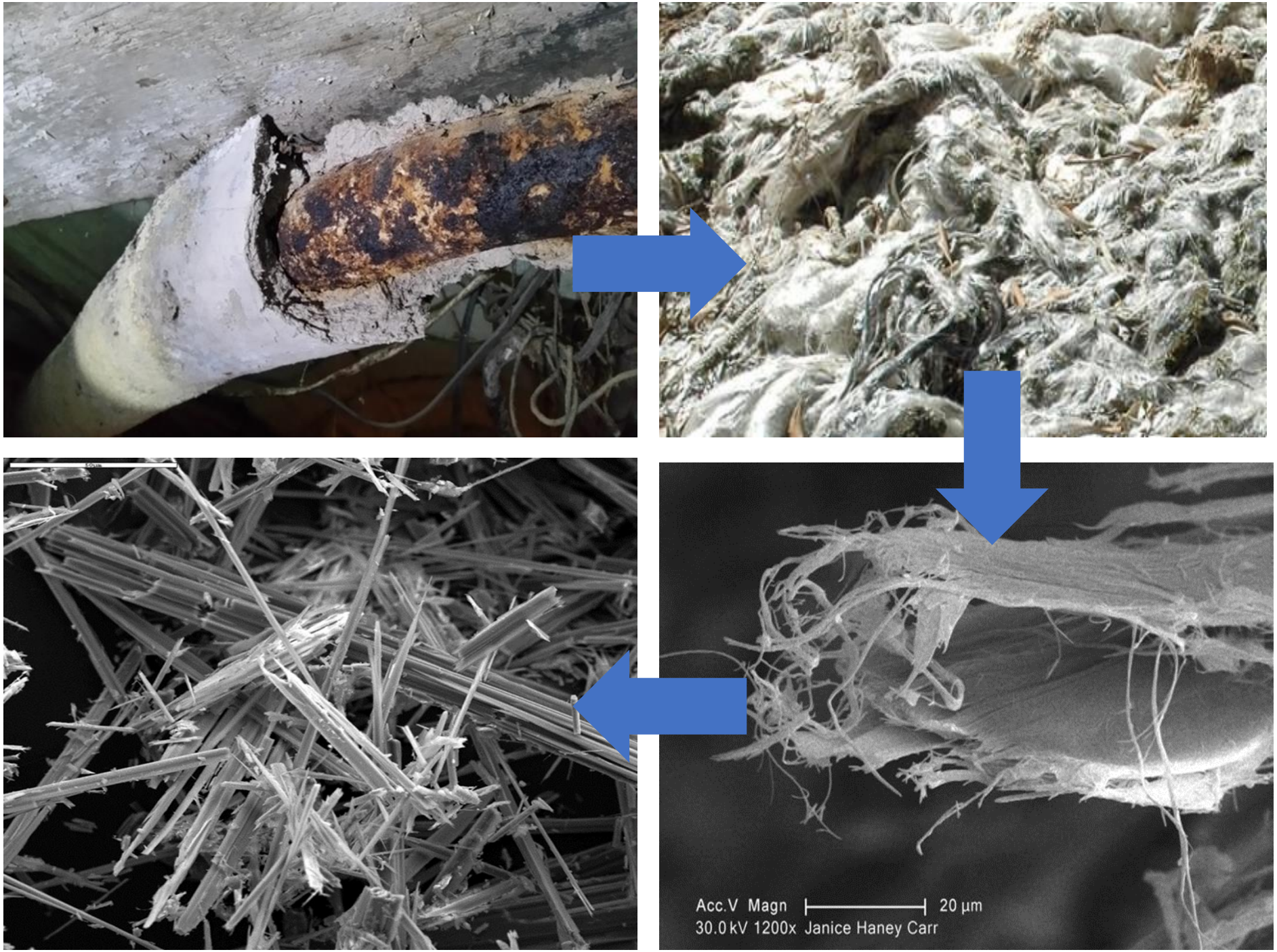
butadiene

Asbestos

- **Asbestos** refers to six naturally occurring silicate minerals.
- All are composed of long and thin fibrous crystals, each fiber being composed of many microscopic 'fibrils' that can be released into the atmosphere by abrasion and other processes.
- Asbestos is an excellent electrical insulator and is highly resistant to heat, so for many years it was used as a building material.
- However, it is a well known health hazard, and today the use of asbestos as a building material is now illegal in many countries. Inhalation of asbestos fibres can lead to various serious lung conditions, including asbestosis and cancer.

Electron microscopic image of asbestos fibers




Acc.V Magn
20 µm
30.0 kV 1200x Janice Haney Carr

Surface water

- **10/2010. (VIII. 18.) VM decree on surface water contamination limit values (connected to Water Framework Directive to determine the general chemical and physical properties of water affecting biological elements such as priority and other substances)**

  56 priority substance, 4 other harmful substance (zinc, copper, chrome, arsenic)

- **28/2004 (XII.25.) KvVM decree on emission values of water pollutants…**

  (technological: 37–types of technology, areal: 35-types of parameters, parameters for release to public sewer: 40 parameters, unique limits: 54 parameters)

Soil and subsurface water

219/2004. (VII. 21.) Government Regulation

About the protection of subsurface water and its implementing regulation:

6/2009. (IV. 14.) KvVM-EüM-FVM joint decree

1. melléklet a 6/2009. (IV. 14.) KvVM–EüM–FVM együttes rendelethez

Anyagcsoportonként (B) szennyezettségi határértékek földtani közegre

CAS szám = Chemical Abstract Service azonosító száma
K_i = a veszélyességet jellemző besorolás, mely szerint K1 a minden esetben veszélyes anyagokat jelöli
B = (B) szennyezettségi határérték

(B) Contamination threshold value

1. Fémek („összes" kioldható) és félfémek (mértékegység: mg/kg szárazanyag)

CAS szám		B	K_i
7440–47–3	Króm összes	75	K2
	Króm VI.	1	K1
7440–48–4	Kobalt	30	K2
7440–02–0	Nikkel	40	K2
7440–50–8	Réz	75	K2
7440–66–6	Cink	200	K2
7440–38–2	Arzén	15	K1
7782–49–2	Szelén	1	K2
7439–98–7	Molibdén	7	K2
7440–43–9	Kadmium	1	K1
7440–31–5	Ón	30	K2
7440–39–3	Bárium	250	K2
7439–97–8	Higany	0,5	K1
7439–92–1	Ólom	100	K2
7440–22–4	Ezüst	2	K2

2. Szervetlen vegyületek (mértékegység: mg/kg szárazanyag)

CAS szám		B	K_i
	Cianid 4,5 pH	2	K1
	Cianid összes	20	K1
	Tiocianátok	1	K1

3. Alifás szénhidrogének (TPH) (mértékegység: mg/kg szárazanyag)

	B	K_i
Összes alifás szénhidrogén (TPH) C_5–C_{40}	100	K1

4. Benzol és alkilbenzolok (BTEX) (mértékegység: mg/kg szárazanyag)

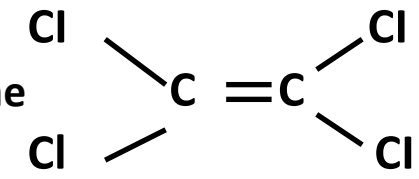
CAS szám		B	K_i
71–43–2	Benzol	0,2	K1
108–88–3	Toluol	0,5	K1
100–41–4	Etil-benzol	0,5	K1
1330–20–7	Xilolok	0,5	K1

Approx. 180 substance

$K_{(1\text{-}2)}$: hazard classification according to toxicity, degradation and accumulation in human body

Example for secondary contaminant in soil-groundwater system:
Among chlorinated hydrocarbon substances in soil:

tetrachloroethylene



Water solubility: 150 mg/L

CSF_{oral} : 0,052

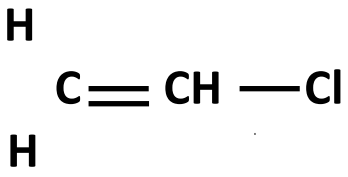
$CSF_{inhalation}$: 0,002

RfDo = 1.0E-02, (i:1,4E-01)

[RfD: mg/bodyweightkg/day]

(„dry" cleaning) degradation in low oxygen environments

Vinyl cloride*



Water solubility : 2670mg/L

CSF_{oral} : 1,5

$CSF_{inhalation}$: 0,03

RfDo = 3.0E-03 (i:2,8E-02)

Which is more water soluble and more reactive with proteins and nucleic acids than the parent compound.

Environmental Impact

- Changes in the environment arising completely or partially from a natural process, phenomenon or activity of an individual or an organization, its products or its services.
- Environmental impact can be favorable or unfavorable.
- In short: any activity with an impact on the environment (or on one of the environmental elements)

Use of the environment

- An activity subject to permit for the use or exposure of the environment or an environmental element.

Use of the environment:

bring change into the environment,

the usage of environment or an element as a natural resource (e.g., ecosystem service)

Environmental impact:

release of a substance or energy into the environment

THE QUESTION IS: Where is the threshold between environmental impact and environmental contamination?

General rules for the use of environment

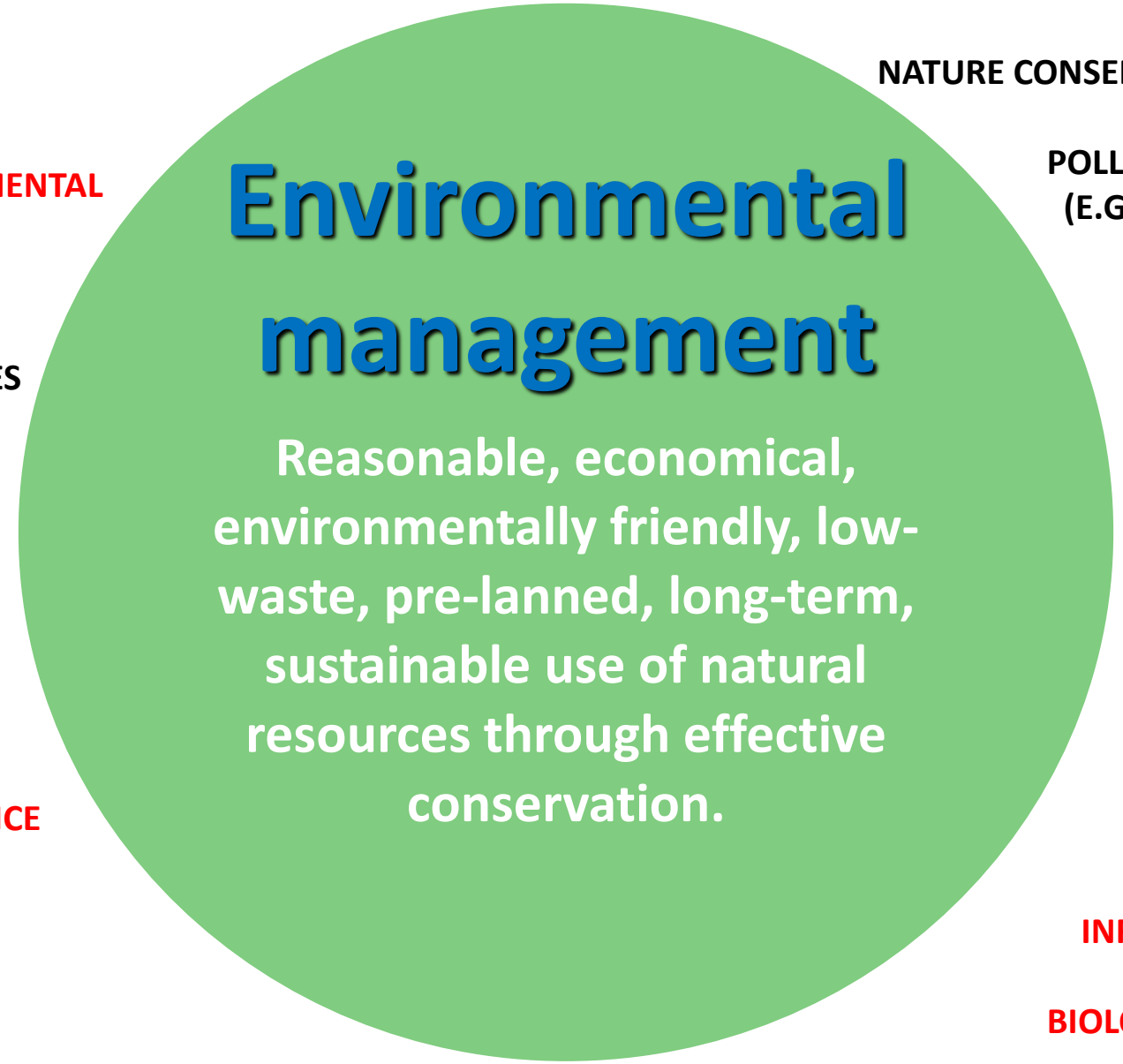
- The use of environment should be organized and carried out in a way to
  - Cause only a minimum impact on environmental elements;
  - Prevent pollution;
  - Exclude damage of the environment.
  - The use of environment should be organized and carried out in a way to
- The use of environment should be carried out following the precautionary principle, the sound and prudent use of environmental elements, the minimalization of waste and the recycling/reuse of natural and produced materials.
- As prevention, the most effective solution should be used to minimize the environmental impact and in the case of activities covered by specific legislation, best available techniques (BATs) should be used.

Environmental Quality Assurance and Condition Assessment

- Quality assurance cannot be discussed without condition assessment!
- Claim: Environmental objectives and tools for development cannot be determined without the accurate exploration of the current state of environmental quality. Changes in quality and stocks of natural resources and the social needs/intentions should be all evaluated.
- Environmental quality assurance: integrated, interdisciplinary approach! Part of the comprehensive **environmental management**.

Environmental management

Reasonable, economical, environmentally friendly, low-waste, pre-lanned, long-term, sustainable use of natural resources through effective conservation.



ENVIRONMENTAL PROTECTION

NATURE CONSERVATION

POLLUTANTS
(E.G. POP, EDC, EMP)?

MITIGATION

DAMAGE CONTROL

REMEDIATION

SEWAGE TREATMENT

WASTE MANAGEMENT

DISASTER CONTROL MANAGEMENT

PROTECTION OF CRITICAL INFRASTRUCTURES

BIOLOGICAL CONTAMINANTS

ENVIRONMENTAL SAFETY

THE CONDITION OF ENVIRONMENTAL ELEMENTS (EXOTOXICOLOGY? MONITORING?)

USAGE OF NATURAL RESOURCES

USE OF ENVIRONMENT AND RESOURCES, ENVIRONMENTAL LOAD

IPPC PERMIT

ENVIRONMENTAL REVIEW

ENVIRONMENTAL PERFORMANCE REVIEW

CORPORATE ENVIRONMENTAL MANAGEMENT AND QUALITY ASSURANCE SYSTEMS

Systems for environmental quality assurance and condition assessment

Environmental engineering MSc

Lecturer: Dr. Edit Kaszab PhD

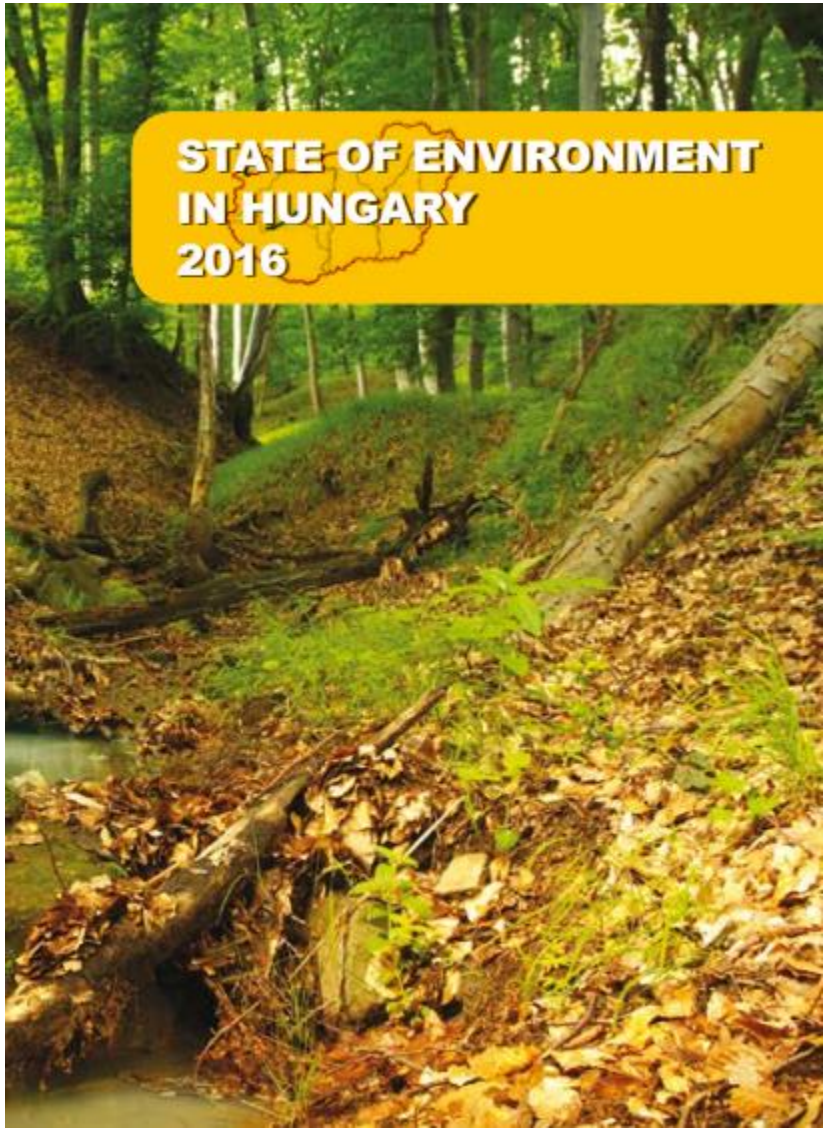
Department of Environmental Protection and Safety

Environmental condition assessment

- In the context of environmental assessment, changes in the state of environmental elements and their systems must to be analyzed in a context with triggering economic, social and environmental processes.
- With a complex analysis, the process can be described so the effects can be more, or less predicted. Given that data sources, information sets are diverse, analysis, models and information systems are essential.

- EXAMPE: the environmental condition of Hungary

Help for your project



Extract
from the State of Environment in Hungary 2016

This publication is an extract from the overview of
"Magyarország Környezeti Állapota 2016."

Publisher: Herman Ottó Institute Nonprofit Ltd. 1223 Budapest Park u. 2.
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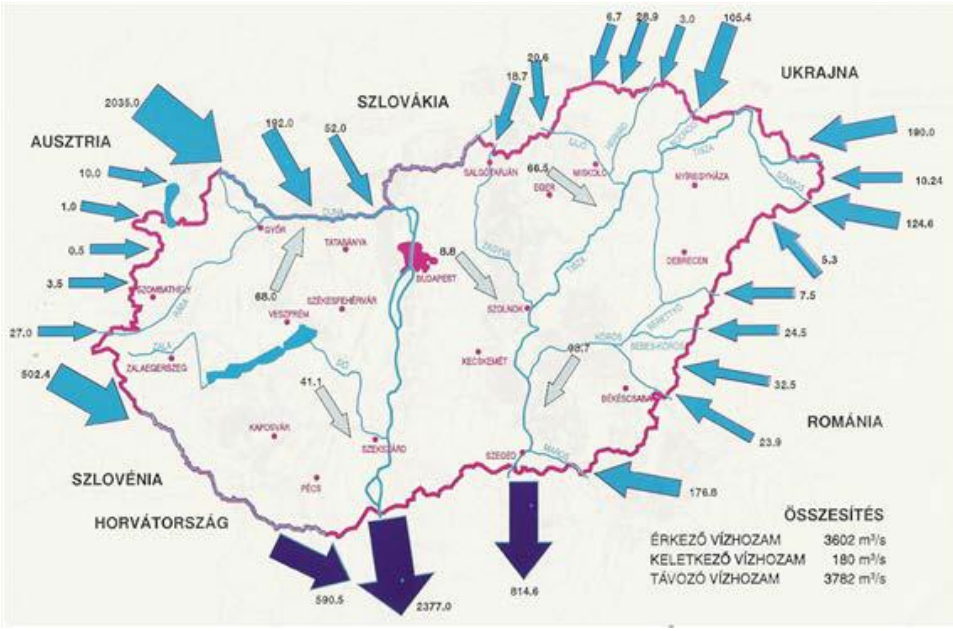
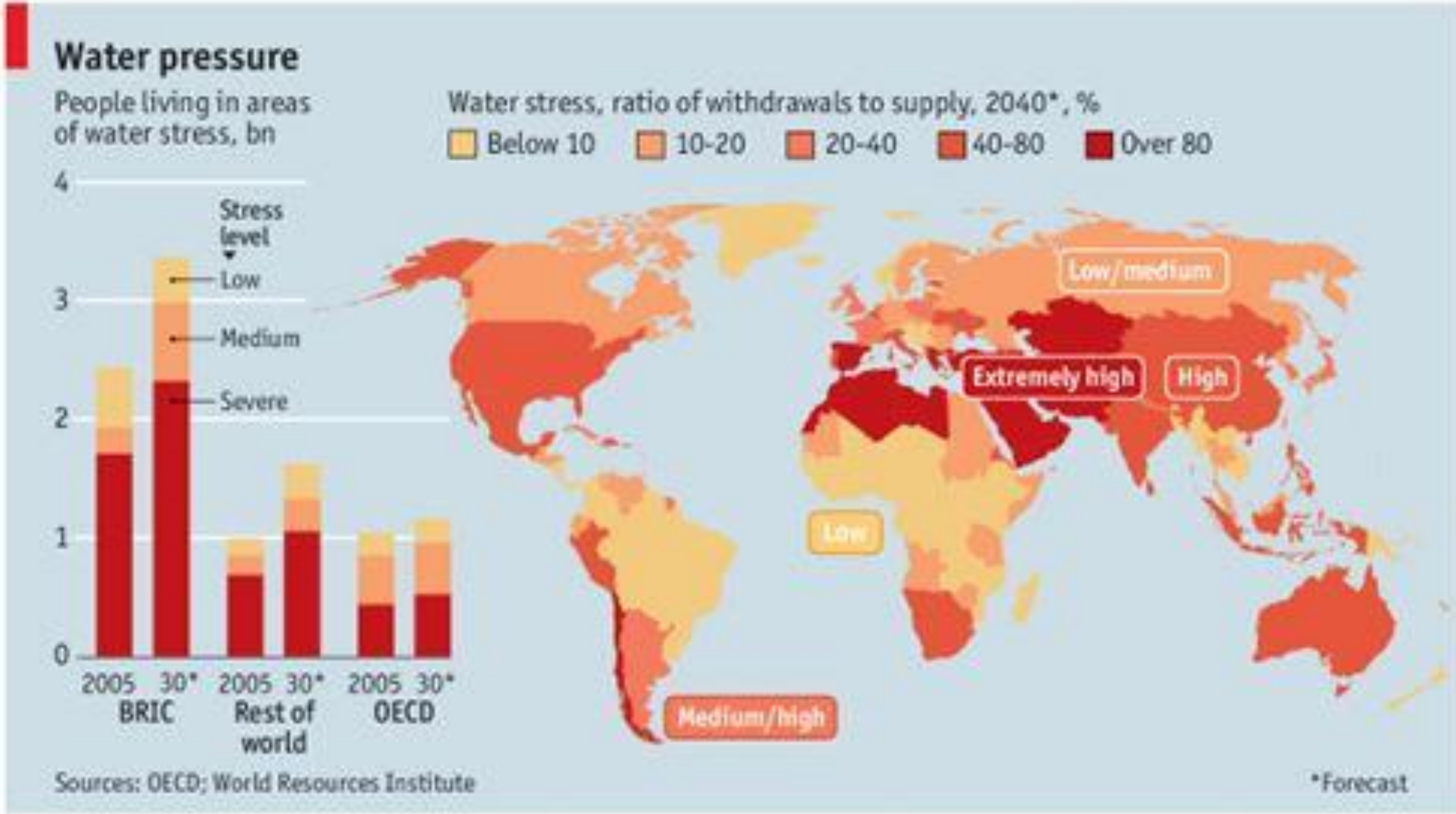
Edited by Annamária Holes

Water

- The hydrology of Hungary is mainly determined by the location of the country
- The amount of water entering the country is 114 billion m3/year while the amount of water leaving the country is 120 billion m3/year.
- These figures shows that the Hungarian water balance is negative.
- the quantity and quality of our watercourses are primarily determined by waters coming from abroad,

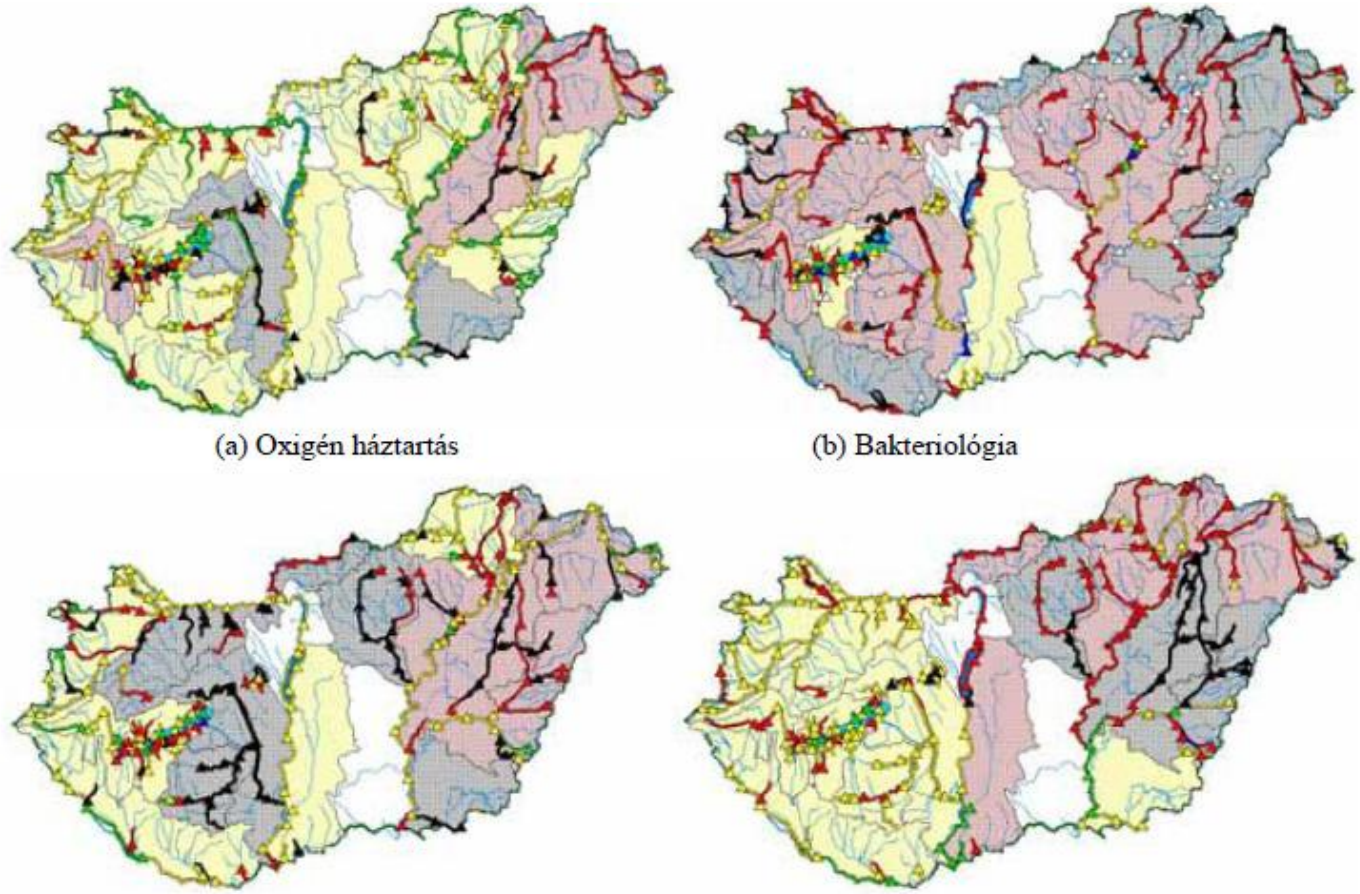




Economist.com

- Hungary has 185 groundwater bodies that can be divided into three main hydrogeological types from a geological point of view: porous, karst and mountainous.
- 95 of our groundwater-bodies are bordering at least one neighbouring country.
- Another important hydrological feature of groundwater bodies is the type of their connection with surface water, wet habitats. 115 groundwater bodies have significant ecosystem connection depending on water.

- In Hungary, the protection and sustainable use of water resources is one of the state responsibilities related to water management.
- The common water policy strategy (called 2000/60/EC Water Framework Directive, hereinafter referred to as WFD) adopted in July 2000, was a major step forward in water-related European Union regulations.
- 77% of water bodies need some intervention to reach the targeted good condition (2016).
- Water pollution from agricultural activities is one of the most serious environmental problems.



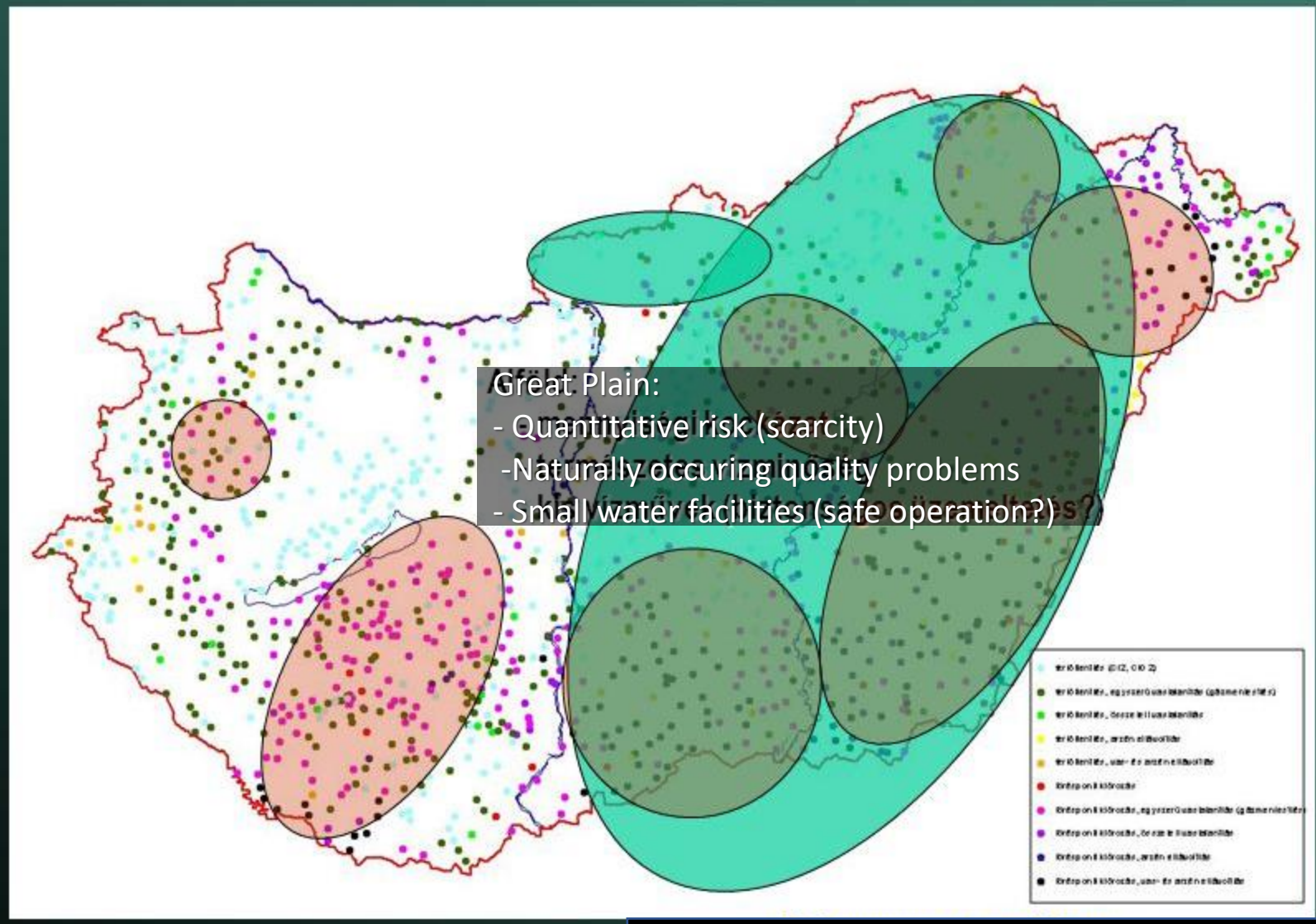
(a) Oxigén háztartás

(b) Bakteriológia

- Quality of surface water (Class I. – blue, Class II. – green, Class III. yellow, Class IV. – red, Class V. – black (Hungarian Standard 12749)

Tisza cyanide spill

1,5 naphthalene disulfonate in Raab river



Blue: scarcity problems
Red: quality problems (geohydrological)

Soil

- In Hungary, the proportion of artificial surfaces increases year by year while the area of cultivated arable land decreased by nearly 9% between 1990 and 2016
- International outlook: In 2015, in the framework of LUCAS (Land Use / Cover Area Frame Statistical Survey), the cover and land use of the Earth has been repeatedly surveyed in the 28 member states of the European Union. The results show that nearly 40% of EU territory is covered by forests and other wooded areas. The proportion of built-in and other artificial areas is the highest in Malta (23.7%), and the lowest (1.4%) in Latvia. In Hungary, based on the LUCAS survey, this indicator is 4.1% which is close to the EU-28 average (4.0%).

Soil

- Among the factors that threaten soil functions, the most recent data are available on saline accumulation (salinisation) based on the 2016 measurements.
- The most harmful is soda (sodium carbonate) because the most crops have a significant decrease in yield in case of even 0.05% soda content.

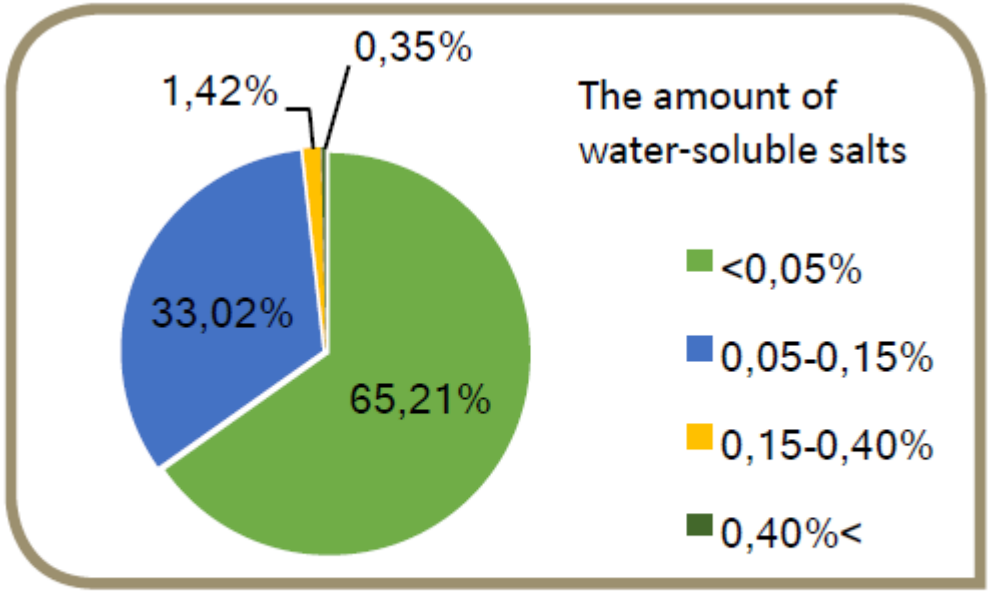
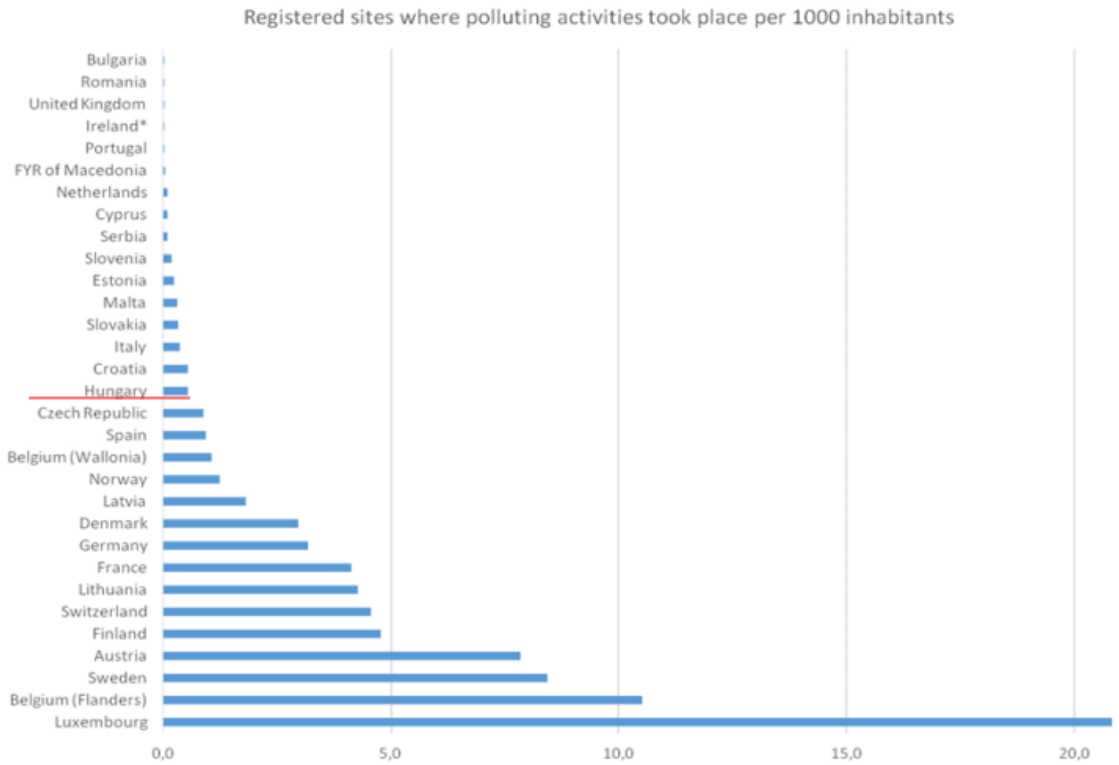
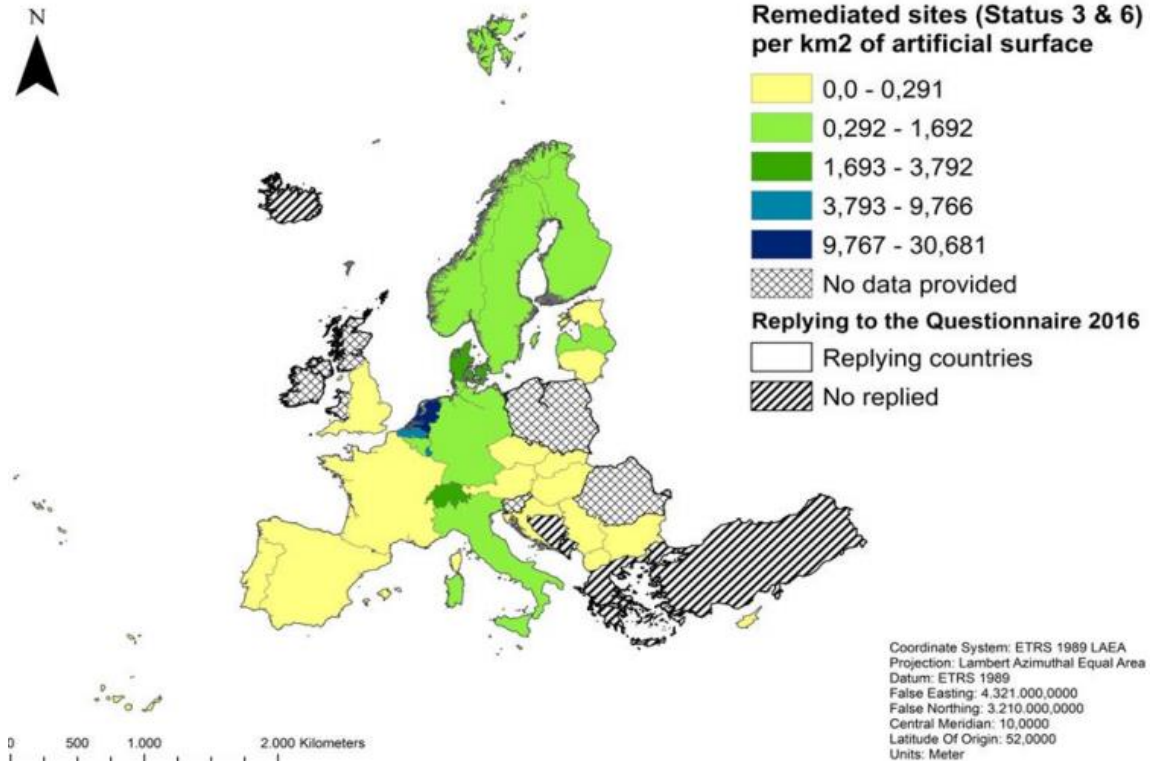


Figure 1.2.: Salt accumulation in the 0-30 cm soil layer at TIM sampling points (2015)
(Source: NÉBIH)

- Regarding of the heavy metal content of the soil, soil quality in Hungary can be considered to be excellent, heavy metal content exceeding the limit can only be found in the localized area of some former heavy industry centres (mostly non-agricultural).
- In our country, nearly 2.3 million hectares of land are endangered by water and wind erosion.

Environmental remediation (source: Herman Otto Institute)

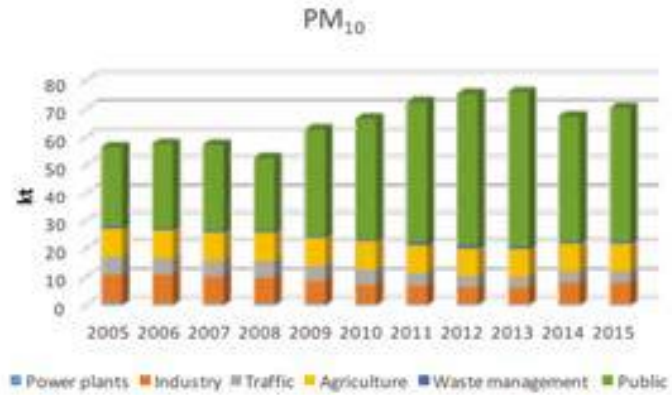




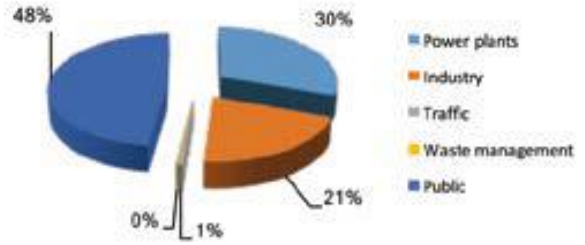
Air quality

- The quality of the ambient air depends on the amount of pollutants emitted, the meteorological conditions, the terrain of the area, the degree of contamination from the built-in and the large distance.
- The most effective measure is prevention, therefore all activities should be designed and implemented in a way to minimize airborne emissions and pollutants.
- Nowadays, solid fires have become an increasingly important source of air pollution, partly because of the increase of fuel prices, especially of natural gas

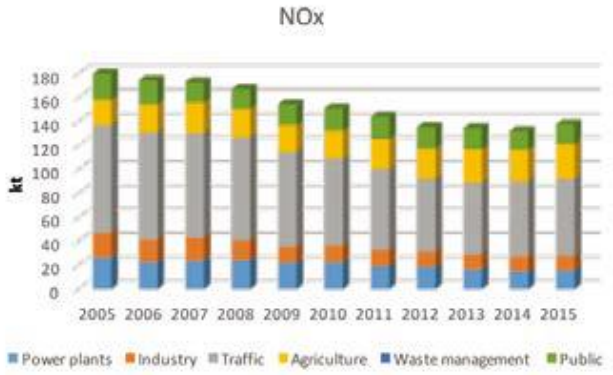
PM10 emissions from 2005 to 2015



Sulfur dioxide emission data by sector by 2015



Evolution of nitrogen oxides emissions in 2005-2015



Built environment

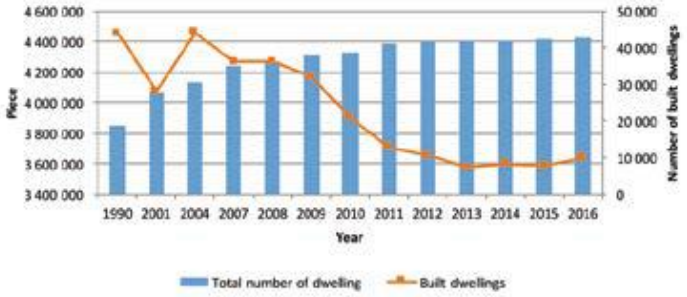
- On October 1, 2016, at the time of the microcensus, 9 million 804,000 people lived in Hungary.
- Considering the population characteristics of the settlement network, it can be seen that there are seven large cities in Hungary that have a population of over 100,000. In Budapest, with 1.7 million inhabitants, there are five districts with a population of over 100,000.
- With the exception of Central Hungary, the population of all regions has decreased since 2011.

Urban climate

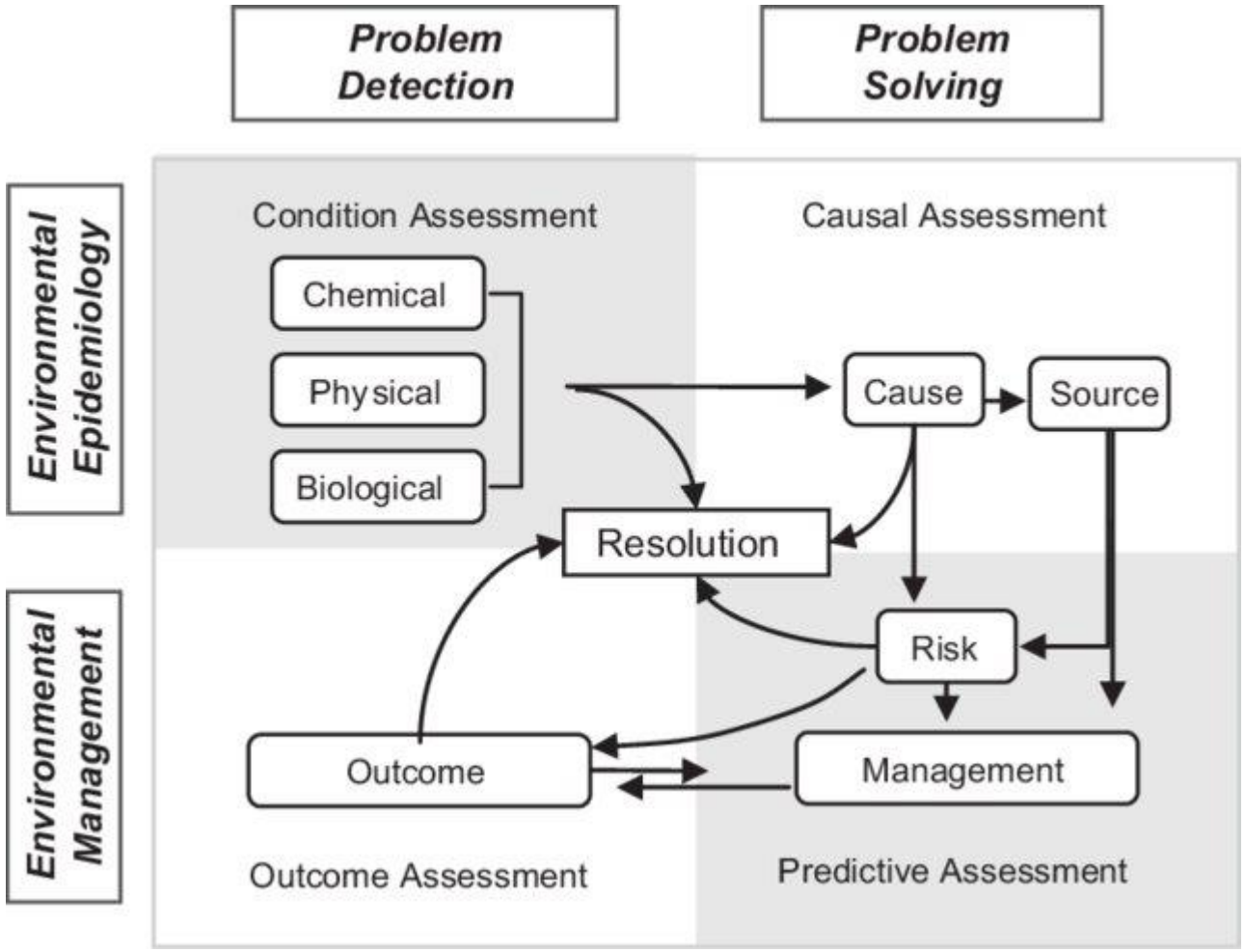
- Due to concentrated human activity in settlements, local climatic conditions can change significantly (e.g. city heat island effect).

- Average age of housing stock in Hungary (2011)

- Changes in the number of dwellings in Hungary
- And the number of built dwellings in the 1990-
- 2006 period



Condition assessment ✓



A framework that integrates all types of environmental assessments (from Cormier and Suter, 2008).
The assessment and management process typically begins with either a condition assessment, based on a monitoring program, or a risk assessment for new chemicals, new effluents, etc.

Disaster management and disaster biology

Definition, types and management of disasters

Dr. Edit Kaszab

Disaster - Catastrophe

- Greek words meaning „bad star” and „down turning”

To define disaster we have to start with safety

Safety is the „lack of danger, risk” or the condition of being protected from harm.

IN THE EVENT OF RISKS AND THREATS
SAFETY IMPROVES EFFECTIVE
PROTECTION AND REDUCES
DAMAGES AND LOSSES
TO A SOCIALLY TOLERABLE
LEVEL.

DIMENSIONS OF SAFETY →

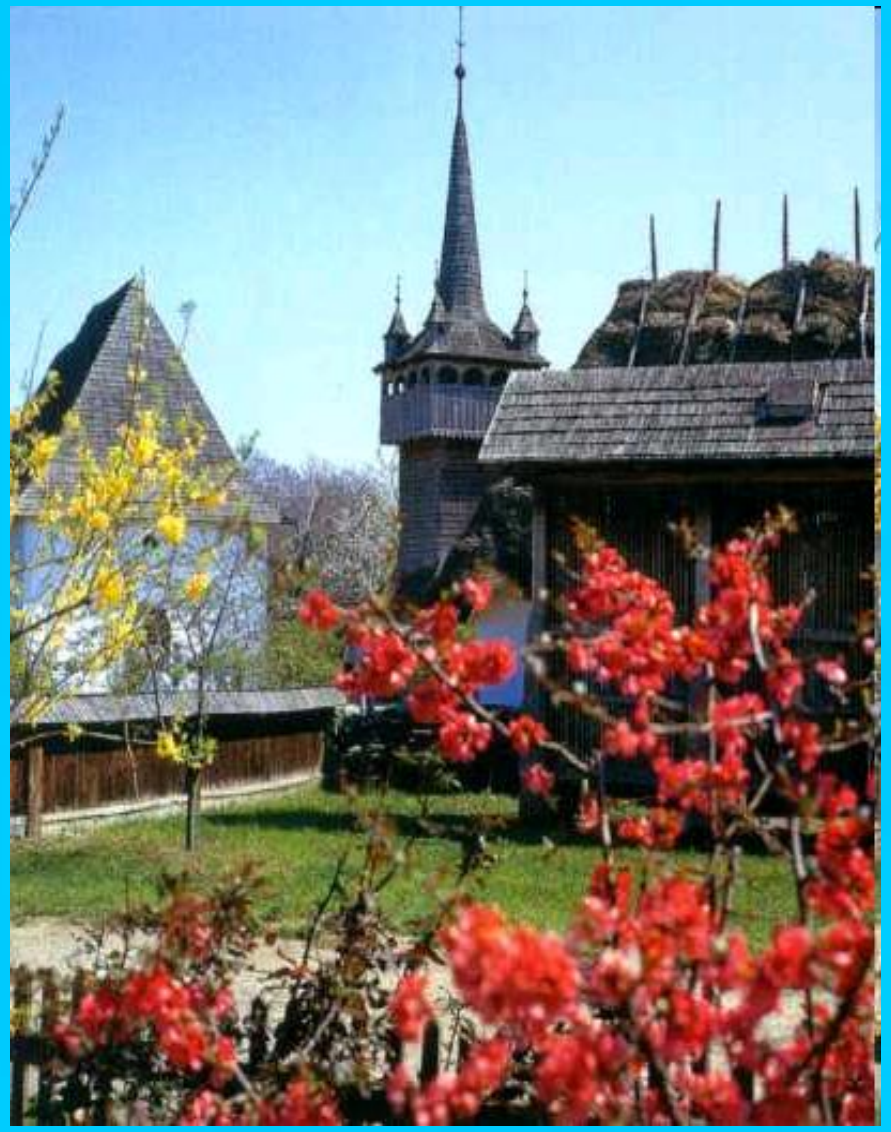
Environmental safety

- The European Community’s capacity to develop, considering the limited environmental resources, and to avoid environmental damage.
- ~ SUSTAINABLE DEVELOPMENT
- The narrowing environmental resources and international environmental pollution are leading to cross-boarder conflicts.

Environmental safety/security definition 2.

- „The level of protection” of environmental elements against human activities such as technical, technological processes.
- At the same time, it represents a state of nature and environment which neither directly, nor through human activities endangers man, and its natural, artificial environment.

- → KEEP ENVIRONMENTAL RISKS IN A SOCIALLY TOLERABLE LEVEL.



What is the socially acceptable level of environmental risks?

- Limit values ☺ (emission, immission)
- Note: based on our current knowledge!

What are the main areas of environmental safety?

- Biological safety
- Chemical safety (including safety instructions for transportation of hazardous materials)
- Industrial safety
- Nuclear safety
- Physical safety (i.e. protection against natural disasters)

- ***Disaster:*** **a state or situation** (e.g. natural, biological of fire event) suitable for the **declaration of an emergency**, or a qualified situation or state that has not reached the emergency level, but **endanger or destruct** human life, health, material values, basic services, natural environment or natural values in a way that is beyond the capability of the designated organizations or requries the introduction of special measures and continuous, coordinated cooperation between councils, and state agencies. In some cases, disasters requires international assistance.

Types of disasters (location, origin) (Barlai és Kővágó, 1996)

- **Located**: single, well-defined events of high intensity.

- **„Threshold” disasters**: more extensive, but usually moderate, slow-growing phenomena.

Location and extension

- **Local disasters**: usually no larger than the factory size, local forces can solve the problem.
- **Regional disasters**: exceed the capacity of local organizations, coordinated efforts of several localities is required.
- **National disasters:** It affects several regions and requires central resources and government-level control.
- **International disasters**: multi-country disasters, continental or global.

Intensity

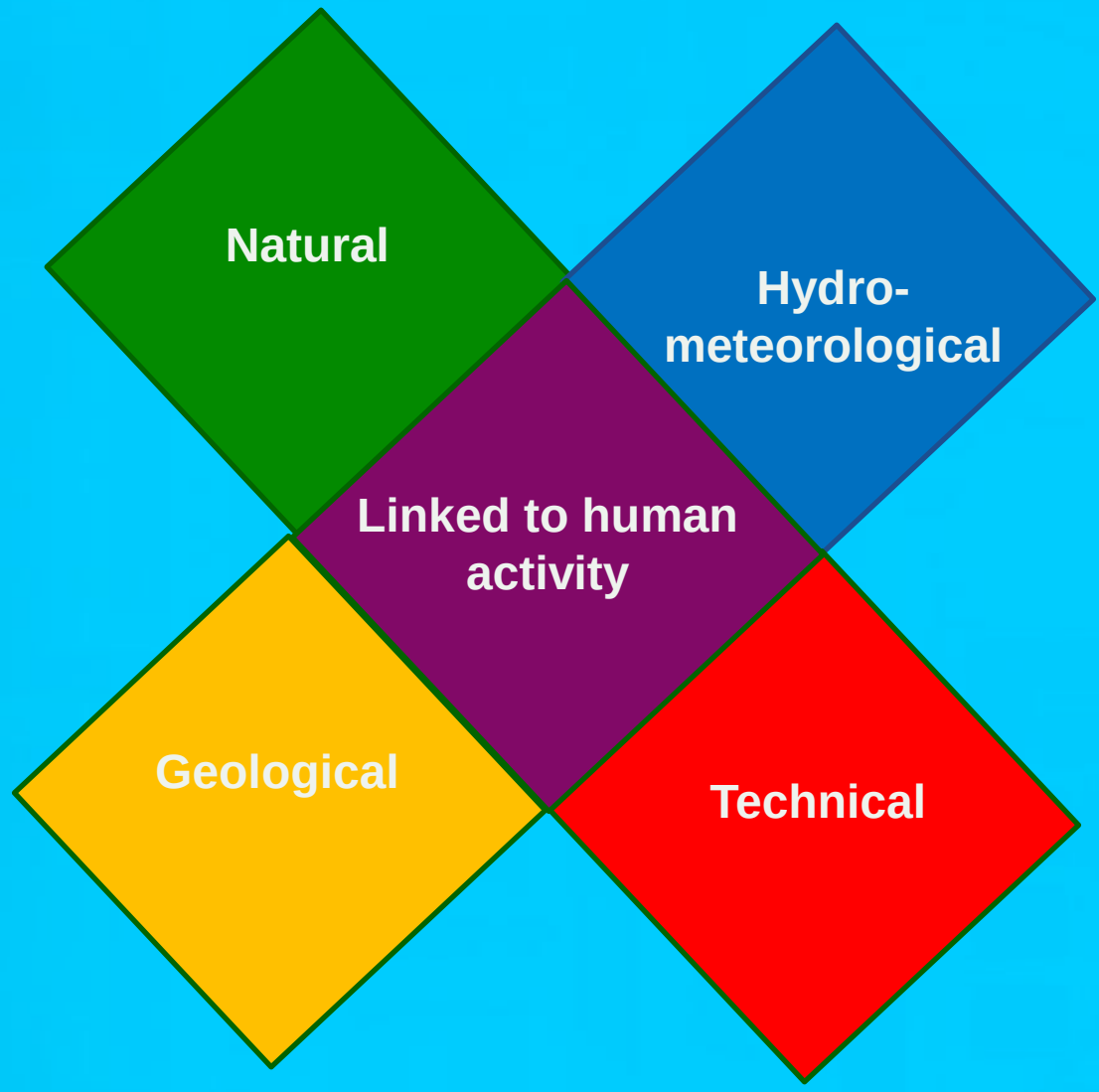
- **Relative disasters**: events of a smaller area, but of an intense nature. Usually it can be solved locally, e.g. rainstorms, windstorms, traffic accidents.
- **Moderate disasters**: High-intensity, large-scale events. Destruction on a scale that local forces can no longer repair (e.g. dam breaks, floods)
- **Absolute disasters**: huge damage occurs, often only internationally manageable, often global. (earthquake, tsunami, fire storm, war).

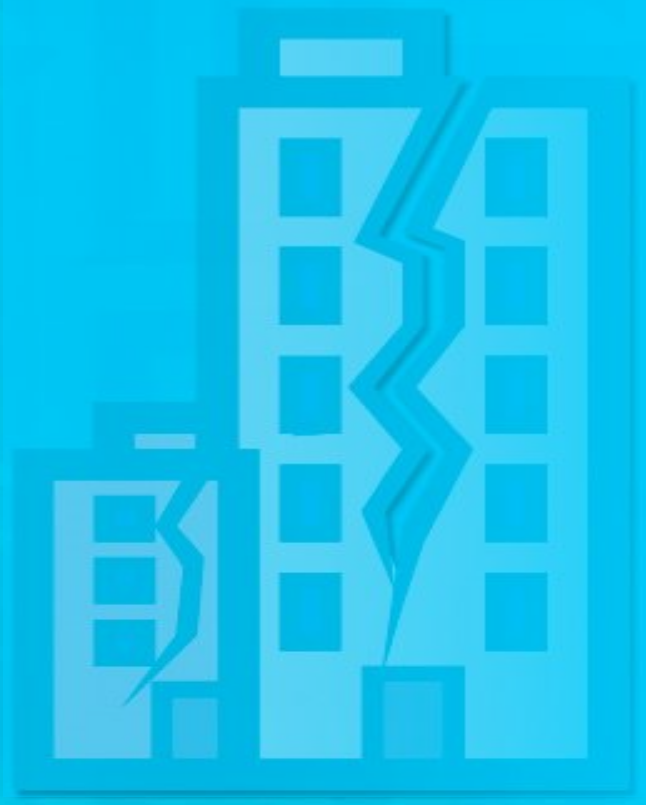
Spatial and temporal dimensions

- **Static**: occurs at the site of origin and can be remediated there.
- **Dynamic**: It usually begins with an accident and then spreads through continuous, intermittent or sudden development. It is often the trigger for new, secondary disasters.

- **Fast running** (seconds, minutes). E.g. windstorm, explosion.
- **Medium** (hours, days). E.g. flood.
- **Slow** (months, years). E.g. drought, environmental pollution.

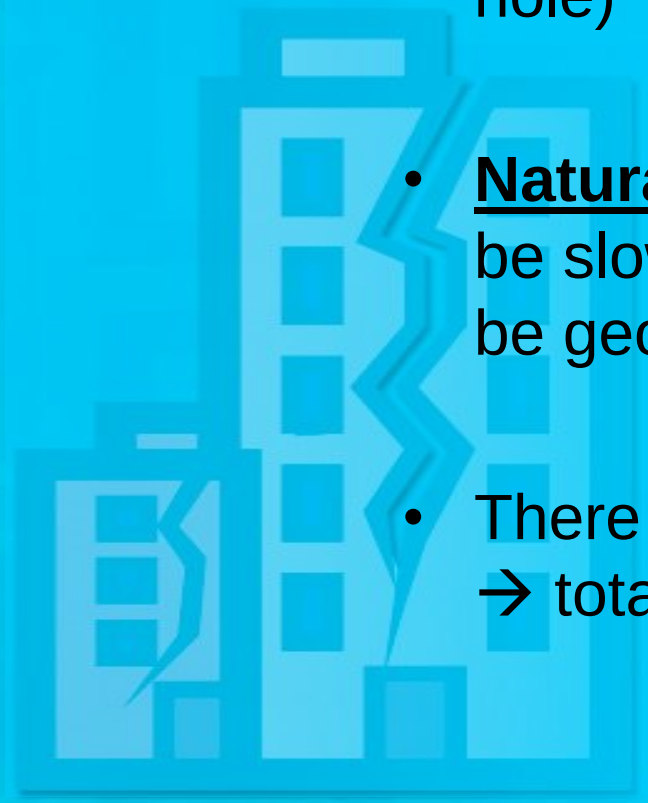
Main categories of disasters





Types of disasters

- **Artificial** (civilization or technological): caused by human activity, that can be intentional (e.g. war), sociological (e.g. famine, overpopulation), industrial, transport addidents, epidemic, or civilization (acid rain, ozone hole)



- **Natural**: events triggered by natural phenomena that can be slow (years) or fast (minutes). Causative agent can be geophysical, hydrological, climatological or biological.

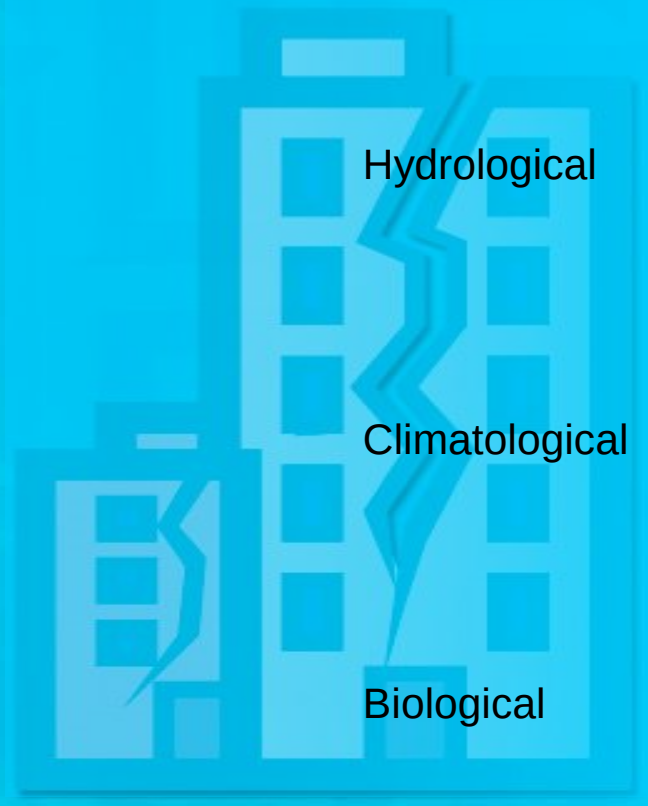
- There is often a connection between these two groups → total disasters, chain of disasters

Main types of natural and artificial disasters (Halász-Nagy, 2002)

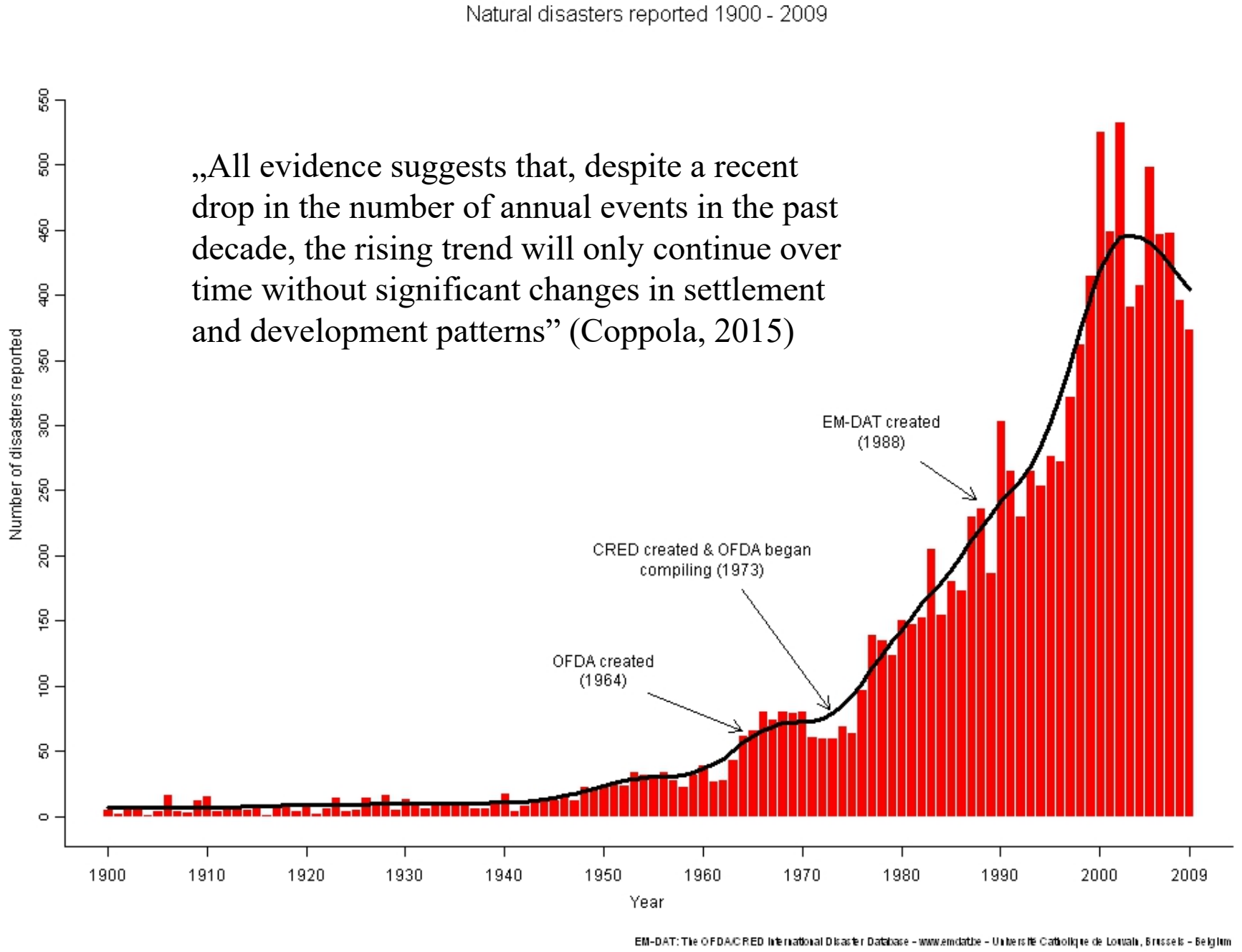
- Floods, inland waters, ice blocks, icy floods
- Snow blizzards, slides, mudslides, downpours, shoreline
- Container and mine collapses, gas and water intrusions into mines
- Earthquake
- Explosions in industrial plants, warehouses, etc.
- Damage caused by lightning, forest fires, agricultural and other large-scale fires
- Mass road accidents, rail accidents
- Other natural disasters strikes (eg locusts)
- Armed conflicts

Groups of natural disasters

Disaster subgroup	Definition	Main types
Geophysical	Events originating from the earth's crust	*Earthquake, Volcano eruption, Tsunami, Mass displacement (dry)*
Meteorological	Events from small to medium, micro and meso-level atmospheric processes (from a few minutes to a few days)	*Storm*
Hydrological	Events resulting from fluctuations in the normal water cycle and / or flooding of water bodies	*Flood, Mass displacement (wet)*
Climatological	Events triggered by long-term, meso- and macro-level events (climatic changes from seasonal to decade)	*Extreme temperature, Drought, Wildfire*
Biological	Disaster caused by (pathogenic) living organisms or their toxic substances	*Epidemics, Instect infestation, animals go berserk*



„All evidence suggests that, despite a recent drop in the number of annual events in the past decade, the rising trend will only continue over time without significant changes in settlement and development patterns" (Coppola, 2015)

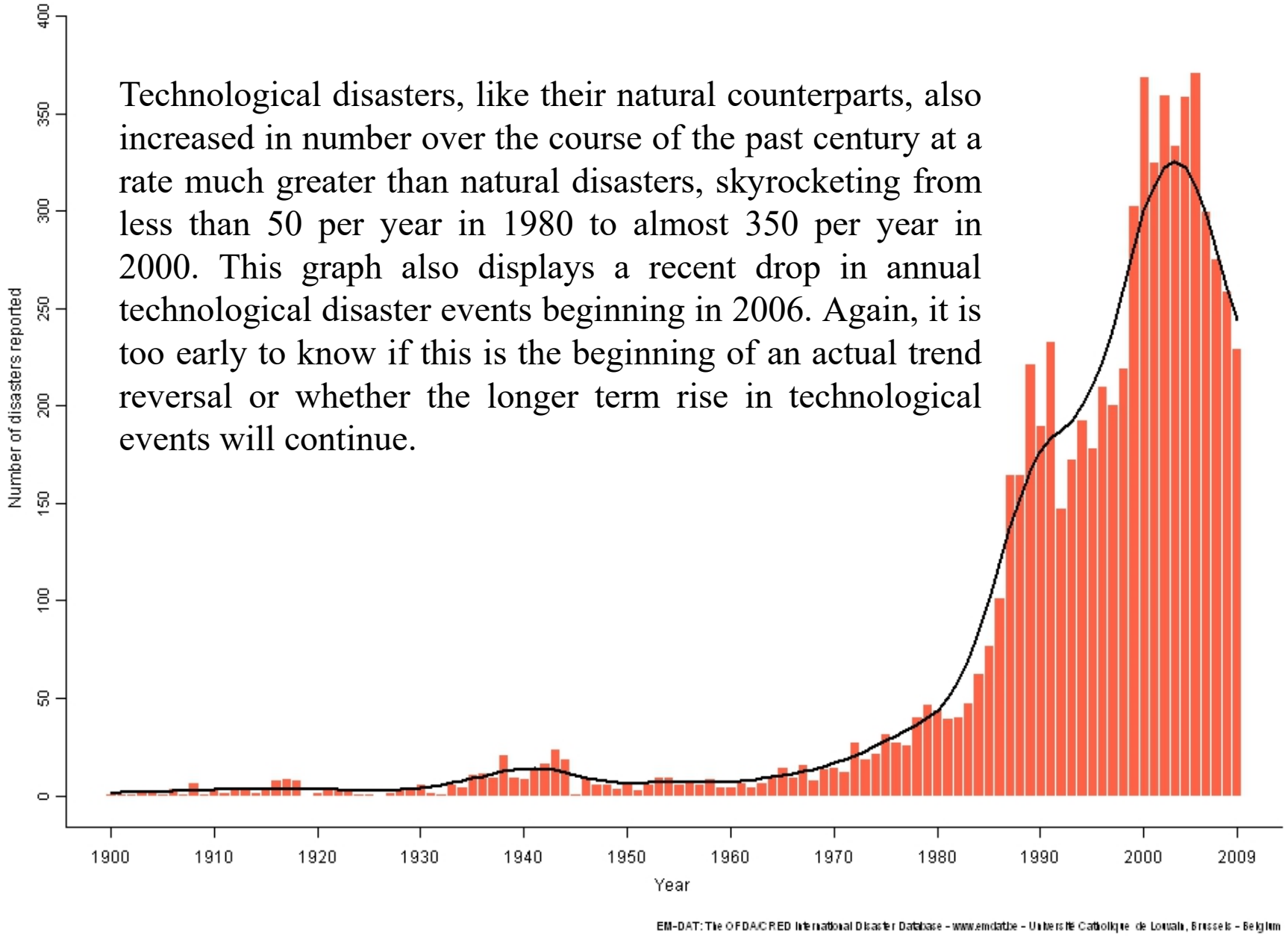


Man-made disasters

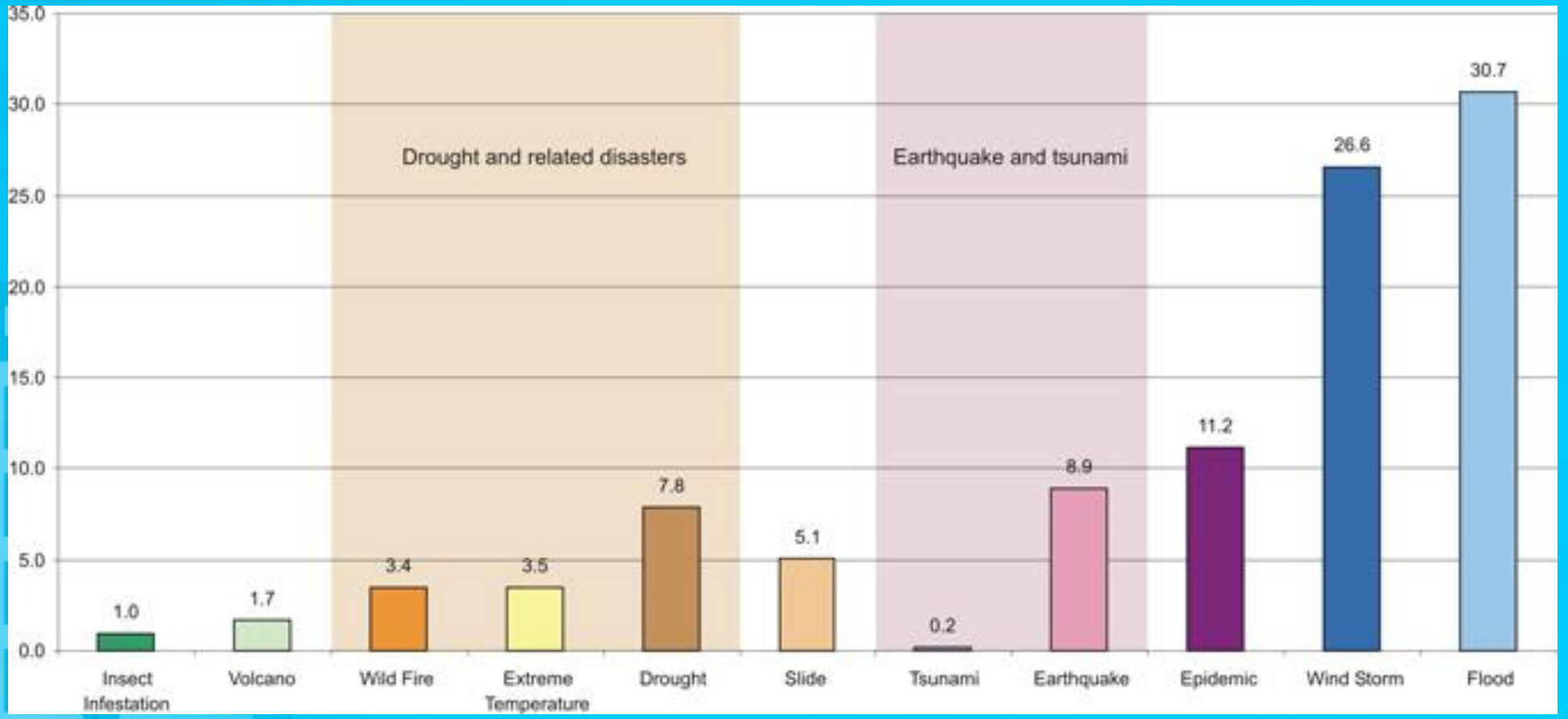
- **Technical**: failure of power and utility systems, failures of technological processes, damage to facilities
- **Industrial**: Hazardous material producing, user plant, warehouse failures, toxic substance release
- **Nuclear**: failure of nuclear power plants, research reactors, isotopes
- **Transport**: risks associated with the transport of hazardous materials, accidents
- **Environmental**: Pollution of environmental elements, nature destruction, landscape degradation
- **Biological**: infections, epidemics, biological weapons
- **Social**: crime, war, terrorist acts, sabotage, strike, riot, migration

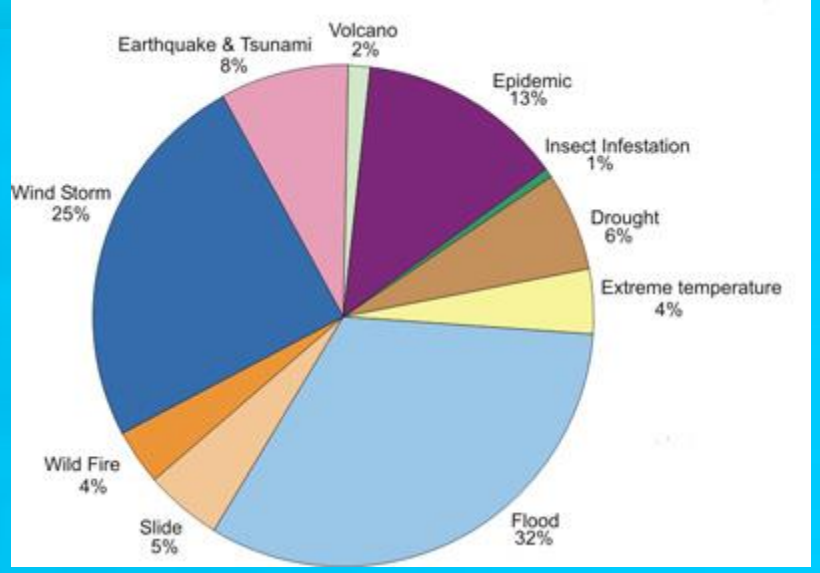
Technological disasters reported 1900 - 2009

Technological disasters, like their natural counterparts, also increased in number over the course of the past century at a rate much greater than natural disasters, skyrocketing from less than 50 per year in 1980 to almost 350 per year in 2000. This graph also displays a recent drop in annual technological disaster events beginning in 2006. Again, it is too early to know if this is the beginning of an actual trend reversal or whether the longer term rise in technological events will continue.

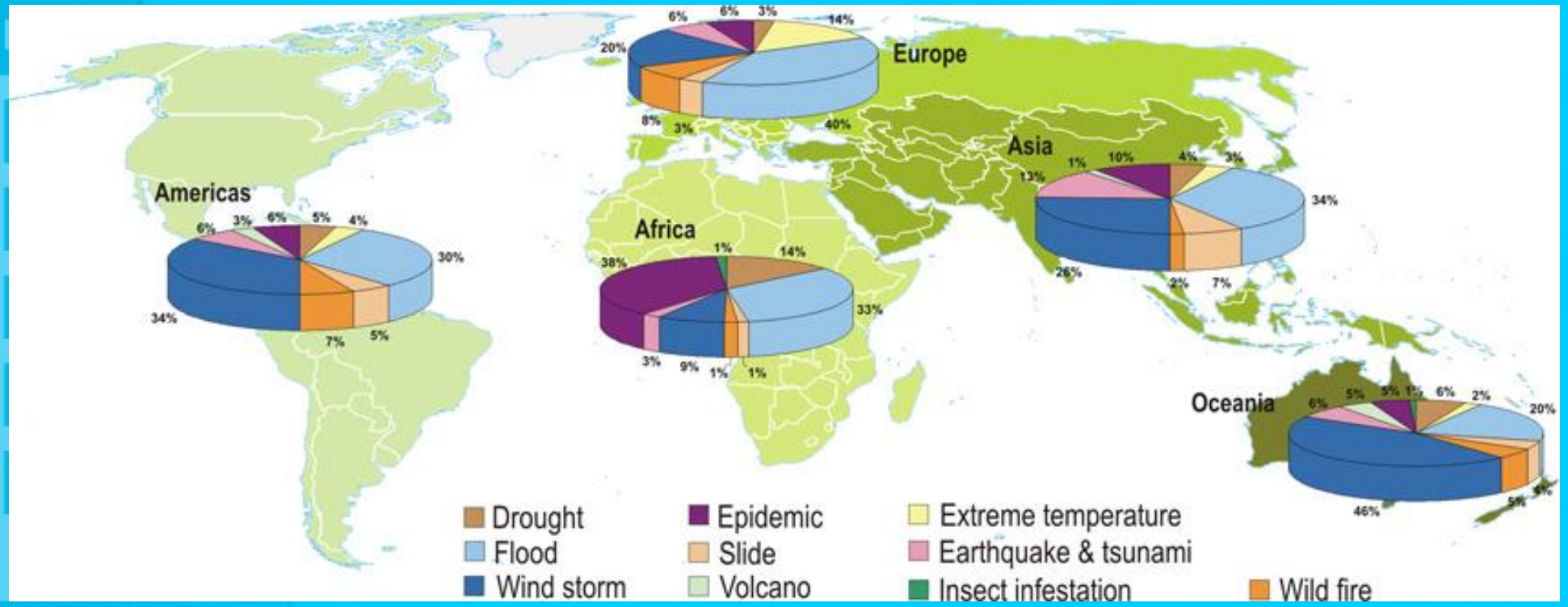


1991-2005

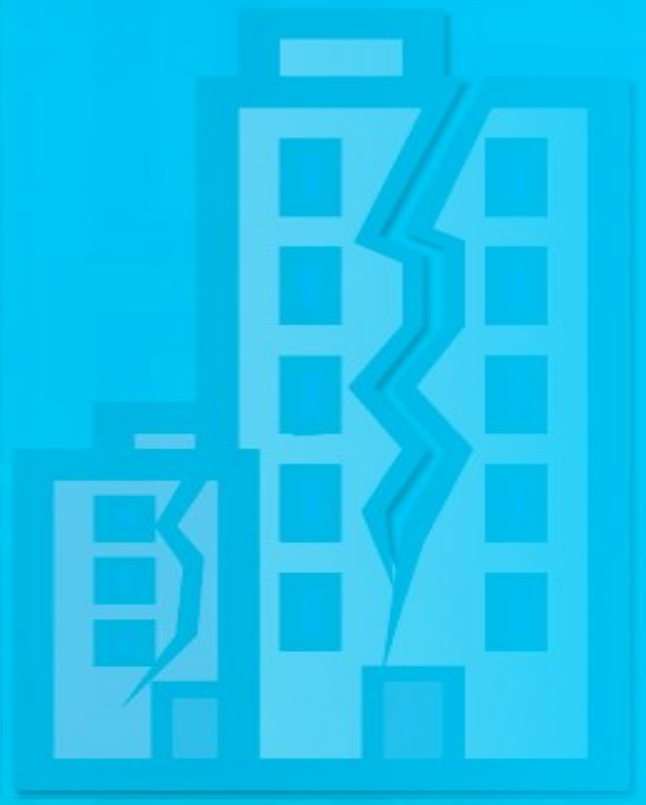

35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Drought and related disasters
Earthquake and tsunami
1.0
1.7
3.4
3.5
7.8
5.1
0.2
8.9
11.2
26.6
30.7
Insect Infestation
Volcano
Wild Fire
Extreme Temperature
Drought
Slide
Tsunami
Earthquake
Epidemic
Wind Storm
Flood


Earthquake & Tsunami
8%
Volcano
2%
Epidemic
13%
Insect Infestation
1%
Drought
6%
Extreme temperature
4%
Wind Storm
25%
Wild Fire
4%
Slide
5%
Flood
32%

2001-2005

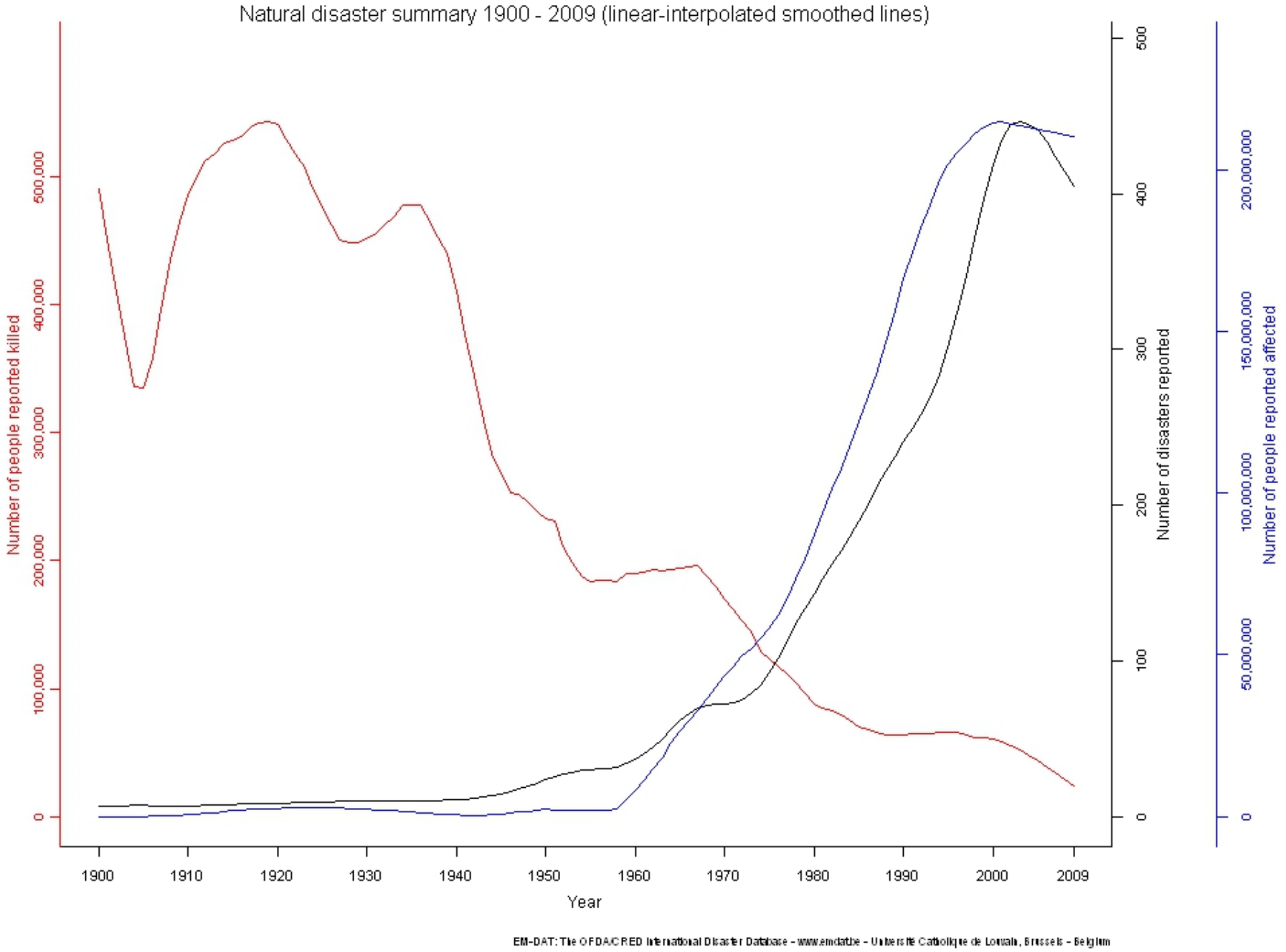

Europe
Asia
Africa
Americas
Oceania
Drought
Epidemic
Extreme temperature
Flood
Slide
Earthquake & tsunami
Wind storm
Volcano
Insect infestation
Wild fire

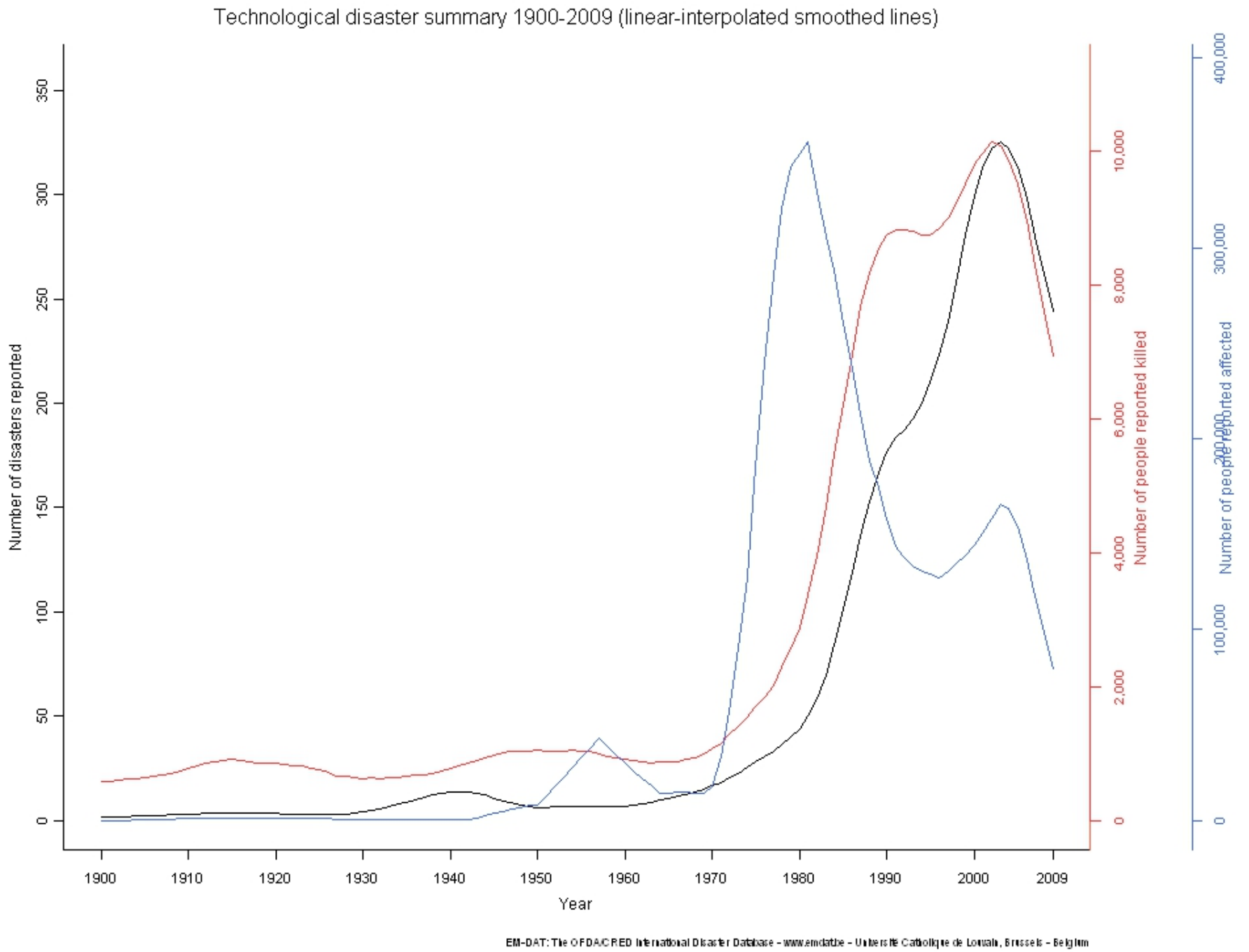
Effects of disasters



- Human (human, physical, psychological)
- Destruction of material goods
- Indirect (e.g. for public utilities)
- Geographical
- Environmental
- Economic

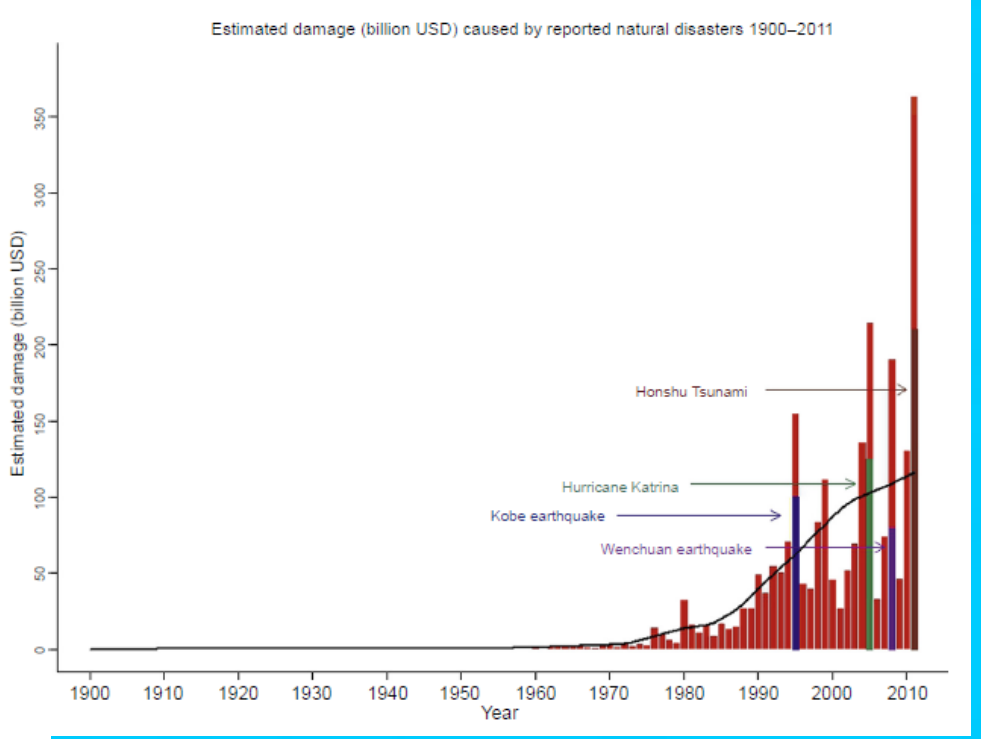
Való

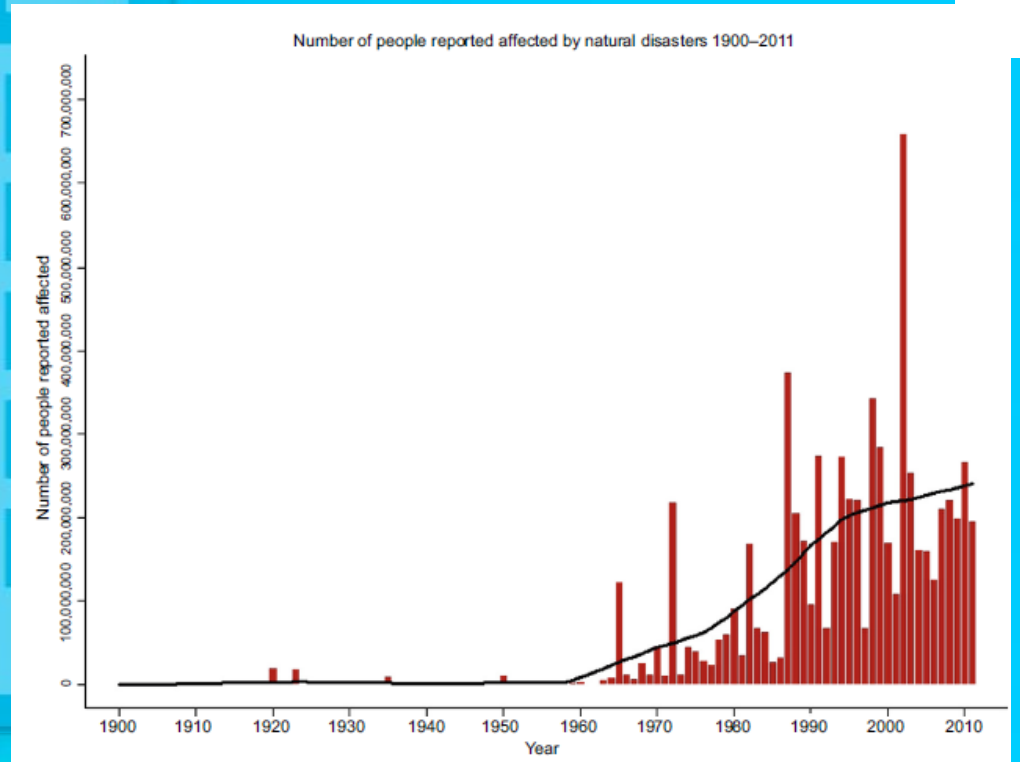

Natural disaster summary 1900 - 2009 (linear-interpolated smoothed lines)
Number of people reported killed
0
100,000
200,000
300,000
400,000
500,000
Number of disasters reported
0
100
200
300
400
500
Number of people reported affected
0
50,000,000
100,000,000
150,000,000
200,000,000
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2009
Year
EM-DAT: The OFDA/CRED International Disaster Database - www.emdat.be - Université Catholique de Louvain, Brussels - Belgium


Technological disaster summary 1900-2009 (linear-interpolated smoothed lines)
Number of disasters reported
0
50
100
150
200
250
300
350
Number of people reported killed
0
2,000
4,000
6,000
8,000
10,000
Number of people reported affected
0
100,000
200,000
300,000
400,000
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2009
Year
EM-DAT: The OFDA/CRED International Disaster Database - www.emdat.be - Université Catholique de Louvain, Brussels - Belgium

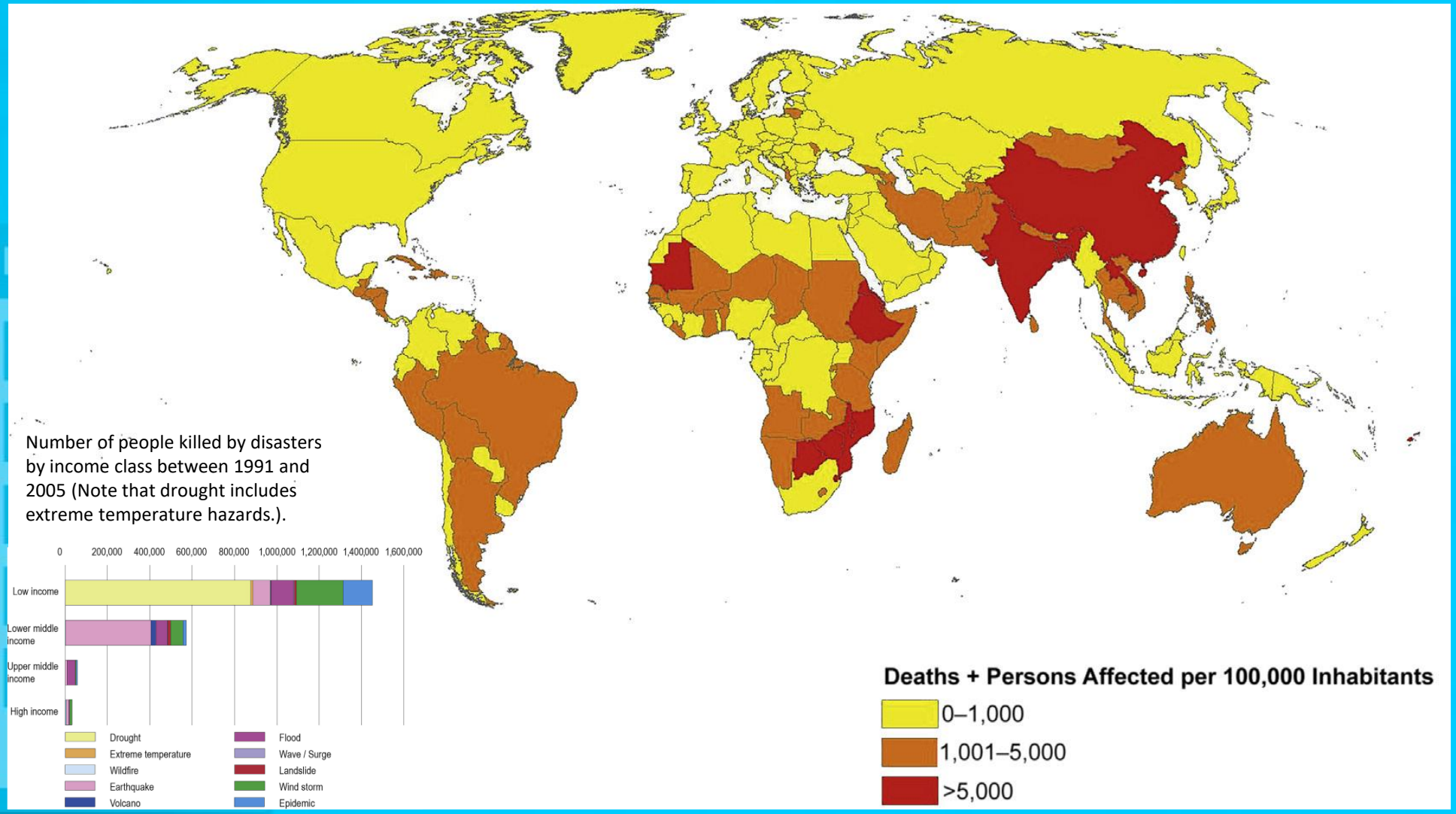
The overall number of people affected by disasters is rising

Source: Introduction to International Disaster Management





Total number of people affected by natural disasters per 100 000 inhabitants from 1974-2003



Number of people killed by disasters by income class between 1991 and 2005 (Note that drought includes extreme temperature hazards.).

Disaster management

- Disasters have adversely affected humans since the dawn of our existence.
- In response, individuals and societies alike have made many attempts to decrease their exposure to the consequences of these disasters, developing measures to address initial impact as well as post-disaster response and recovery needs.
- Regardless of the approach adopted, all of these efforts have the same goal: **disaster management**.

(Source: Introduction to International Disaster Management)

Disasters through history

Disaster	Year	Number Killed
Mediterranean earthquake (Egypt and Syria)	1201	1,100,000
Shaanxi earthquake (China)	1556	830,000
Calcutta typhoon (India)	1737	300,000
Caribbean hurricane (Martinique, St. Eustatius, Barbados)	1780	22,000
Tamboro volcano (Indonesia)	1815	80,000
Influenza epidemic (world)	1917	20,000,000
Yangtze River flood (China)	1931	3,000,000
Famine (Russia)	1932	5,000,000
Bangladesh cyclone (Bangladesh)	1970	300,000
Tangshan earthquake (China)	1976	655,000

Source: St. Louis University, 1997; NBC News, 2004.

(Source: Introduction to International Disaster Management)

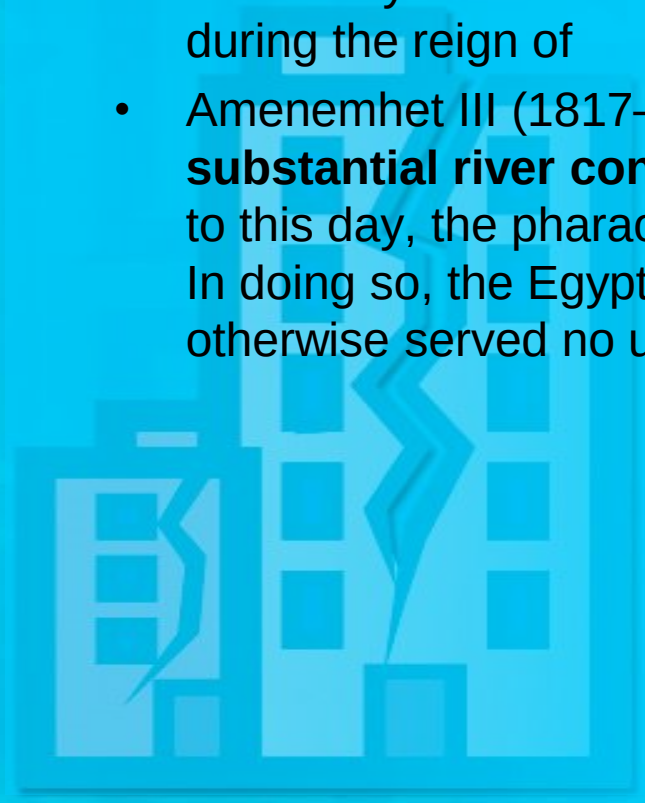
History of disaster management

- Various applications of disaster management appear throughout the historical record.
  - Noah's ark from the Old Testament, for example, is a lesson in the importance of warning, preparedness, and mitigation.
- Evidence of risk management practices can be found as early as 3200 BC. In what is now modern day Iraq lived a social group known as the Asipu. The Asipu, used a process similar to modern-day hazards risk management (analyse the problem, propose several alternatives, give possible outcomes) = *decision analysis*

(Source: Introduction to International Disaster Management)

Modern roots

- Many of the concepts that guide today's disaster management practice can be traced to the achievements of past civilizations. E.g.: Egypt
- Floods have always confounded human settlements. However, some early civilizations made attempts to formally address the flood hazard. One of the most celebrated of these attempts occurred in Egypt during the reign of
- Amenemhet III (1817–1722 BC). Amenemhet III created what has been described as **history's first substantial river control project**. Using a system of over 200 "water wheels," some of which remain to this day, the pharaoh effectively diverted the annual floodwaters of the Nile River into Lake Moeris. In doing so, the Egyptians were able to reclaim over 153,000 acres of fertile land that would have otherwise served no use (Quarantelli 1995; ESIS n.d.).



(Source: Introduction to International Disaster Management)

Modern roots

- The roots of the modern fire department trace back 2,000 years to when the city of Rome was nearly destroyed by fire. Following the great fire, Emperor Augustus established a formal, city-wide firefighting unit from within the Roman army called the Corps of Vigiles. As a result, the firefighting profession became highly respected and, likewise, highly effective, and was emulated throughout the vast Roman Empire for 500 years.

Modern disaster management

- Modern disaster management, in terms of the emergence of global standards and organized efforts to address preparedness, mitigation, and response activities for a wide range of disasters, did not begin to emerge until the mid-twentieth century.
- National emergency management capacity began to take a more centralized role in the 1970s and ‘80s as countries focused on the creation of national-level emergency management systems.

Modern disaster management

- On December 11, 1987, the United Nations General Assembly declared the 1990s to be the "**International Decade for Natural Disaster Reduction" (IDNDR).** This action was taken to promote internationally coordinated efforts to reduce material losses and social and economic disruption caused by disasters, especially in developing countries, through capacity building.

The Yokohama strategy

- In May 1994, UN member states met at the World Conference on Natural Disaster Reduction in Yokohama, Japan, to assess the progress attained by the IDNDR. At this meeting, they developed the Yokohama Strategy and Plan of Action for a Safer World.

Yokohama strategy

Through this document, the UN affirmed that:

- **Impact of natural disasters in terms of human and economic losses has risen in recent years**. Those usually most affected are the poor and socially disadvantaged groups in developing countries.
- **Disaster prevention, mitigation, preparedness, and relief are four elements** which contribute to and gain from the implementation of sustainable development policies.
- Disaster prevention, mitigation, and preparedness are **better than disaster response** in achieving [disaster reduction] goals. . . . Disaster response alone is not sufficient, as it yields only temporary results at a very high cost.

Yokohama Strategy

- **The world is increasingly interdependent**. All countries shall act in a new spirit of partnership to build a safer world based on common interests and shared responsibility to save human lives, since natural disasters do not respect borders.
- **The information, knowledge, and some of the technology necessary to reduce the effects of natural disasters** can be available in many cases at low cost and should be applied.
- **Community involvement and their active participation should be encouraged** to gain greater insight into the individual and collective perception of development and risk.

The adopted Yokohama Strategy and related Plan of Action for the rest of the Decade and beyond:

a. Will note that each country has the sovereign responsibility to protect its citizens from natural disasters;

b. Will give priority attention to the developing countries;

c. Will develop and strengthen national capacities and capabilities including the mobilization of non-governmental organizations and participation of local communities;

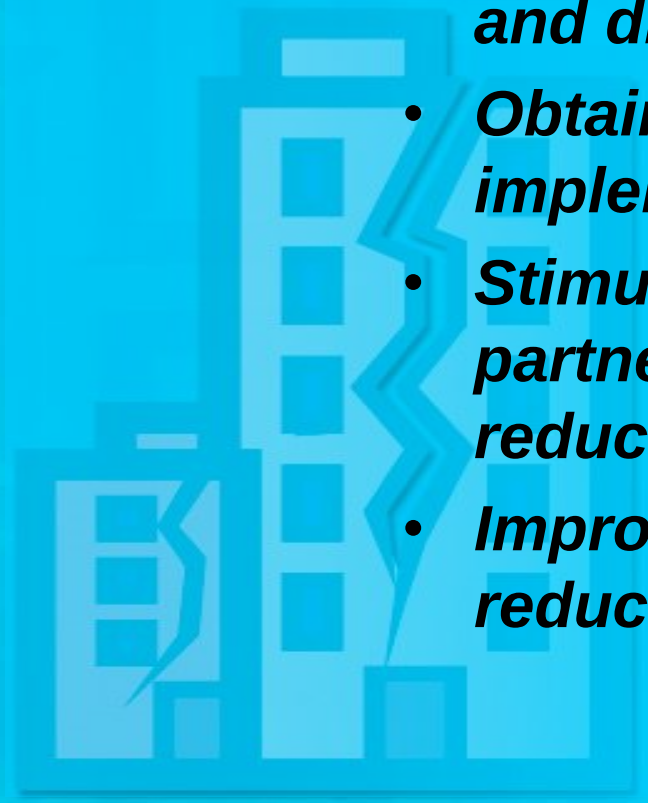
d. Will promote and strengthen subregional, regional, and international cooperation, with particular emphasis on:

- - Human and institutional capacity-building and strengthening;
- - Technology sharing, the collection, the dissemination, and the utilization of information;
- - Mobilization of resources.

Yokohama Strategy

- The international community and the United Nations system in particular must provide adequate support to [natural disaster reduction].
- The Yokohama Conference is at a crossroad in human progress. United Nations and the world community can change the course of events by reducing the suffering from natural disasters. Action is urgently needed.
- Nations should view the Yokohama Strategy for a Safer World as a call to action to implement policies and goals reaffirmed in Yokohama and to use the International Decade for Natural Disaster Reduction as a catalyst for change. (ISDR1994)

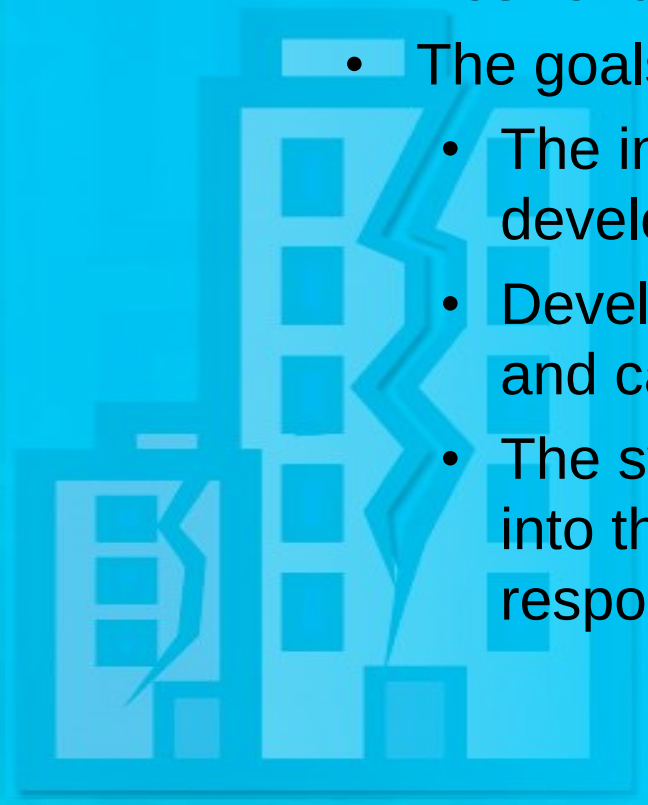
Four objectives of Yokohama Strategy



- ***Increase public awareness about risk, vulnerability, and disaster reduction.***
- ***Obtain commitment from public authorities to implement disaster reduction policies and actions.***
- ***Stimulate interdisciplinary and intersectoral partnerships, including the expansion of risk-reduction networks.***
- ***Improve scientific knowledge about disaster reduction.***

The HYOGO Framework for action (HFA)

- In 2005, at The World Conference on Disaster Risk Reduction in Kobe, Japan, the 168 countries in attendance adopted the Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters.
- The goals included:
  - The integration of disaster risk reduction into sustainable development policies and planning;
  - Development and strengthening of institutions, mechanisms, and capacities to build resilience to hazards; and
  - The systematic incorporation of risk reduction approaches into the implementation of emergency preparedness, response, and recovery programs.



Modern disaster management – A four phase approach

1. ***Mitigation.*** Also called Disaster Risk Reduction (DRR), mitigation involves reducing or eliminating the likelihood or the consequences of a hazard, or both. Mitigation seeks to “treat” the hazard such that it impacts society to a lesser degree.

2. ***Preparedness.*** This involves equipping people who may be impacted by a disaster or who may be able to help those impacted with the tools to increase their chances of survival and to minimize their financial and other losses.

3. ***Response.*** This involves taking action to reduce or eliminate the impact of disasters that have occurred or are currently occurring, in order to prevent further suffering, financial loss, or a combination of both. Relief, a term commonly used in international disaster management, is one component of response.

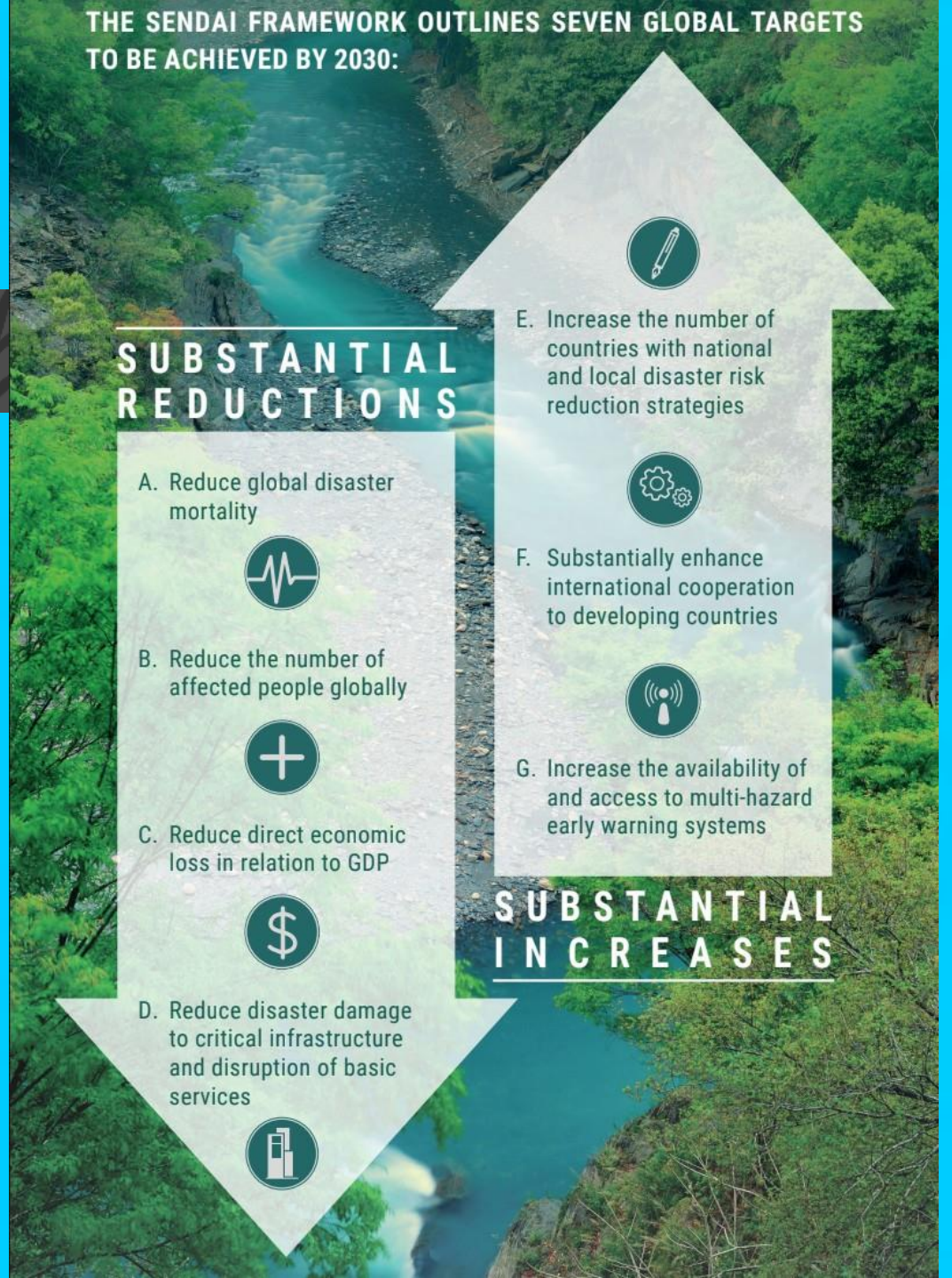
4. ***Recovery.*** This involves returning victims’ lives back to a normal state following the impact of disaster consequences. The recovery phase generally begins after the immediate response has ended, and can persist for months or years thereafter.

2015-2030:
Sendai Framework

UNDRR United Nations Office for Disaster Risk Reduction

Priorities for action:

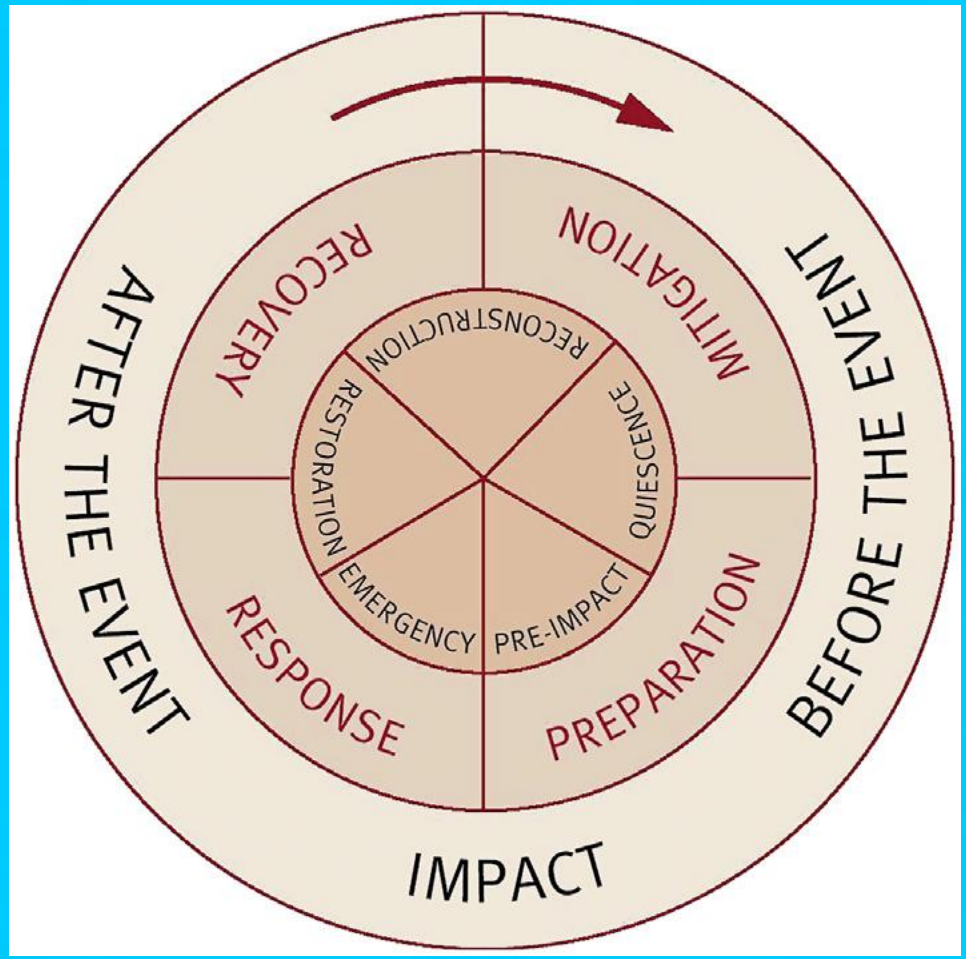
- Understanding disaster risk
- Strengthening disaster risk governance to manage disaster risk
- Investigating in disaster risk reduction for resilience
- Enhancing disaster preparedness for effective response and to „Build Back Better” in recovery, rehabilitation and reconstruction



Basics of disaster management

- *„Security is a civil right and a national value.”*
- Every citizen have the right and duty to
  - **be aware of a coming disaster and to learn the rules of defense**,
  - **to contribute to disaster management.**
- **Disaster management**: *the integration of activities to plan, organize, coordinate, implement manage, establish operate disaster management process and to provide information, alert communicate and controll all related activites. Namely…*
- **Disaster prevention, intervention and restoration.**

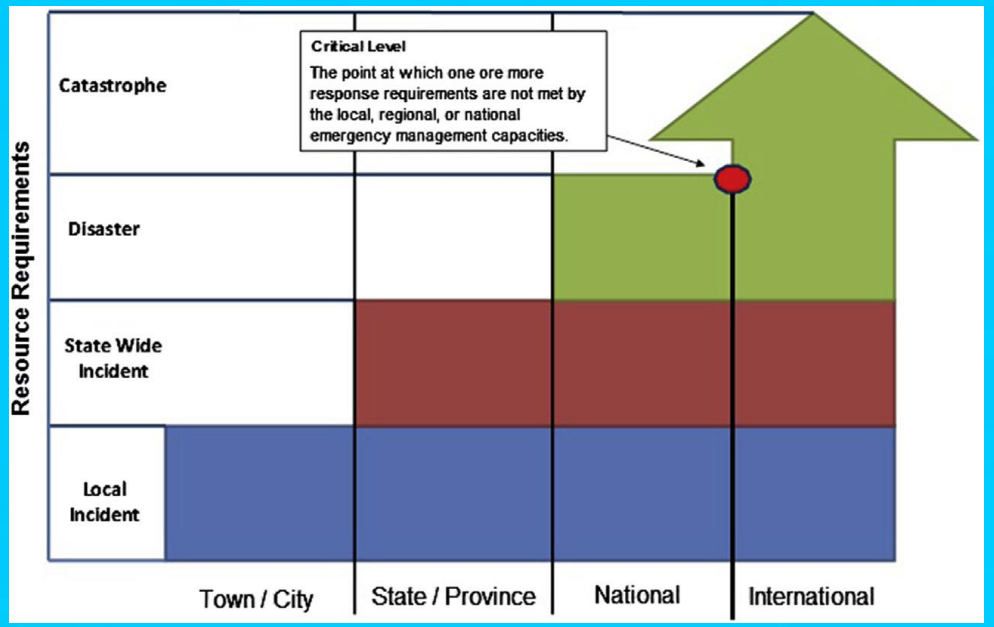
The disaster management cycle



Source: *Alexander, 2002*.

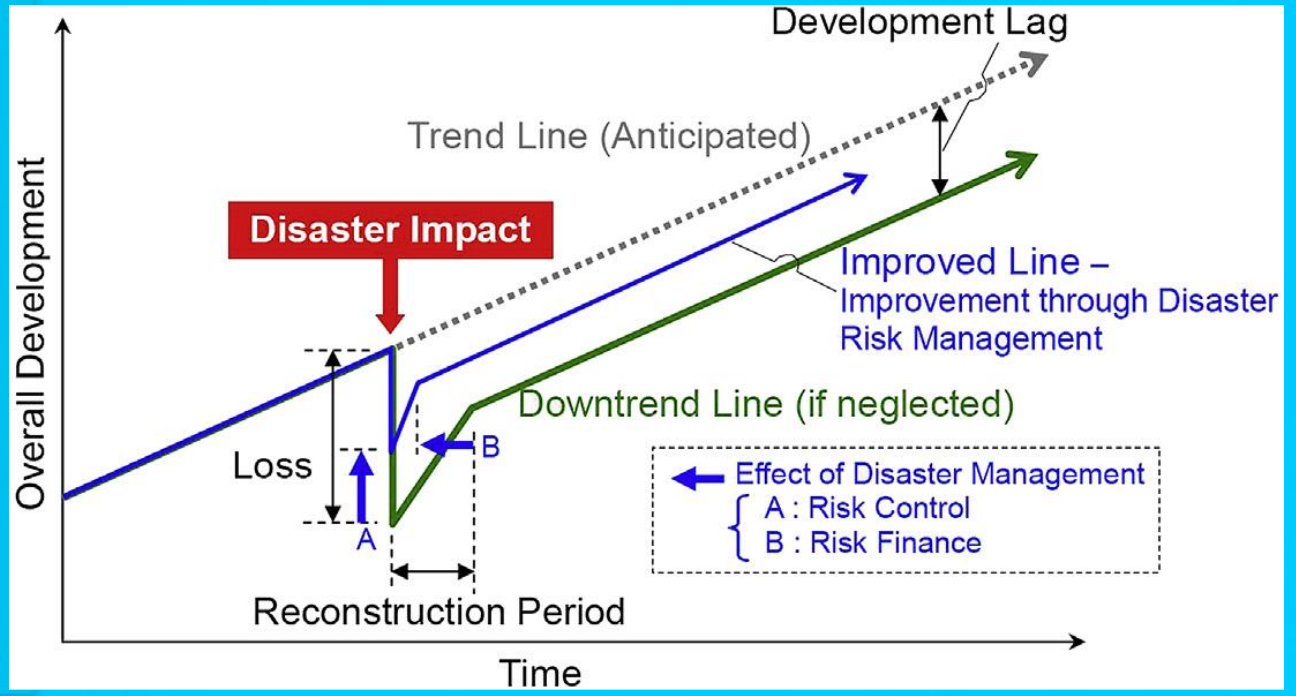
International disaster management

- 1) the study of the diverse emergency and disaster management systems and structures that exist throughout the world; and
- (2) the study of disaster management in scenarios where the capacity of a single nation's response mechanisms are overwhelmed.

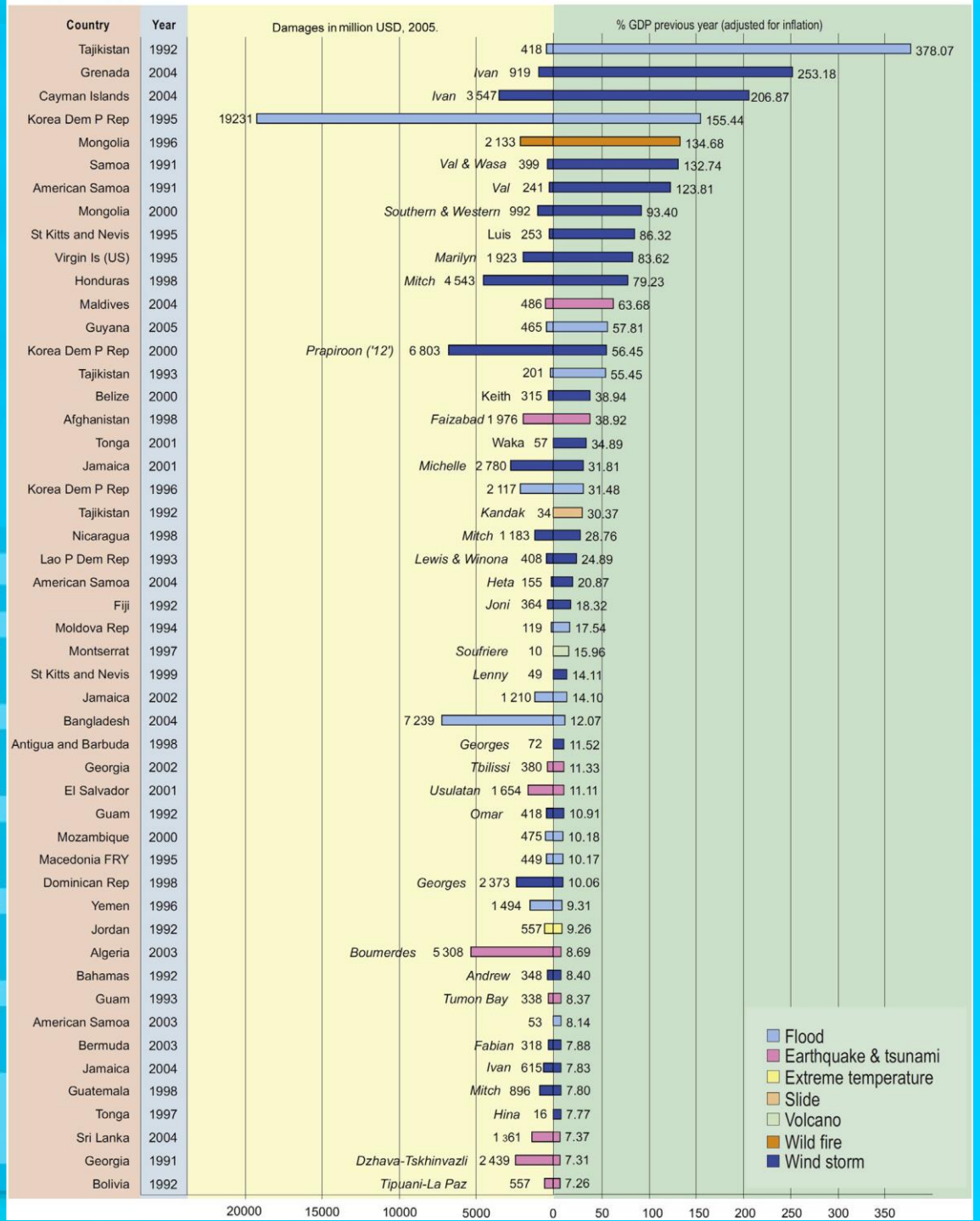


Disasters, poverty and development

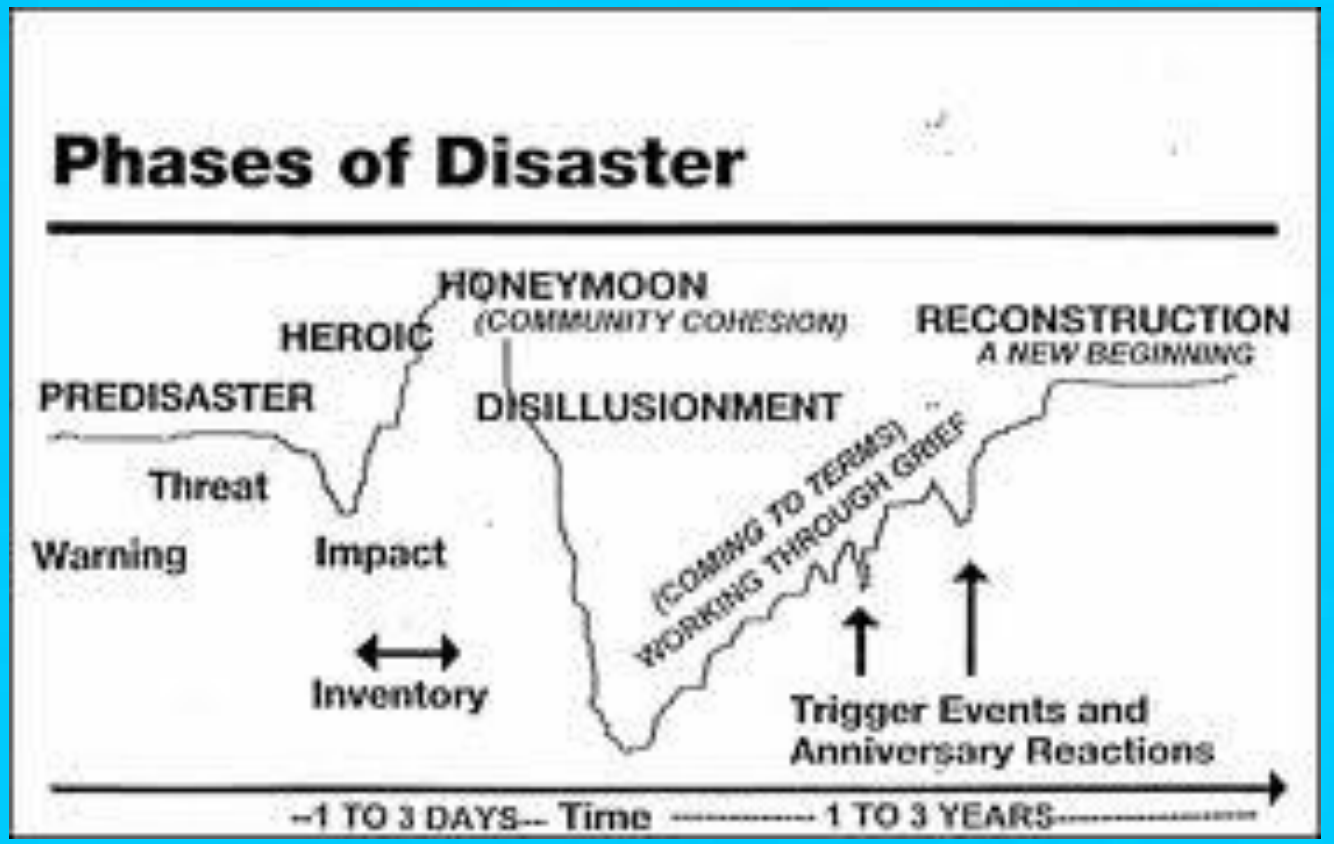
- Research and practice support the theory that there exists a strong correlation between disasters and poverty. It is well documented that those developing countries repeatedly subject to disasters experience stagnant or even negative rates of development over time.



Adapted from ADRC, 2005.



- Selected natural disasters: total damage and share of the GDP between 1991 and 2005.
- *Source: EM-DAT – International Disaster Database.*

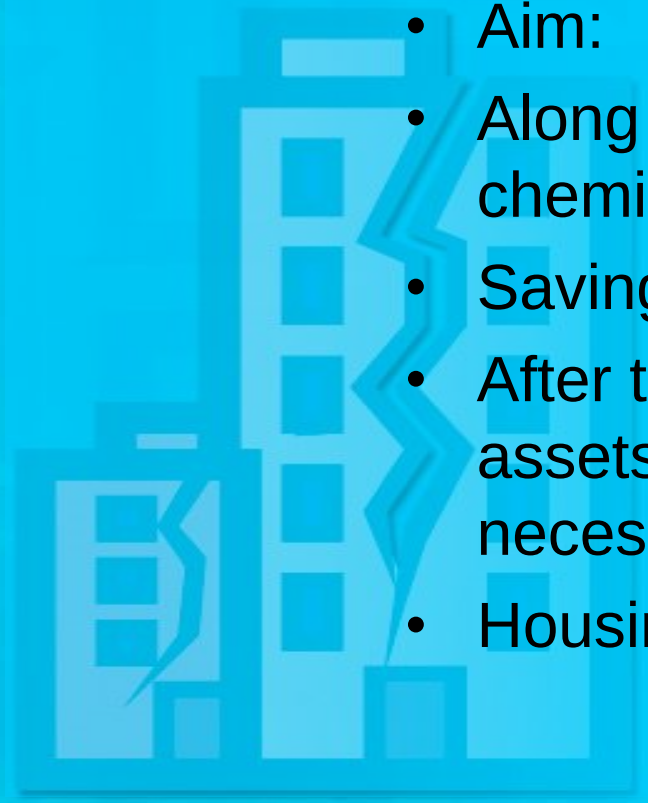

Phases of Disaster
HONEYMOON
(COMMUNITY COHESION)
HEROIC
RECONSTRUCTION
A NEW BEGINNING
PREDISASTER
DISILLUSIONMENT
Threat
(COMING TO TERMS)
WORKING THROUGH GRIEF
Warning
Impact
Inventory
Trigger Events and
Anniversary Reactions
–1 TO 3 DAYS– Time ---------- 1 TO 3 YEARS----------

Phases of disaster management and its activities

(Poser and Dransch, 2010).

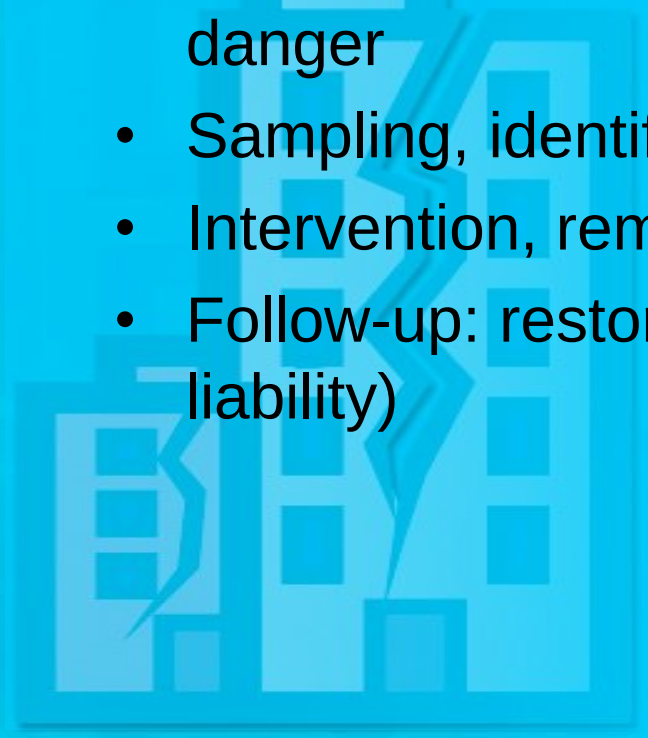
Disaster management requirements

- Advanced technical and other technology,
- Organized, trained, agile, professionally trained forces,
- Instant, bulk forces,
- Coordinated, competent, fast management.
- Aim:
- Along with technical tasks, health, disease control, chemical protection, law enforcement, expulsion, etc.
- Saving lives is always a priority.
- After the rescue, or at the same time, saving valuable assets, animals, etc., which are of great value or necessary for survival.
- Housing those who has become homeless



Basic disaster management activities

- Protection, rescue: individual (protective equipment), collective (safety of people, e.g. shelter)
- Evacuation, eviction, confinement
- Reconnaissance (pedestrian, vehicle, visual, instrumental…) - exploration of danger
- Sampling, identification
- Intervention, remediation
- Follow-up: restoration (traffic, utilities), survey (damage, contamination, liability)



Prevention of disasters

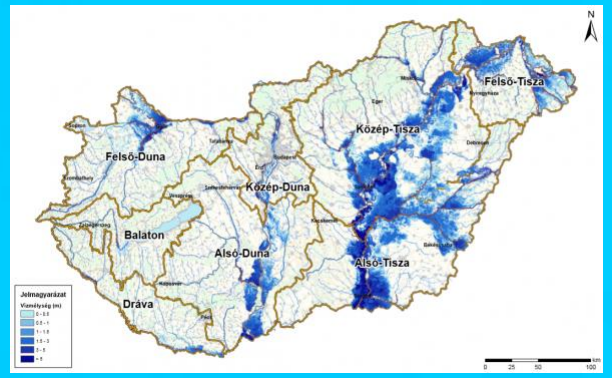
- A set of measures and considerations to ensure that human actions and natural phenomena do not result in catastrophic or similarly serious emergencies.

- Its **purpose**s are to
  - eliminate, minimize the **causative agents** of disasters
  - reduce, or eliminate the **negative effect**s
  - provide adequate conditions for effective defense.

- Predictability! According to predictability:
  - Highly predictable (e.g. flood)
  - Sudden (e.g. earthquake)

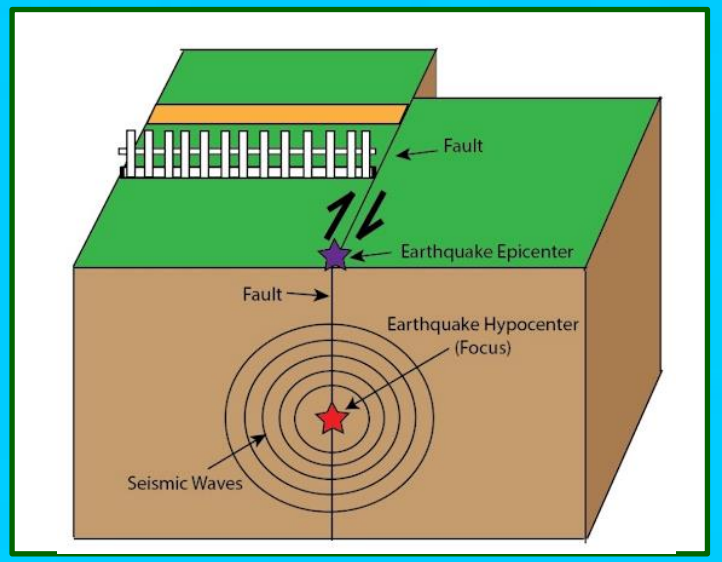
Floods

- The most important natural disaster in Hungary [21,000 km^2 (23%) below river flood level]
- Climatic conditions
- Continuous damage to property
- Can be predicted
- Possibilities of defense:
  - Passive - bear it & escape
  - Preventive – flood protection eg. dikes, dams
  - Active - conscious change e.g. water management
- 97% of the country's floodplains are flood-protected (4220 km of prime flood protection dam)



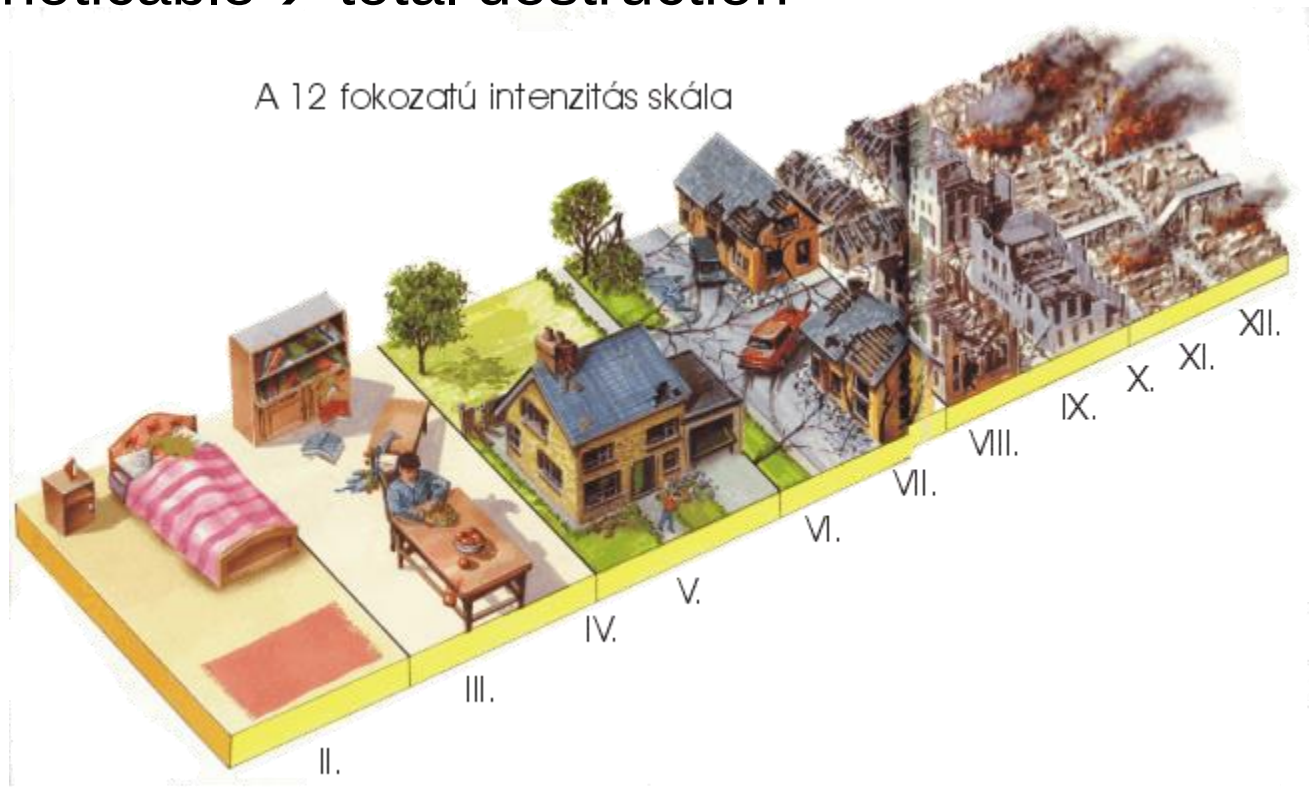
Earthquakes

- Globally the most devastating natural disaster
- 1925-1950: 350,000 people, $ 10 billion in material damage
- Cause: Continental drift in well-defined regions of Earth - Earthquake belts (approaching, moving away, slipping) or volcanic activity, collapse of underground cavities
- Earthquake Nest: A destruction zone where permanent deformation can occur.
- Theoretical center: hypocentre,
- perpendicular to the surface: epicenter



Richter scale (magnitude) based on destructive energy

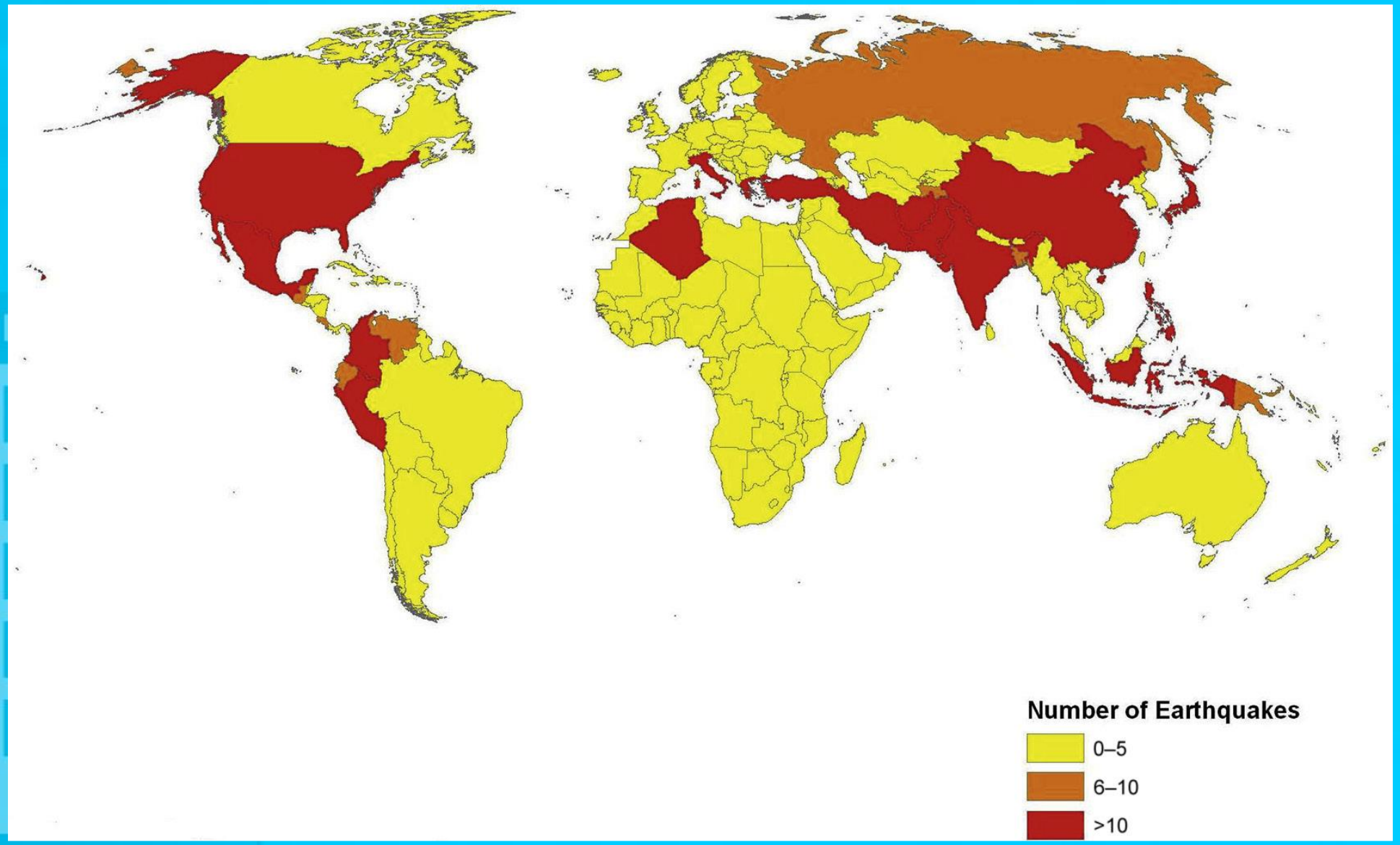
Barely noticable→ total destruction



Frequency: tens of thousands per year, 1-16 km average nest depth

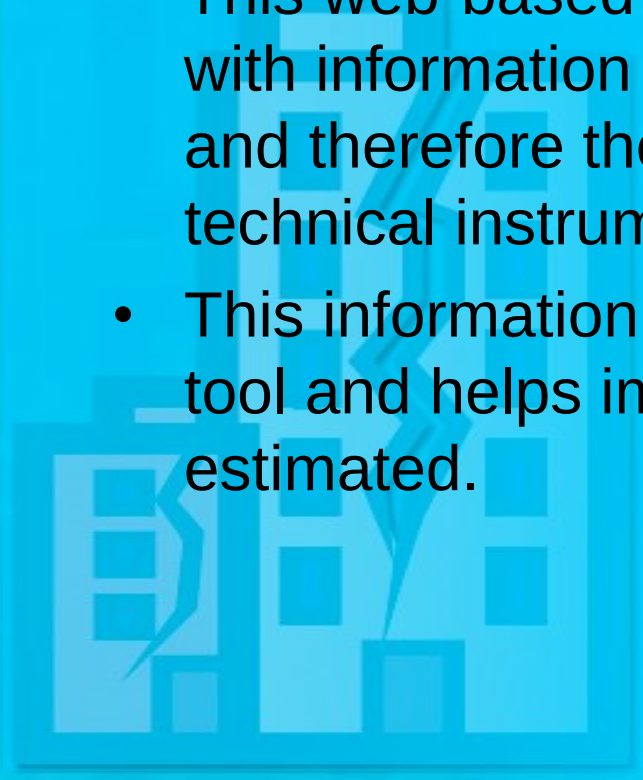
Forecast: Measurement of "ground currents", natural water sources, radon gas content of deep wells.

Number of earthquakes per country from 1974 to 2003

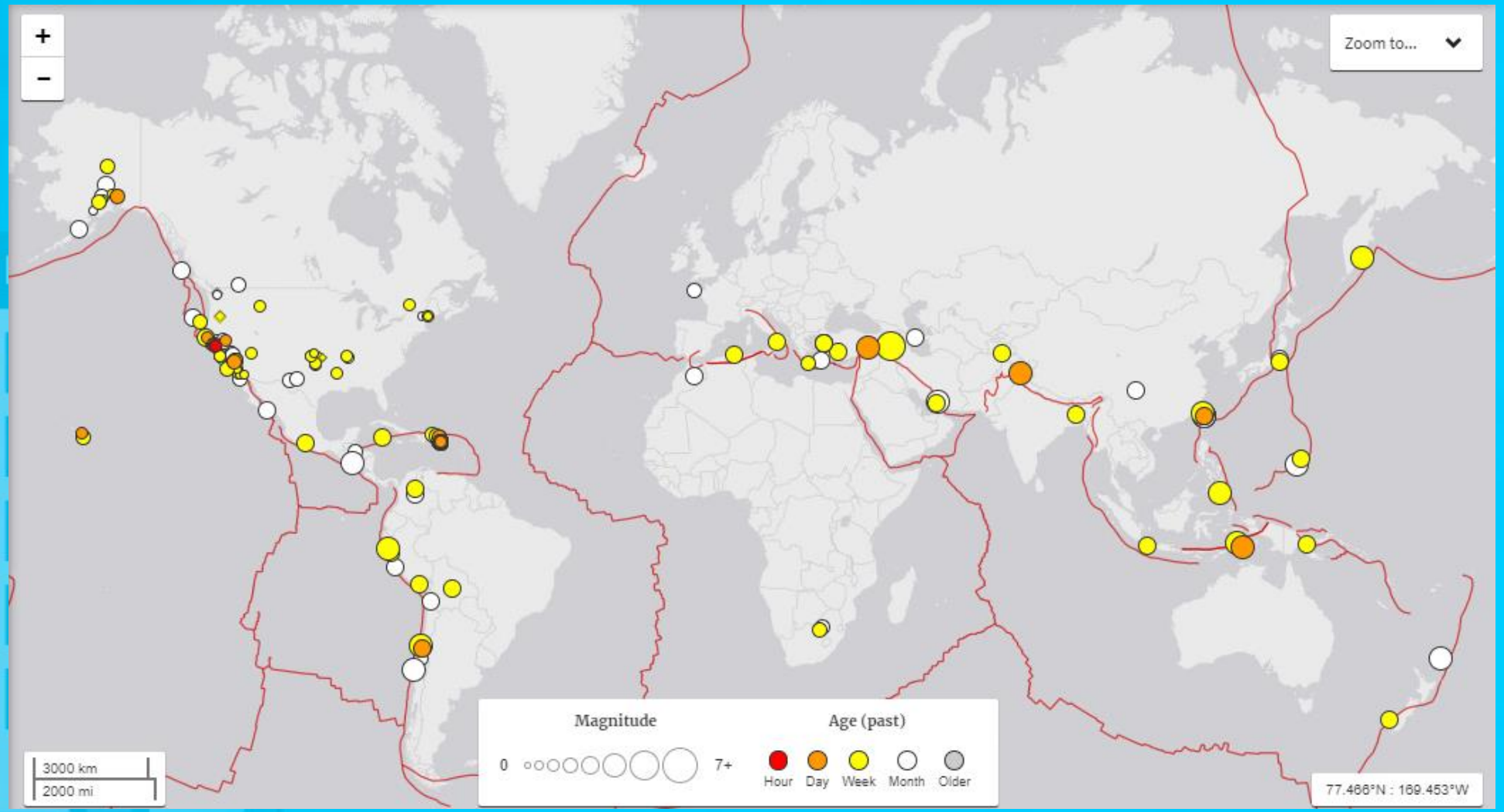


EARTHQUAKES - THE US GEOLOGICAL SURVEY “DID YOU FEEL IT?” APPLICATION

- The United States Geological Survey (USGS) utilizes a crowdsourcing system for measuring earthquake intensity that provides incredibly rapid and highly accurate assessments almost anywhere in the world.
- This web-based program, called “Did You Feel It?”, can provide responders with information about which specific areas experienced the most shaking and therefore the most potential damage, even in areas with few or no technical instruments.
- This information provides an almost immediate post-earthquake response tool and helps improve the methods by which future earthquake losses are estimated.



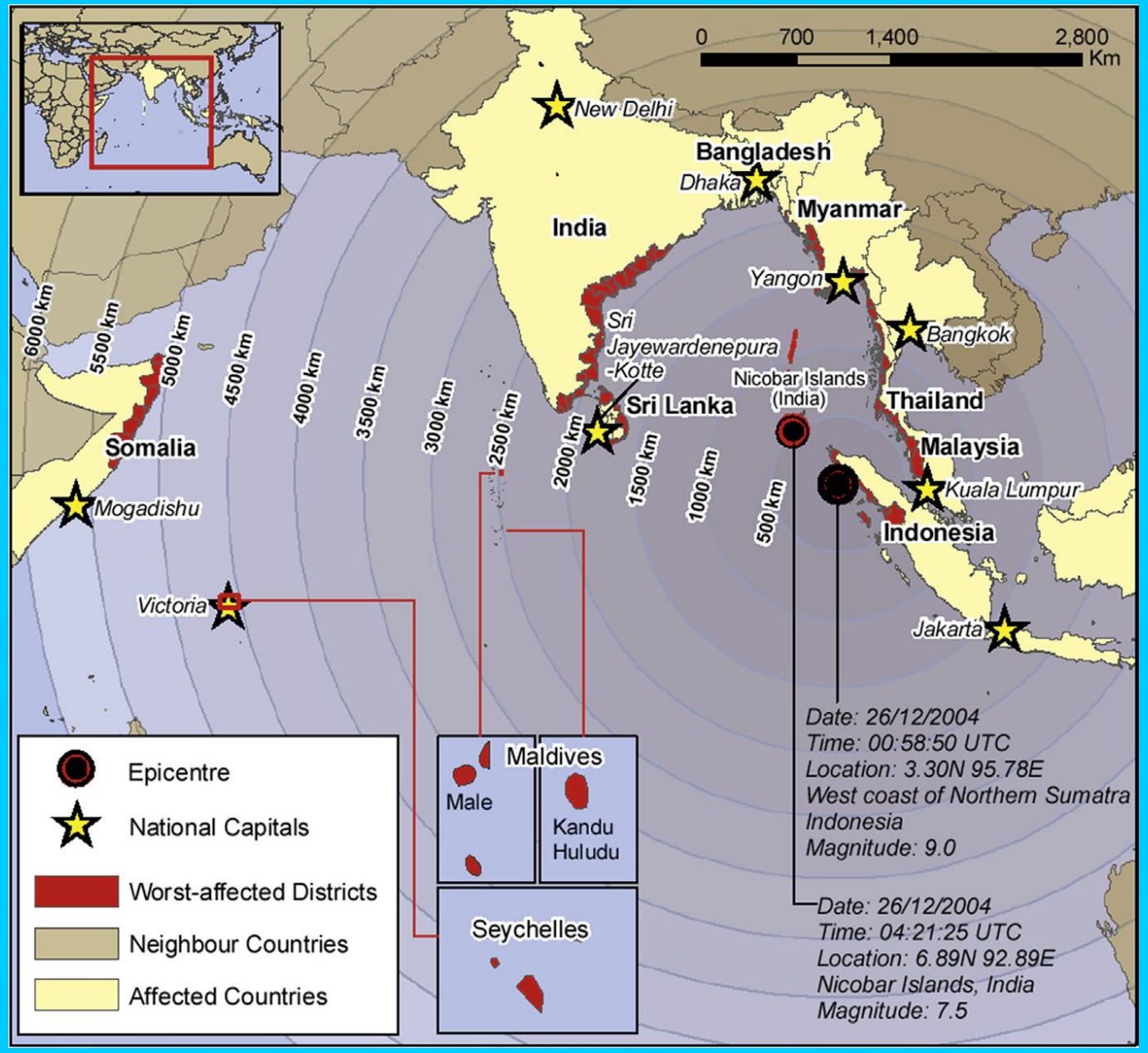
Earthquakes between 24-02-2020 and 26-02-2020



Early Warninig

- The UN Platform for the Promotion of Early Warning states that four separate factors are necessary for effective early warning:
    1. Prior knowledge of the risks faced by communities
    2. A technical monitoring and warning service for these risks
    3. The dissemination of understandable warnings to those at risk
    4. Knowledge by people of how to react, and the capacity to do so

Tsunami


0 700 1,400 2,800 Km
New Delhi
Bangladesh
Dhaka
India
Myanmar
Yangon
Bangkok
Sri Jayewardenepura -Kotte
Nicobar Islands (India)
Sri Lanka
Thailand
Malaysia
Kuala Lumpur
Indonesia
Jakarta
Somalia
Mogadishu
Victoria
6000 km
5500 km
5000 km
4500 km
4000 km
3500 km
3000 km
2500 km
2000 km
1500 km
1000 km
500 km
Epicentre
National Capitals
Worst-affected Districts
Neighbour Countries
Affected Countries
Maldives
Male
Kandu Huludu
Seychelles
Date: 26/12/2004
Time: 00:58:50 UTC
Location: 3.30N 95.78E
West coast of Northern Sumatra
Indonesia
Magnitude: 9.0
Date: 26/12/2004
Time: 04:21:25 UTC
Location: 6.89N 92.89E
Nicobar Islands, India
Magnitude: 7.5

Failure of advance notification

December 26, 2004, Indian Ocean Tsunami - much more complex than a simple lack of sensors.

In fact, many sensors were in place, and awareness of the earthquake's 9.0 magnitude and high tsunami likelihood began just minutes after it struck.

Waves struck within minutes— much less time than is typically required to launch an international alert.

Several countries had seismic detection and tsunami forecasting systems in place, including the United States, China,

Russia, and Japan. Unfortunately, few of the impacted countries had this capacity, and recognition was therefore possible only through information exchange. Availability of data was the first failure.

Even those countries that maintain sensing capabilities did not have in place standard mechanisms through which information could be quickly and efficiently packaged and communicated to the international community.

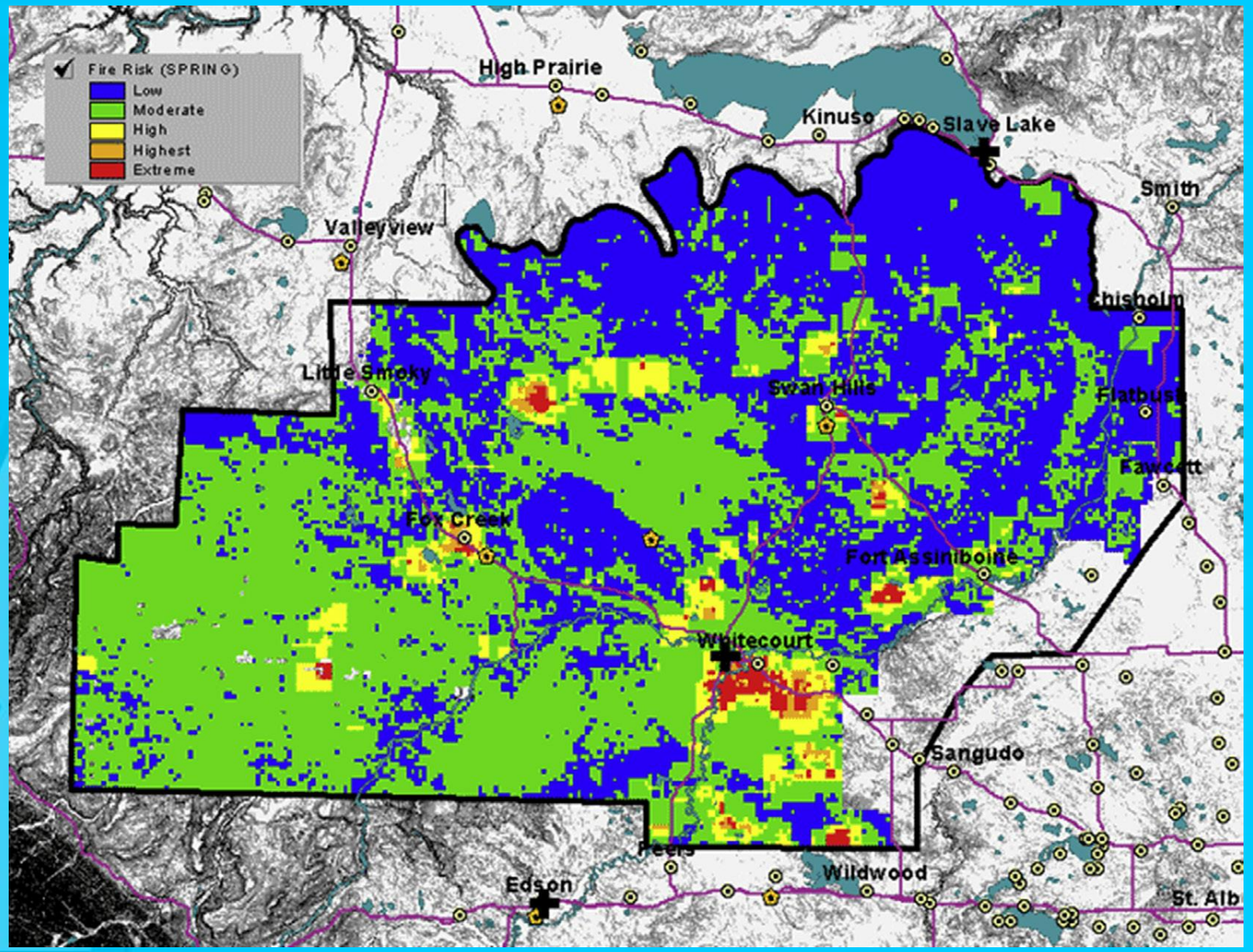
There were few, if any, pre-existing relationships between governments to facilitate the sharing of warnings, and virtually no information sharing protocols. Those countries that did receive notifications by the Pacific Tsunami Warning System did so by telephone—and only after the US Geological Survey requested that the US Department of State identify appropriate contacts and share the information as they were able.

And lastly, for those countries that did receive warnings, there were no mechanisms in place that would allow rapid and effective message transmission to the at-risk communities. Any such measures would have to have been in place prior

to the event and included communications systems, local protocols for receiving and acting on the information transmitted, and knowledge among citizens about how to react to the warnings.

Based on: Coppola, 2014.

Map detailing the likelihood of fire determined by activities and presence of causative agents



From Alberta Sustainable Resource Development.

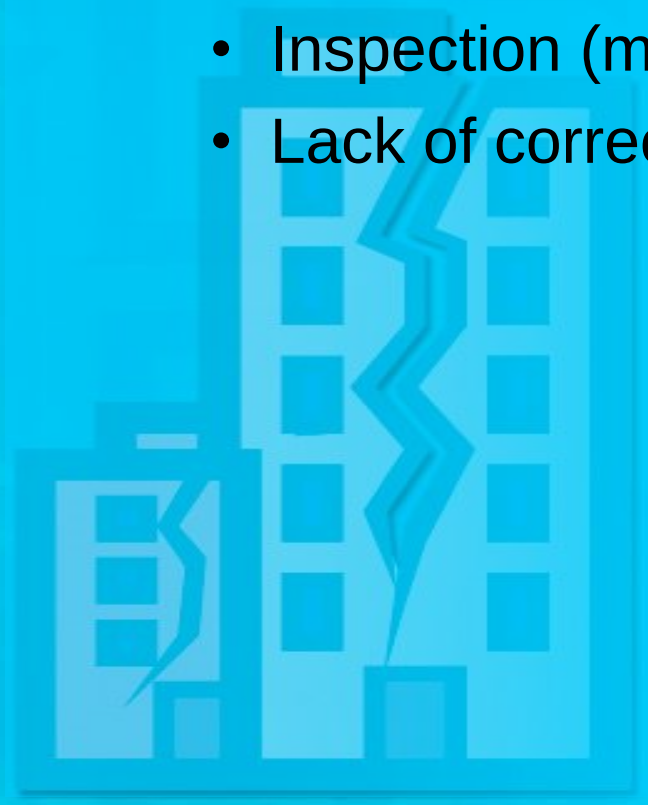
Methods for prevention

- Risk assessment
- Impact studies
- Modeling defense
- Development of protection plans
- Public information, education

- **SEVESO** guidelines: for industrial accidents
  - 1982. SEVESO I. - Prevention of major industrial accidents, reduction of harmful effects
  - 1997. SEVESO II. - indicates clear activities, defines tasks. E.g. preparation of external, internal security plan, security report, security analysis.
  - 2012. SEVESO III. – control of major-accident hazards involving dangerous substances

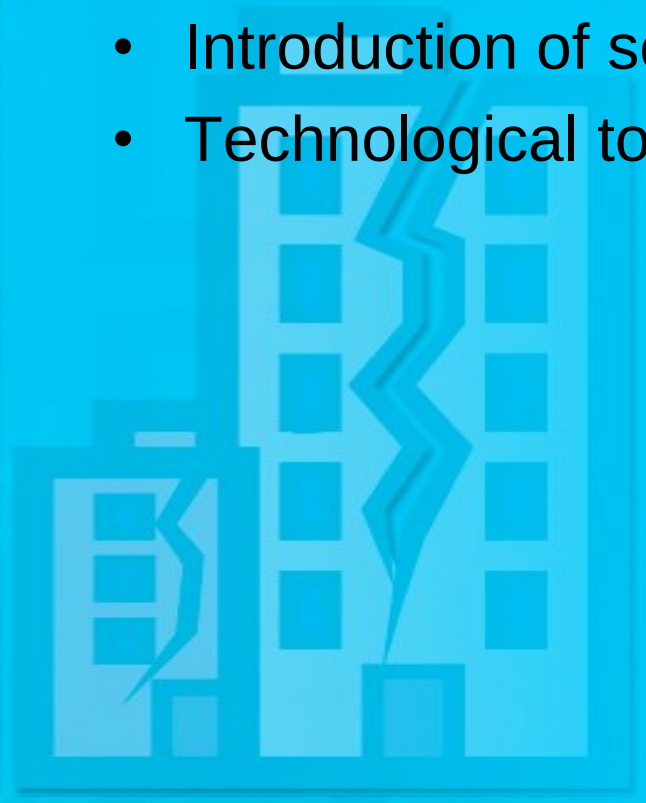
Move to SEVESO III

- Main areas of change:
  - Scope
  - Public information (more requirements)
  - Inspection (maintain current system)
  - Lack of correction system for substances moving in and out of scope



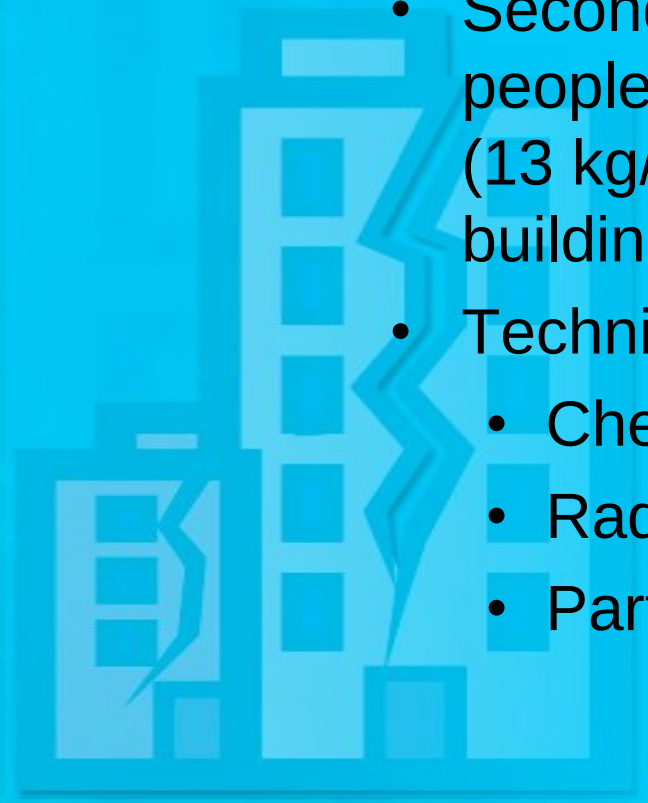
Possibilities for the prevention of civilization disasters

- The role of prevention -
  - Impact-resistant industrial facilities
  - Best Available Techniques (BAT)
- Introduction of security measures (monitoring systems)
- Technological tools for localization



Mitigation

- Urgent tasks: alerting the population, e.g. evacuation of people who’s escape routes are blocked, exstinguishing fires
- Secondary tasks: evacuation and accomodation of people affected [food (1.3 kg/day), water (2.0 kg/day), air (13 kg/day/person], first aid, temporary restoration of buildings elimination of sources of danger
- Technical rescue:
  - Chemical (decontamination)
  - Radiation abatement (deactivation)
  - Partial or complete

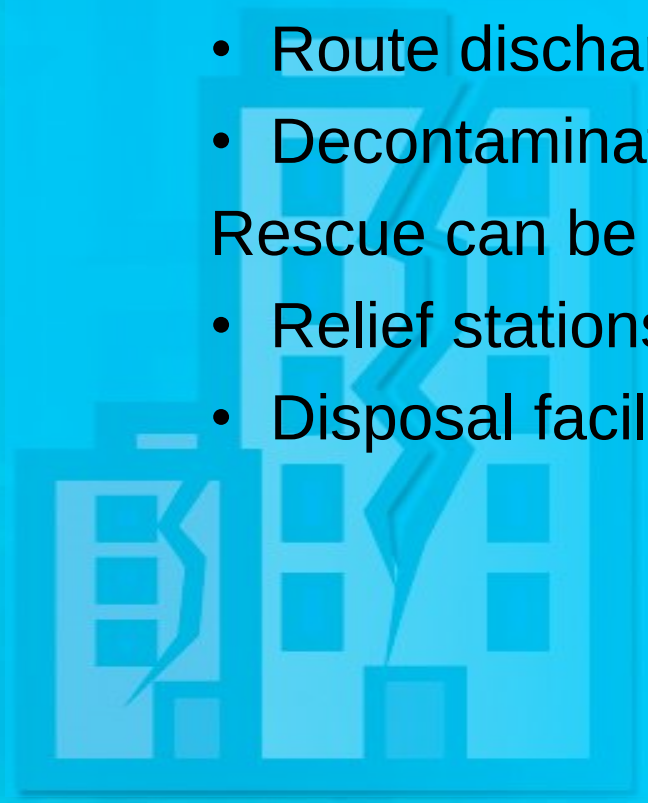


Rescue

- Personal
- Equipment, clothing, protective equipment, items, etc.
- Motor vehicles, technical equipment backup
- Route discharge
- Decontamination of buildings, wall surfaces, floors

Rescue can be done:

- Relief stations installed
- Disposal facilities



EIA, IPPC and SEVESO

- **EIA**: **general information tool** (Directive 85/337/EEC; 97/11. EC)
  - Linked to „project consent” decision making
  - Environmental statement (report) – any relevant impacts including emissions and health, environment and safety risks of accidents
- **IPPC: technical criteria for project decision-making**
  - Emission standards based on Best Available Technology (BAT) (Directive 96/61/EC)
- **SEVESO: risk assessment tool** (Directive 96/82/EC, 2003/105/EC)
  - Risk of major accidents for man and environment, and limit the consequences

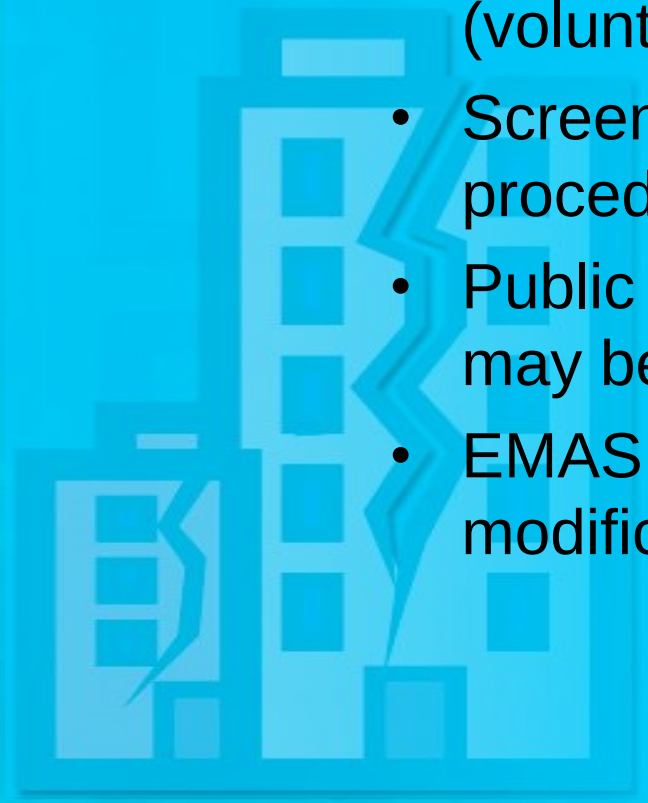
INTEGRAL

Fields of application

- **EIA:** all categories of projects likely to have significant impact
  - Screening required for IPPC projects/SEVESO activities within scope of EIA Directive
- **IPPC:** Industrial and some agricultural activites
  - Nearly all IPPC Annex I categories also in EIA Annex I or Annex II
- **SEVESO:** establisments with dangerous substances
  - SEVESO projects are included in both EIA and IPCC Annexes
- **All:** new projects, existing activities with changes and extensions

Exchangeable tools and procedures

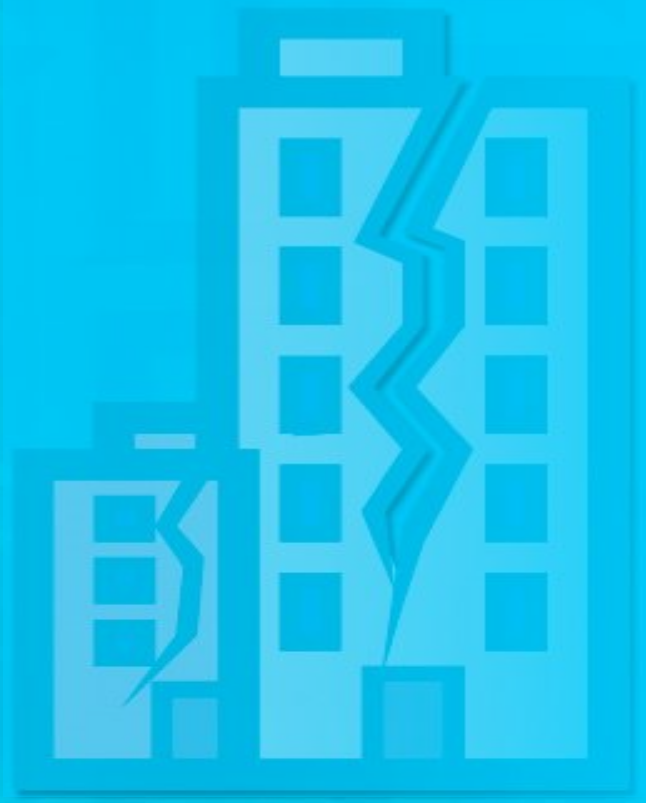
- EIA Annex III: tool to screen substantial changes or modifications, estimate significance also for IPPC/SEVESO
- Scoping: EIA tool also useful for IPPC/SEVESO (voluntary)
- Screening phase: efficiency of decision-making procedure when case is in scope of 2-3 Directives
- Public participation: process for EIA, IPPC, SEVESO may be joined
- EMAS: Information useful for appraising significance of modification and determining application of EIA/IPPC



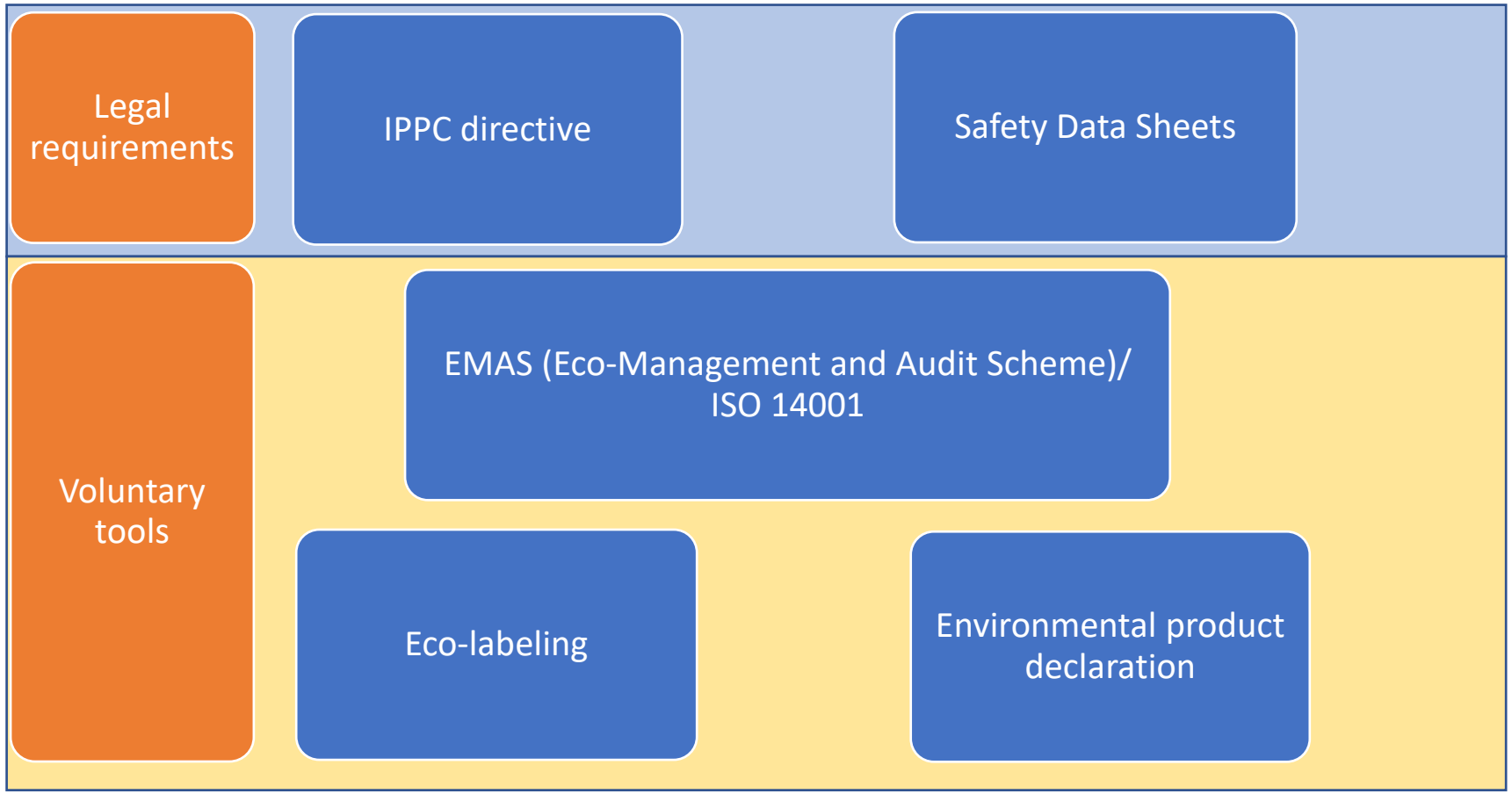
Required information, documentation

- Environmental report/information/documentation from applicant:
  - Always required to provide (synergy possible)
  - EIA, IPPC: effects, preventing, mitigating measures
  - SEVESO: risk analysis, safety conditions (also part of EIA/IPPC)
- To avoid duplication:
  - Coordinate stages where information is submitted
  - Esnsure information exchange between authorities
  - EIA can serve as basis for IPPC/SEVESO
  - Uniform classification system may save problems and time

The end



The five tools of the environmental management system



ENVIRONMENTAL PERMITTING

- Environmental permitting is a key instrument for
  - regulating a wide spectrum of industry and
  - reducing industry's environmental impacts,
  - Facilitating its compliance with environmental requirements and
  - promoting technical innovation
- All over the world, different policies and practices are being implemented to prevent and control industrial emissions in order to ensure a high level of environmental and human health protection. But inherent in many of these policies is the BAT (best available techniques) concept which has evolved as one of the key elements for setting emission limit values and other permit conditions in preventing and controlling the industrial emissions.

IPPC
INTEGRATED POLLUTION PREVENTION AND CONTROL

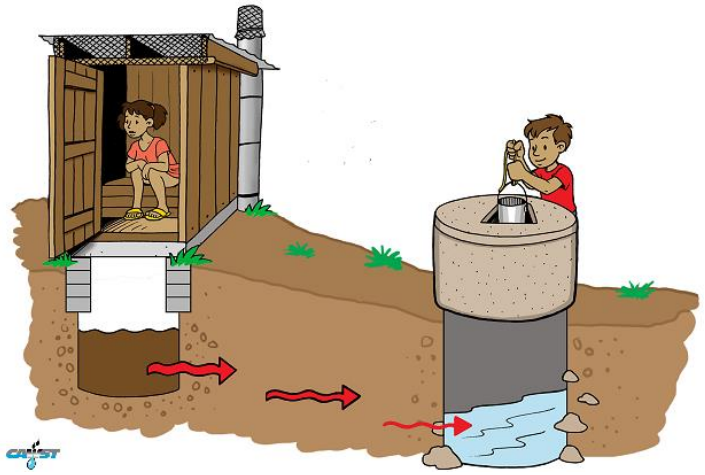
- Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control
- Newly recorded: 2008/1/EC directive
- (Background of the European low: **Regulation, :** A "regulation" is a binding legislative act. It must be applied in its entirety across the EU.
- **Directive:** A "directive" is a legislative act that sets out a goal that all EU countries must achieve. However, it is up to the individual countries to devise their own laws on how to reach these goals.)
- → national regulation

Main principles of IPPC Directive

- to **achieve integrated prevention and control of pollution** arising from the activities listed in Annex I.
- It lays down measures designed to **prevent** or, where that is not practicable, to **reduce emissions** in the air, water and land from the abovementioned activities, including measures concerning waste,
- in order to **achieve a high level of protection** of the environment taken as a whole
- Special focus on high output activities of agricultural and industrial activity

Integrated approach

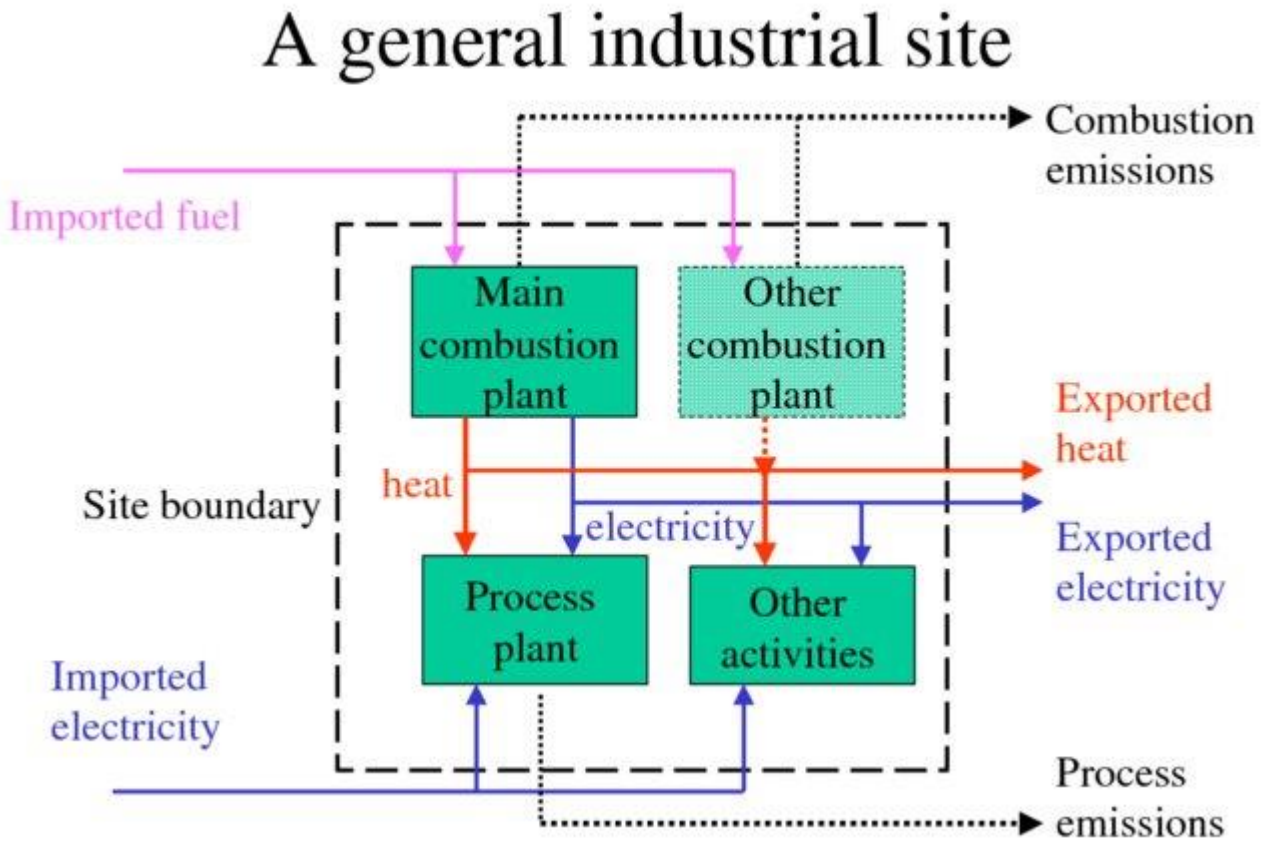
- To protect the environment as a whole (not just its individual components) during different uses of the environment.
- Ensure that contaminants/pollutants of industrial, agricultural (or even remediation) activities are not transmitting or disperse contaminants from one environmental compartment to another
- It is not allowed to contaminate or damage an environmental element for the sake of the prevention, reduction, elimination or remediation of another!
- Arising questions: Remediation? Use of the environment? Pollution? Use of the environment?



Main principles of IPPC Directive

Establishment level regulation

- Pollution effects must be evaluated in a broader way, not just in the level of an individual technological process or activity.
- The environmental impact of the whole installation is regulated (SCOPE!)



A general site in the industrial, commercial or public sector (Steve Sorrell, researchgate.net)

- IPPC regulates emission, but goes further and deals with
  - environmental consequences such as **energy efficiency, waste minimization, accidents with environmental consequences**,
  - the restoration of environmental condition after abandoning a site (**recultivation**).
- BAT (Best Available Techniques)
  - Application of BAT is required by the law.
  - In practice, BAT means that process (design, licensing, implementation, operation, decommissioning) reduce emissions at source and natural resources are used efficiently.

BAT

‘best available techniques’ means **the most effective and advanced stage in the development of activities** and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed **to prevent** and, where that is not practicable, generally **to reduce emissions and the impact on the environment as a whole.**

Best Available Technique (BAT)

"Technique" means both the **technology** and the way the **installation** is designed, built, maintained, operated and decommissioned.

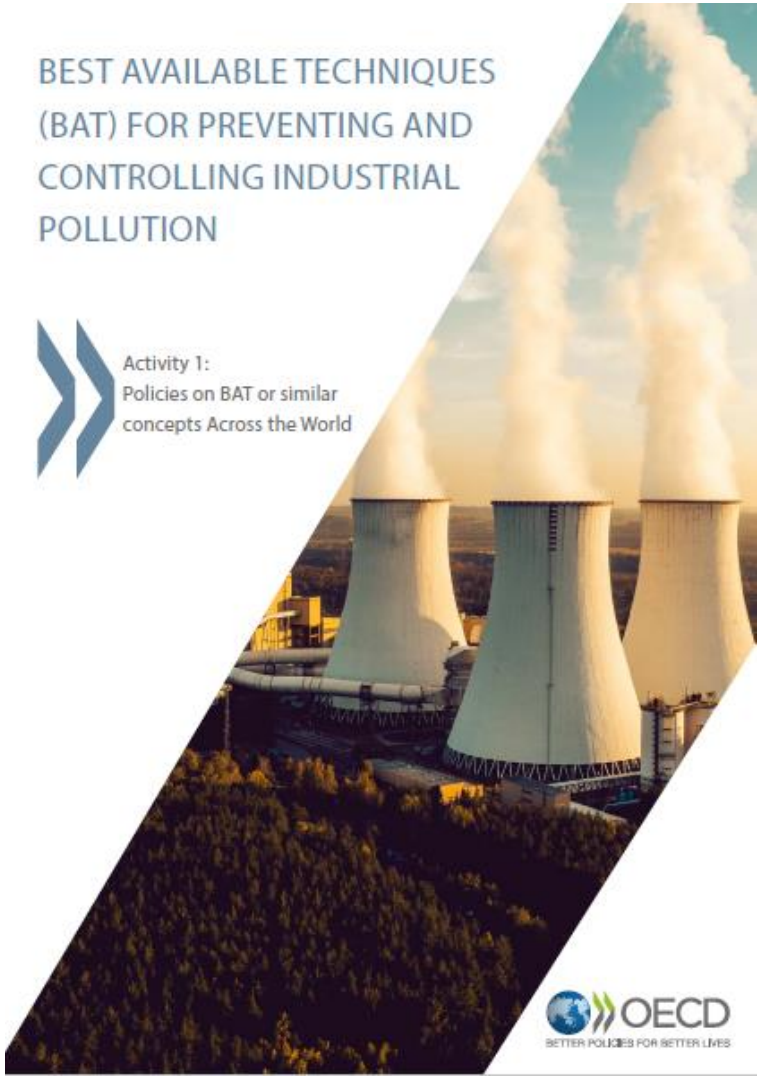
"Available" means techniques developed on a scale which allows them to be used in the relevant industrial sector, under economically and technically viable conditions.

"Best" means most effective techniques for achieving a high level of protection of the environment as a whole.

OECD, 2007


OECD

BAT around the world



ENV/JM/MONO(2017)12

OECD Environment, Health and Safety Publications
Series on Risk Management
No. 40

REPORT ON OECD PROJECT ON BEST AVAILABLE TECHNIQUES FOR PREVENTING AND CONTROLLING INDUSTRIAL CHEMICAL POLLUTION

ACTIVITY 1: POLICIES ON BAT OR SIMILAR CONCEPTS ACROSS THE WORLD

IOMC
INTER-ORGANIZATION PROGRAMME FOR THE SOUND MANAGEMENT OF CHEMICALS
A cooperative agreement among FAO, ILO, UNDP, UNEP, UNIDO, UNITAR, WHO, World Bank and OECD

Environment Directorate
ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT
Paris 2017

- United States
- European Union
- India
- People's Republic of China
- Japan
- Russian Federation

Hungarian regulation (general information) on BAT

314/2005. decree Section 17: in order to prevent pollution and to reduce the environmental load, the user of the environment shall take the following measures **using the best available techniques**:

Specific reductions in the use of environmentally hazardous materials required for the operation;

The efficient use of material and energy for the activity;

The prevention or minimization of emissions;

The prevention of waste generation and, in accordance with the priority list of the waste hierarchy…

- the reduction of the amount and the hazard of the waste generated;
- The preparation of waste for re-use;
- Recycling or other recovery.

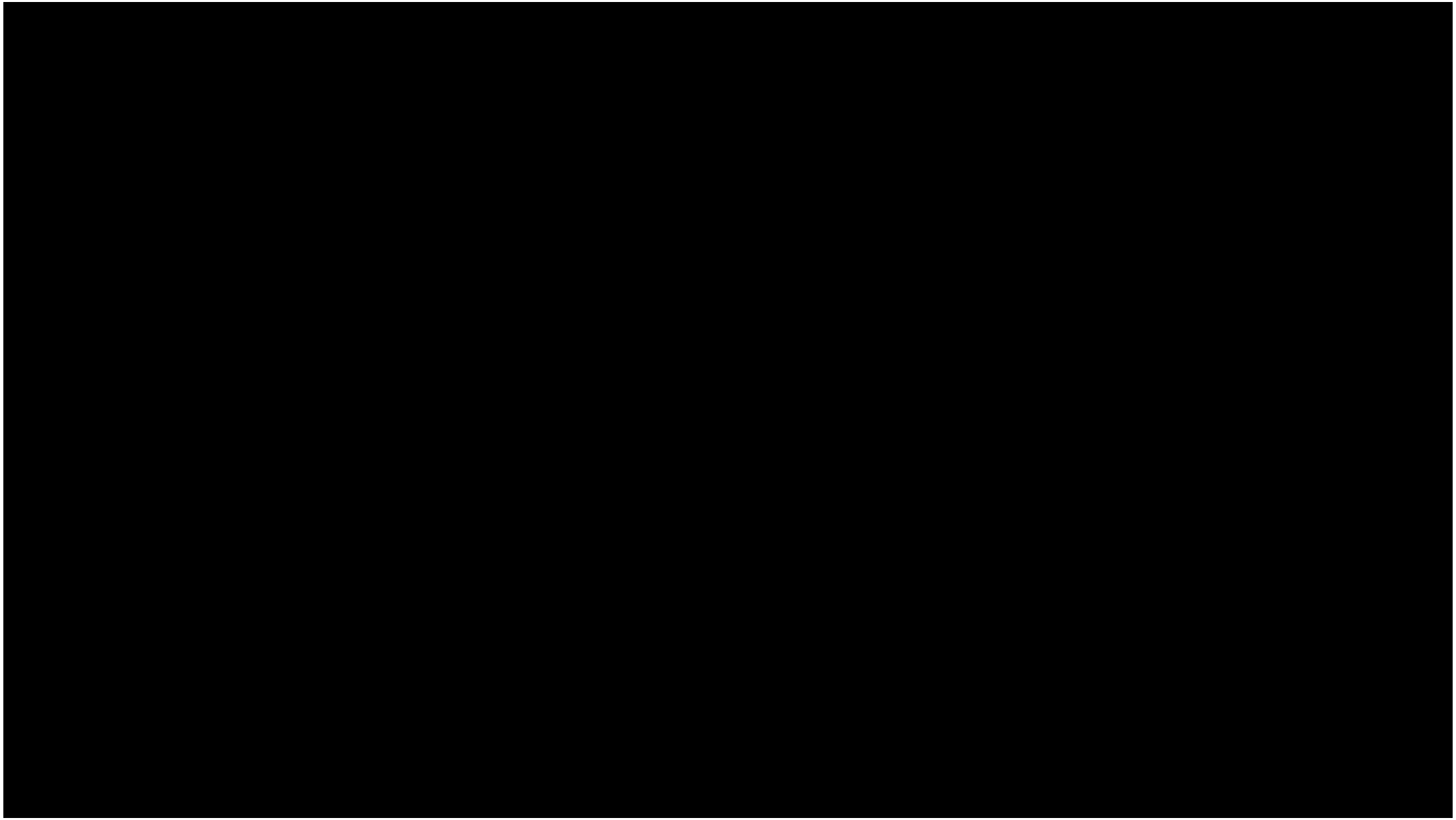
The prevention of environmental accidents and the reduction of their environmental consequences

In the event of **decommissioning** (finishing the activity), the prevention of environmental pollution or deterioration and the restoration of deteriorated environment.

BAT reference documents (BREFs)

EUROPEAN INTEGRATED POLLUTION PREVENTION AND CONTROL BUREAU, SEVILLA
http://eippcb.jrc.ec.europa.eu/reference/

- **The BREFs are a series of reference documents covering, as far as is practicable, the industrial activities listed in Annex 1 to the EU's IPPC Directive.**
- **They provide descriptions of a range of industrial processes and for example, their respective operating conditions and emission rates.**
- **Member States are required to take these documents into account when determining best available techniques generally or in specific cases under the Directive.**



Reference documents under the IPPC Directive and the IED

The table below presents, in alphabetical order, the list of reference documents that have been drawn (or are planned to be drawn) as part of the **exchange of information** carried out in the framework of Article 13(1) of the **Industrial Emissions Directive (IED, 2010/75/EU)**. The table contains the Best Available Techniques (BAT) reference documents, the so-called BREFs (as well as a few other reference documents) that have been adopted under both the IPPC Directive (2008/1/EC) and the IED. For BREFs adopted under the IED, the table shows in the column "Adopted document" also the BAT conclusions adopted according to IED Article 13(5). The "BAT conclusions" is a document containing the parts of a BAT reference document laying down the conclusions on best available techniques. According to Article 14(3) of the IED, BAT conclusions shall be the reference for setting the permit conditions to installations covered by the Directive.

For each BREF in the table below, the following information can be found:

- The latest reference document itself. In short, each document generally gives information on a specific industrial/agricultural sector in the EU, on the techniques and processes used in this sector, current emission and consumption levels, techniques to consider in the determination of the best available techniques (BAT) and emerging techniques.
- The list of references (background material) quoted in the reference document.
- Links to webpages containing relevant legislation/standards.
- Additional technical information.
- Translations of the Executive Summaries for BREFs adopted under the IPPC Directive.

For Reference documents developed under other legislative instruments/policy documents which are not a part of the information exchange under the IED/IPPC Directive (i.e. Management of Tailings and Waste-Rock in Mining Activities (MTWR), Hydrocarbons exploration and extraction (HC)), please click **here**.

Best available techniques Reference document (BREFs) developed under the IPPC Directive and the IED

- Ceramic Manufacturing Industry
- Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector
- Common Waste Gas Treatment in the Chemical Sector
- Emissions from Storage
- Energy Efficiency
- Ferrous Metals Processing Industry
- Food, Drink and Milk Industries
- Industrial Cooling Systems
- Intensive Rearing of Poultry or Pigs
- Iron and Steel Production
- Large Combustion Plants
- Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilisers

Code	Adopted/Published Document	Formal draft (*)	Meeting report	Estimated review start (**)
CER	**BREF** (08.2007)			
CWW	BATC **BREF**			
WGC				Drawing up started
EFS	**BREF** (07.2006)			
ENE	**BREF** (02.2009)			
FMP	**BREF** (12.2001)		**MR** (11.2016)	
FDM	**BREF** (08.2006)	**D1** (01.2017)	**MR** (10.2014)	
ICS	**BREF** (12.2001)			
IRPP	BATC (07.2017) **BREF**			
IS	BATC (03.2012) **BREF**			
LCP	BATC (07.2017)	**FD** (06.2016)	**MR** (10.2011)	
LVIC-AAF	**BREF** (08.2007)			

BATC: BAT conclusions. Among other things, a description of the emission levels associated with the BAT and the monitoring that goes along with it.

Large Volume Inorganic Chemicals – Solids and Others Industry	LVIC-S	**BREF** (08.2007)			
Large Volume Organic Chemical Industry	LVOC	**BREF** (02.2003)	**FD** (02.2017)	**MR** (12.2010)	
Manufacture of Glass	GLS	BATC (03.2012) **BREF**			
Manufacture of Organic Fine Chemicals	OFC	**BREF** (08.2006)			
Non-ferrous Metals Industries	NFM	BATC (06.2016) **BREF**			
Production of Cement, Lime and Magnesium Oxide	CLM	BATC (04.2013) **BREF**			
Production of Chlor-alkali	CAK	BATC (12.2013) **BREF**			
Production of Polymers	POL	**BREF** (08.2007)			
Production of Pulp, Paper and Board	PP	BATC (09.2014) **BREF**			
Production of Speciality Inorganic Chemicals	SIC	**BREF** (08.2007)			
Refining of Mineral Oil and Gas	REF	BATC (10.2014) **BREF**			
Slaughterhouses and Animals By-products Industries	SA	**BREF** (05.2005)			2017/2018
Smitheries and Foundries Industry	SF	**BREF** (05.2005)			

Surface Treatment Of Metals and Plastics

Surface Treatment Using Organic Solvents (including Wood and Wood Products Preservation with Chemicals)

Tanning of Hides and Skins

Textiles Industry

Waste Incineration

Waste Treatment

Wood-based Panels Production

Reference Document (REFs)

Economics and Cross-media Effects

Monitoring of emissions from IED-installations

Code	Adopted Document	Formal draft (*)	Meeting report	Estimated review start
STM	BREF (08.2006)			
STS	BREF (08.2007)	D1 (10.2017)	MR (11.2015)	
TAN	BATC (02.2013) BREF			
TXT	BREF (07.2003)			Review started
WI	BREF (08.2006)	D1 (05.2017)	MR (01.2015)	
WT	BREF (08.2006)	FD (10.2017)	MR (11.2013)	
WBP	BATC (11.2015) BREF			
ECM	REF (07.2006)			
ROM	REF (07.2003)	Revised FD (06.2017)		

(*) Formal draft of (B)REFs have no legal value. They only reflect work in progress and are available for information only to those interested in the exchange of information under Article 13(1) of the IED.

(**) For further indications, please consult **the latest iteration in the EIPPCB work programme** for the revision of BAT reference documents (BREF); the EIPPCB work programme updates can be found by following **the works of the IED art. 13 forum**.

BREF or REF, indicates that a document has been published by the European Commission under the IED (post 2010). Under Adopted Document, both the BREF and the related BAT conclusions can be found.

FD, indicates that the document has been sent to the IED Article 13 Forum for its opinion.

D1/D2/D3, indicates the latest formal draft which is available.

Indicates that work has started but a draft is not yet available.

Indicates work is planned to commence in the year shown but has not yet started.

BREF or REF, indicates that a document has been formally adopted by the European Commission under the IPPC Directive (2008/1/EC).

Indicates that work has not yet started.

- BREF or 'BAT reference document' means a document, resulting from the exchange of information organised pursuant to Article 13 of Directive 2010/75/EU, drawn up for defined activities and describing, in particular, applied techniques, present emissions and consumption levels, techniques considered for the determination of best available techniques as well as BAT conclusions and any emerging techniques, giving special consideration to the criteria listed in Annex III to Directive 2010/75/EU. A similar definition was applicable under the IPPC Directive (2008/1/EC).

- REF or 'reference document' or 'reference report" means a document, which is not a BREF, used as the main reference for a specific horizontal task or topic in the Sevilla process.

- BATC or 'BAT conclusions'' means a document containing the parts of a BAT reference document laying down the conclusions on best available techniques, their description, information to assess their applicability, the emission levels associated with the best available techniques, associated monitoring, associated consumption levels and, where appropriate, relevant site remediation measures.

How to implement BAT and IPPC? (Hungarian example)

The IPPC Directive entered Hungarian environmental legislation through two procedures:

- **ENVIRONMENTAL IMPACT ASSESSMENT** (previously existed in Hungary)
- **INTEGRATED ENVIRONMENTAL AUTHORIZATION** (IEA, "IPPC Procedure", emphasis on BAT)

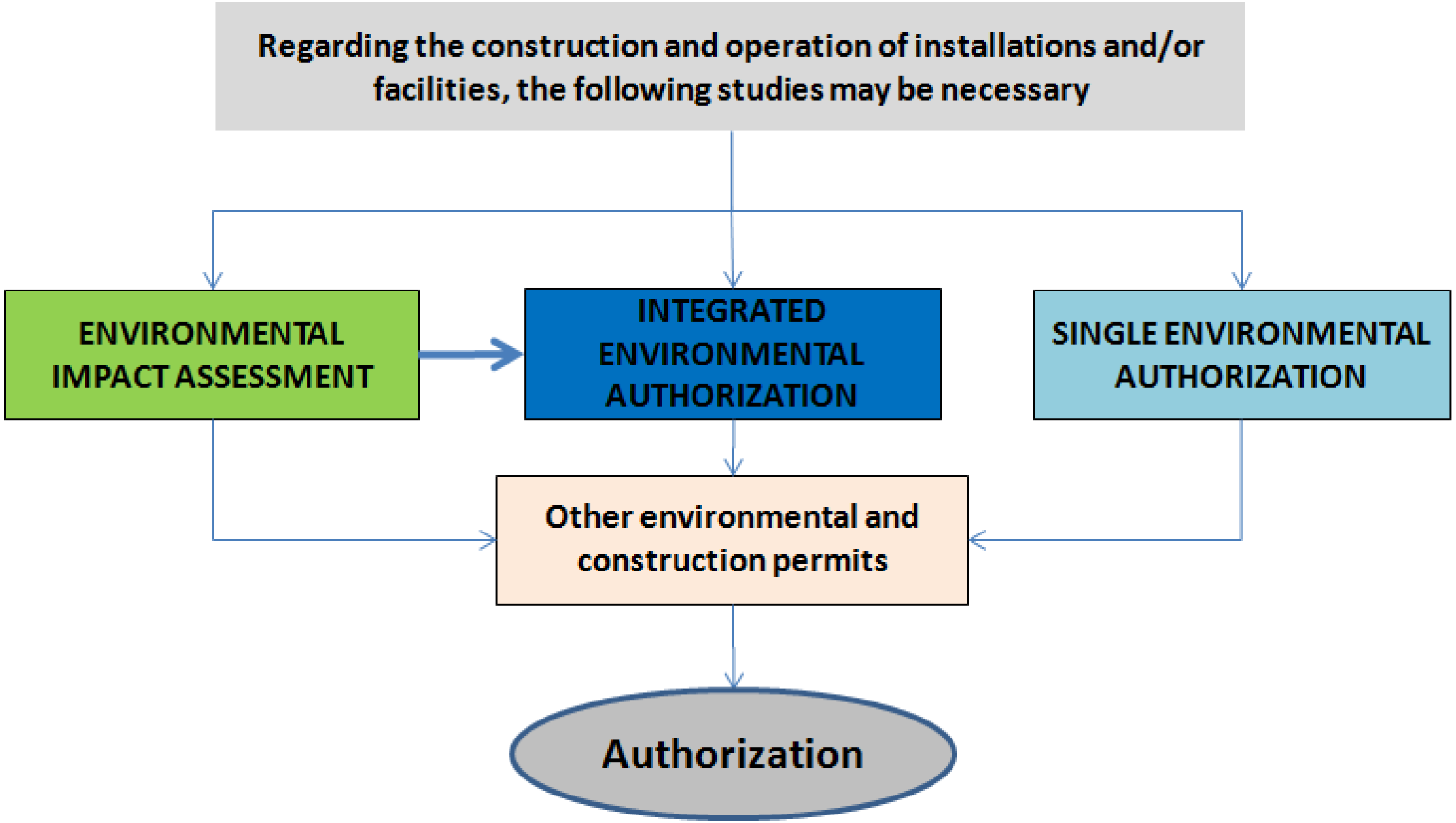
314/2005. (XII.25.) decree (both are regulated by this decree)

314/2005 decree…

- Identify activities with significant environmental effects that's
  - installation (establishment)
  - operation (implementation)
  - abandonment (cease)

can be carried out with environmental impact assessment and/or integrated environmental authorization.

- Provides the rules for the conduction of these procedures, the content requirements of the study and the documentation that should be submitted for authorization.


Regarding the construction and operation of installations and/or facilities, the following studies may be necessary
ENVIRONMENTAL IMPACT ASSESSMENT
INTEGRATED ENVIRONMENTAL AUTHORIZATION
SINGLE ENVIRONMENTAL AUTHORIZATION
Other environmental and construction permits
Authorization

Which activity (or both) should be used?

- DECISION CRITERION: overview of the three annexes whether the activity is in one or more, regardless limit values.
- REMINDER:
- List of activities with the requirement of environmental impact assessment
- Activities bound to the integrated environmental authorization
- Activities requiring environmental impact assessment when the environmental authority requires.

The environmental user is not „left alone” in decision process, procedure will be clarified by the environmental authority:

Preliminary investigation

- The environmental user must submit a request for a preliminary investigation to the environmental authority if he intends to carry out an activity of listed activities

Preliminary consultation

- An environmental user may seek prior consultation with the environmental authority if he intends to carry out an activity which is listed in annexes.

In order to establish both procedures, a documentation with the required content should be submitted to the environmental authority

- Emphasizing important environmental and nature conservation aspects:
  - Preliminary assessment of the likely effects of the installation, operation and decommissioning on the environment considering the influencing factors in particular:
    - Triggering effect of impact factors and in case of a new installation, changes in the condition and function of the chosen area as a result of the installation with special attention to climate change.
    - Scope of impact – area should be marked on a map
    - Environmental status of the marked area (land use, demographic data, and the estimated environmental changes (impacts)
    - Description of nature conservation areas, caves, Natura 2000 sites, impact on protected species
    - Description of the effects on the landscape (structure, use, nature and landscape)

Authority decision

- Appropriate procedure for conducting the procedures or merging EIA and IEA
- Specify the content requirement for the documentation
- If the thresholds or conditions of Annex 3 are not met, the authority shall indicate what prior authorization is required to carry out the activity.

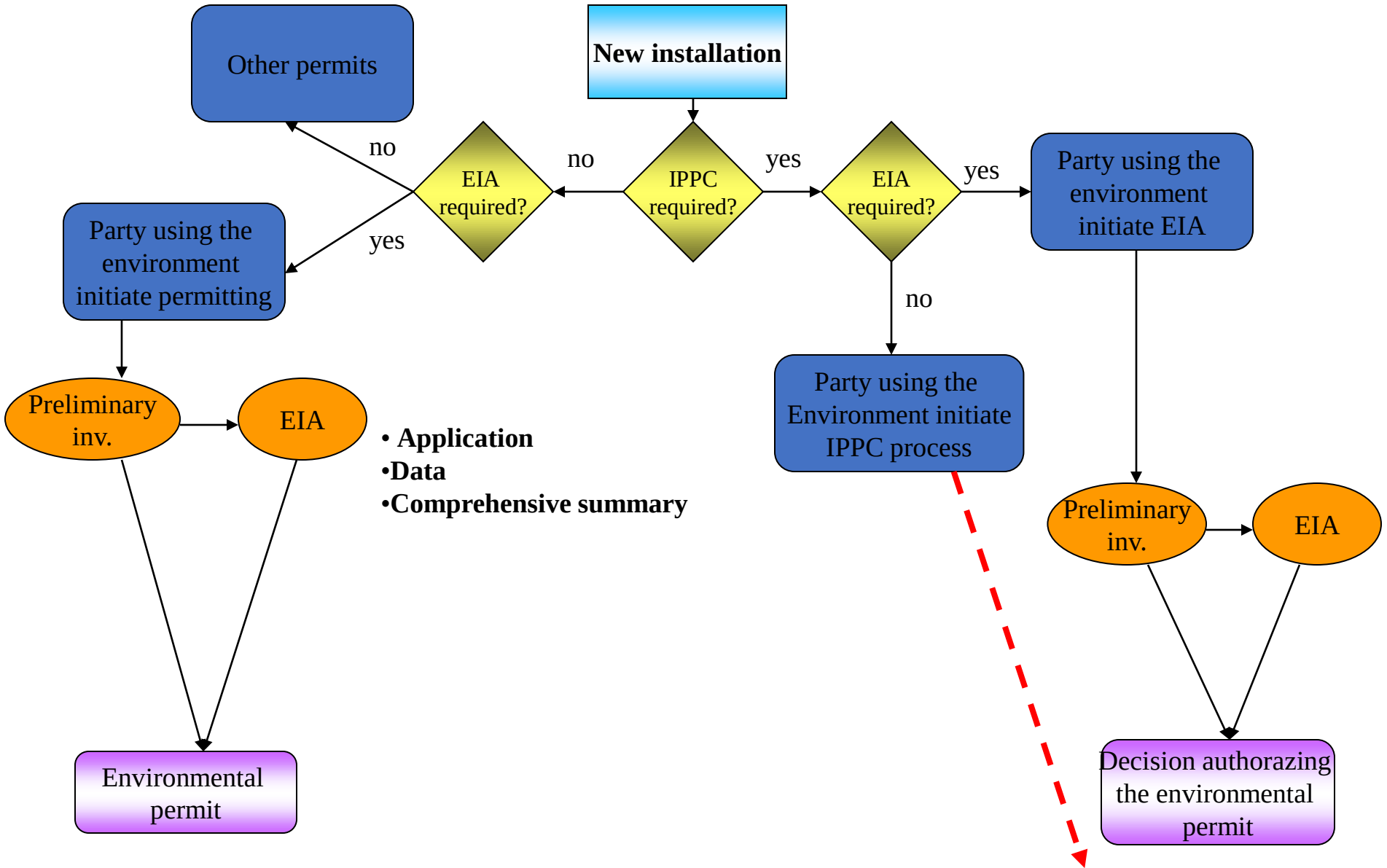
About thresholds

EIA required (1. annex)	IPPC required (2. annex)	EIA requirement is up to the decision of authority (3. annex)
Poultry farm 85 000 places (broiler)	40 000	100 livestock, i.e. 10000 (0,01 livestock)
Pork plant 3 000 (over 30 kg)	2 000	500 livestock, i.e. 1000 (25-110 kg porker 0,2 livestock)
Pork plant 900 sow	750	150 livestock 300 (sow 0,5 livestock)

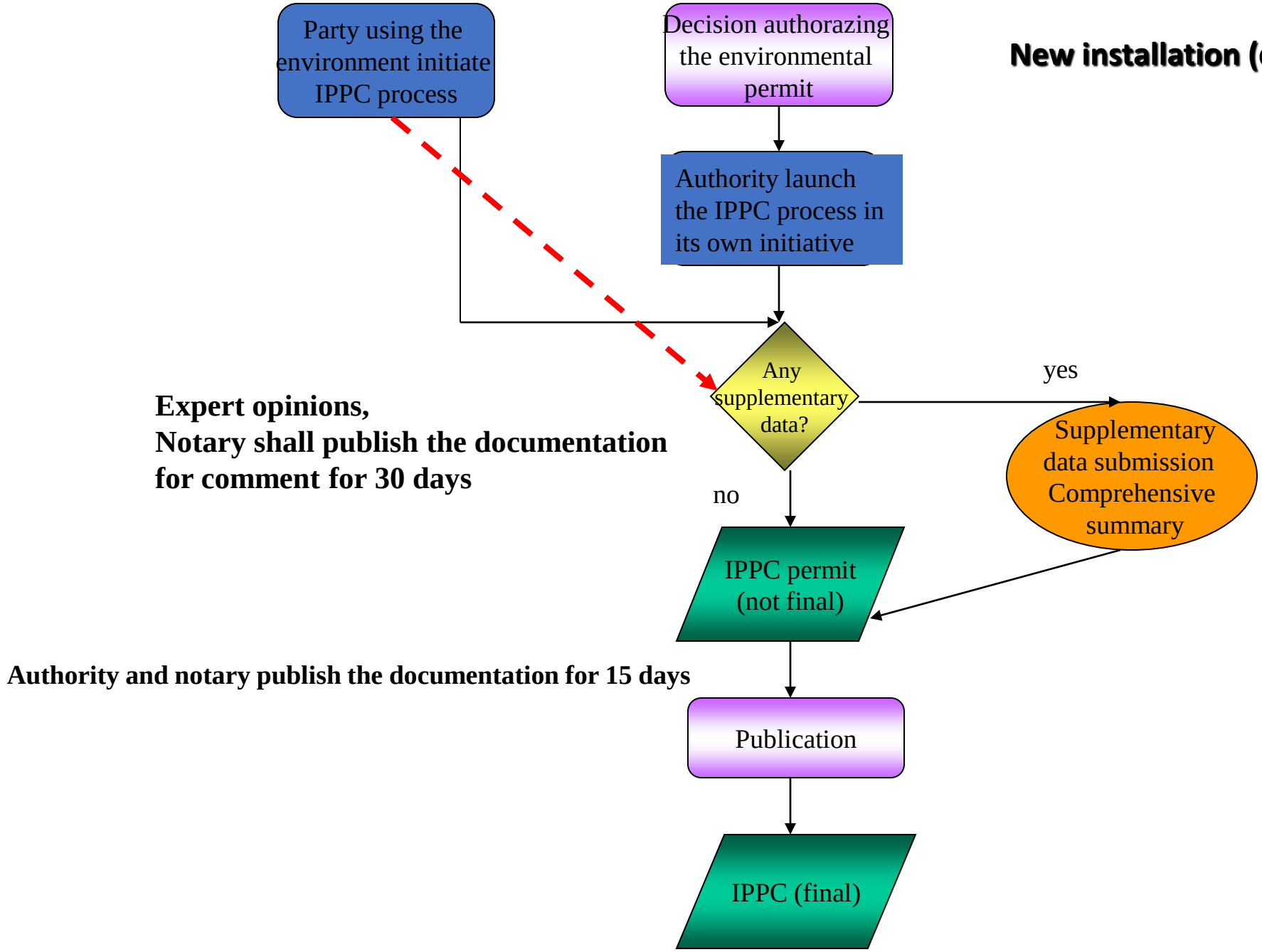
Procedures can be merged

- **When EIA and IPPC permitting are both required, procedures can be merged upon request.**
- **If procedures are running separatedly, the first is always environmental impact assessment.**

New installation IEA or IPPC



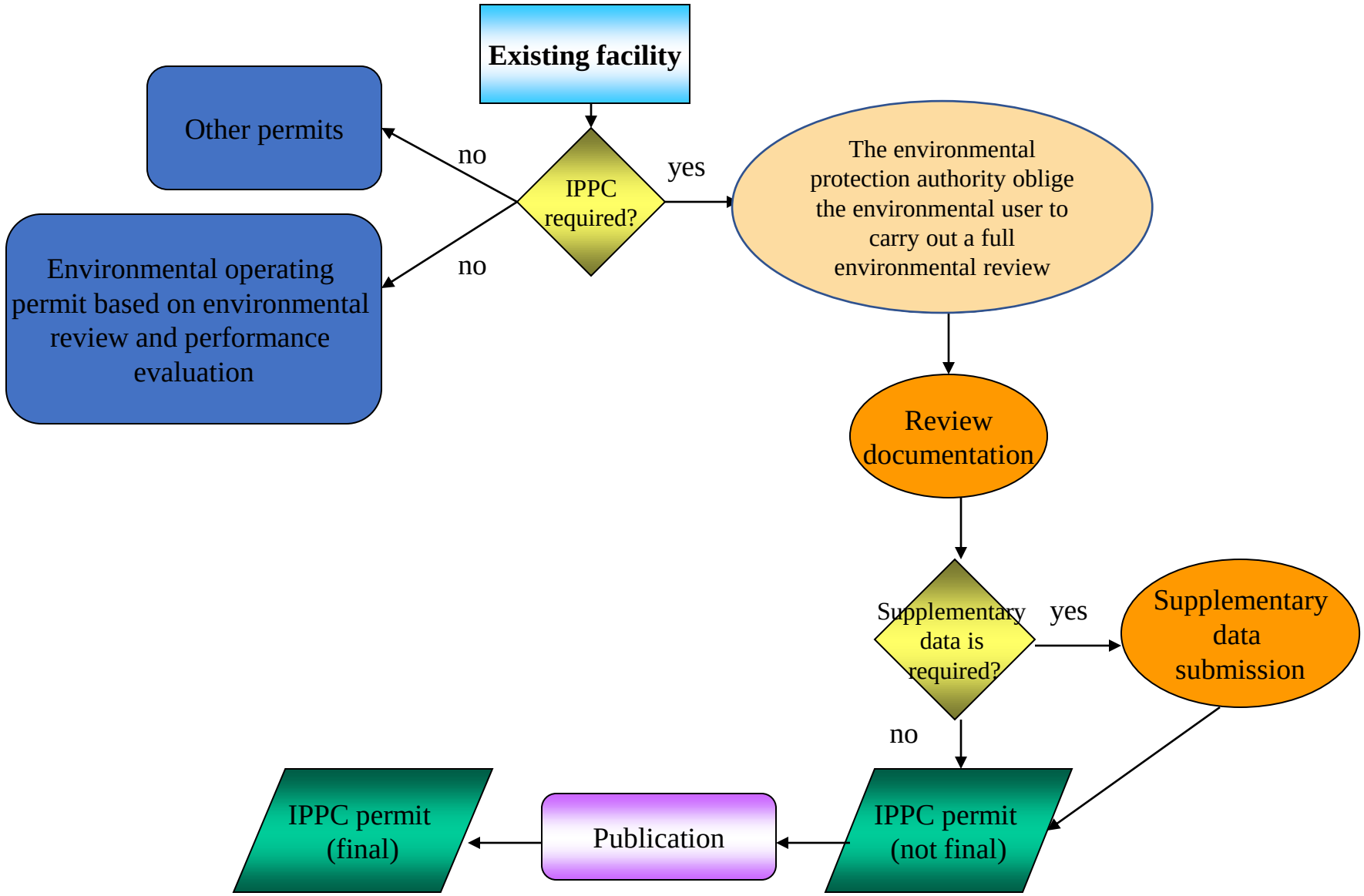
New installation (continue)



Expert opinions,
Notary shall publish the documentation for comment for 30 days

Authority and notary publish the documentation for 15 days

Existing faclility - Hurray! ONLY IPPC



Authorization of establishment and permission for the activity

- **After EIA procedure, activity will be licenced with Environmental Permit.**
- **After a succesful IPPC process, installation will get an IPPC permit (usually at least 10 years).**

EPER

- **IN THE EU MEMBER STATES (INCLUDING HUNGARY) THE IPPC DIRECTIVE REQUIRES REPORTING OF SITE EMISSIONS TO THE EUROPEAN COMMISSION.**
- **DATA of the REPORTED emissions to air and water are publicly available on the internet, updated every three years through a public system. →**
- **The European Pollutant Release and Transfer Register (E-PRTR)**
- **IPPC AUTHORIZATION MUST BE EXAMINED EVERY 5 YEARS ESPECIALLY FROM BAT'S VIEW**
- **Emissions and impacts of installations operating under the EIA or IPPC PERMIT should be monitored as it was required in the permit, plus the annual inspections of the authority.**
- **Environmental audit should be done even if the installation is not operating properly or if there is a contamination.**

Environmental impact assessment (EIA) procedure covers

- **Environmental elements** (soil, ambient air, water, biosphere, biological diversity, with a special attention to nature conservation areas and NATURA 2000 areas, landscape, soil, built environment, historic buildings, archeological heritage) and their **condition** (exposure, route of exposure).
- **Effects** on the system, process and structure of environmental elements, especially on landscape, settlements, climate and the ecosystem.
- **Expected changes** in the state of health and the social and economic situation of the population concerned (particulary in terms of quality of life and land use).

STAKEHOLDERS

1. Location and extent of the area of activity; 2. Capacity of activity, material and energy balance, material and energy circulation; 3. detailed operation and technological guidelines, alternative solutions, outputs from the technology (secondary materials, waste); 4. possible changes over time

BASIC INFORMATION (A)

Determination of IMPACT FACTORS (B)

IMPACT PROCESSES (assessment overview) (C)

IMPACT FACTORS = a causes of environmental changes, emissions and/or abatement of substances/energy. Activity has to be subdivided into separate parts, i.e. technological elements = impact factors.

IMPACT AREA estimation, demarcation

IMPACT PROCESSES = link between influencers and impact factors, i.e. processes triggered by impact factors causing changes in environmental elements and systems. E.g. during road construction, they may reach groundwater, which may be polluted. The goal is to find, describe and evaluate these impacts.

Changes of IMPACT FACTORS = changes in technology and process

Presentation of environmental status of the impact area and the sensitivity of stakeholders (E)

Estimation of impact processes and state changes in the impact area (F)

Junction!

Assessment of state changes for each environmental componenet, system and environment as a whole! (G)

Here's the point!

Are state changes acceptable?

No

Is there a way to change the plan?

Yes

No

Plan is unacceptable from an environmental point of view.

Yes

Plan is acceptable

Logic of environmental impact assessment method

Despite the differences in legislation, the basic logic of the impact assessment method is the same in each country!

The process of estimating the change in state is shown in the figure.

Impact assessment steps to be taken in each case:

- definition of impact factors,
- describe and evaluate impact processes,
- preliminary demarcation of the impact area,
- description of the state of environment (determination of sensitivity of potential stakeholders,
- estimation of impact processes and state changes, evaluation of state changes

How to prepare and environmental impact assessment document

Environmental impact = change in environmental state

1. Summary of the history e.g. description of previous authority decisions

2. A detailed description of the planned activities, including related operations and facilities in particular: preliminary investigation, consultation document, hazardous material plant operations and their connections, exposure to earthquakes, hazard of accidents, operational failures and impact factors, etc.

3. Description of impact processes and impact areas e.g. impact processes triggered by impact factors should be analyzed separately for each environmental element and for the environmental system as a whole. Indirect impact processes, climate change-related impacts should be all revealed.

Impact factors:

(Causes of change. Emission of withdrawal of material or energy.)

- Emission of pollutants
- Emission of noise and vibration, radiation
- Disruption or destruction of habitats
- A change in the stock of natural resources
- Termination of environmental elements
- Establishing artistic elements
- Change the flow, propagation and movement of moving environmental elements
- Change in land use

Estimation and evaluation of expected environmental impacts

- **Characterization of the resulting changes in the environmental status of the environmental compartments and systems concerned, taking into account in particular the following: strength, durability, reversibility of the effect, spatial extent and temporal distribution, whether favorable or unfavorable;**
- **whether the impact can be added to that of other activities; change of landscape, land use, landscape structure, landscape character;**
- **the replacement of endangered or potentially degraded natural resources;**
- **an assessment of the impact of the changes in the status of the waters as a result of the impact on the waters and a timetable for achieving the environmental objective for the water bodies and protected areas concerned in the plan;**
- **a projected year-to-year calculation of greenhouse gas emissions based on calculations;**
- **a description of the short- and long-term effects on the health status of the population, based on an assessment of the environmental exposure of the population;**
- **the extent to which the health risk is quantifiable;**
- **ways to prevent, reduce, and reduce health risks to an acceptable level, etc.**

Techniques used for identifying environmental impacts

- **Checklists**
  - expected to encompass all possible impacts of this kind
- **Matrix**
  - very suitable for EIA as they link a particular environmental factor to a specific action of the development projec
- **Networks**
- **Overlay techniques**

Comprehensive Environmental Pollution Index (CEPI) - India

- CEPI is an index that gives a rational number between 0 and 100 to characterize the environmental quality of an industry. It is based on the effect that an industry has on air, water, land, health and ecology. 88 industrial clusters have been selected by the Pollution Control Boards (CPCB), in consultation with the Ministry of Environment & Forests Government (MOEF) of India.
- A new classification uses color codes for the environmental impact. Scores (or industries) between 60 and 100 are classified “red”, scores between 30 and 59 are classified “orange”, scores between 21 and 40 are classified “green” and scores 0 under 21 are classified “white”.

Leopold matrix

- **The Leopold matrix is the best known matrix methodology available for predicting the impact of a project on the environment.**
- **It is a comprehensive matrix, which has 88 environmental characteristics along the top axis and 100 project actions in the left hand column.**
- **Potential impacts are marked with a diagonal line in the appropriate cell and a numerical value can be assigned to indicate their magnitude and importance.**

Leopold matrix

- **Three major groups of matrices**
  - **Physical conditions: soil, water, air**
  - **Biological conditions: fauna, flora, ecosystems**
  - **Social and cultural conditions: land use, historical and cultural issues, populations, economy**

Leopold matrix

- **Advantages**
  - **Link action to impact**
  - **Good method for displaying EIA results**
- **Disadvantages**
  - **Difficult to distinguish direct and indirect impacts**
  - **Significant potential for double counting of impacts**
  - **Quantitative**

The original Leopold matrix (Leopold, 1971)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

II PROPOSED ACTIONS WHICH MAY CAUSE ENVIRONMENTAL IMPACT

INSTRUCTIONS

1- Identify all actions (located across the top of the matrix) that are part of the proposed project.
2- Under each of the proposed actions, place a slash at the intersection with each item on the side of the matrix if an impact is possible.
3- Having completed the matrix, in the upper left-hand corner of each box with a slash, place a number from 1 to 10 which indicates the MAGNITUDE of the possible impact; 10 represents the greatest magnitude of impact and 1, the least, (no zeroes). Before each number place + if the impact would be beneficial. In the lower right-hand corner of the box place a number from 1 to 10 which indicates the IMPORTANCE of the possible impact (e. g. regional vs. local); 10 represents the greatest importance and 1, the least (no zeroes).
4- The text which accompanies the matrix should be a discussion of the significant impacts, those columns and rows with large numbers of boxes marked and individual boxes with the larger numbers.

SAMPLE MATRIX

	a	b	c	d	e
a		2/1			8/5
b		7/2	8/8	3/1	10/7

		PROPOSED ACTIONS	A. MODIFICATION OF REGIME													B. LAND TRANSFORMATION AND CONSTRUCTION																			C. RESOURCE EXTRACTION							D. PROCESSING																E. LAND ALTERATION						
			a. Exotic flora or fauna introduction	b. Biological controls	c. Modification of habitat	d. Alteration of ground cover	e. Alteration of ground water hydrology	f. Alteration of drainage	g. River control and flow modification	h. Canalization	i. Irrigation	j. Weather modification	k. Burning	l. Surface or paving	m. Noise and vibration	a. Urbanization	b. Industrial sites and buildings	c. Airports	d. Highways and bridges	e. Roads and trails	f. Railroads	g. Cables and lifts	h. Transmission lines, pipelines and corridors	i. Barriers including fencing	j. Channel dredging and straightening	k. Channel revetments	l. Canals	m. Dams and impoundments	n. Piers, seawalls, marinas, and sea terminals	o. Offshore structures	p. Recreational structures	q. Blasting and drilling	r. Cut and fill	s. Tunnels and underground structures	a. Blasting and drilling	b. Surface excavation	c. Subsurface excavation and retorting	d. Well drilling and fluid removal	e. Dredging	f. Clear cutting and other lumbering	g. Commercial fishing and hunting	a. Farming	b. Ranching and grazing	c. Feed lots	d. Dairying	e. Energy generation	f. Mineral processing	g. Metallurgical industry	h. Chemical industry	i. Textile industry	j. Automobile and aircraft	k. Oil refining	l. Food	m. Lumbering	n. Pulp and paper	o. Product storage	a. Erosion control and terracing	b. Mine sealing and waste control	c. Strip mining rehabilitation	d. Landscaping	e. Harbor dredging	f. Marsh fill and drainage
I. PHYSICAL AND CHEMICAL CHARACTERISTICS	1. EARTH	a. Mineral resources																																																													
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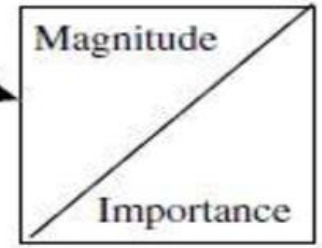
Modified Leopold Matrix
(after UNEP EIA Training Manual, 1996)

SOCIAL ENVIRONMENT

Environmental Effects / Waste Disposal Activity	Recreation	Landscape/visual	Historical/cultural	Societal values	Risks and enxieties	Existing land uses	Land value	Settlement	Employment	Public participation
Treatment										
Comminution										
Sedimentation										
Millscreening										
Oxidation ponds										
Activated sludge										
Trickling filter										
Nutrient removal										
Chlorination										
Further offsite treatment										
Disposal --- Land										
Rapid infiltration										
Surface flooding										
Spray irrigation										
Disposal --- Inland Water										



Next time – Leopold matrix in practice

Systems for environmental quality assurance and condition assessment III.

Environmental engineering MSc

Lecturer: Dr. Edit Kaszab PhD

Department of Environmental Protection and Safety

Definition of impact factors

First step: divide activity to individual technological steps.
Second step: transfer technological activities into impact factors.
Activities covered by the EIA are not necessarily means the appearance of installations (e.g. agricultural activities, deforestation).
At this stage, gathering initial information is essential!
Based on this information, impact factors (emissions, withdrawals, resource utilization) can be determined.

Required information are:

- Description of the area (and alternative areas) of activity, (location, extent).
- Capacity of the activity, material and energy balance, material and energy requirement.
- Detailed operation and technological processes, alternative solutions, material outputs (secondary materials, waste)

Ilustration of environmental impacts (impact processes)

The purpose of illustration in to connect the identified effects (causal relationships, mechanisms) in a systematic network.

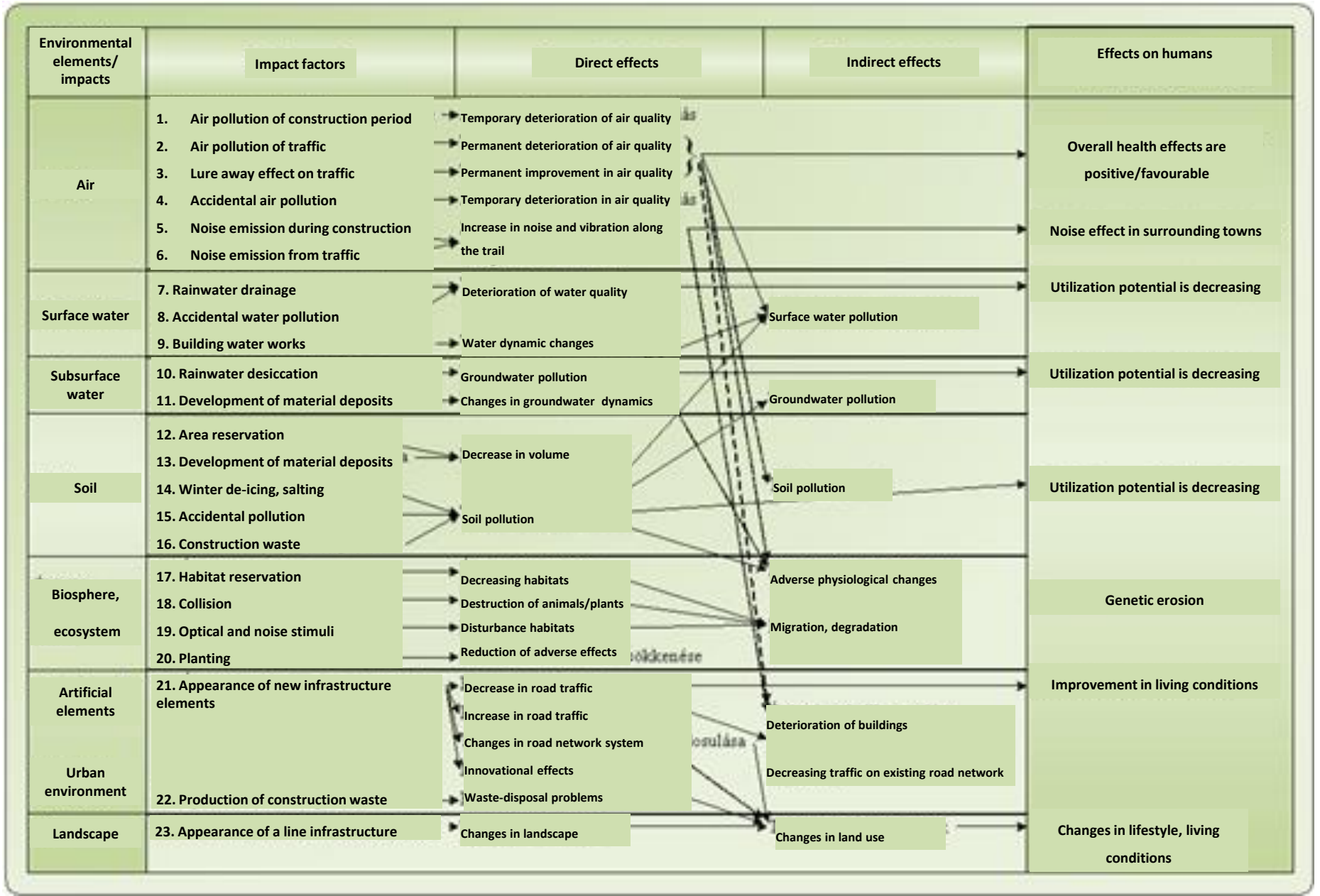
How to create a good flowchart for environmental impact assessment?

1. Identify the investment/project (and its alternatives) with environmental impact;
2. Determine sub-activities that can be considered as impact factors
3. Identify primary environmental changes for each environmental factors through questionaires or impact matrices.
4. Defining the direction (positive or negative) of the presumed environmental changes (e.g. certain plant species can appear/disappear; biodiversity is increasing/dicreasing).

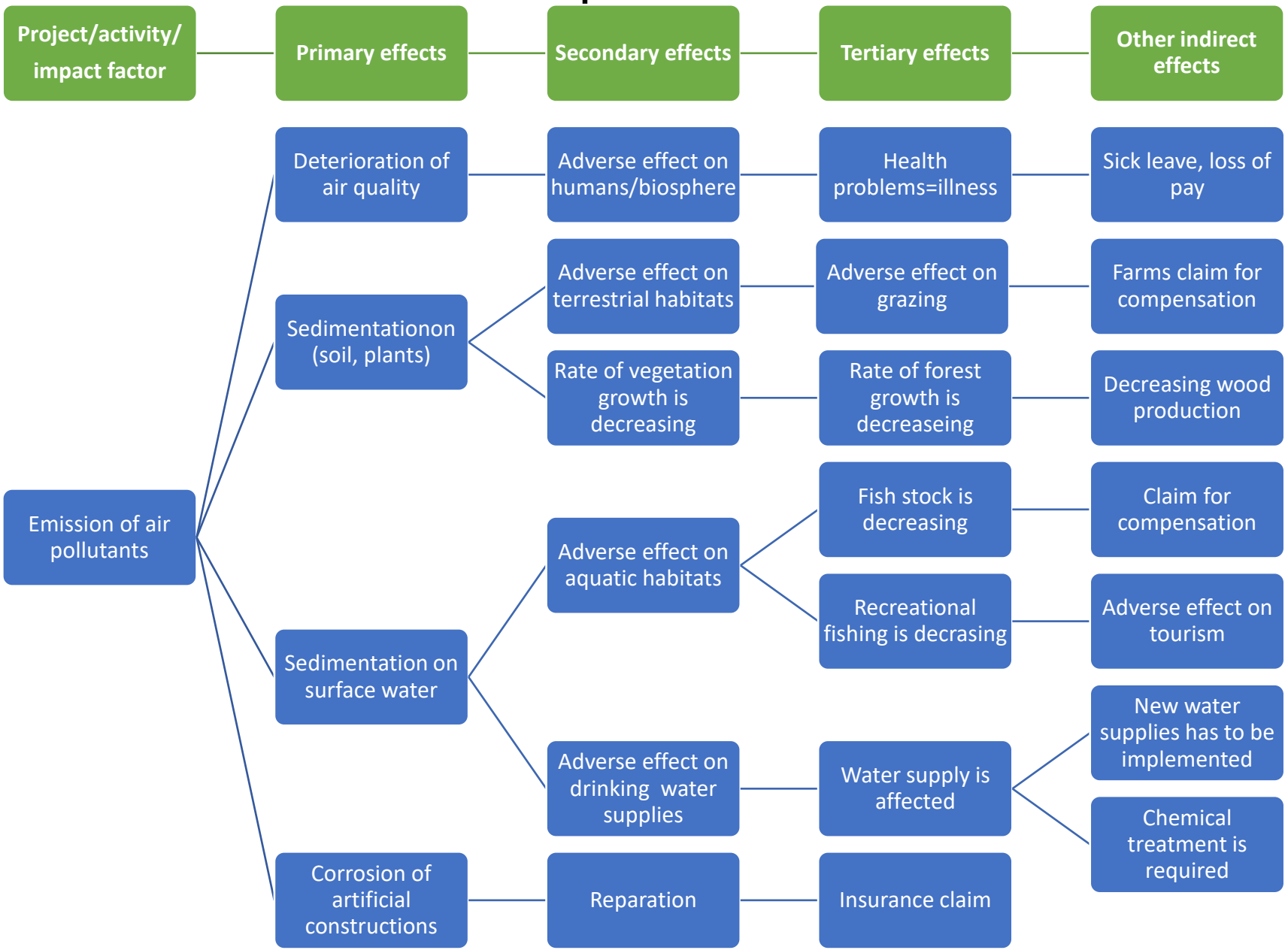
How to create a good flowchart for environmental impact assessment?

5. Determining the duration (short term or long term), magnitude and probability of environmental impact.
6. Follow-up the consequences of primary impacts on ecosystem (define secondary and tertiary effects)
7. **Characterize the magnitude and duration of each impact factor-environmental impact relationship!** Screening is supporting further investigation of significant impacts.

Examples for environmental impact flowcharts – highway



Examples for environmental impact flowcharts – air pollution



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Leopold matrix – evaluation of impact factors (Josimovic and Petric, 2014)

Impact factors can be evaluated separately for each relevant environmental component, and scored on a scale from 0 to 5 for **impact magnitude**, according to the following scale:

0 – no observable effect;
1 – low effect;
2 – tolerable effect;
3 – medium high effect;
4 – high effect;
5 – very high effect (devastation).

Leopold matrix – evaluation of impact factors (Josimovic and Petric, 2014)

In addition to the standard form of the Leopold matrix, the following criteria can also be used:

Impact significance with designations from L to M, according to the following scale:
L – limited impact on location;
O – impact of importance for municipality;
R – impact of regional character;
N – impact of national character;
M – impact of cross-border character.

Impact probability with designations from M to I, according to the following scale:
M – impact is possible (probability of less than 50%);
V – impact is probable (probability of over 50%);
I – impact is certain (100% probability).

Impact duration with designation P (occasional/temporary) and D (long-term/permanent).

Terms and definitions

- CEA: Competent Environmental Authority
- GBRs: General Binding Rules
- EECCA: Eastern Europe, Caucasus and Central Asia
- EIA: Environmental Impact Assessment
- ELV: Emission limit value
- EMS: Environmental management system
- EQO/EQS: Environmetal quality objective/standard
- OECD: Organisation for Economic Co-operation and Development
- EPR: Environmental Permitting Regulations
- E-PRTR: European Pollutant Release and Transfer Register
- IED: Industrial Emissions Directive
- IEP: Integrated Environmental Permit
- IPPC: Integrated Pollution Prevention and Control
- BAT: Best Available Techniques
- BREF: Reference Document on Best Available Techniques