



Advancing Sustainability of Process Industries through Digital and Circular Water Use Innovations

Industrial Wastewater Fundamentals

AquaSPICE Course 2024

Laurence Palmowski & Team

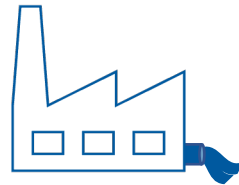


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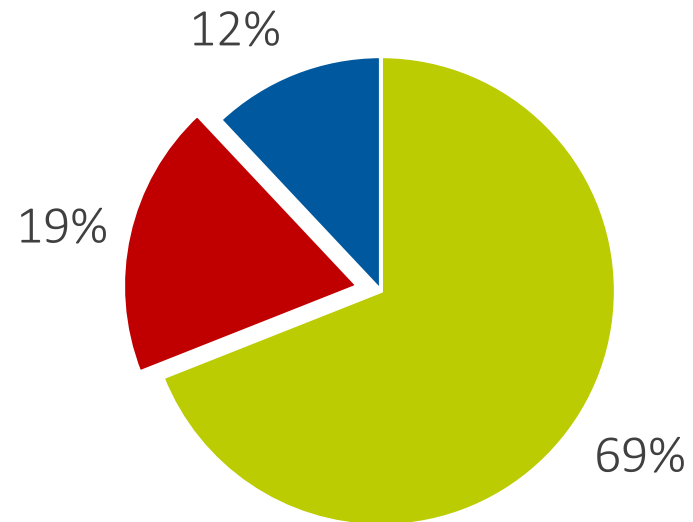
- Industrial Wastewater Fundamentals
- Industrial Wastewater Policies
- Best Available Techniques



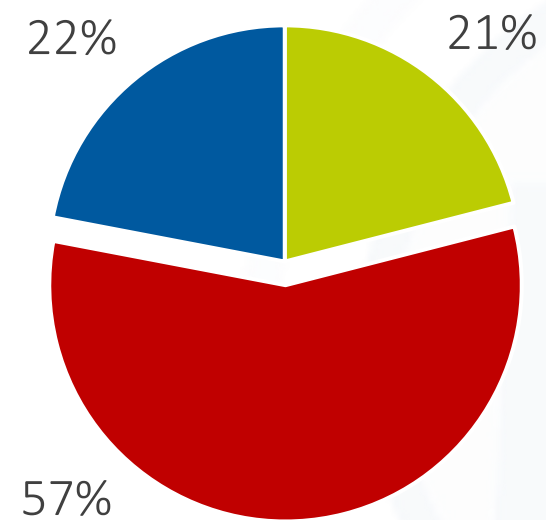
Industrial Wastewater Fundamentals



■ Global water use



■ European water use



■ Agriculture ■ Industries ■ Municipalities

Use of Water in Industry



Reaction medium/solvent [4]



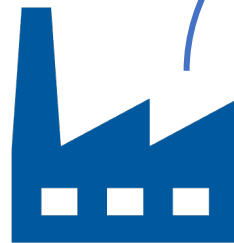
Cooling Towers [1]



Fire fighting water [3]



Integral part of the product [5]



Cleaning [2]

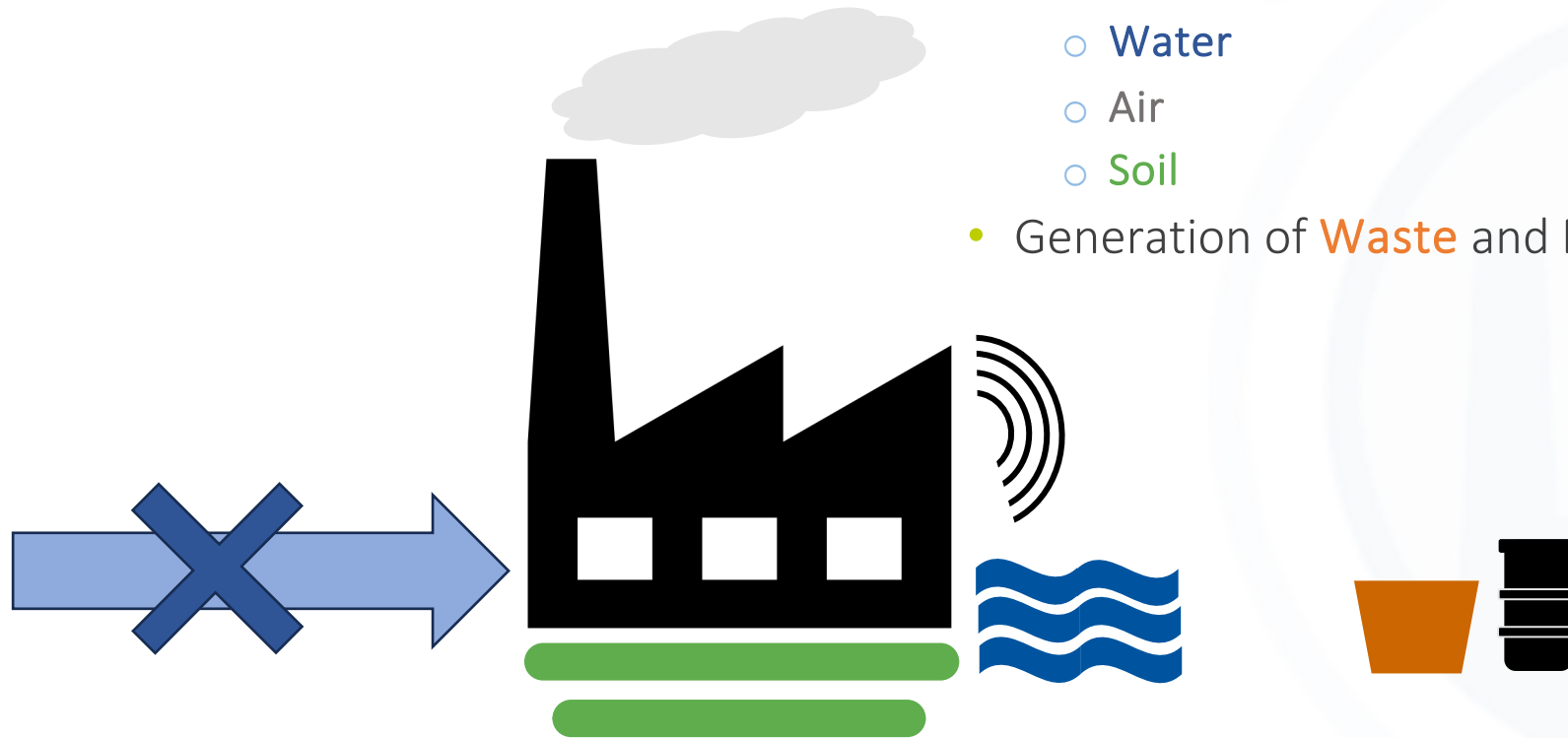
- Water/resource availability

- Water/environmental pollution

- Emissions to:

- Water
- Air
- Soil

- Generation of **Waste** and Noise



- Extensive metering and water balances
- Leak detection
- Compliant water discharge within limit values, specified in regulations



- Appropriate water and wastewater treatment techniques → Process Innovation



Digital Innovation

- Water reuse → Circular Innovation



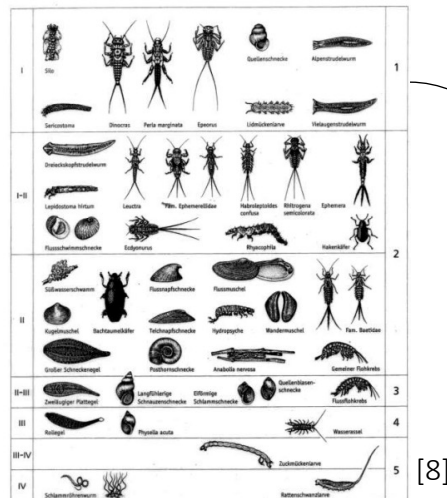
Pollutants (depending on industry):

- Organic pollutants
 - Human and animal waste
- Inorganic pollutants
 - Heavy metals
 - Metal ions
 - Pesticides
- Suspended solids (e.g. sand, clay, colloids)
- Nutrients (e.g. phosphorus, ammonia)
- Pathogens (e.g. viruses, bacteria)
- etc.



Water quality parameters:

- Physical parameters (e.g. temperature, total suspended/dissolved solids (TSS, TDS), electrical conductivity, color, odor,...)
- Chemical parameters (e.g. pH, water hardness, dissolved oxygen, ...)
- Biological parameters



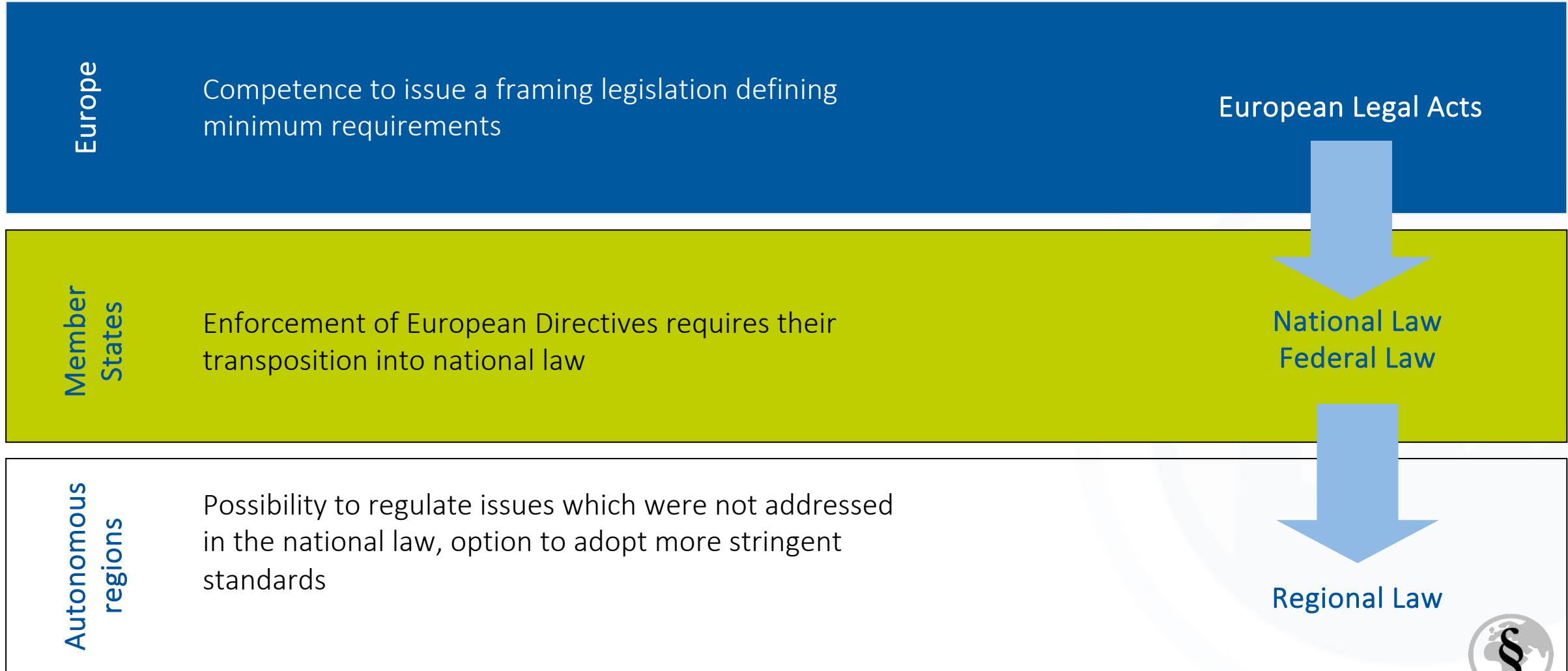
Industrial Wastewater Policies

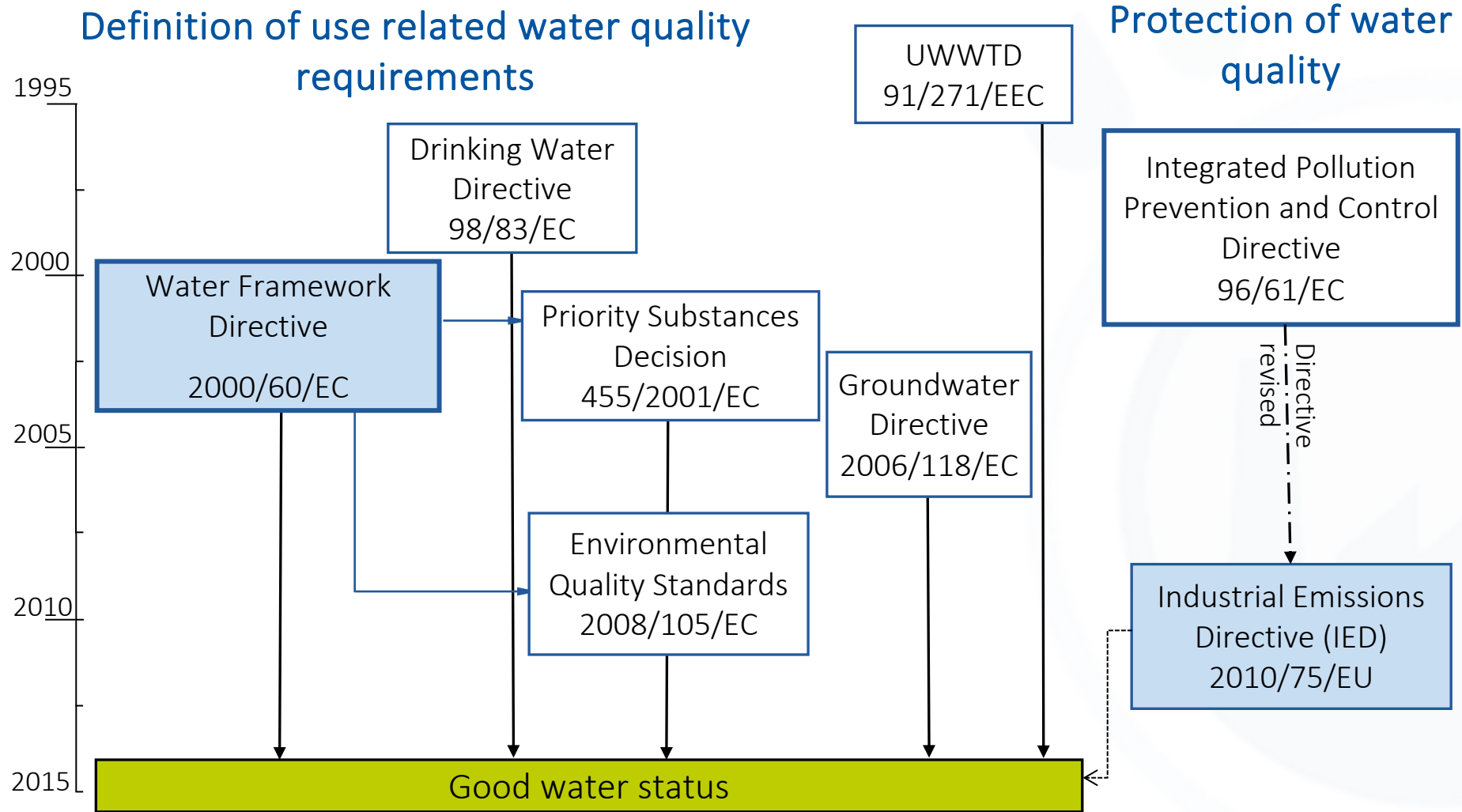




- Target 6.3:
“[...] improve water quality by reducing pollution, [...] substantially increasing recycling and safe reuse globally.
- Target 6.4:
“[...] increase water-use efficiency across all sectors [...] to address water scarcity.
- Target 12.4:
“[...] achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil [...].

Levels of European Legislation



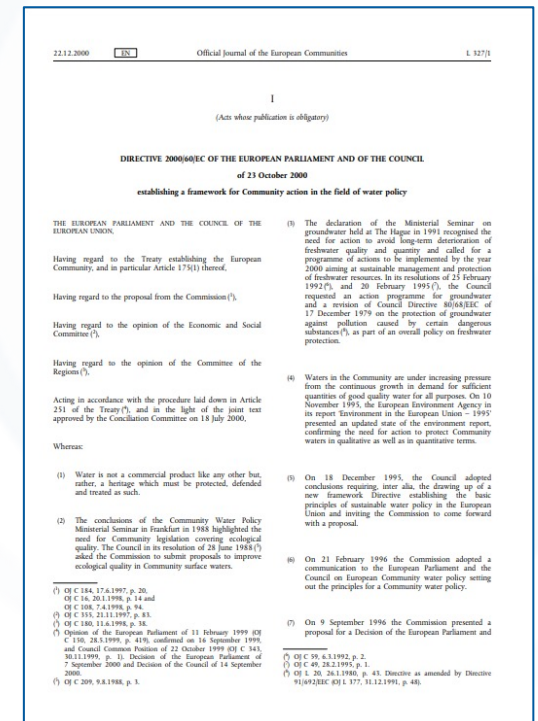


Water Framework Directive (WFD)

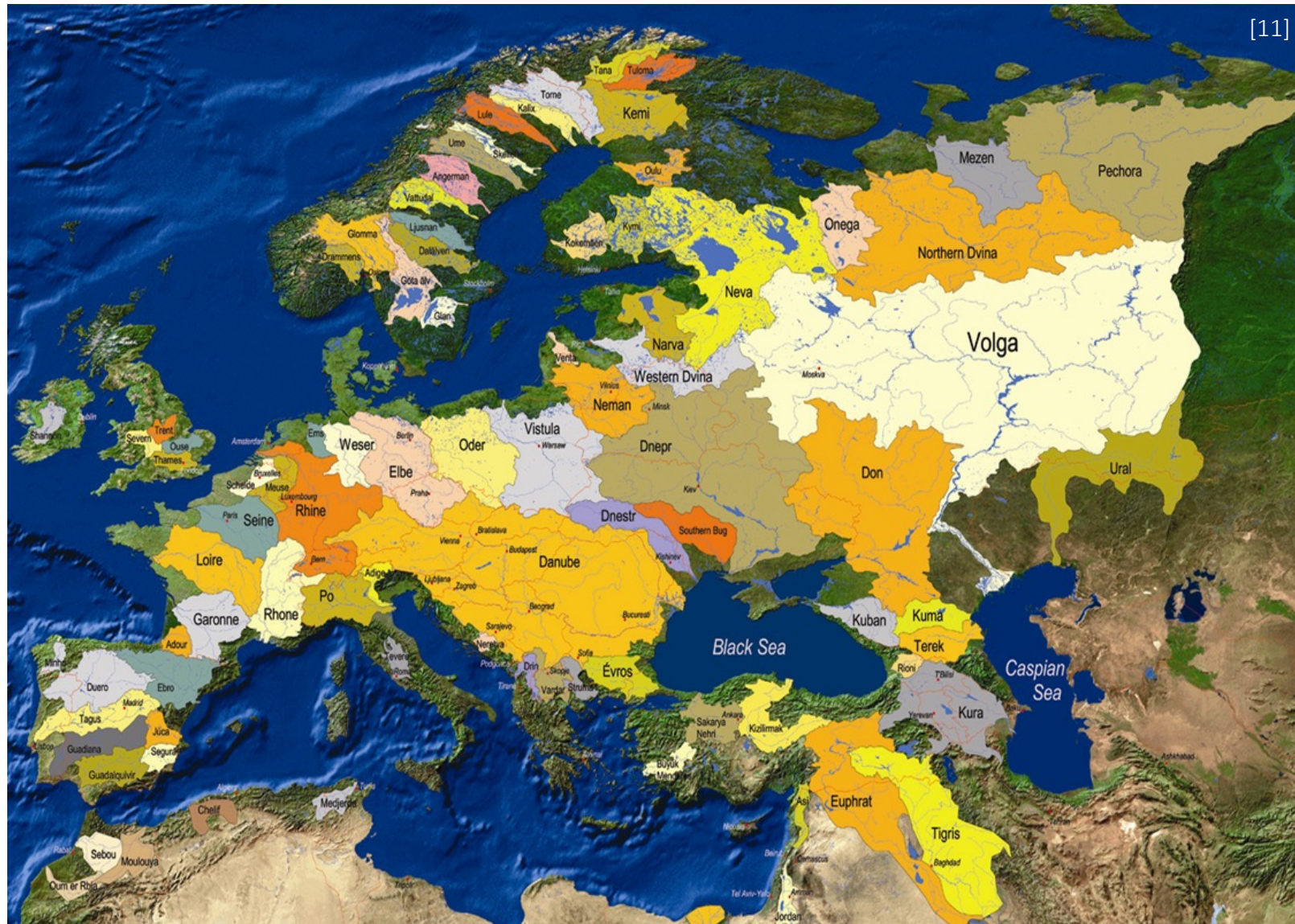
WFD



- Aim: Achieving "good status" for all EU ground and surface waters by 2015/2027
- Background:
 - natural conditions and water management issues vary greatly across EU
 - WFD sets quality goals and methods to maintain good water quality
- Strategy: Water management based on river basins
 - Set reference conditions and monitor status of water
 - Assess impact of human activity
 - Full cost recovery of water services, polluters pay principle

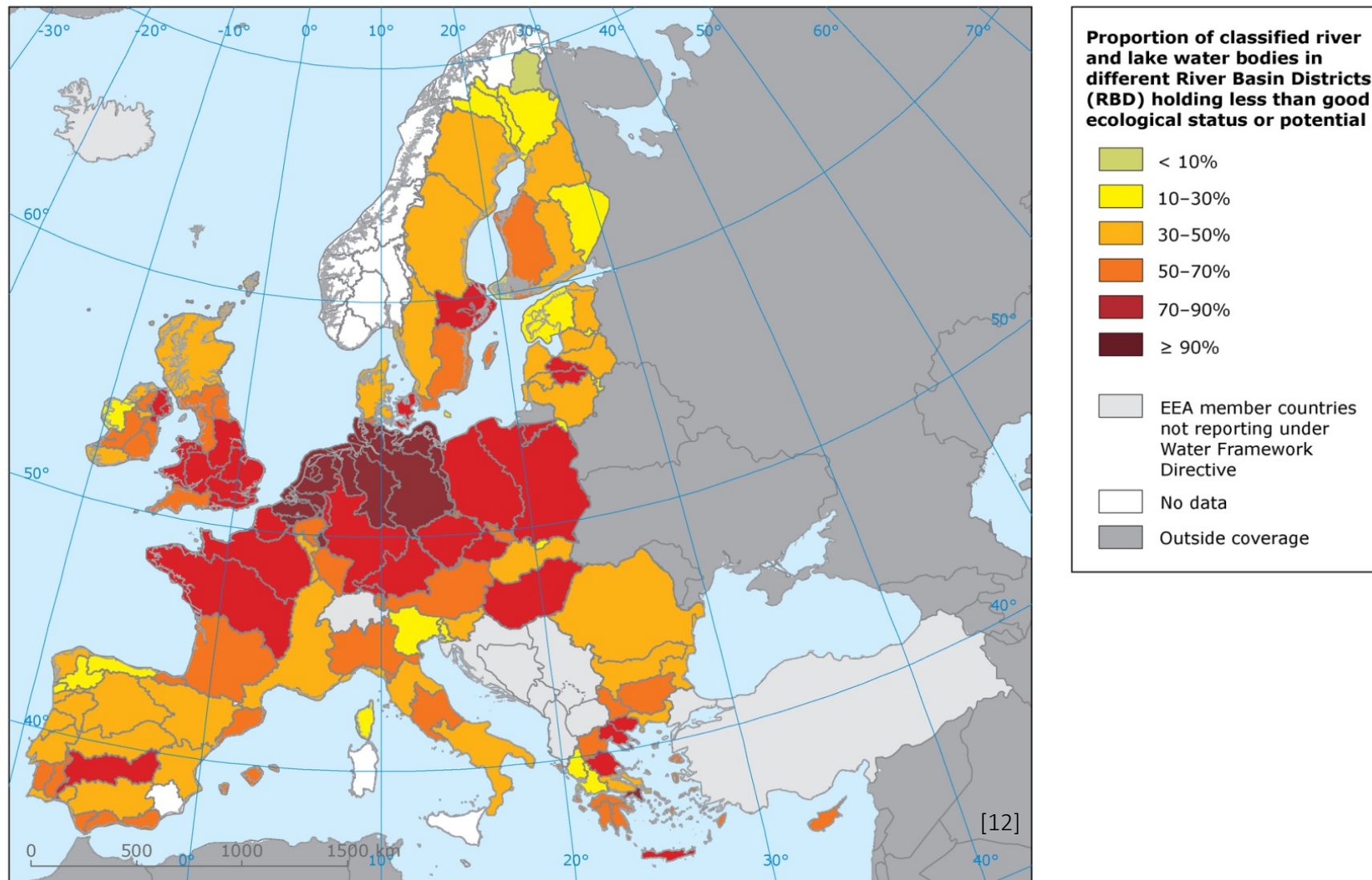


European River Catchments

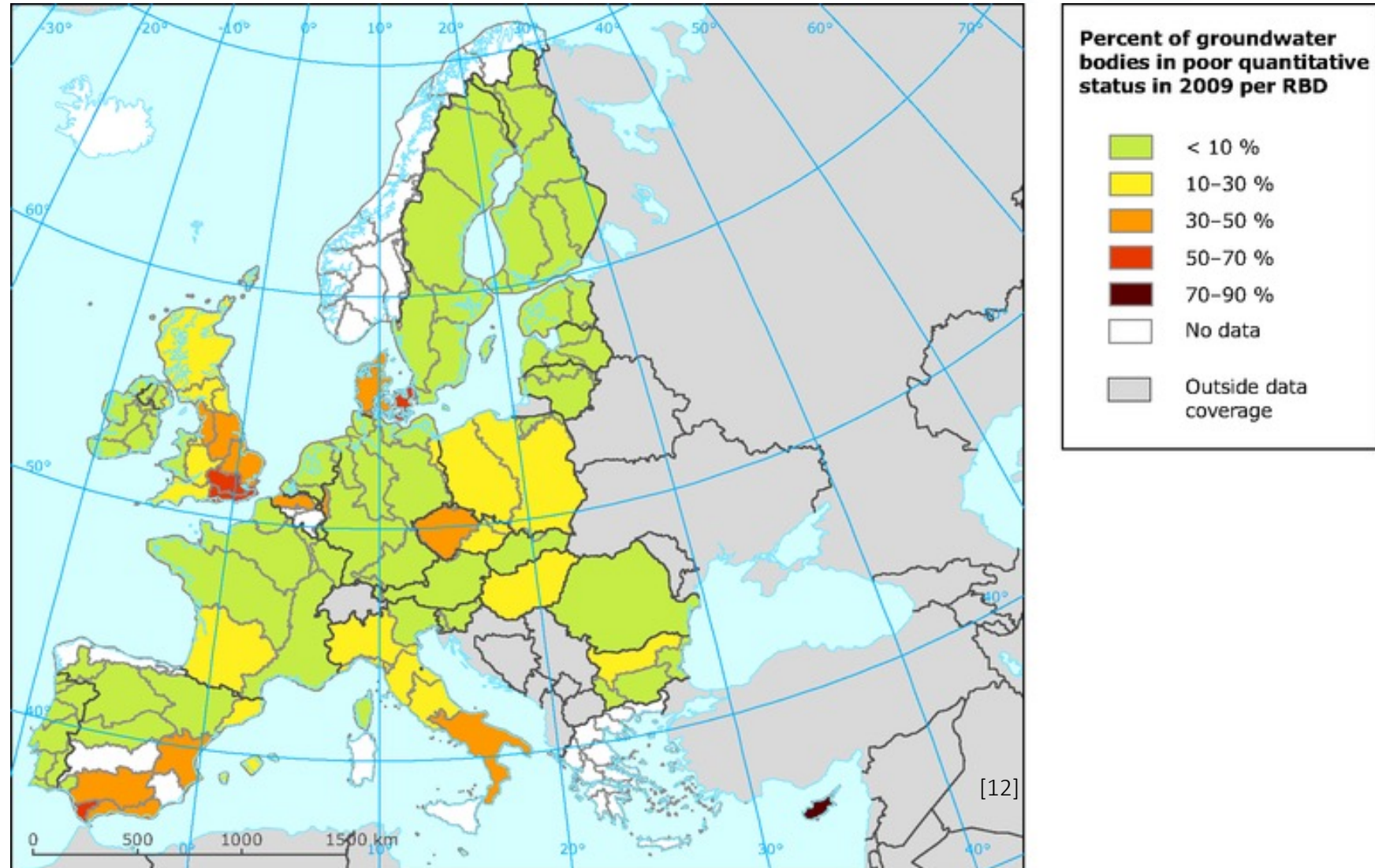


[11]

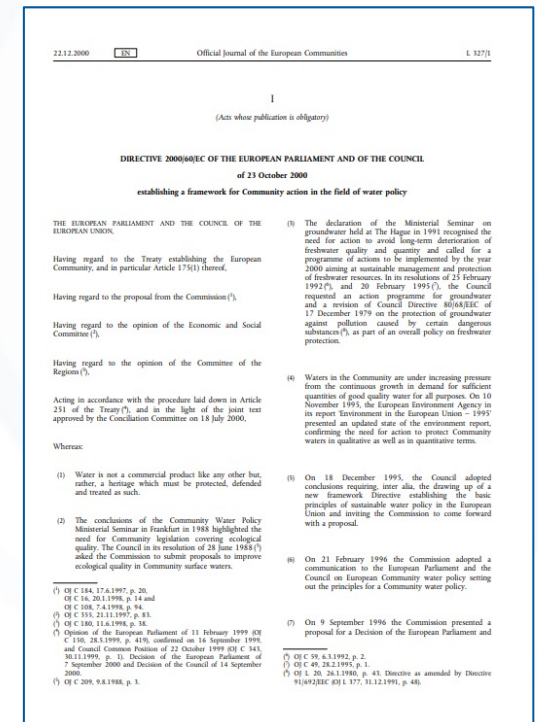
Ecological status of EU surface water bodies



Ecological status of EU groundwater bodies



- Aim: Achieving "good status" for all EU ground and surface waters by 2015/2027
- Background:
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- Strategy: Water management based on river basins
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 - Assess impact of human activity
 - Full cost recovery of water services, polluters pay principle
- Review (December 2019)
 - Room for improvements (investments, implementation, ...)
 - WFD achieved higher level of water bodies
→ contribute to achieving SDGs
- Proposal for revision (adopted in October 2022)
 - Updated list of pollutants



Industrial Emissions Directive (IED)

IED

- Aim: Achieve a high level of environmental protection from industrial activities
- Sectors:
 - Energy
 - Chemicals
 - Metal production and processing
 - Waste management
 - Etc.
- Operator obligations:
 - prevent/reduce industrial emissions into air, water and land
 - Avoidance of waste production, recycling where possible, disposal while avoiding any impact on the environment
 - Efficient use of energy

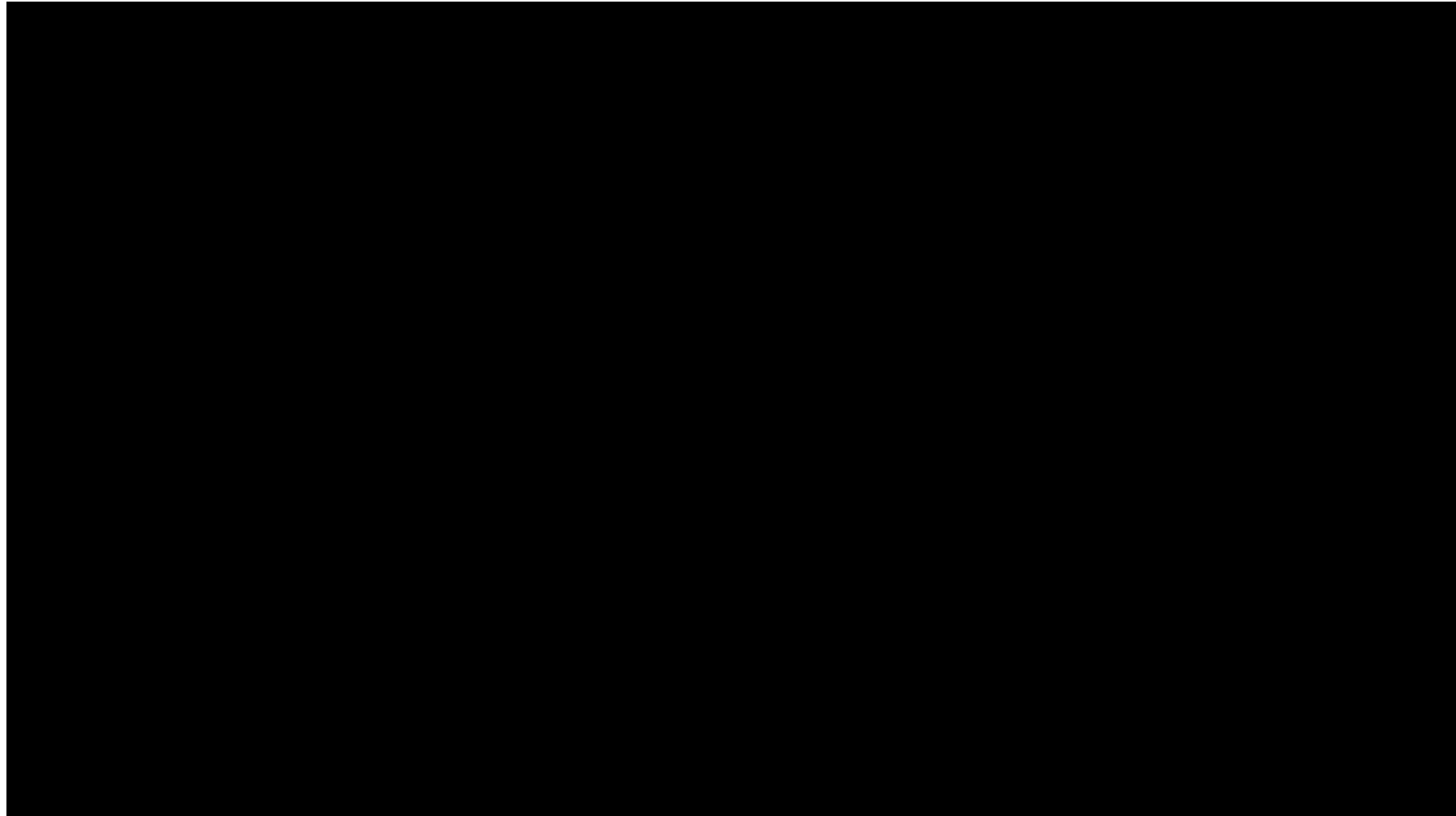


→ All appropriate preventive measures are taken by applying the best available techniques (BAT)

Best Available Techniques



- Definition of the European Commission for **Best Available Techniques (BAT)**
 - Most effective and advanced stage of operation methods which indicate the practical suitability of particular techniques to prevent or reduce emissions.
 - **Best** = Most effective in achieving a high level of protection of the environment as a whole.
 - **Available** = Implementation in relevant industrial sector feasible under economically and technically viable conditions.
 - **Techniques** = Both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.



<https://www.youtube.com/watch?v=d2kprBd8Tk0>



Prevention and control of industrial pollution to protect **human health** and the **environment across countries**

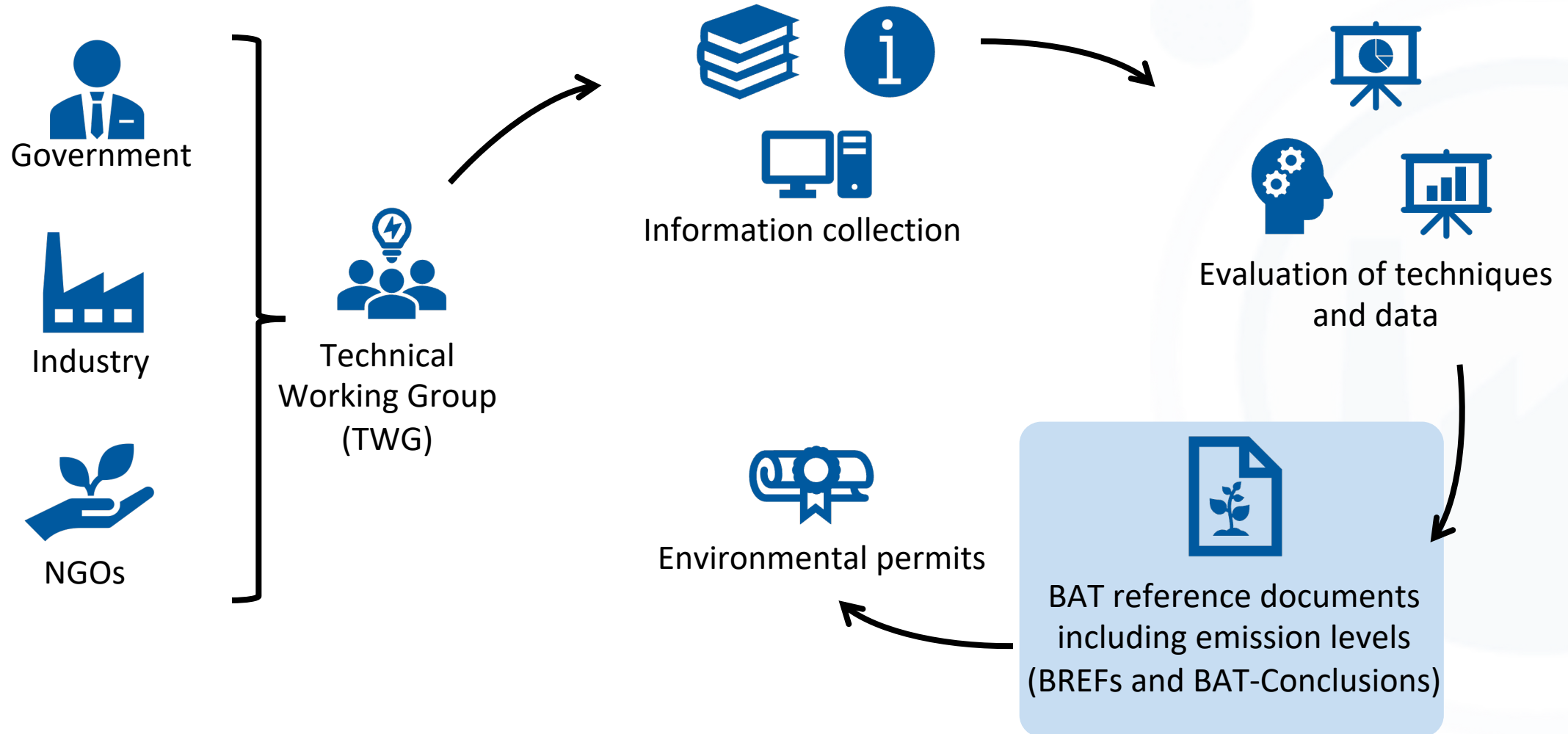


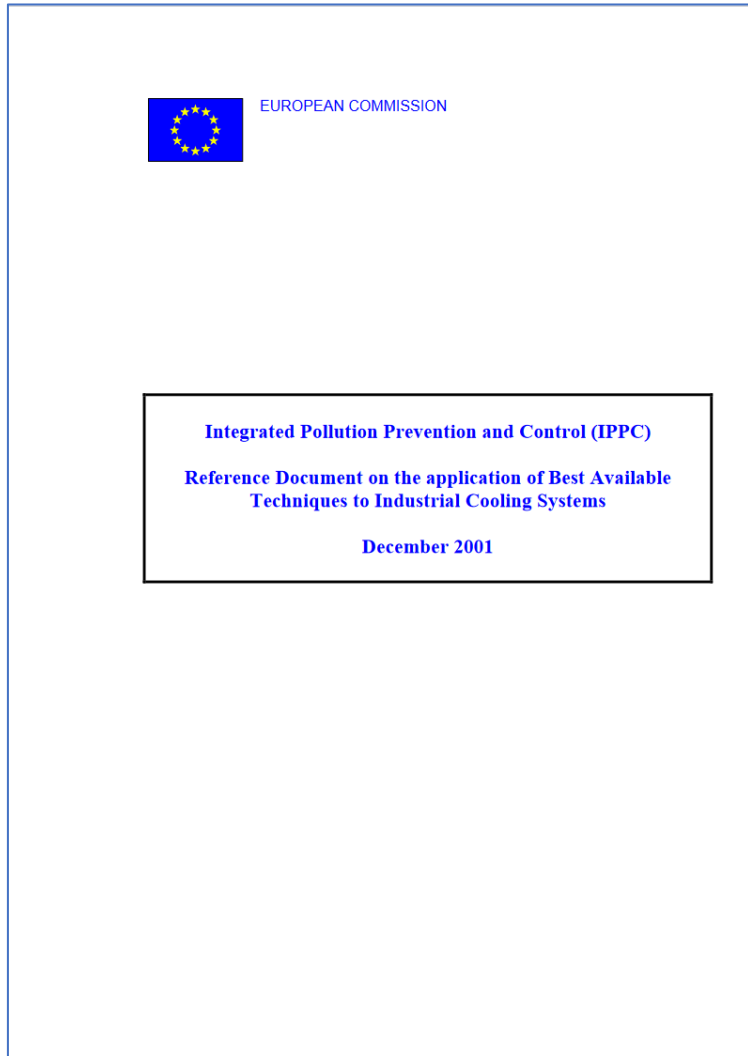
Global level goal: harmonize procedures and technologies

Local level goal: provide guidance for governments to identify permit conditions for industry (BAT-based permitting), e.g.:

- Emission level values (obtained under normal operating conditions using BAT or a combination of BAT)
- Technical requirements
- Plant/production management requirements
- Plant/production monitoring requirements (for emissions, consumption of resources and waste generation)

How to determine BATs in the EU - Sevilla Process





EUROPEAN COMMISSION

Integrated Pollution Prevention and Control (IPPC)

Reference Document on the application of Best Available Techniques to Industrial Cooling Systems

December 2001

Industrial Cooling Systems (2001)



European Commission

JRC SCIENCE FOR POLICY REPORT

Best Available Techniques (BAT) Reference Document for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector

Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control)

Thomas Brinkmann, Germán Giner Santonja, Hande Yükseler, Serge Roudier, Luis Delgado Sancho

2016



Joint Research Centre EUR 28112 EN

Chemical Sector (2016)



European Commission

JRC SCIENCE FOR POLICY REPORT

Best Available Techniques (BAT) Reference Document for Waste Treatment

Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control)

Antoine Pinasseau, Benoit Zerger, Jozse Roth, Michele Canova, Serge Roudier

2018



Joint Research Centre EUR 29362-EN

Waste Treatment (2018)

BREF WT content:

- Scope
 - General Information
 - Types of wastewater in EU
 - Economics of waste treatment sector
 - ...
 - Processes and techniques commonly used for waste treatment
- BAT conclusions, including
 - BAT for wastewater treatment
 - BAT-associated limit values (BAT-AEL)



■ BAT for wastewater treatment

BAT 20. In order to reduce emissions to water, BAT is to treat waste water using an appropriate combination of the techniques given below.

Technique ⁽¹⁾	Typical pollutants targeted	Applicability
<i>Preliminary and primary treatment, e.g.</i>		
a. Equalisation	All pollutants	Generally applicable.
b. Neutralisation	Acids, alkalis	
c. Physical separation, e.g. screens, sieves, grit separators, grease separators, oil-water separation or primary settlement tanks	Gross solids, suspended solids, oil/grease	
<i>Physico-chemical treatment, e.g.</i>		
d. Adsorption	Adsorbable dissolved non-biodegradable or inhibitory pollutants, e.g. hydrocarbons, mercury, AOX	
e. Distillation/rectification	Dissolved non-biodegradable or inhibitory pollutants that can be distilled, e.g. some solvents	
f. Precipitation	Precipitable dissolved non-biodegradable or inhibitory pollutants, e.g. metals, phosphorus	

■ BAT-associated limit values (BAT-AEL)

Table 6.1: BAT-associated emission levels (BAT-AELs) for direct discharges to a receiving water body

Substance/Parameter	BAT-AEL ⁽¹⁾	Waste treatment process to which the BAT-AEL applies
Total organic carbon (TOC) ⁽²⁾	10–60 mg/l	• All waste treatments except treatment of water-based liquid waste
	10–100 mg/l ⁽²⁾ ⁽³⁾	• Treatment of water-based liquid waste
Chemical oxygen demand (COD) ⁽²⁾	30–180 mg/l	• All waste treatments except treatment of water-based liquid waste
	30–300 mg/l ⁽²⁾ ⁽⁴⁾	• Treatment of water-based liquid waste
Total suspended solids (TSS)	5–60 mg/l	• All waste treatments
Hydrocarbon oil index (HOI)	0.5–10 mg/l	<ul style="list-style-type: none"> • Mechanical treatment in shredders of metal waste • Treatment of WEEE containing VFCs and/or VHCs • Re-refining of waste oil • Physico-chemical treatment of waste with calorific value • Water washing of excavated contaminated soil • Treatment of water-based liquid waste



■ OECD BAT project

- Aims at spreading knowledge and experience on BAT and BAT-based policies amongst OECD member states and partner countries

■ Publications:

<https://www.oecd.org/chemicalsafety/risk-management/best-available-techniques.htm>



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Thank you!

Laurence Palmowski & Team

- [1] - <https://www.kkl.ch/kernenergie/unsere-kraftwerke/gebäude-und-komponenten/kühlturm>
- [2] - <https://www.ecotech.at/waschen-schwemmen-und-hochdruckreinigen-mit-dem-radlader/>
- [3] - https://www.paderborn.de/microsite/feuerwehr/aktuelles/einsatz/Einsatz_Feuerwehr_Paderborn2023_11_29_Feuer_Frankfurter_Weg.php
- [4] - <https://www.itoms.com/applications/solvent-extraction/>
- [5] - <https://braumagazin.de/article/krones-sauerstoff/>
- [6] - <https://felsundwald.de/trinkwasser/>
- [7] - <https://www.sanitaer.org/magazin/ph-wert-im-wasser-201911182>
- [8] – „Fachfortbildung für Nationalpark-Kitas Eifel Mai 2023 – Wasser ist Leben“
- [9] - <https://www.umweltbundesamt.de/themen/wasser/gewaesser/gewaessertyp-des-jahres/gewaessertyp-2011-steiniger-kalkarmer#lebensraum>
- [10] - <https://pumps-systems.netzsch.com/de/anwendungen-und-loesungen/umwelt-energie/industriabwasser>
- [11] - http://www.wfd-croatia.eu/userfiles/image/photogallery/maps/RB_Europe.png
- [12] - EEA, 2016