In Memoriam Zsuzsanna Flachner

Water
in a changing Europe

László Somlyódy
Janusz Kindler

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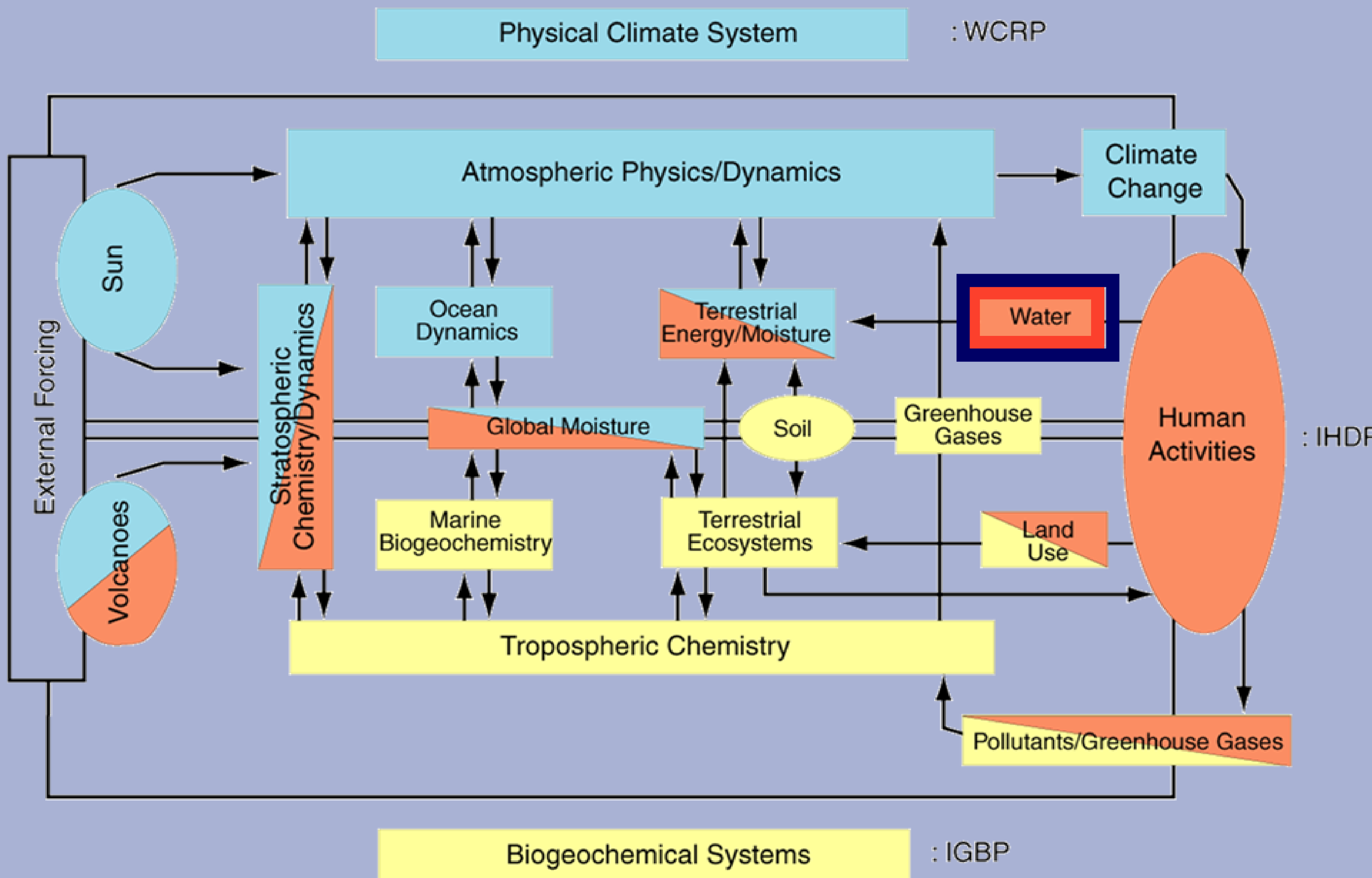
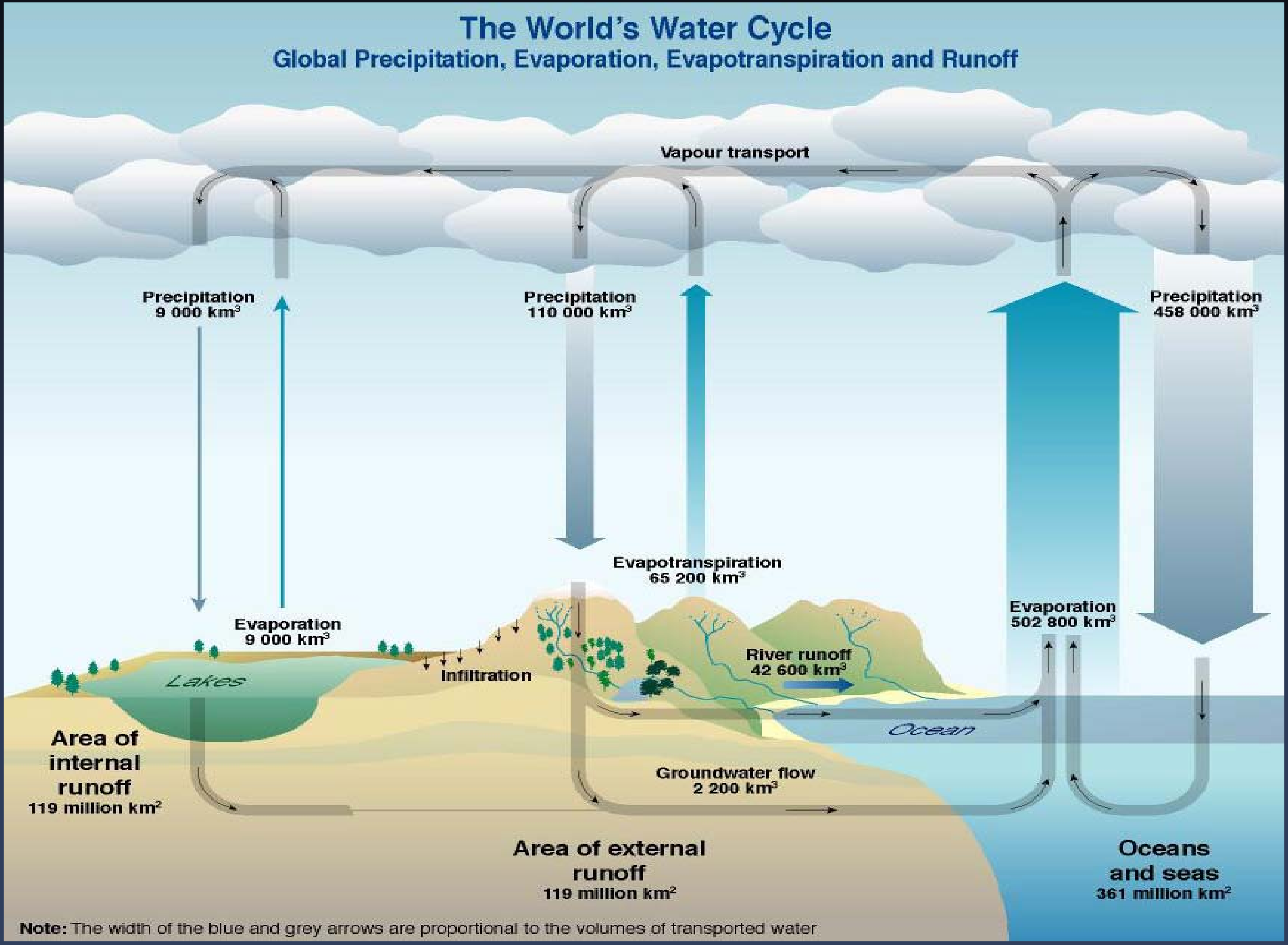
The Earth System and Changes: Impacts on the Physical, Biogeochemical and Human Components



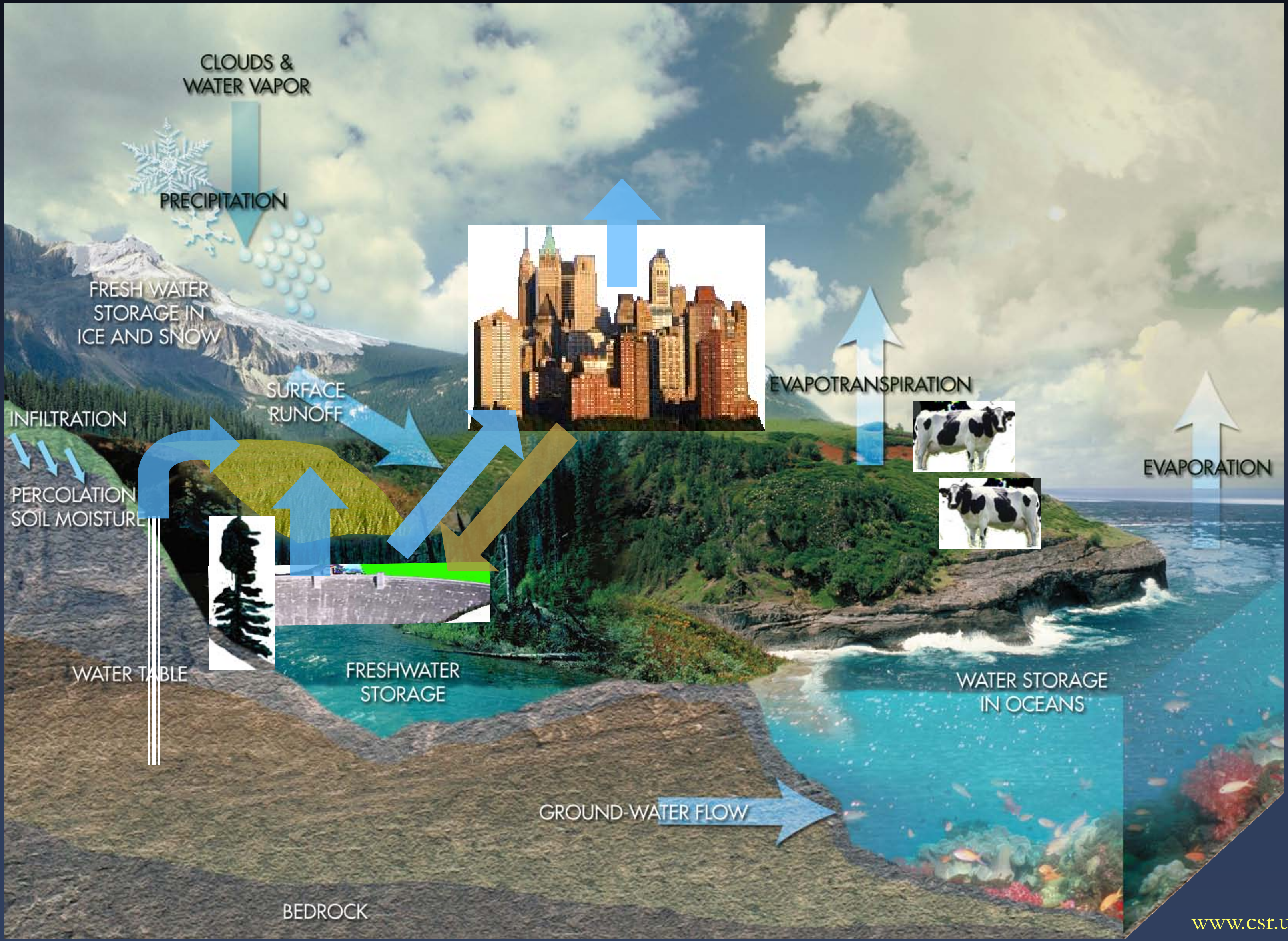
UNESCO (2007)

Global water (and material) cycle

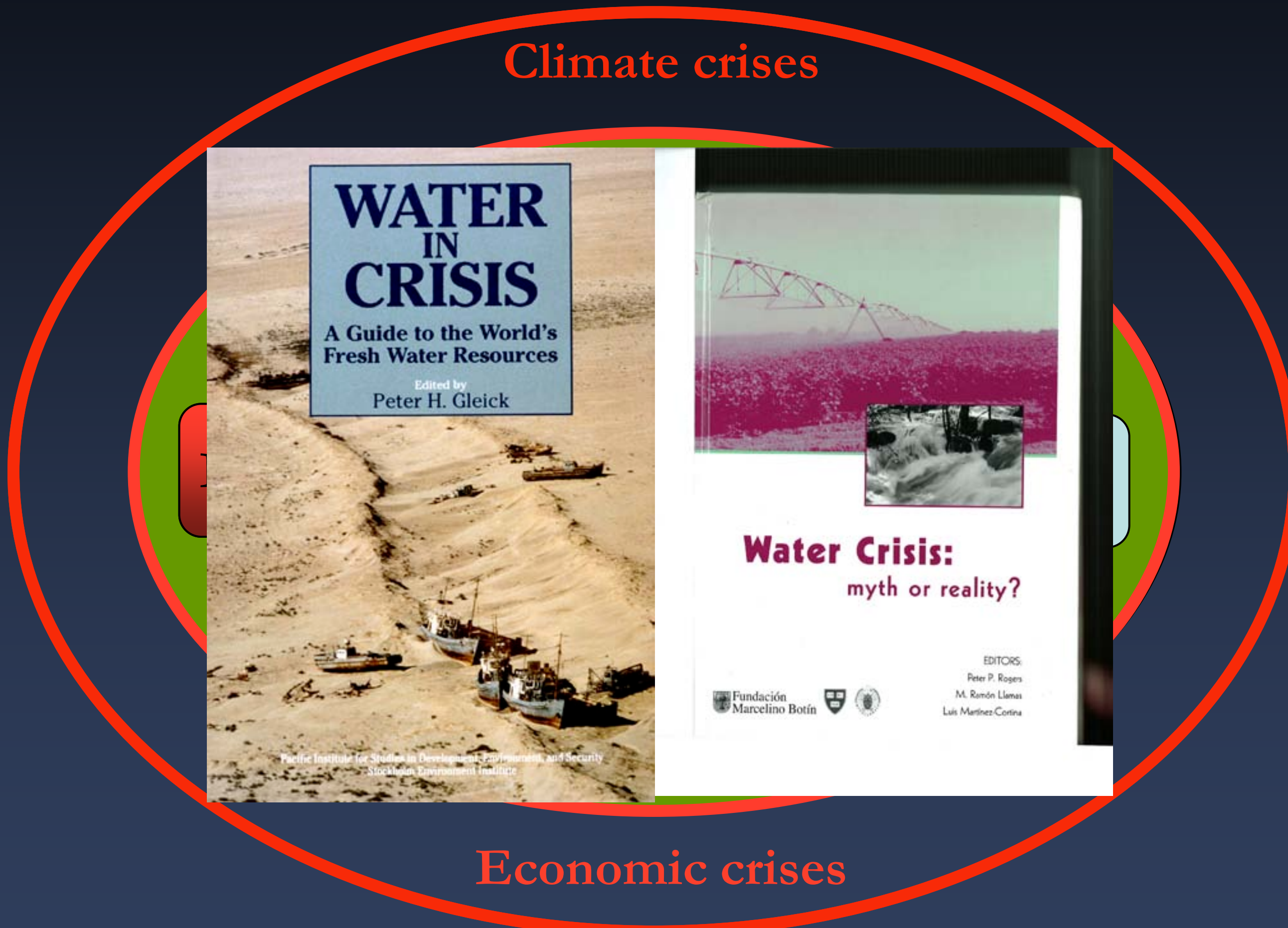


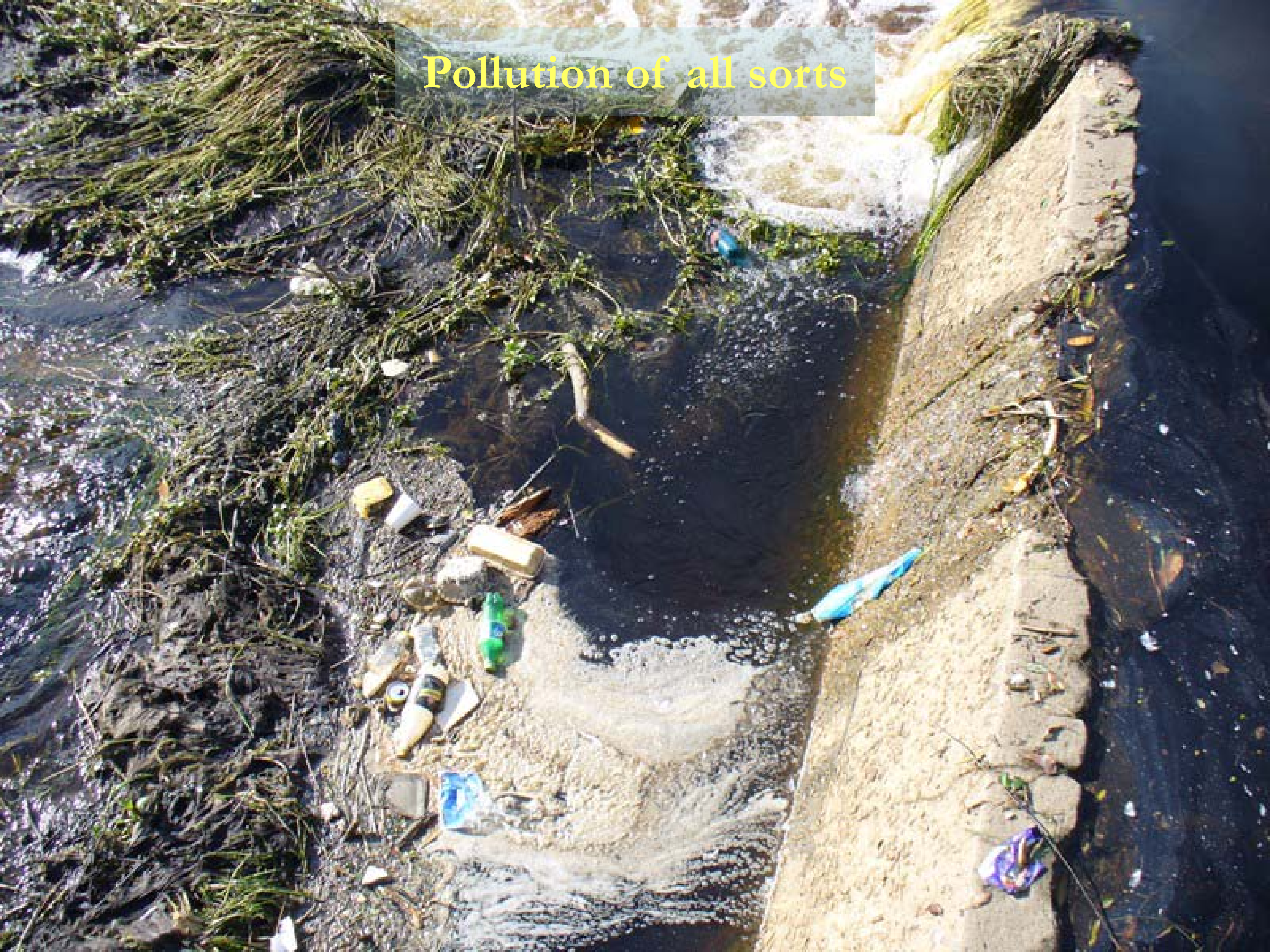
Vital Water Graphics (UNEP, 2000)

Hydrological cycle and human impacts

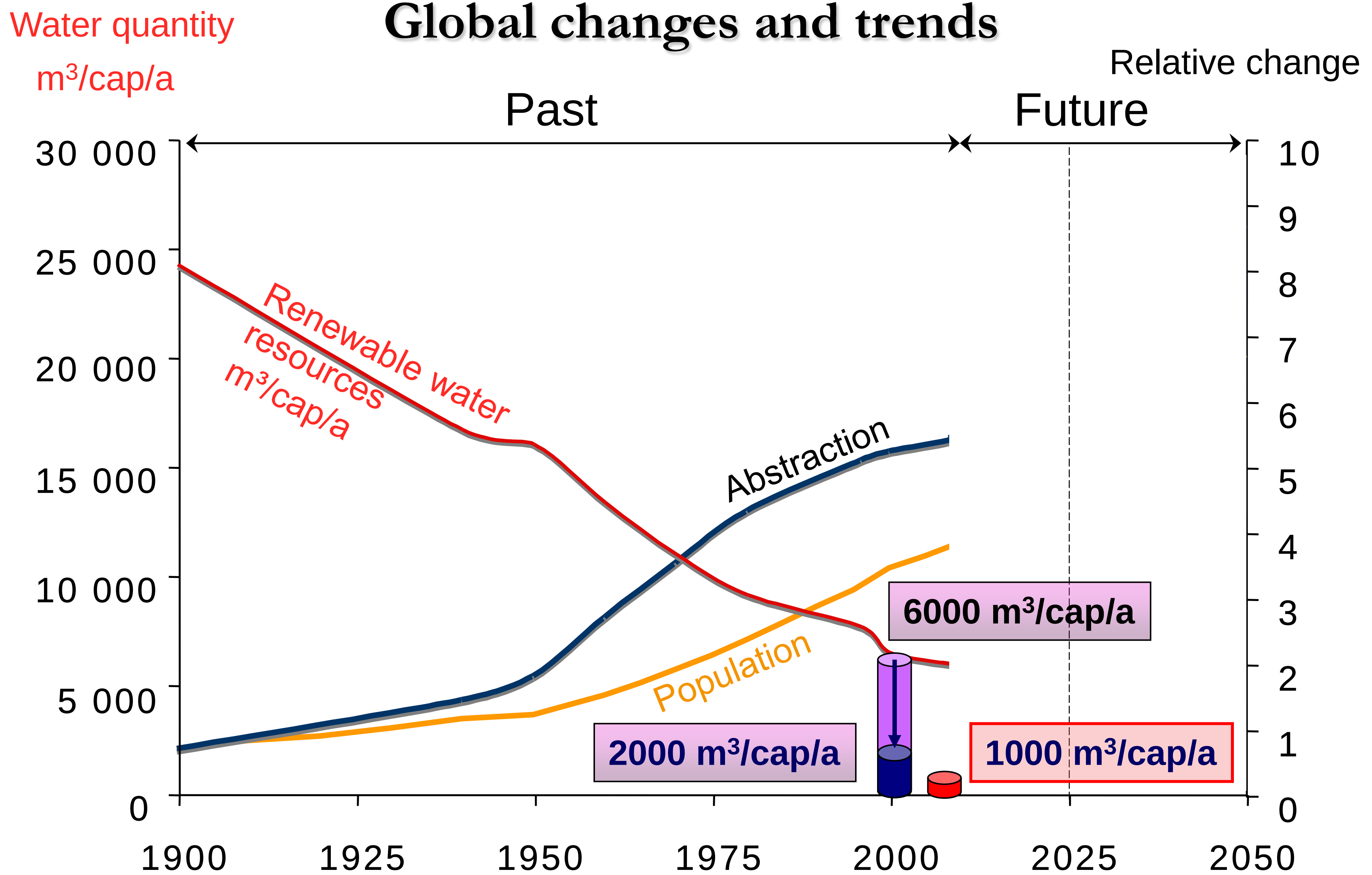


Crises


Climate crises
WATER IN CRISIS
A Guide to the World's Fresh Water Resources
Edited by
Peter H. Gleick
Water Crisis:
myth or reality?
EDITORS:
Peter P. Rogers
M. Ramón Llamas
Luis Martínez-Cortina
Fundación Marcelino Botín
Economic crises

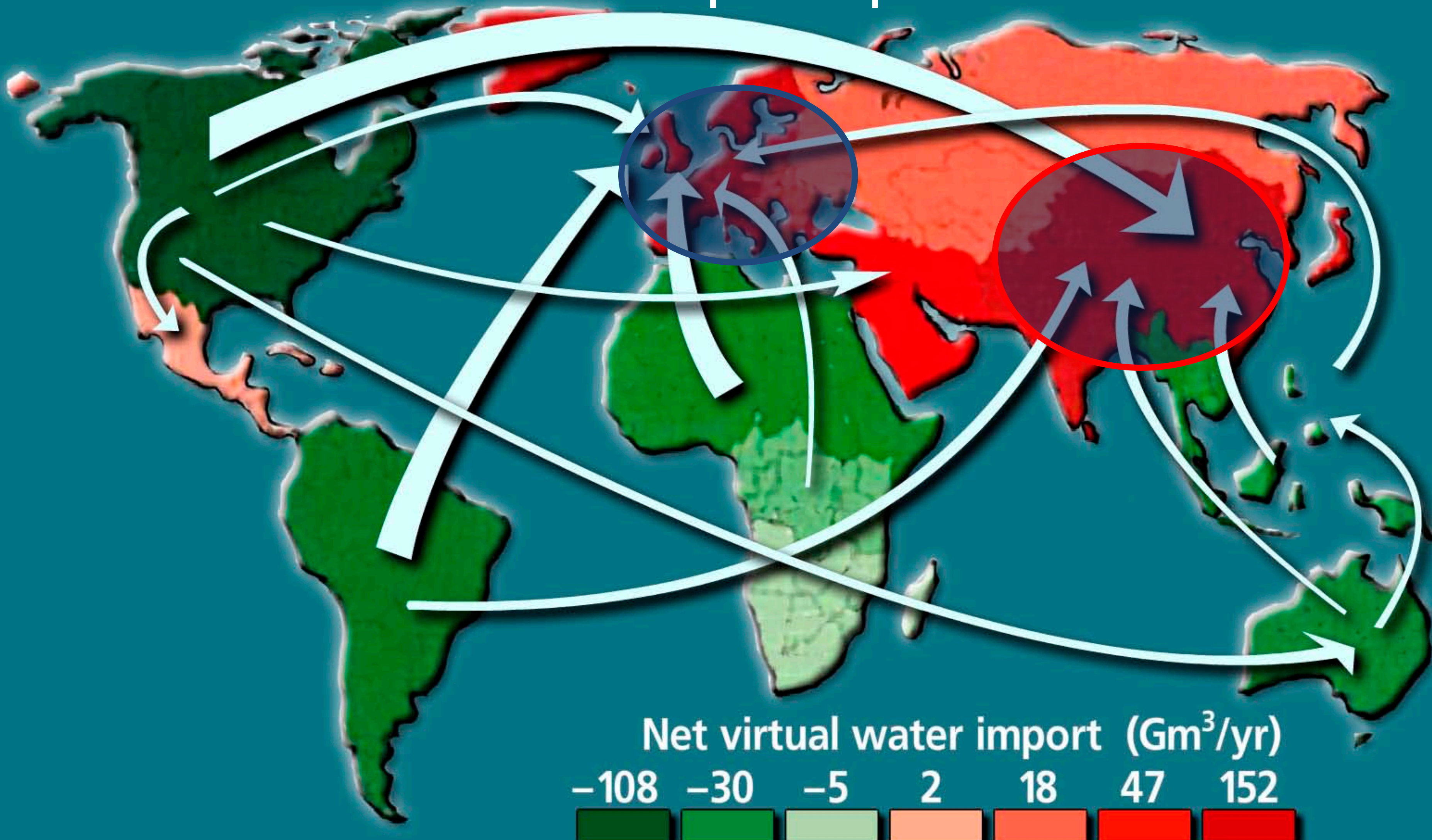

Pollution of all sorts

Global changes and trends



Global trade and virtual water

Water footprint imported



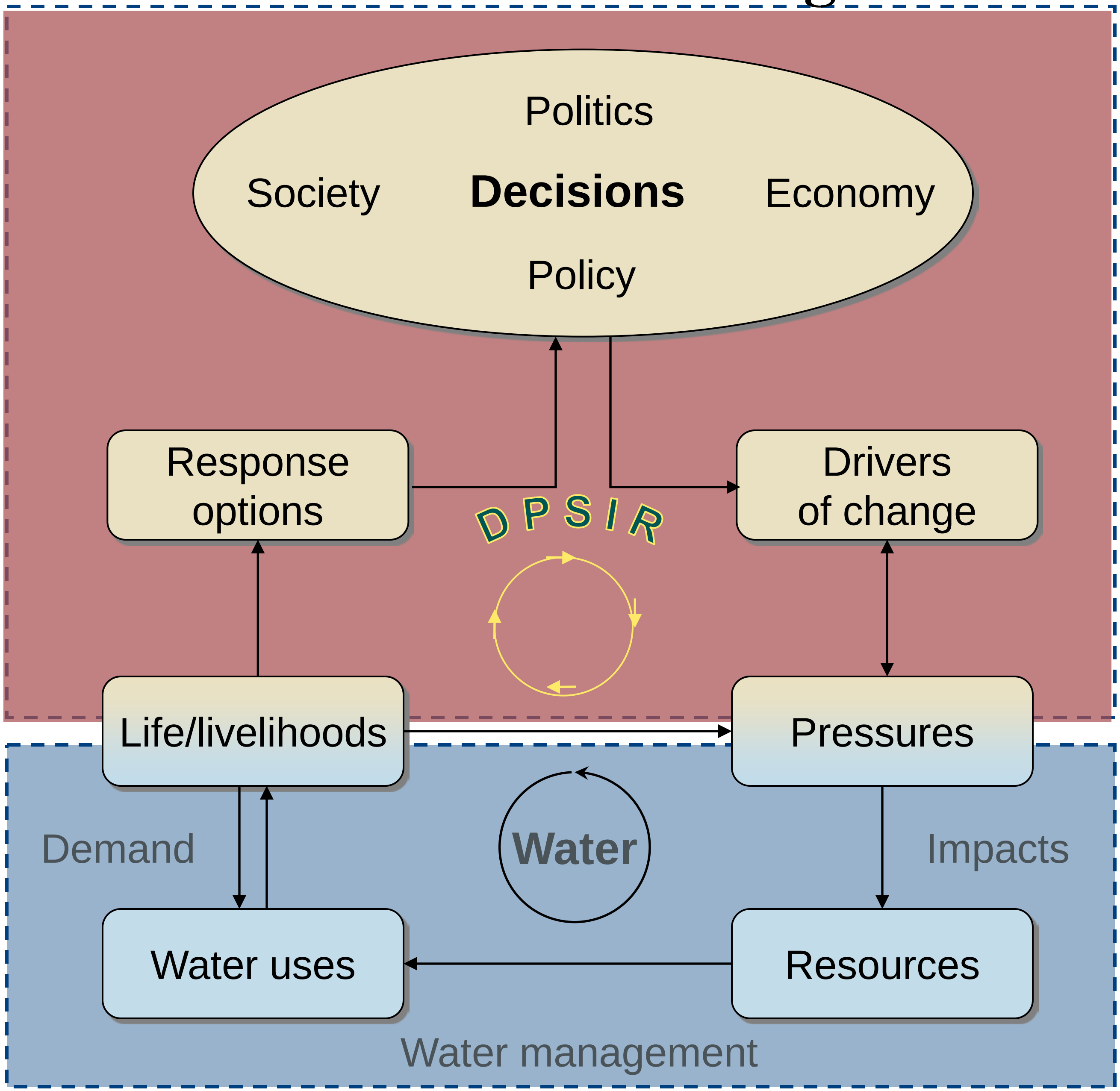
World Water Development Report 3 (2009)

EU countries in 1981 2019 future

?

Source: The official website of the EU

Future water management



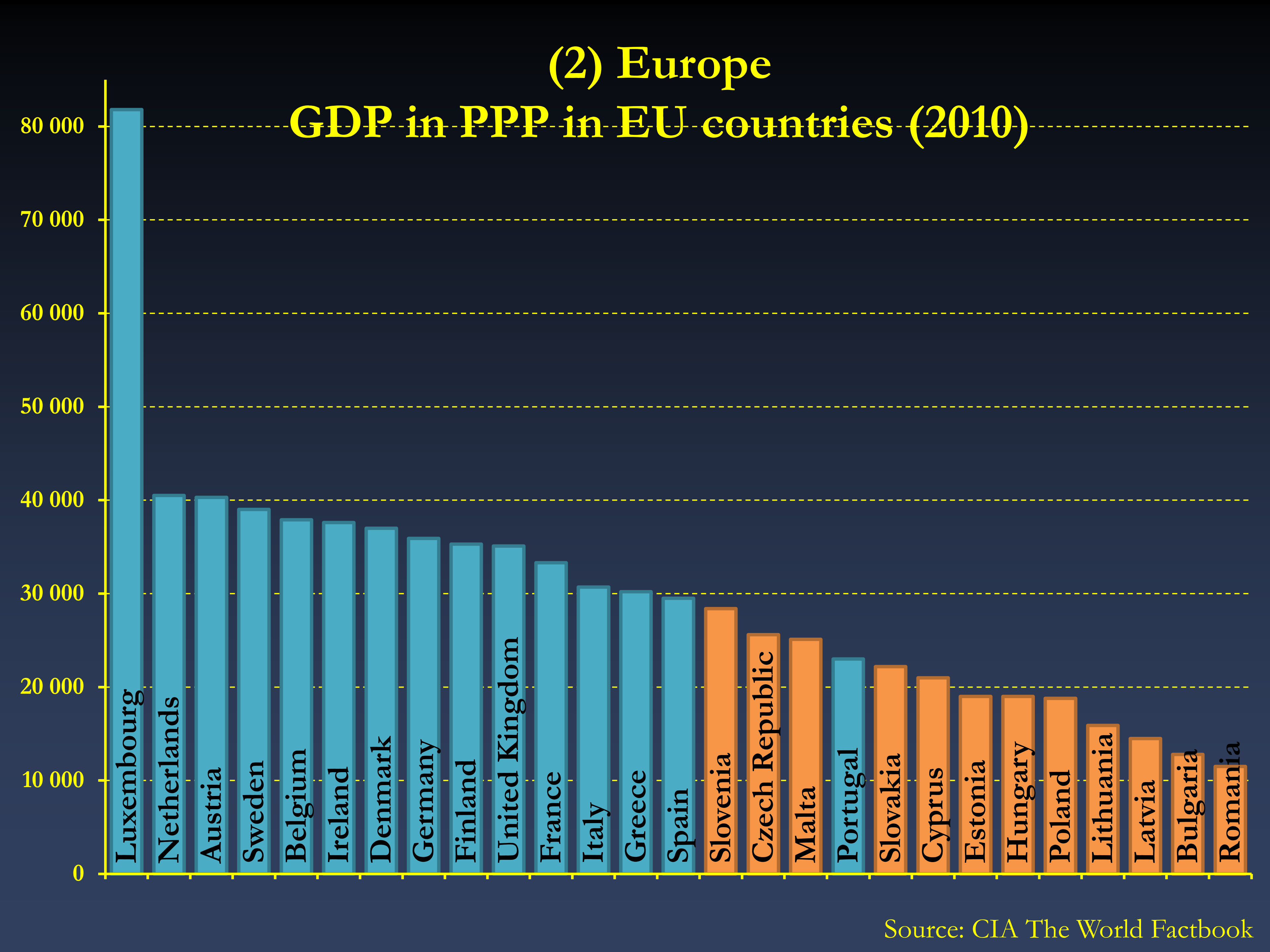
World Water Development Report 3 (2009)

Changing world....

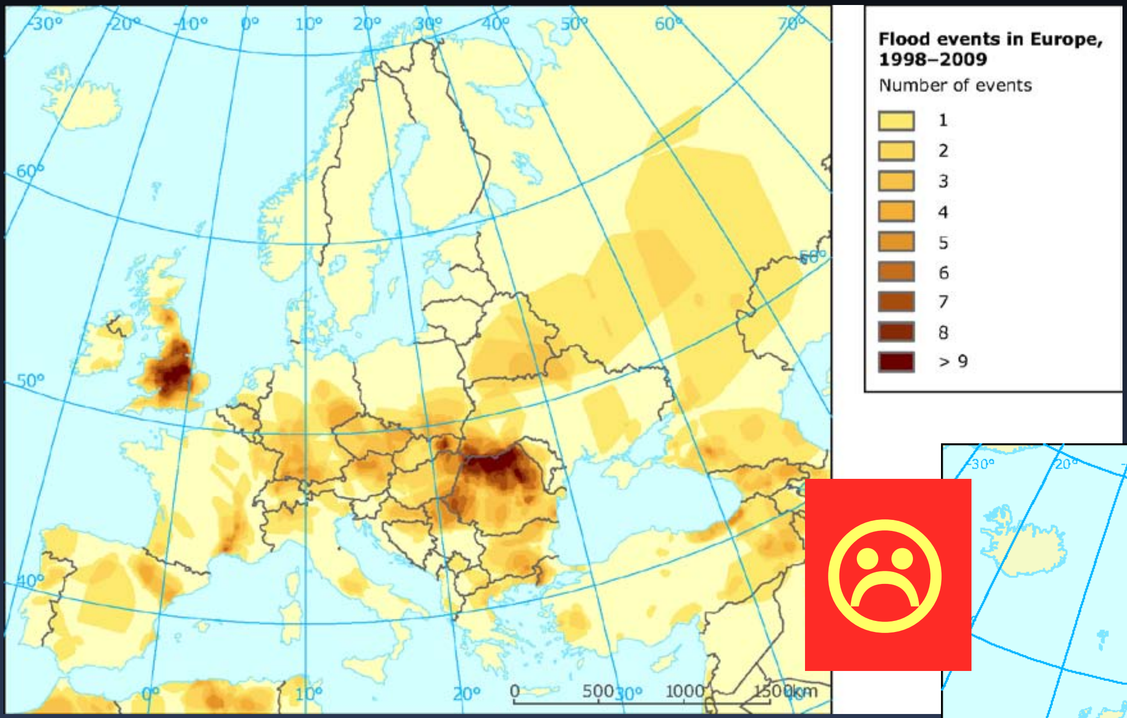
We entered a new era of info-communication. How it will develop?

Global issues
Conclusions (1)

- ☞ Water problems are much more complicated than say a decade ago
- ☞ Many of the causes are outside the traditional water management. Thus solutions should be looked for also „out of the box”
- ☞ Due to globalization and crises, Europe is not isolated from the rest of the World. Europe has the capacity to take the lead in handling the water dilemma

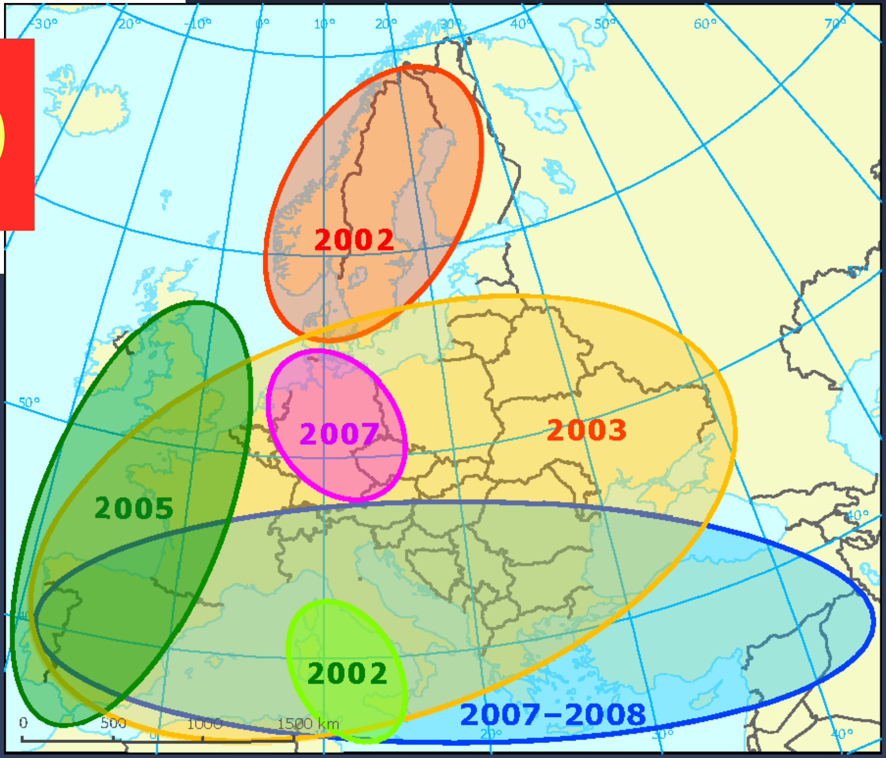

(2) Europe
GDP in PPP in EU countries (2010)
80 000
70 000
60 000
50 000
40 000
30 000
20 000
10 000
0
Luxembourg
Netherlands
Austria
Sweden
Belgium
Ireland
Denmark
Germany
Finland
United Kingdom
France
Italy
Greece
Spain
Slovenia
Czech Republic
Malta
Portugal
Slovakia
Cyprus
Estonia
Hungary
Poland
Lithuania
Latvia
Bulgaria
Romania
Source: CIA The World Factbook

Floods and droughts in Europe (last decade)



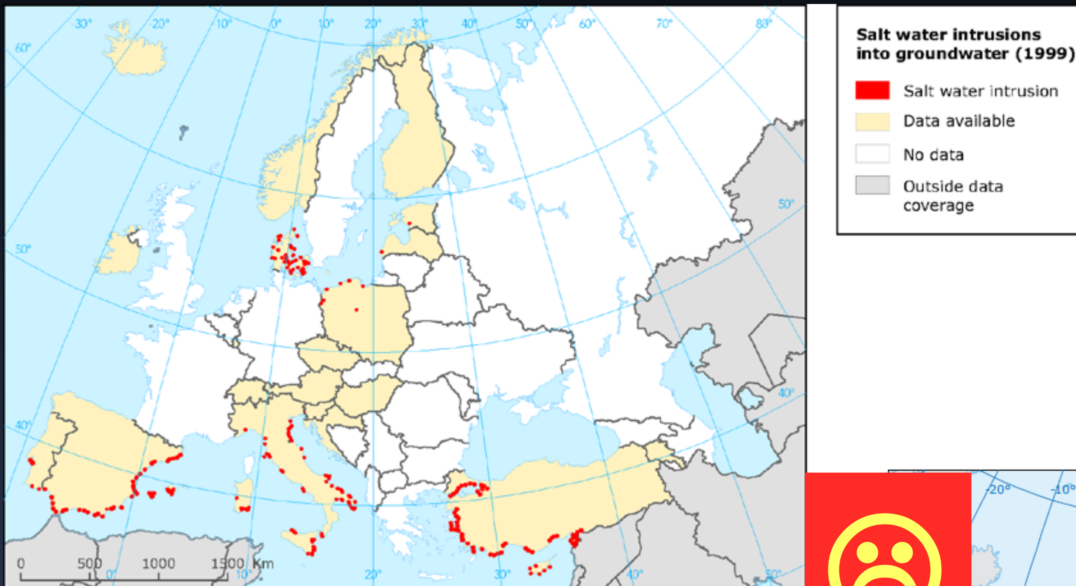
Floods

Droughts



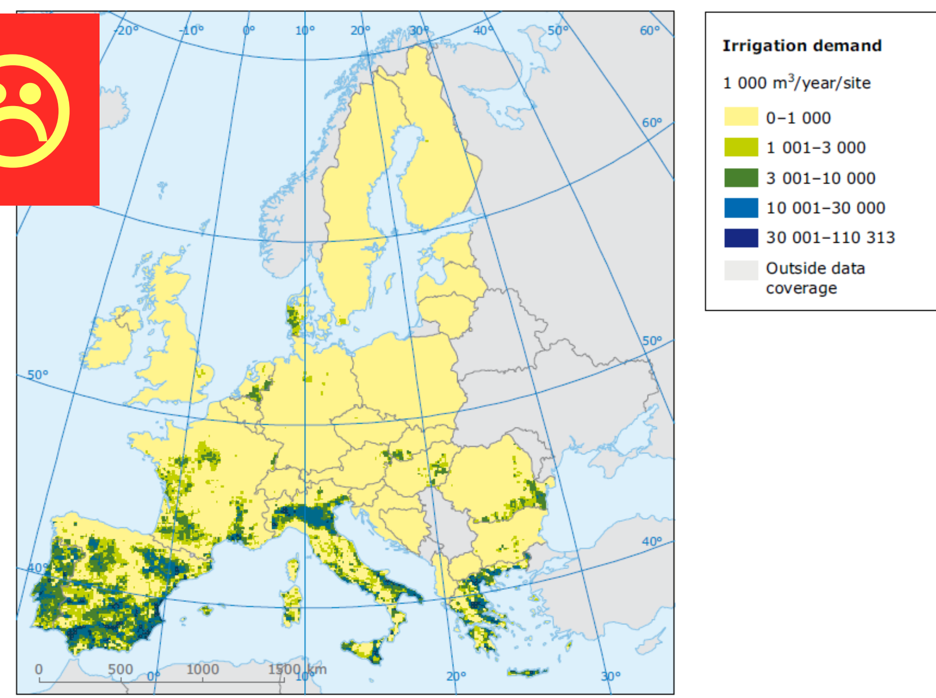
EEA (2009)

Salt water intrusion and irrigation pattern



Intrusion sites

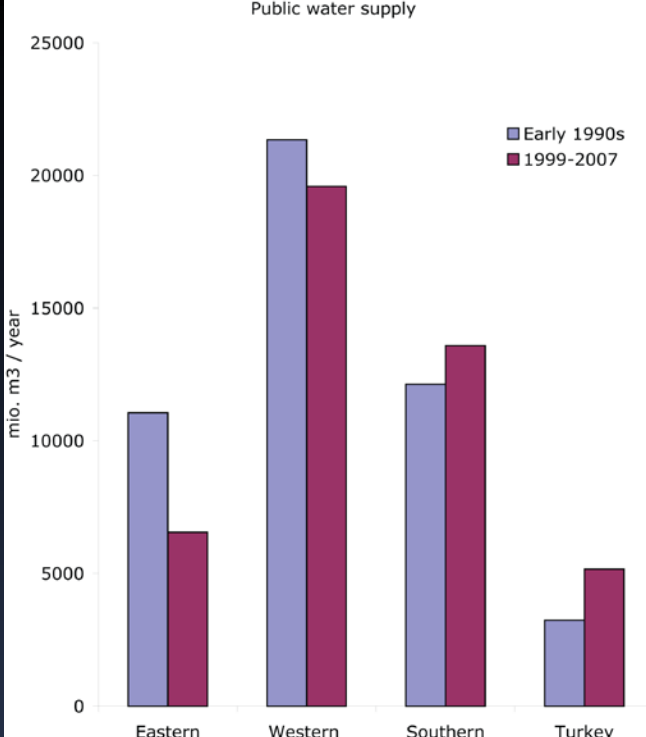
Irrigation demand (m³ per 10 x 10 km cell)



Source: Wriedt *et al.*, 2008.

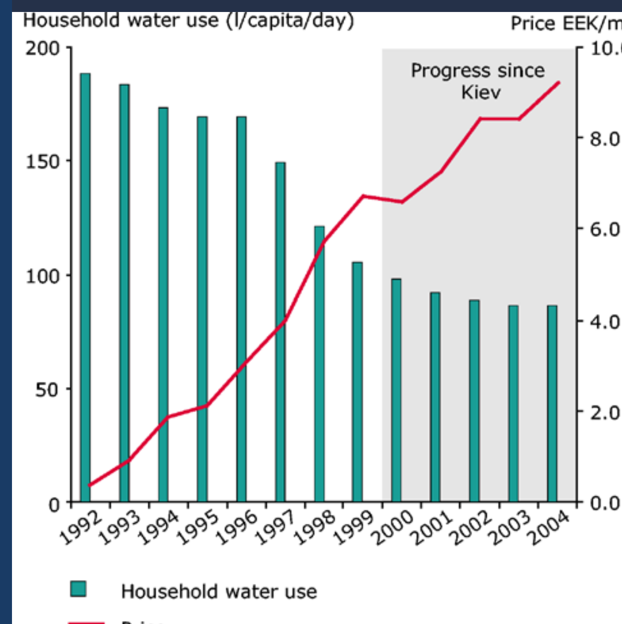
EEA (2009)

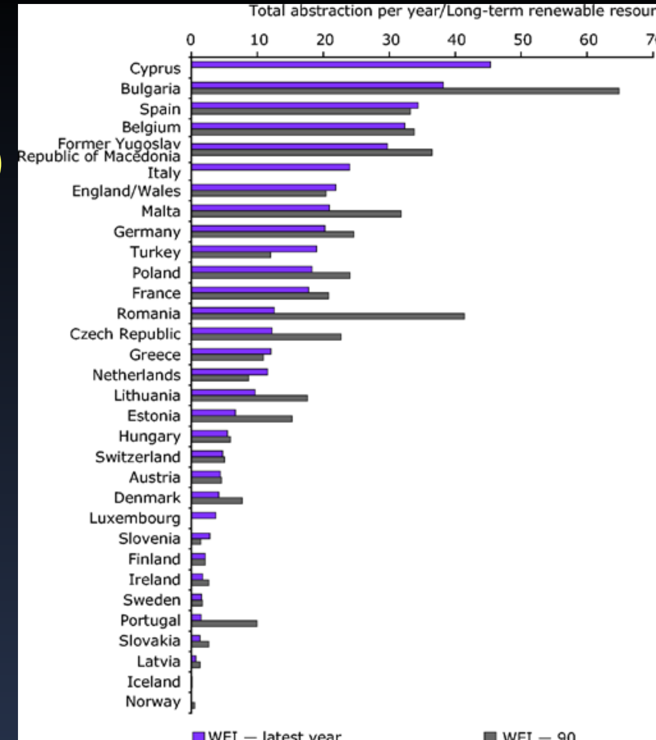
Public WS & exploitation (%)



Public water supply in 4 regions of Europe

Price vs use in Denmark





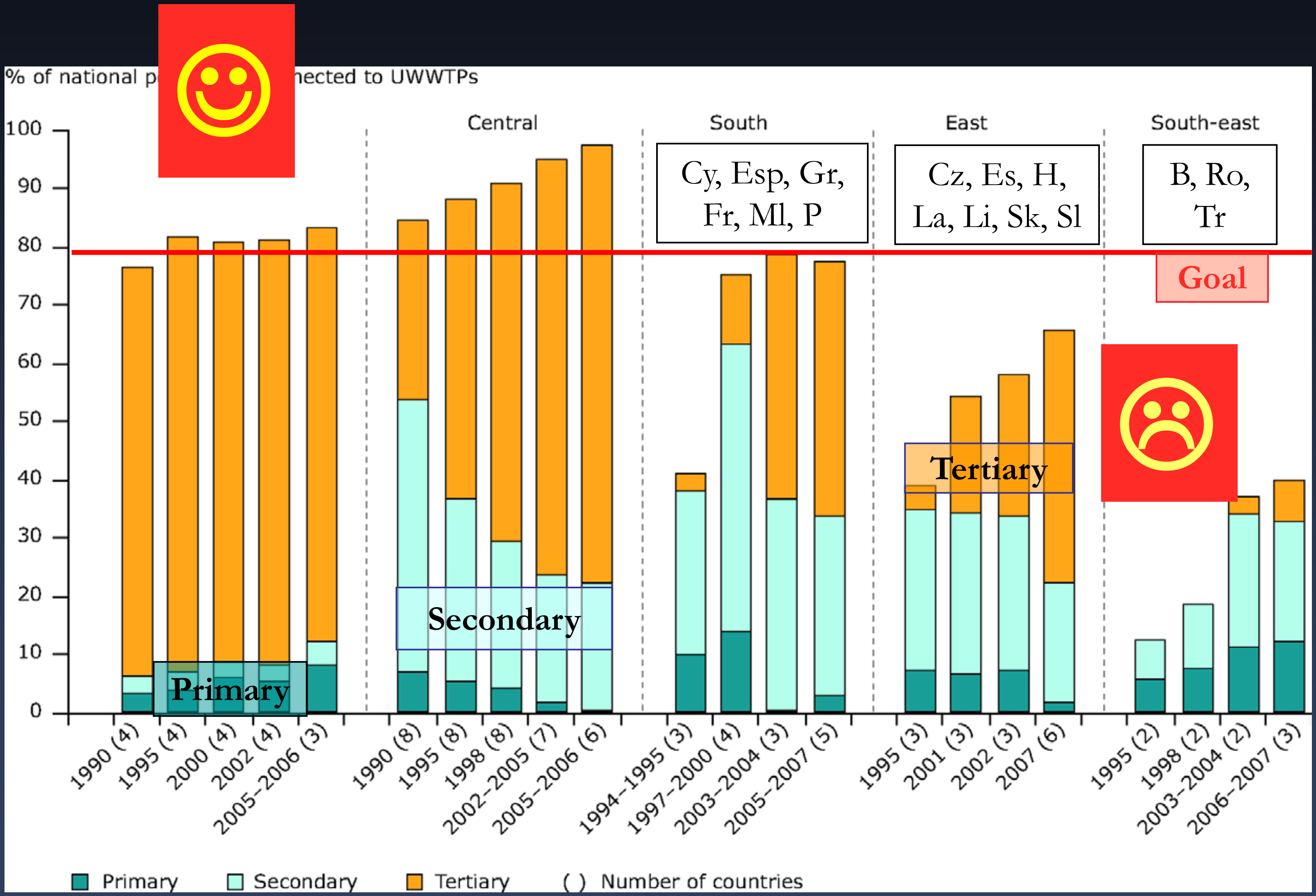
Exploitation rate in European countries

EEA (2009)

P

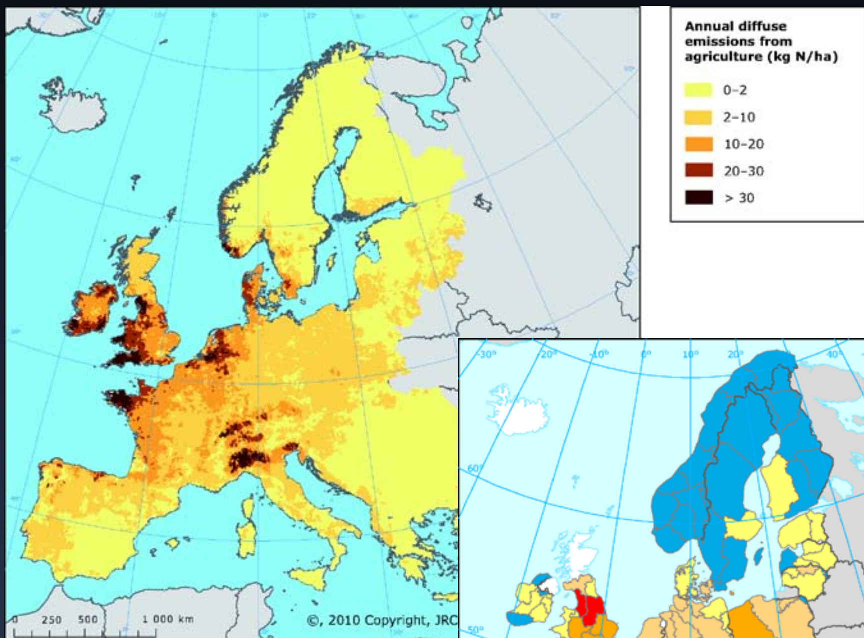
w

National population connected to UWWTP (%)

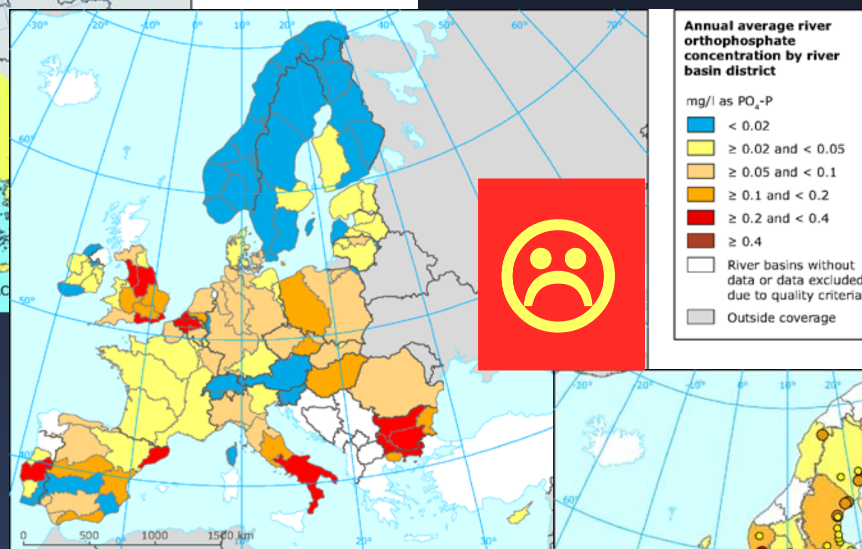


EEA (2010)

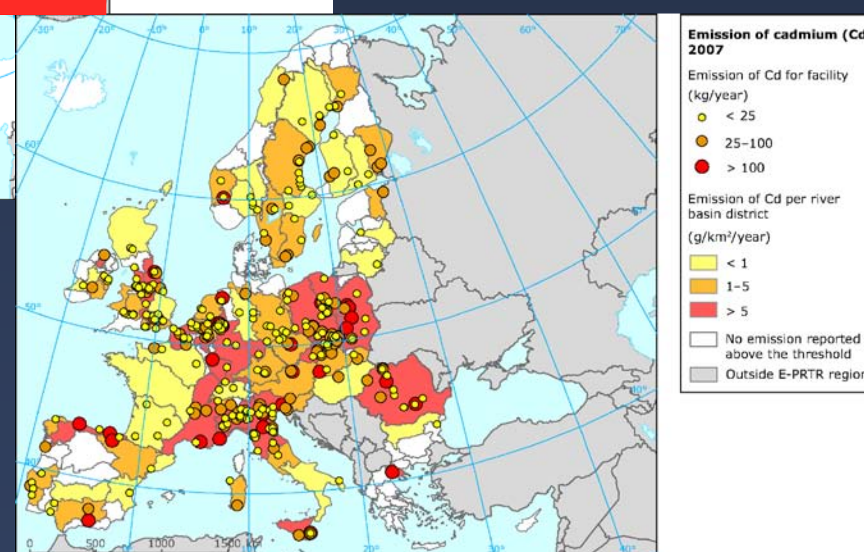
Emissions and water quality



Diffuse N emissions (kg/ha/a)



Average PO4-P concentration (mg/l)

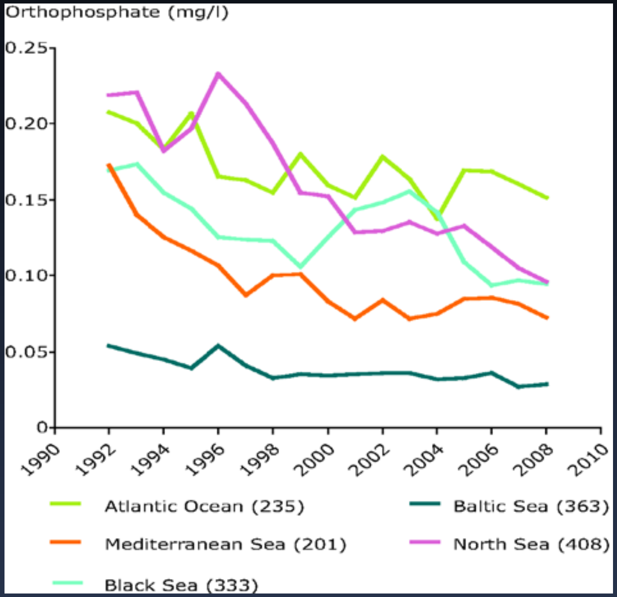


Average Cd emissions ($g/km^2/a$)

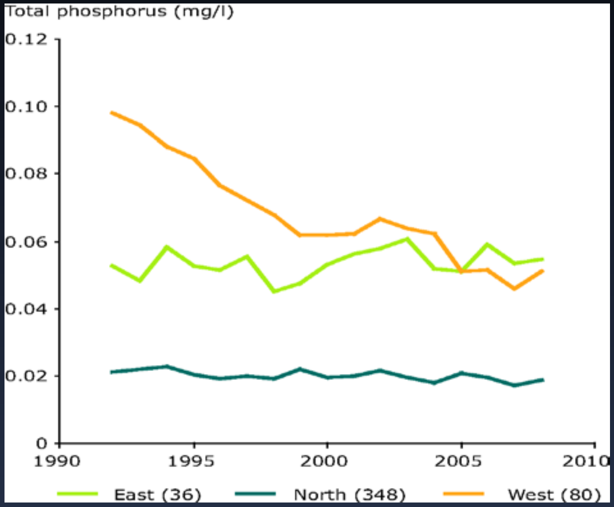
EEA (2010)

European water quality trends

PO4-P

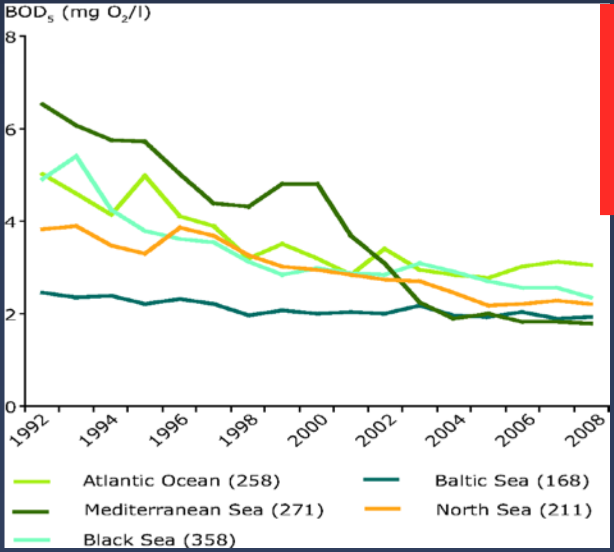


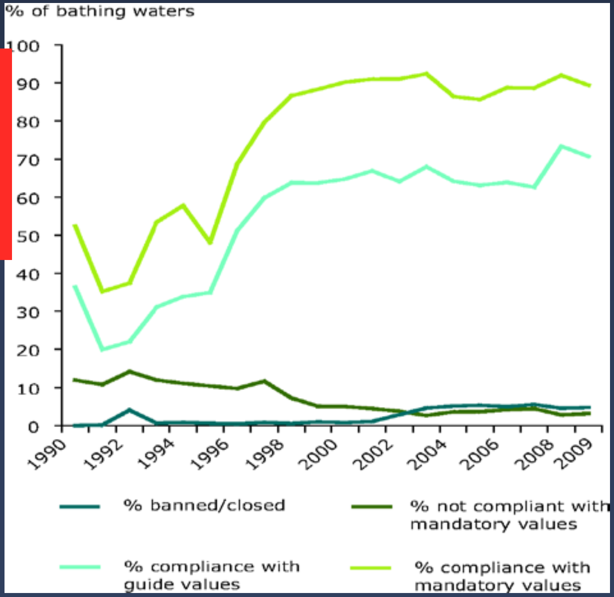
TP



% of bathing waters

BOD5





EEA (2010)

1995-2006: 11 of the 12 years were the warmest since 1850
Climate change?

Waltraud Grubitzsch, dpa, 2003

Europe
Conclusions (2)

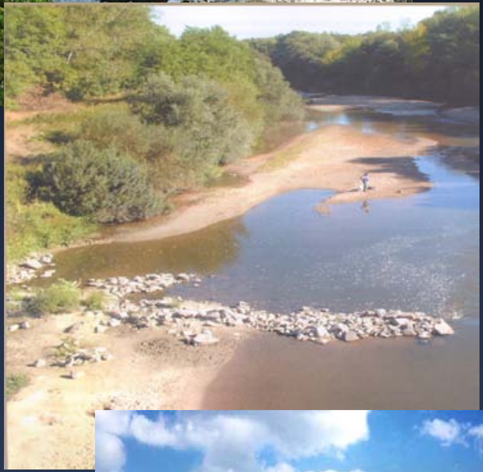
- ☞ Lots of information. Data credibility? Quantity and quality?
- ☞ Economic disparities and affordability
- ☞ Many positive signs: everything may look all right
- ☞ But, is it really the case?
- ☞ Extremes, climate change, overexploitation, non-point sources, nutrients, micropollutants, EDS, biodiversity loss, water bodies at risk
- ☞ Some of the dilemmas and future questions: next blocks

(3) Water Framework Directive

Objectives

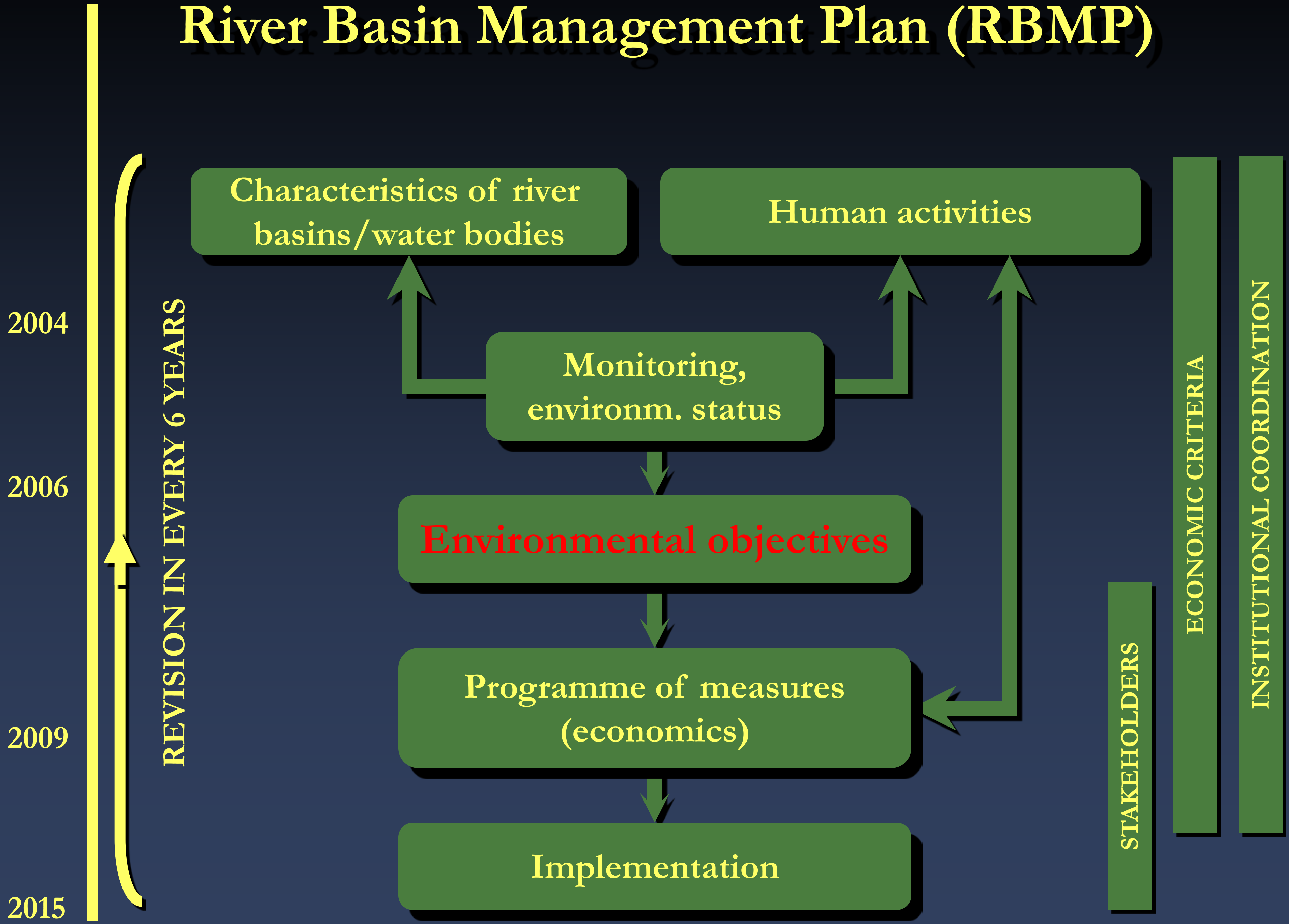
☞ To achieve the „good ecological status" of waters for different eco-regions.

☞ Programes of measures under the condition of full cost recovery and public participation.

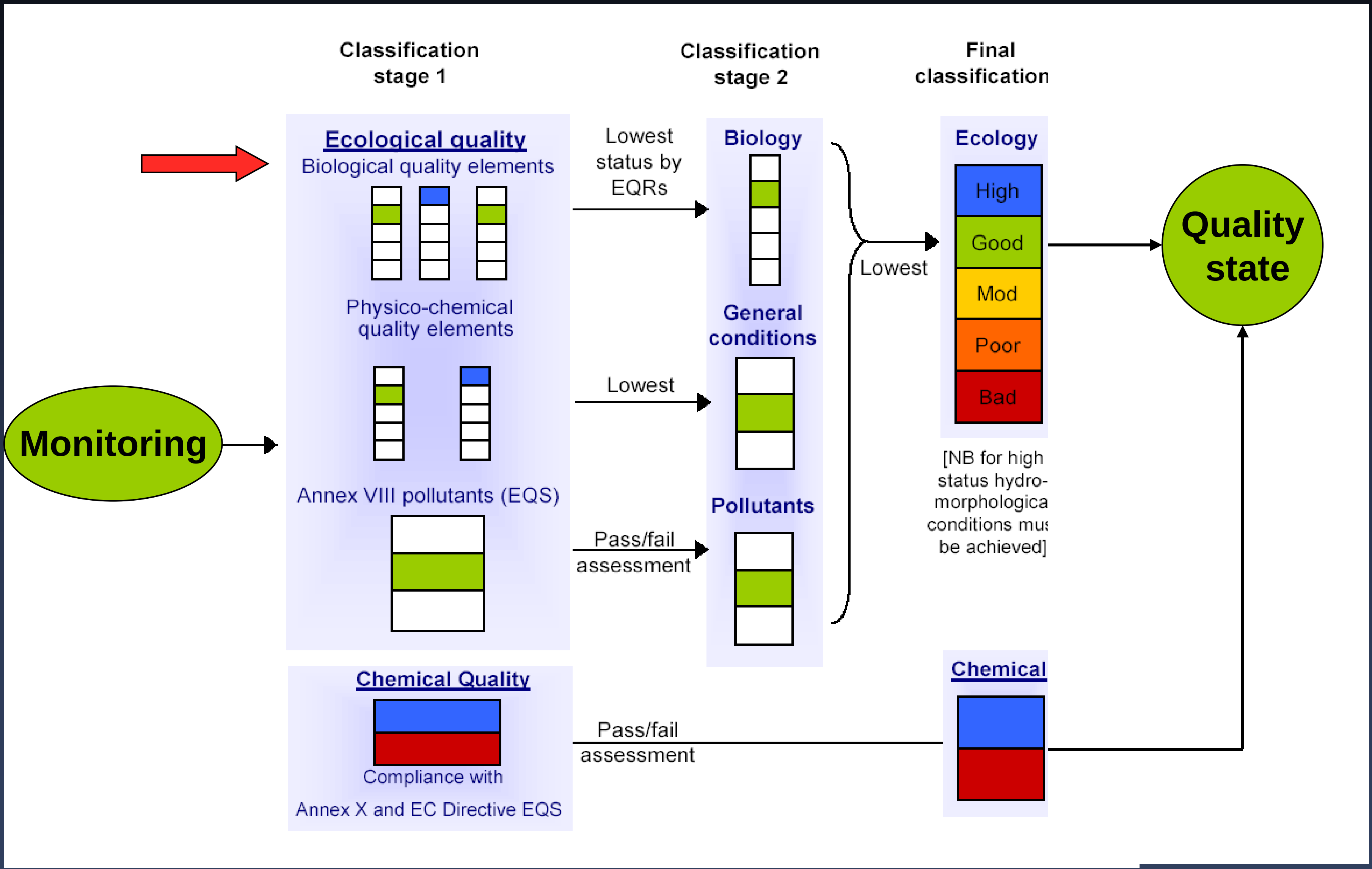


☞ Details and the institutional settings are left to countries.

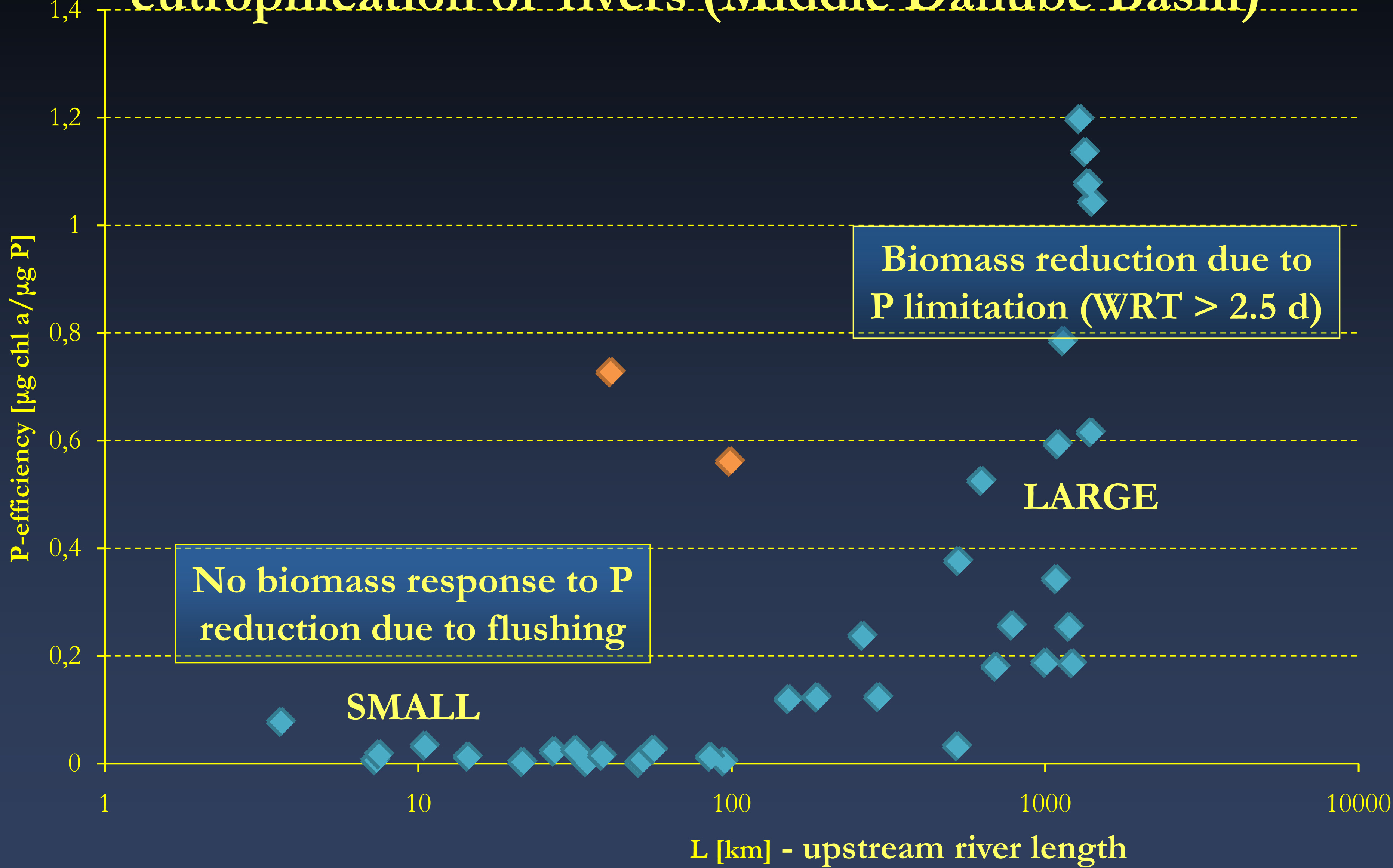
River Basin Management Plan (RBMP)



WFD quality classification

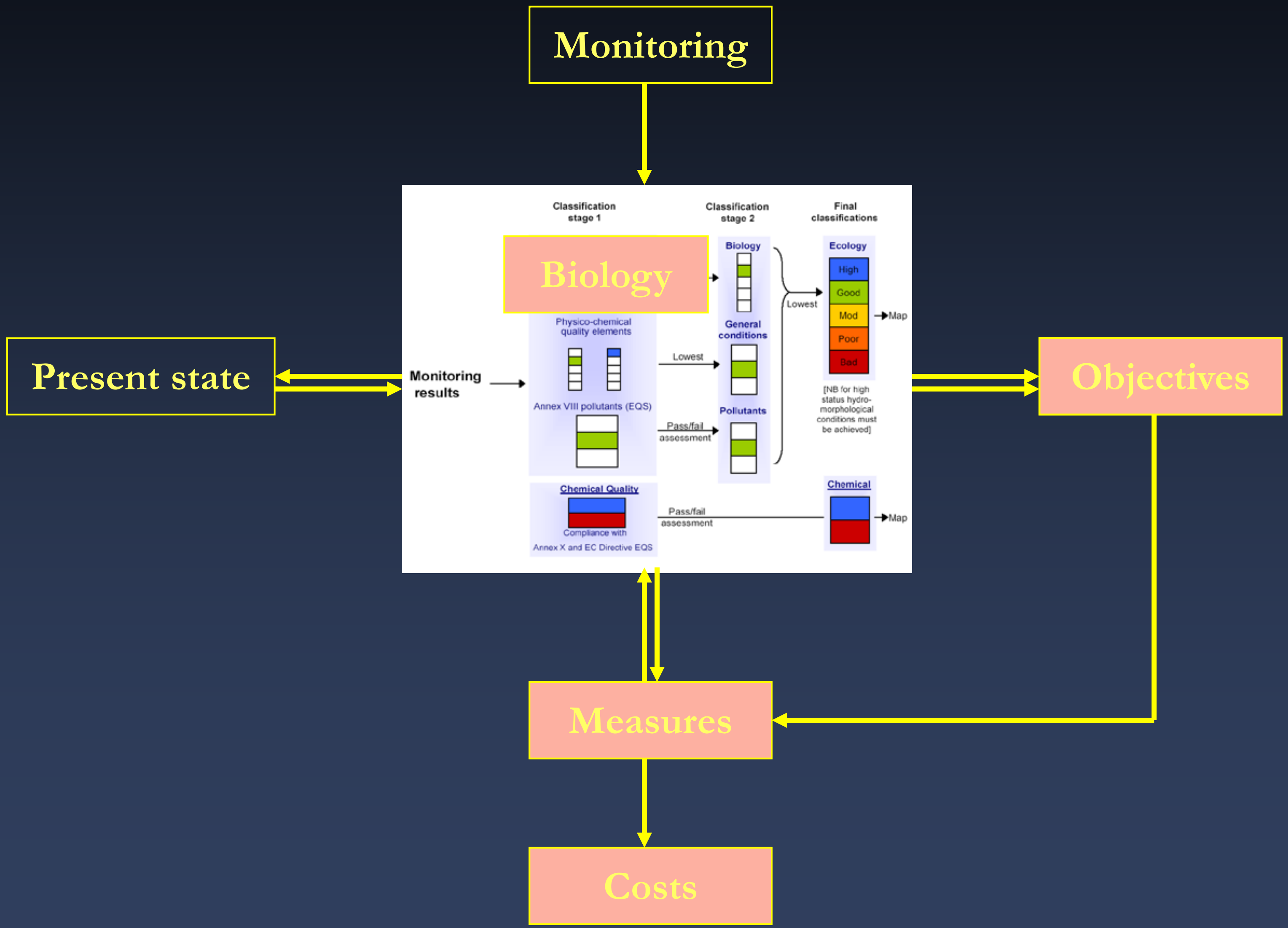


Efficiency of nutrient management in controlling eutrophication of rivers (Middle Danube Basin)



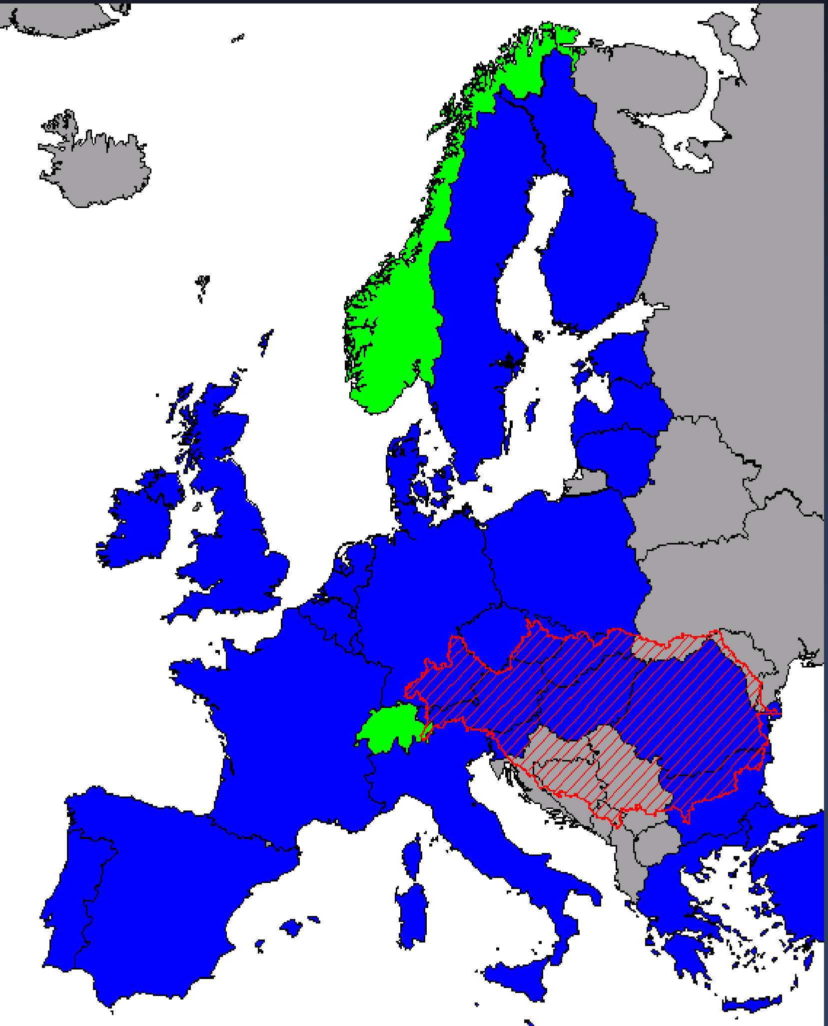
Istvánovics and Honti (2011, submitted)

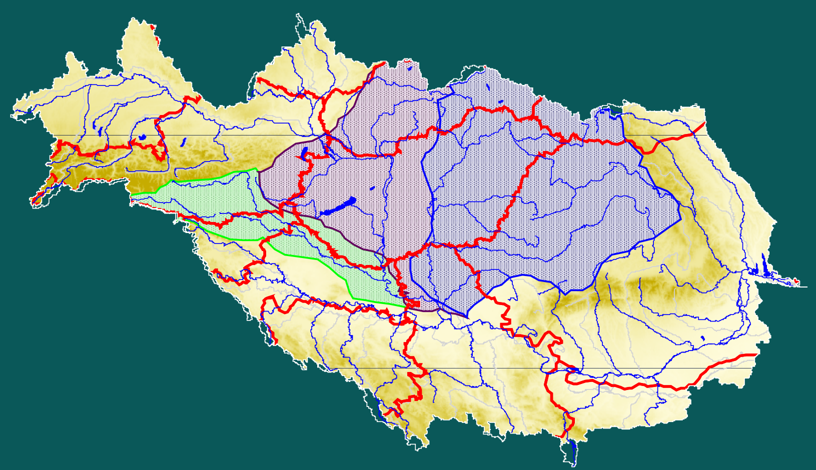
Uncertainties in applying the WFD



RBMP: Is Integration and Coordination on Different Levels Easy?

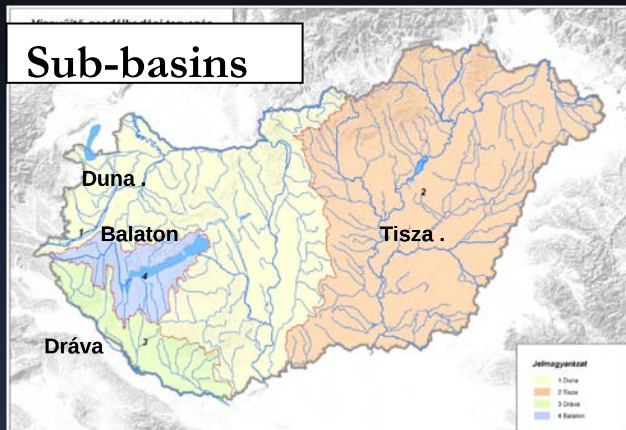
- Large river basins (e.g. Danube)
    - Sub-basins
        - Countries
            - Water bodies/planning units

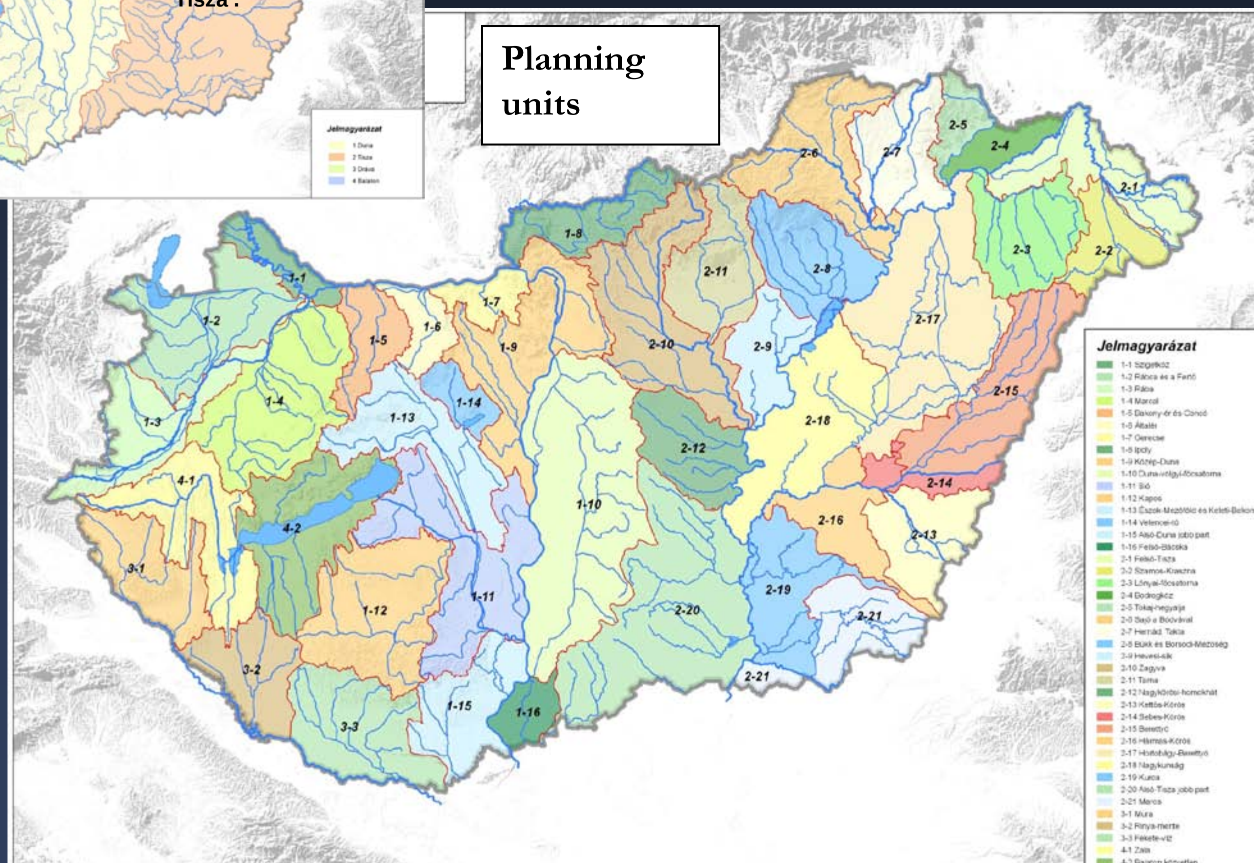




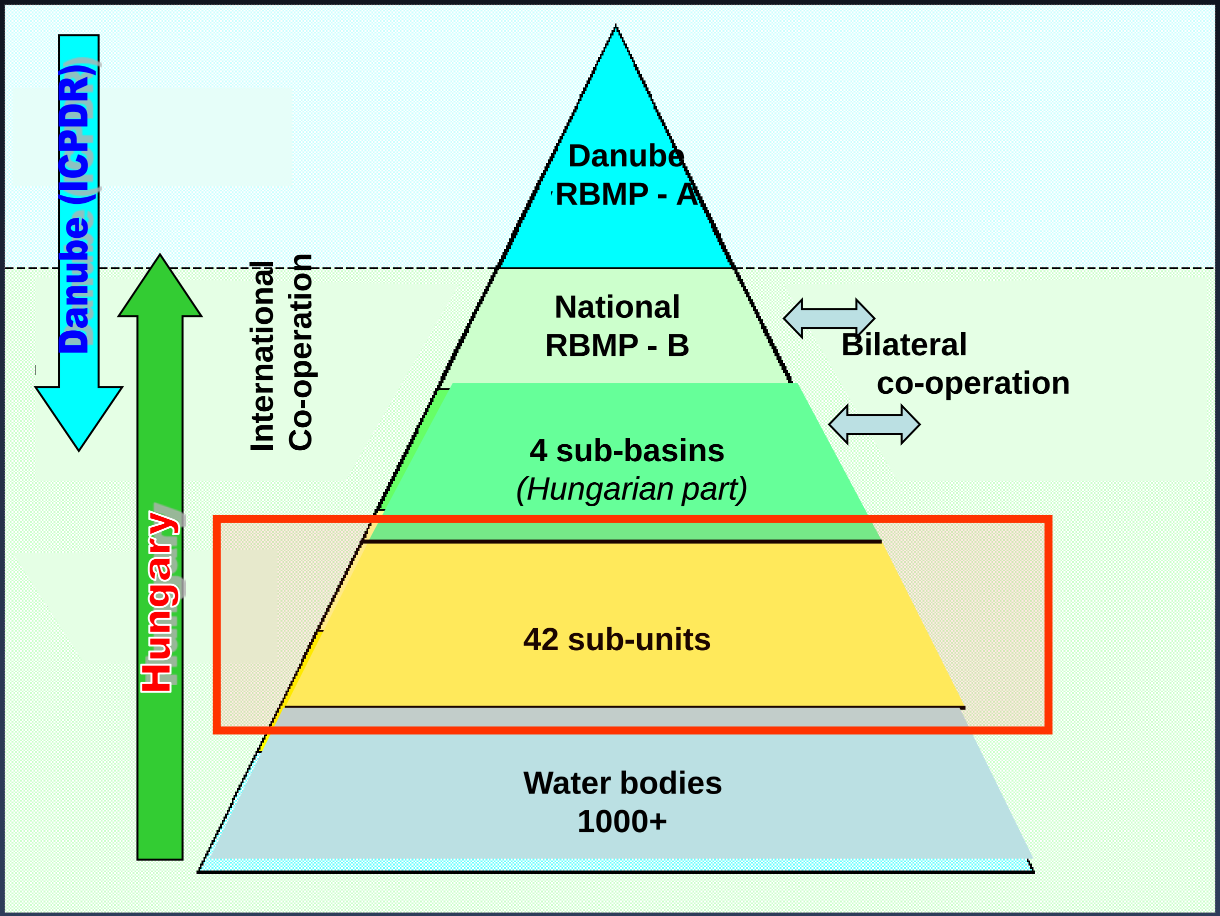
Danube Basin

River basin management plan (Hungary)
Danube water district – ICPDR





Main structure of RBMP in the Danube basin



Macro-scale, aggregated

Micro-scale, many details

Be as specific as needed and as general as possible.
Iterative process of „top-down" and „bottom up" approach

Water Framework Directive Conclusions (3)

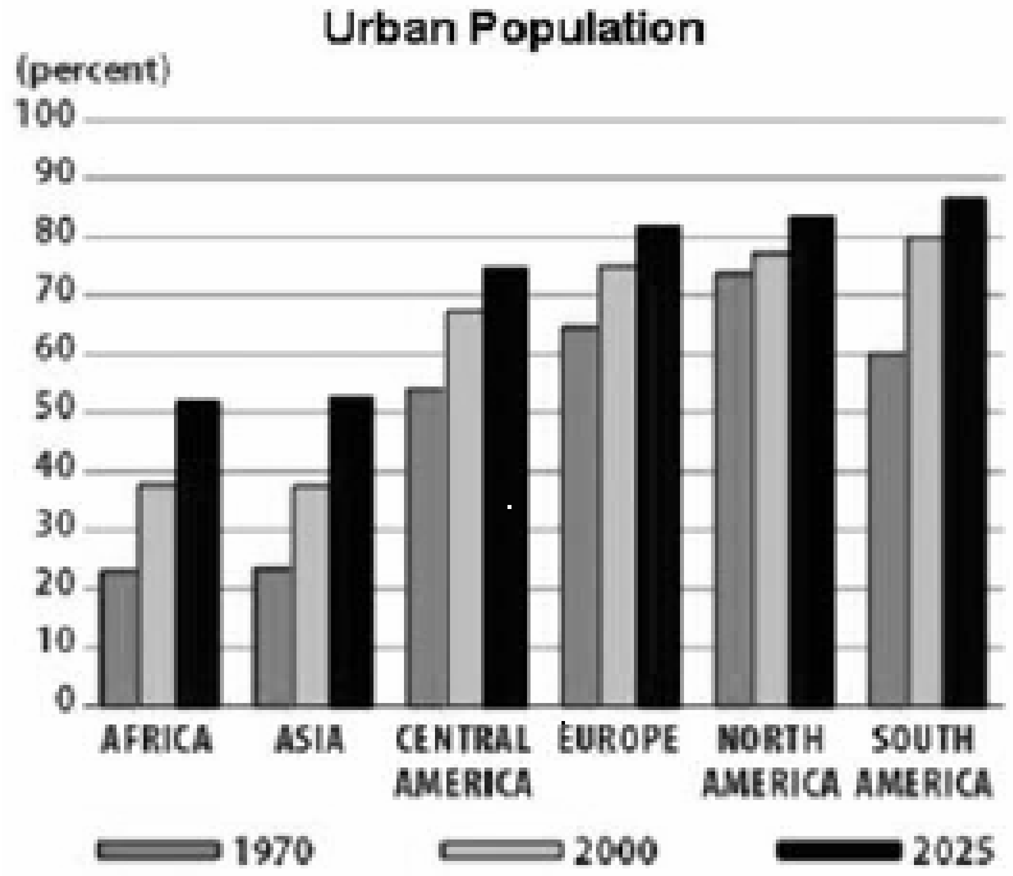
- ☞ Leading concept world wide
- ☞ Lack of sufficient amount of monitoring data: biological classification is extremely uncertain
- ☞ Measures vs biological state vs costs? Research needs
- ☞ Uncertainty is an inherent feature of water management
- ☞ Integrating the WFD, the flood directive, draught management, CAP and spatial planning?

Budapest (2002)

(4) Asset management (AM)

Pipe burst: aged water infrastructure

Urban water infrastructure



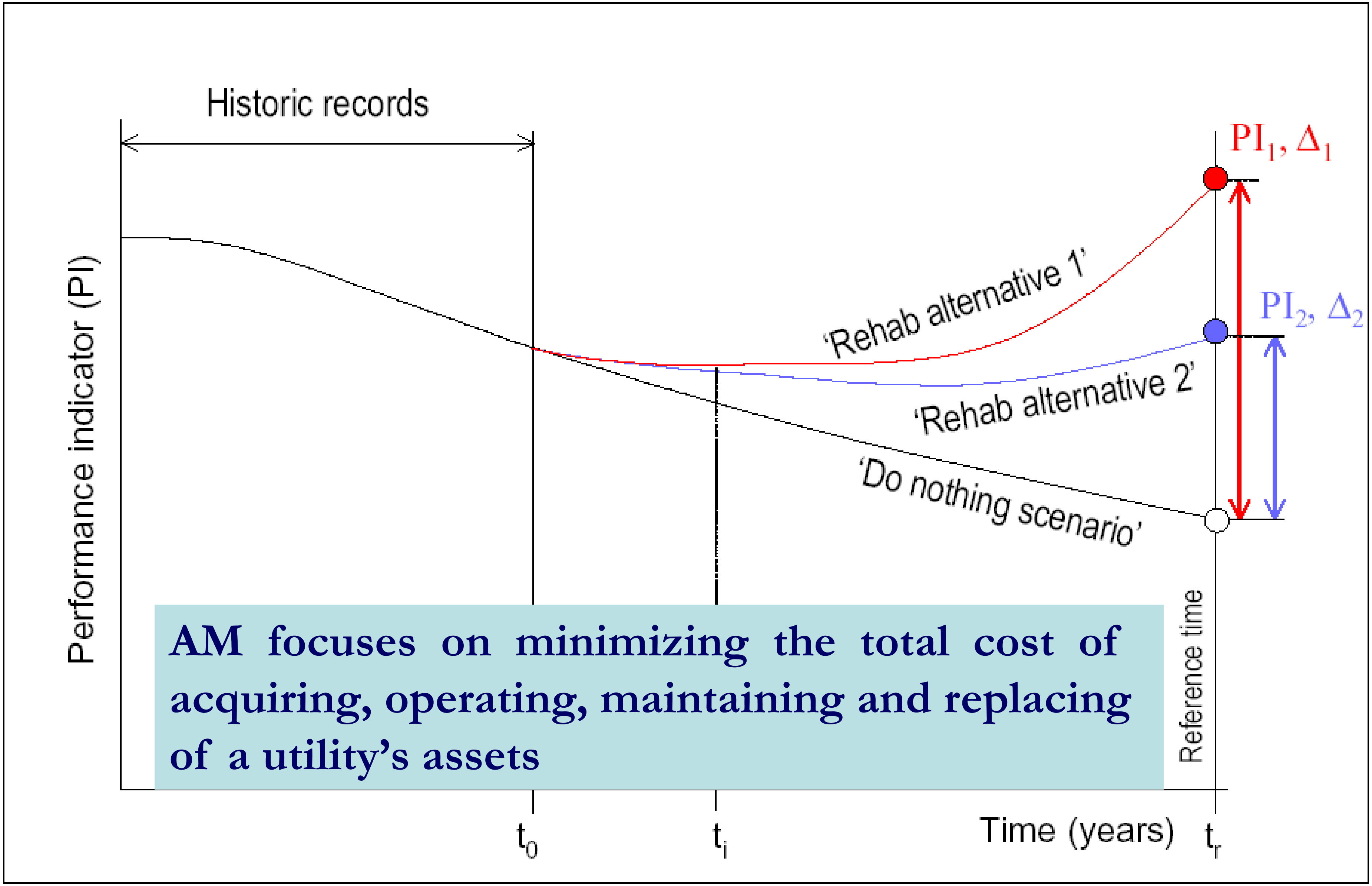
Urban water systems and 5 components of the water cycle: 1. Precipitation, 2. Stormwater, 3. Water supply, 4. Wastewater, 5. Receiving waters

Importance of the issue

- European water sector is 1 % of EU GDP
- Urban water systems comprise 40 % of the total replacement value
- 20 % of EU funded infrastructure invest-ments are for urban water systems
- Europe's existing urban infrastructure is aging. Funds are not sufficient: systems deteriorate faster than they are rehabilitated
- It is a technological and financial challenge to maintain and upgrade the systems - asset management (AM)

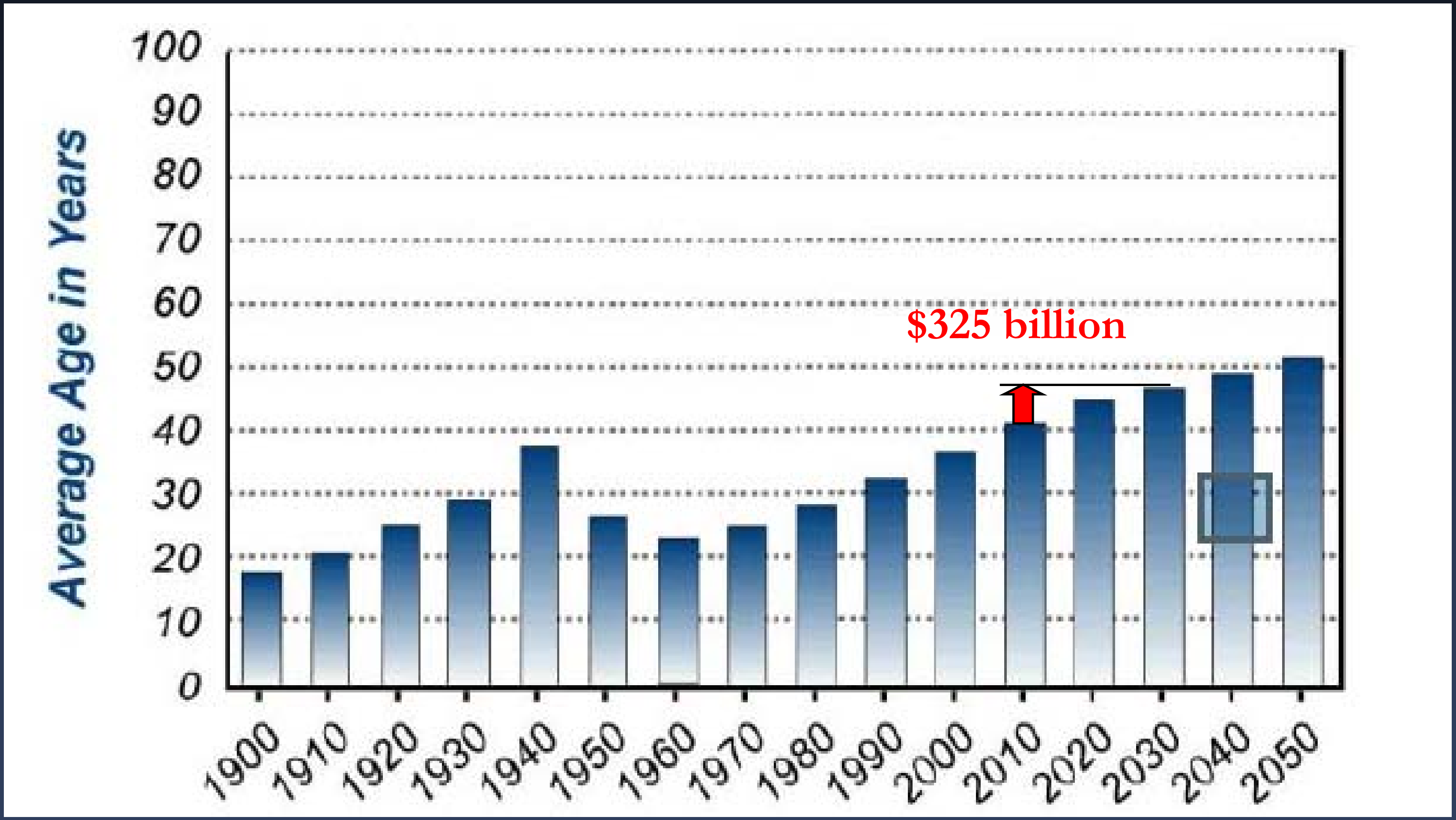
http://villamos.budapest.hu/esem/nepszcso.html

Long-term rehabilitation planning

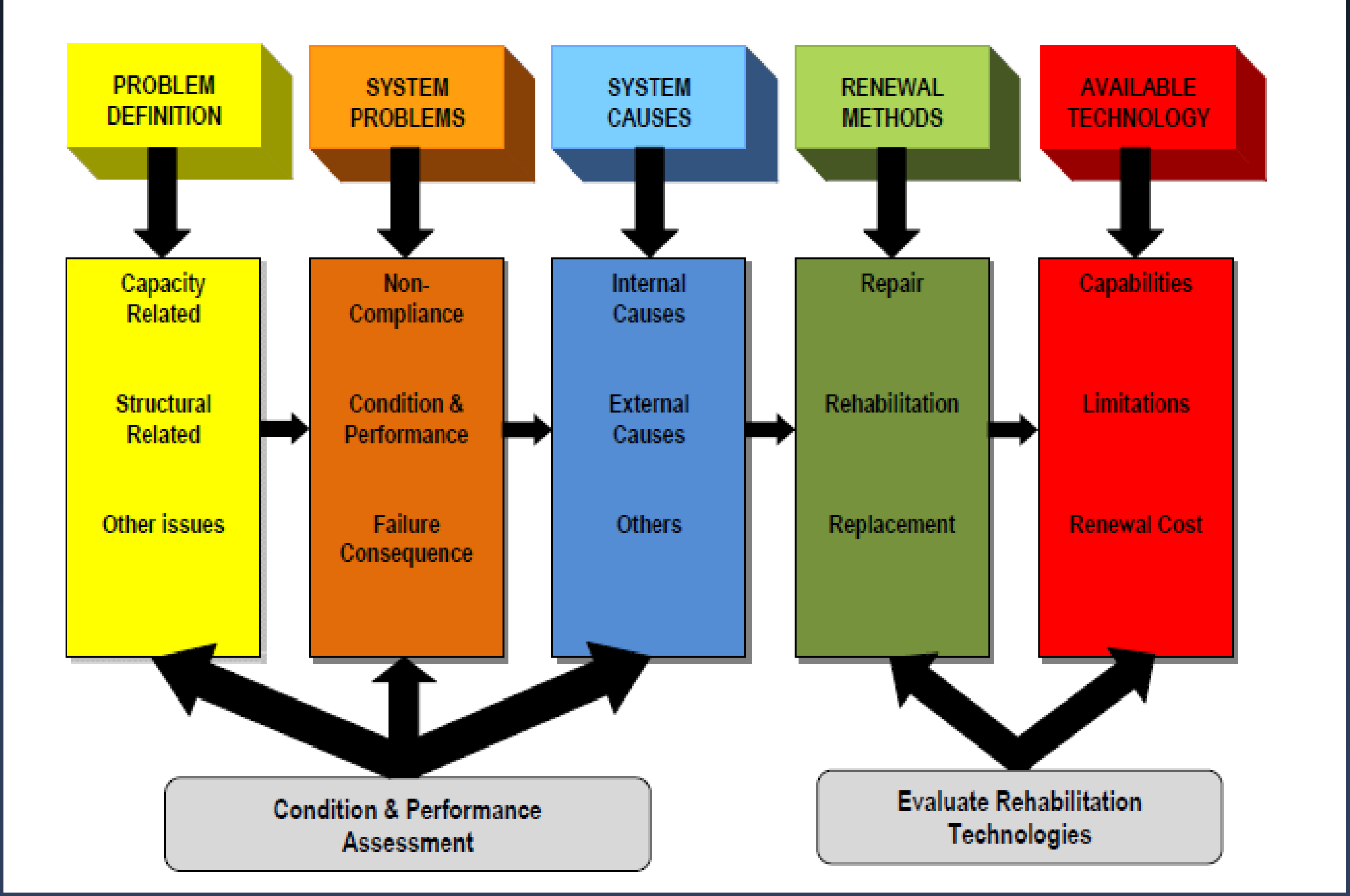


AM focuses on minimizing the total cost of acquiring, operating, maintaining and replacing of a utility's assets

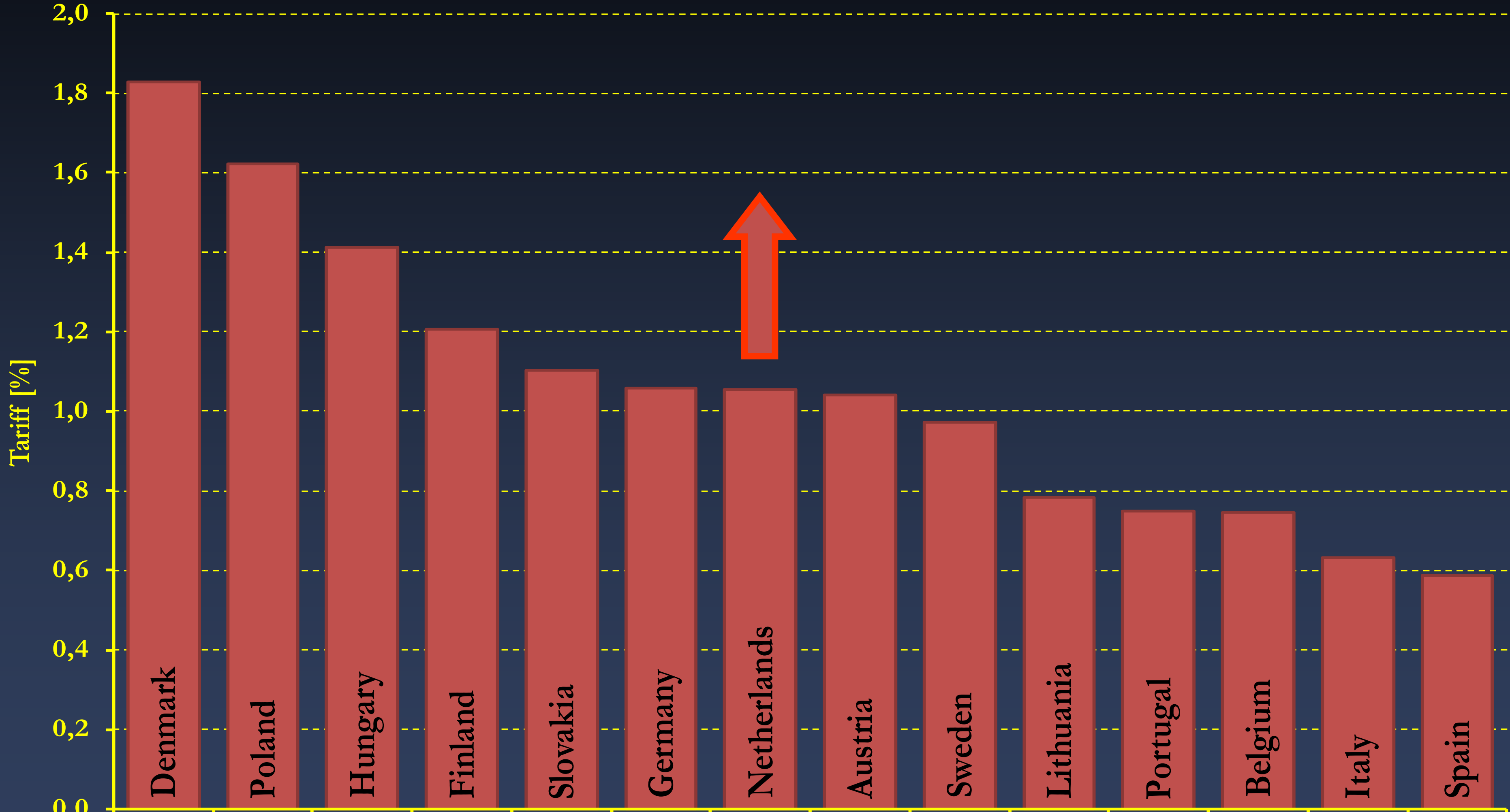
For comparison - Historical and projected average age of U.S. water systems (EPA, 2009)



Conceptual framework for selecting appropriate technologies for system rehabilitation (EPA, 2009)

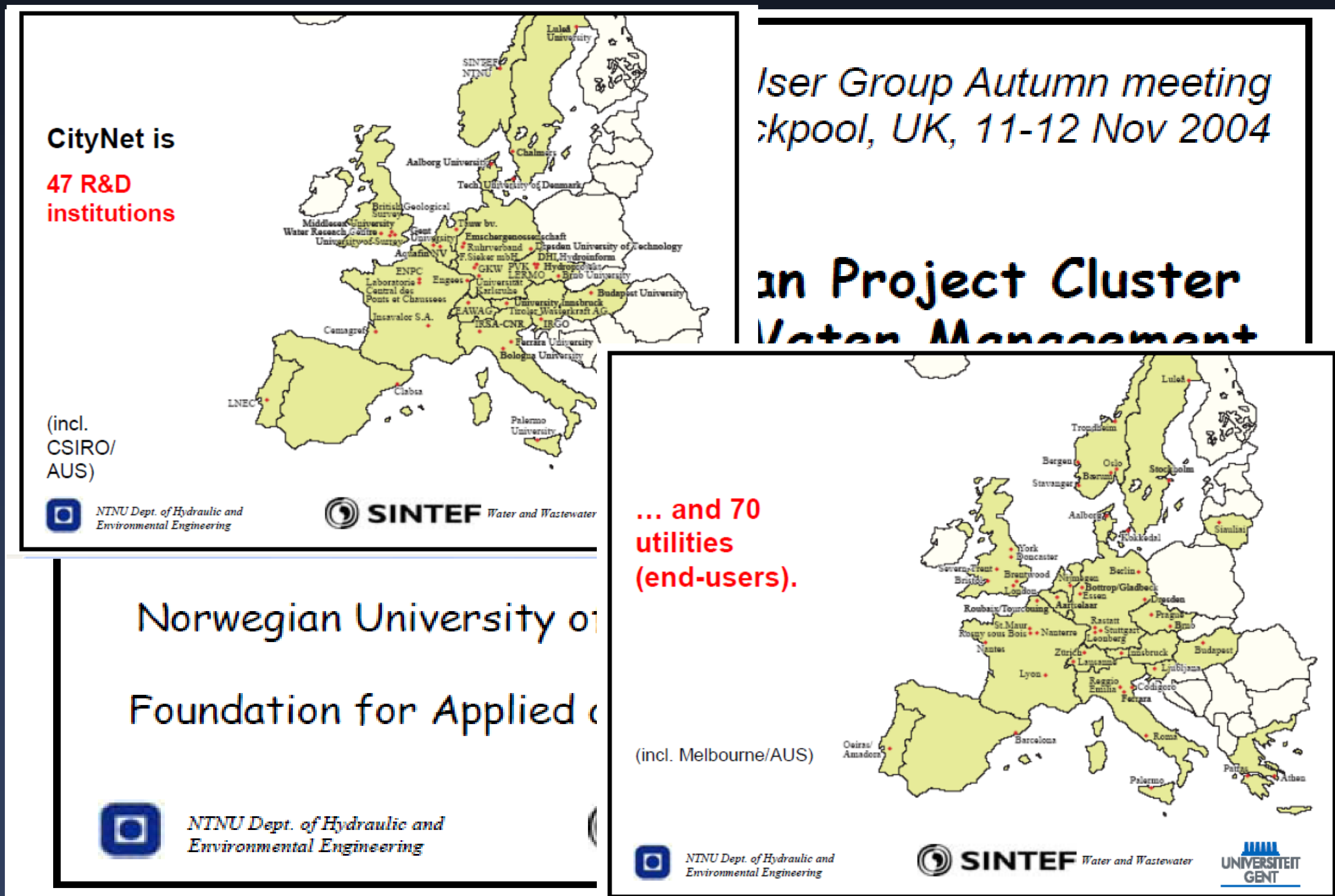


Annual water and wastewater tariff/net income in PPP [%] Households (2008)



Source: IWA International Statistics for Water Services ((2010)
Tárki European Social Report (2008)

A good base to initiate specific AM works is the former EU project covering 47 R&D institutions and 70 utilities:



Asset management
Conclusions (4)

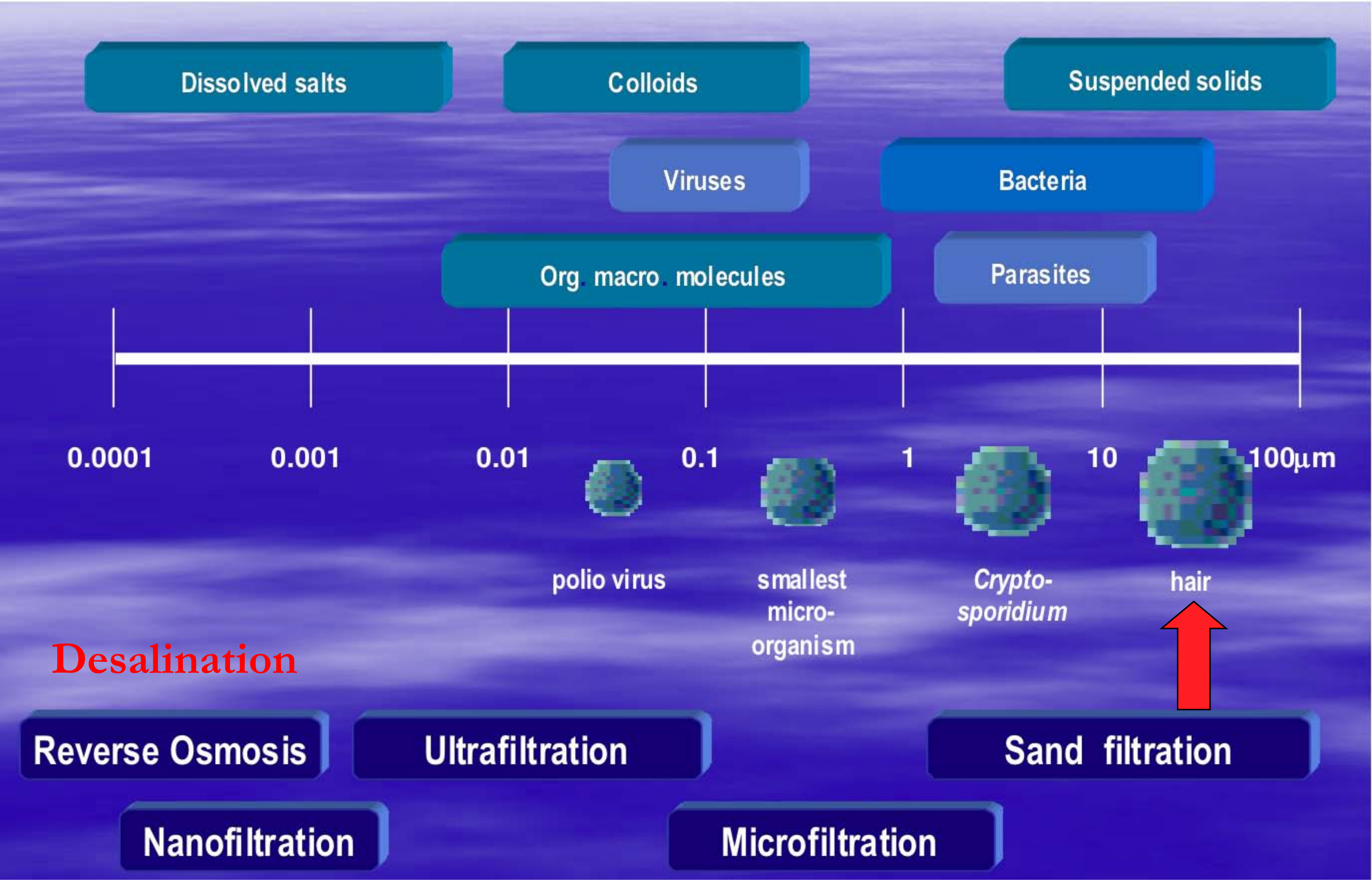
- ☞ Water infrastructure forms a huge (mostly underground, non-visible) asset
- ☞ Europe’s water infrastructure is ageing
- ☞ There is an urgent need to create proper financial resources and to develop long-term rehabilitation programs
- ☞ Such long-term programs should address what future infrastructure we foresee. Are we going to preserve the good-old flushing toilette based systems for the 21st century and beyond or can we move towards more sustainable concepts?

(5) Technology development

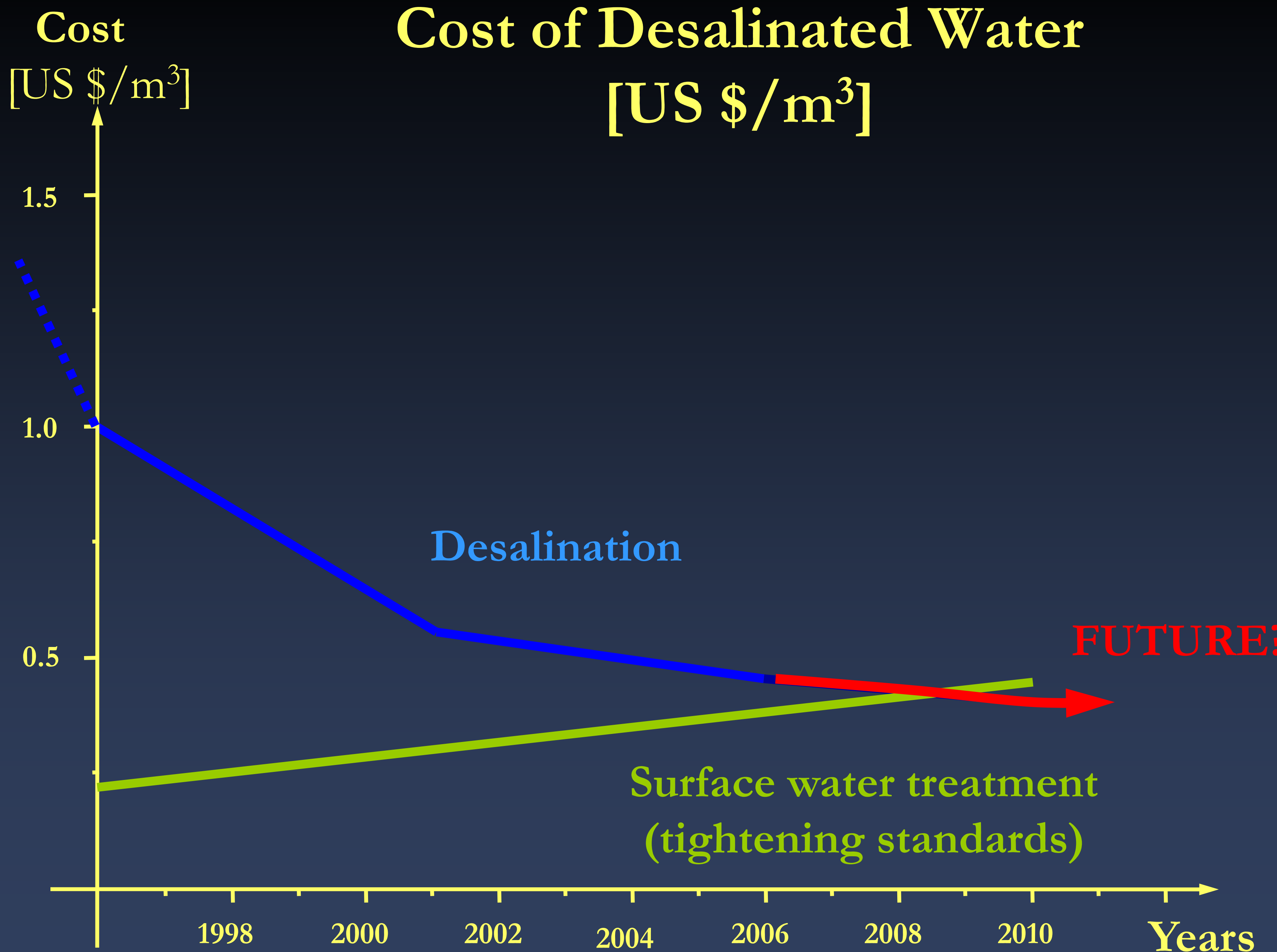
Urine separation: black, grey and yellow waters
Plus re-use, re-cycling and rainwater harvesting

Membrane units for water and wastewater treatment

Membrane technology & size domains



Cost of Desalinated Water [US $/m^3]

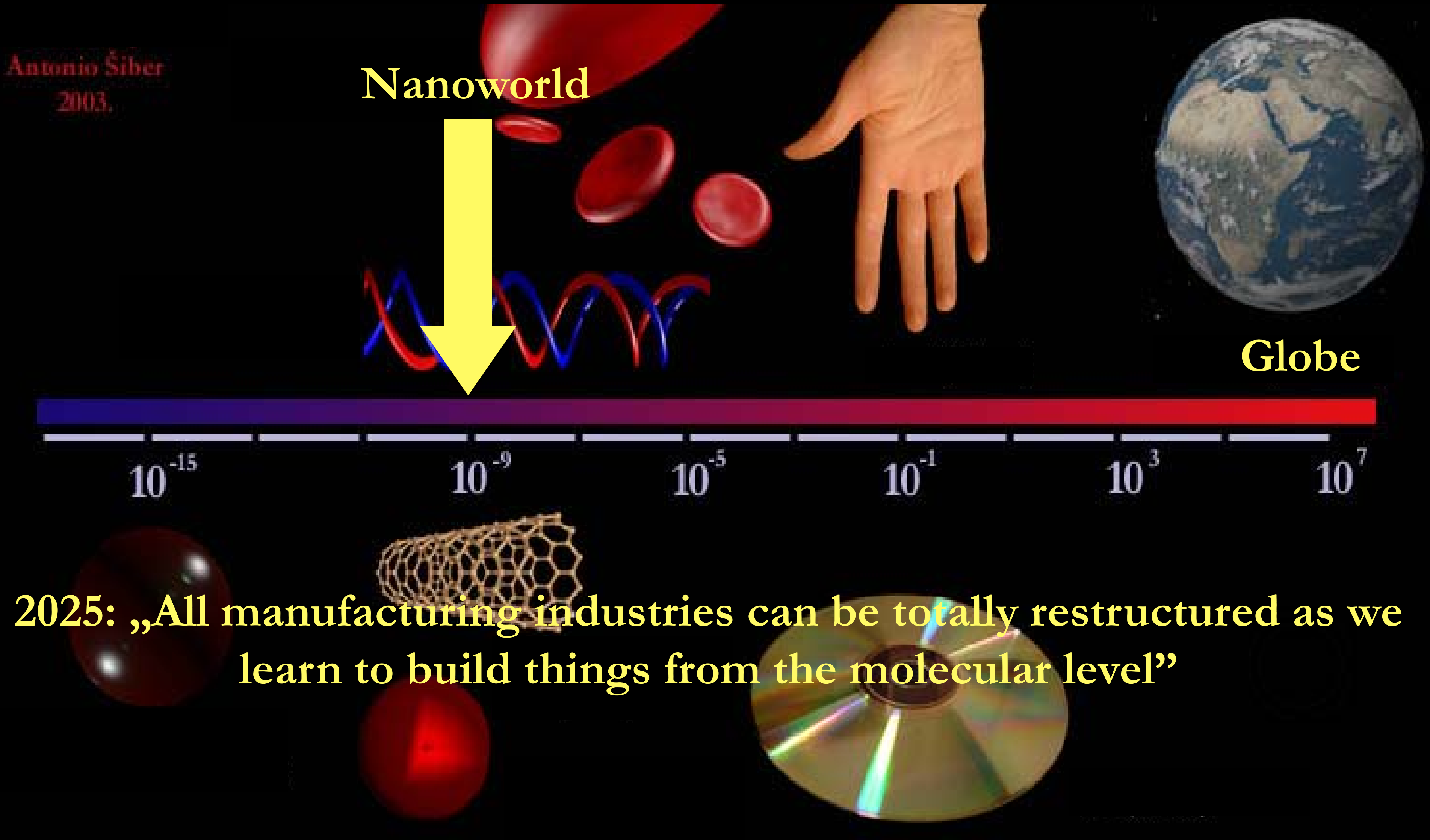


Vontchkov (2004)

Global Water Intellingence (2005)

Singapore – little water and „high tech" for closing cycles

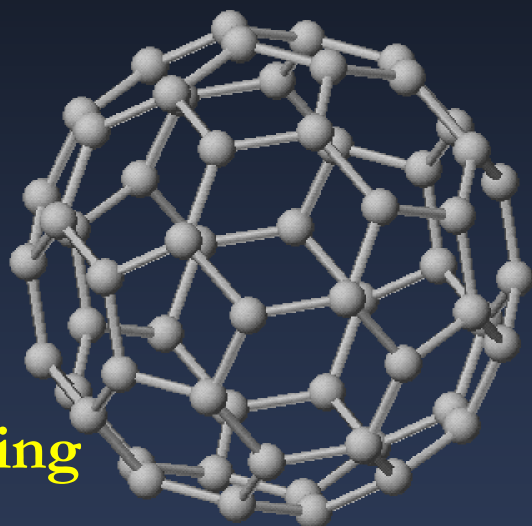
How Will Nanotechnology Change Water Technology?



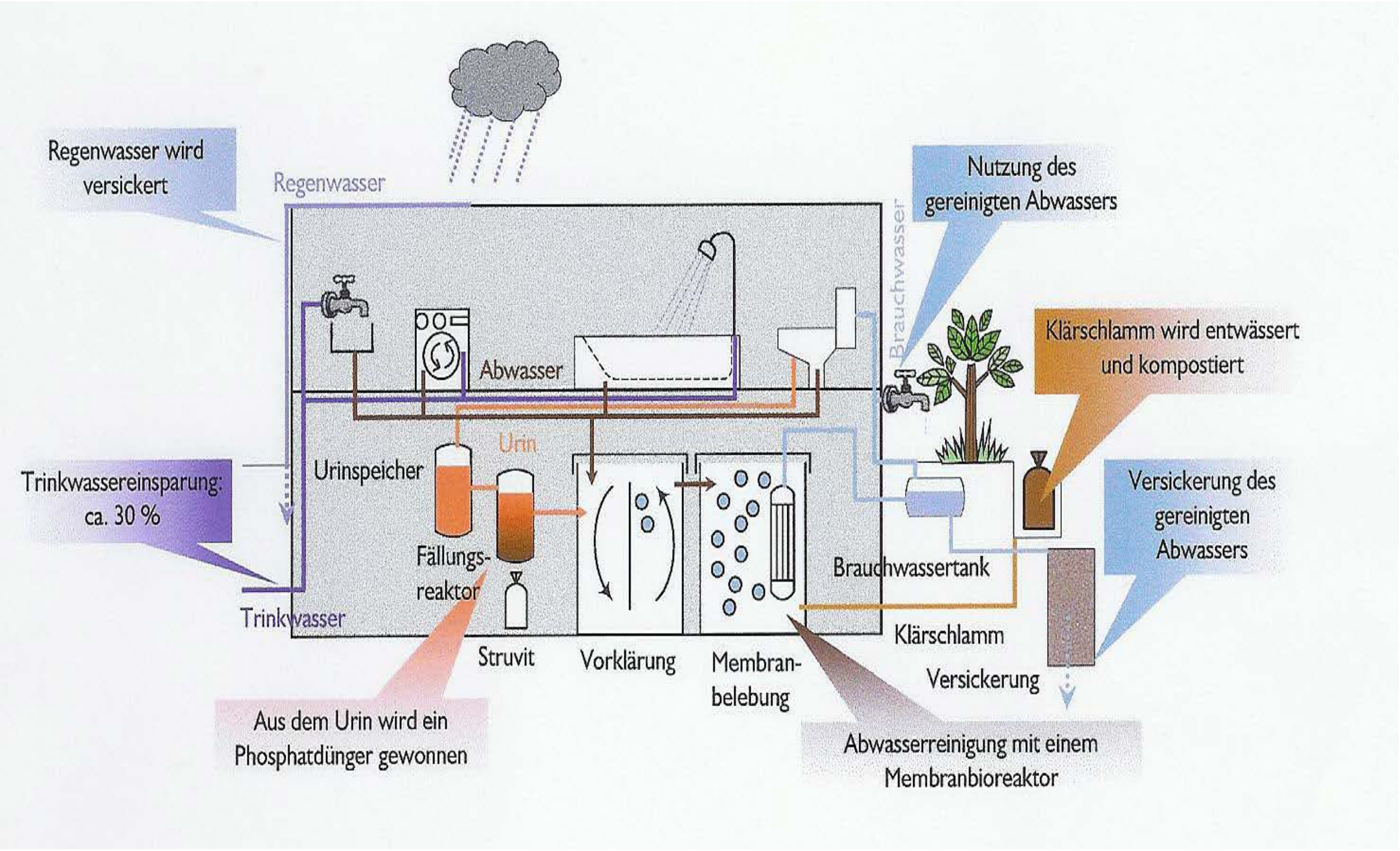
2025: „All manufacturing industries can be totally restructured as we learn to build things from the molecular level”

What Are the Research Objectives in Nano-tech? (CBEN/Rice University and EPA)

- ☞ Remediate/remove organic wastes, TCE, PCB (soil and groundwater), arsenic, lead and mercury
- ☞ Remove contaminants to extreme low levels
- ☞ Upgrade filtration and disinfection
- ☞ Inhibit biofilm formation and reduce biofouling
- ☞ Reduce energy requirements by nano-engineered membranes (e.g. desalination)
- ☞ High-science for the developing world: water purification where power is not available



Zero emission house

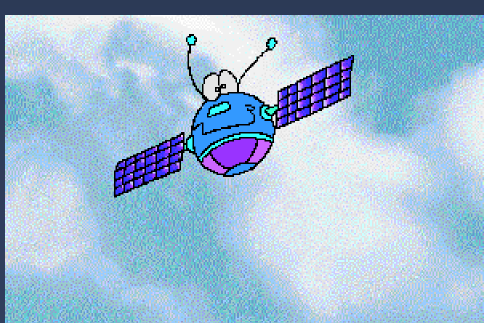


EAWAG, 2004

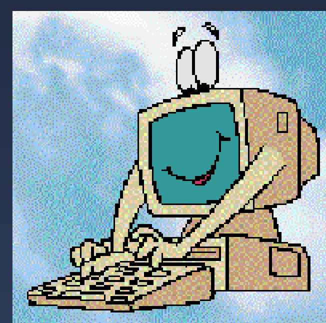
Advanced monitoring and integrated assessments

Distributed measurements

Advanced monitoring

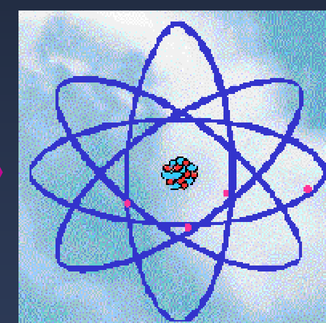


GIS, dynamic models, decision support



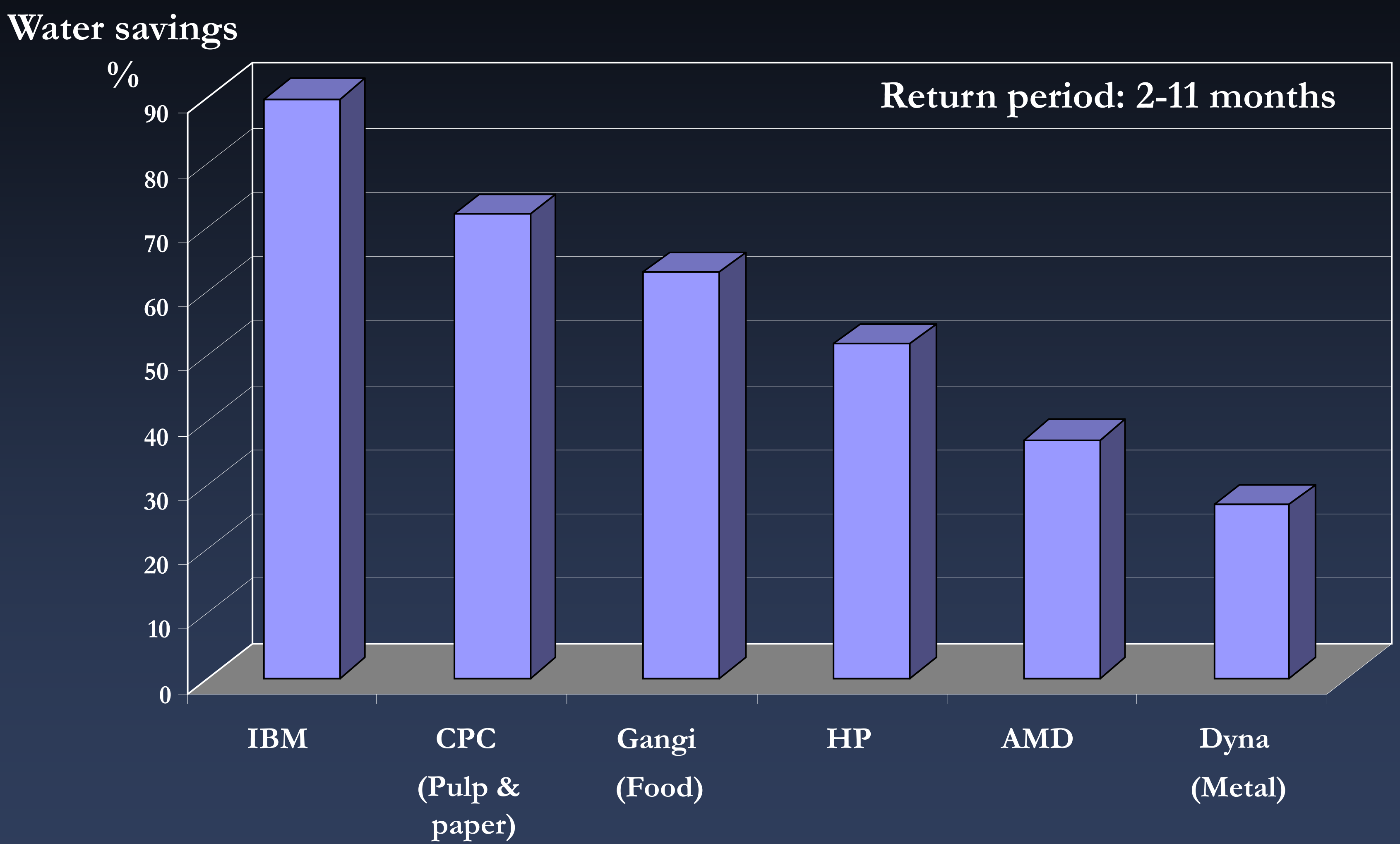
Advanced information technology

Decisions



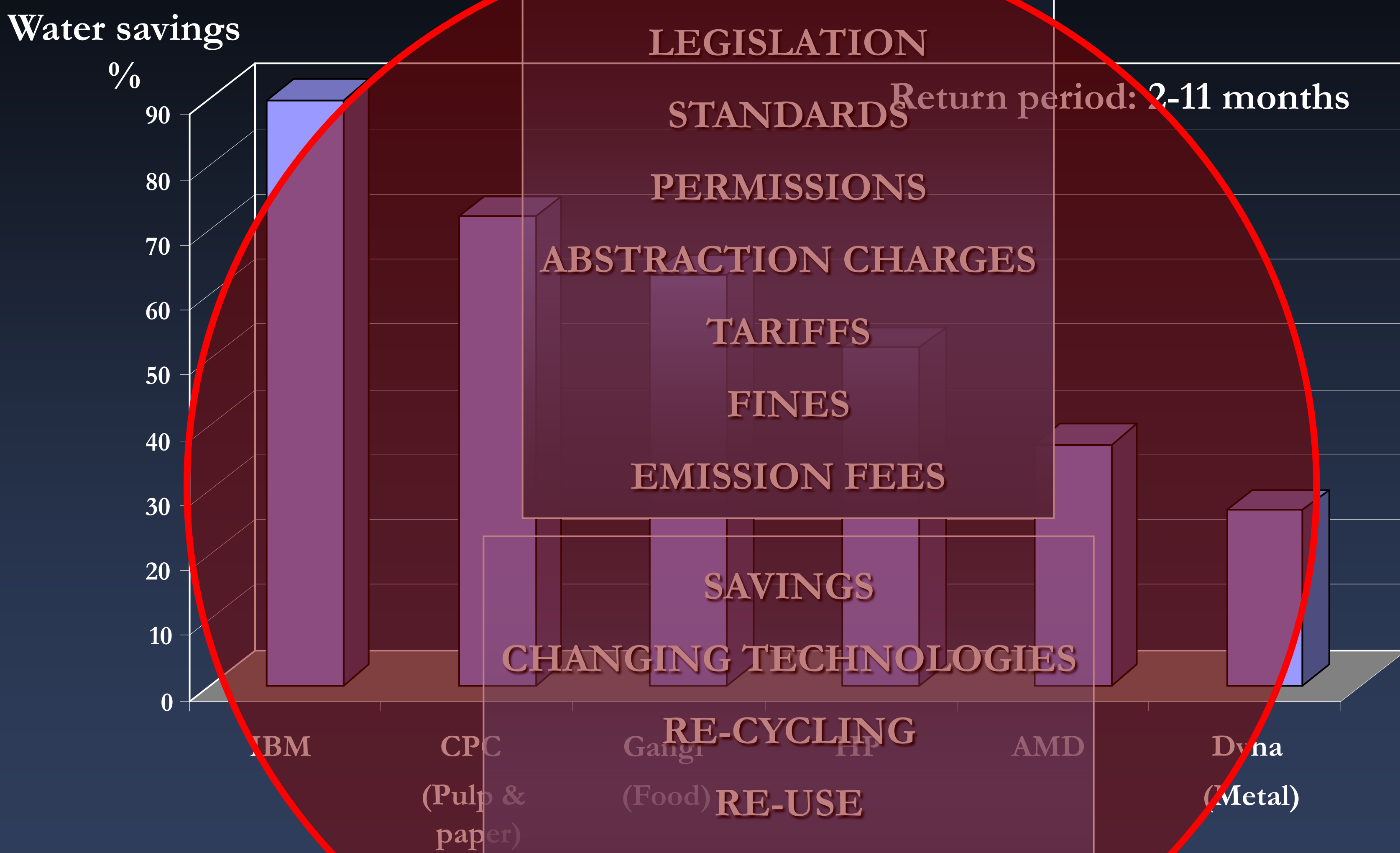
Knowledges, experiences

Industrial water management in California



How?

Industrial water management in California



LEGISLATION

STANDARDS

PERMISSIONS

ABSTRACTION CHARGES

TARIFFS

FINES

EMISSION FEES

SAVINGS

CHANGING TECHNOLOGIES

RE-CYCLING

RE-USE

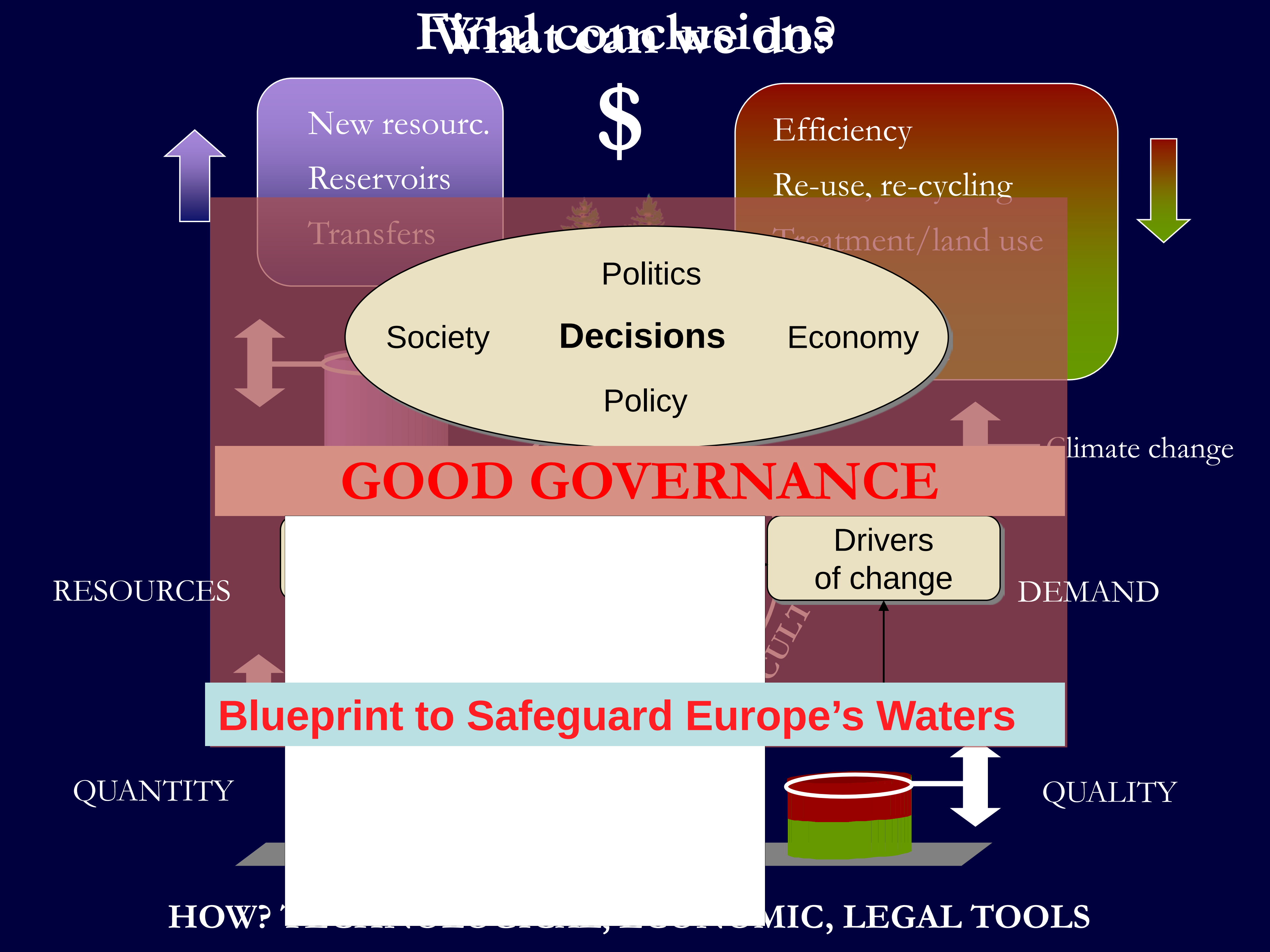
CLOSING CYCLES

How?

DECENTRALIZATION

Technology development
Conclusions (5)

- Huge developments in technologies (monitoring, information, treatment etc.)
- Promising results in bio- and nano-technologies
- High-tech for „cheap" solutions?
- Membrane as chips of water infrastructure?
- Advanced methods in analyses, planning etc.
- Gaps in applications and knowledge transfer



What can we do?
Final conclusions
$
New resourc.
Reservoirs
Transfers
Efficiency
Re-use, re-cycling
Treatment/land use
Politics
Society
Decisions
Economy
Policy
Climate change
GOOD GOVERNANCE
Drivers
of change
RESOURCES
DEMAND
Blueprint to Safeguard Europe's Waters
QUANTITY
QUALITY
HOW? TECHNOLOGICAL, ECONOMIC, LEGAL TOOLS