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Istituto Superiore per la Protezione
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IMPEL
European Union Network for
the Implementation and Enforcement
of Environmental Law

IMPEL Project
Integrated Water Approach & Urban Reuse

EGU General Assembly,
Vienna, Austria
12 April 2018

Genève Farabegoli – *Italian Institute for Environmental Protection and Research*

Anabela Rebelo - *Portuguese Environment Agency*

Francesco Andreotti - *Italian Institute for Environmental Protection and Research*

THE AIMS OF THE PROJECT

Efficient water use

- **Quantity** of water supply/wastewaters
- **Quality** of water supply/wastewaters

Sectors

- **Industrial** - Reuse of water in Industrial Emissions Directive (IED) installations
- **Urban** - Reuse of urban treated wastewaters for beneficial purposes

Aims

- **Guidelines** for practitioners with best practices to promote an efficient water use to ensure compliance of IED and Water Framework Directive (WFD)

THE PROJECT

Integrated Water Approach

Under IED installations

Urban water reuse

Agriculture irrigation

INTEGRATED WATER APPROACH (UNDER IED INSTALLATIONS)

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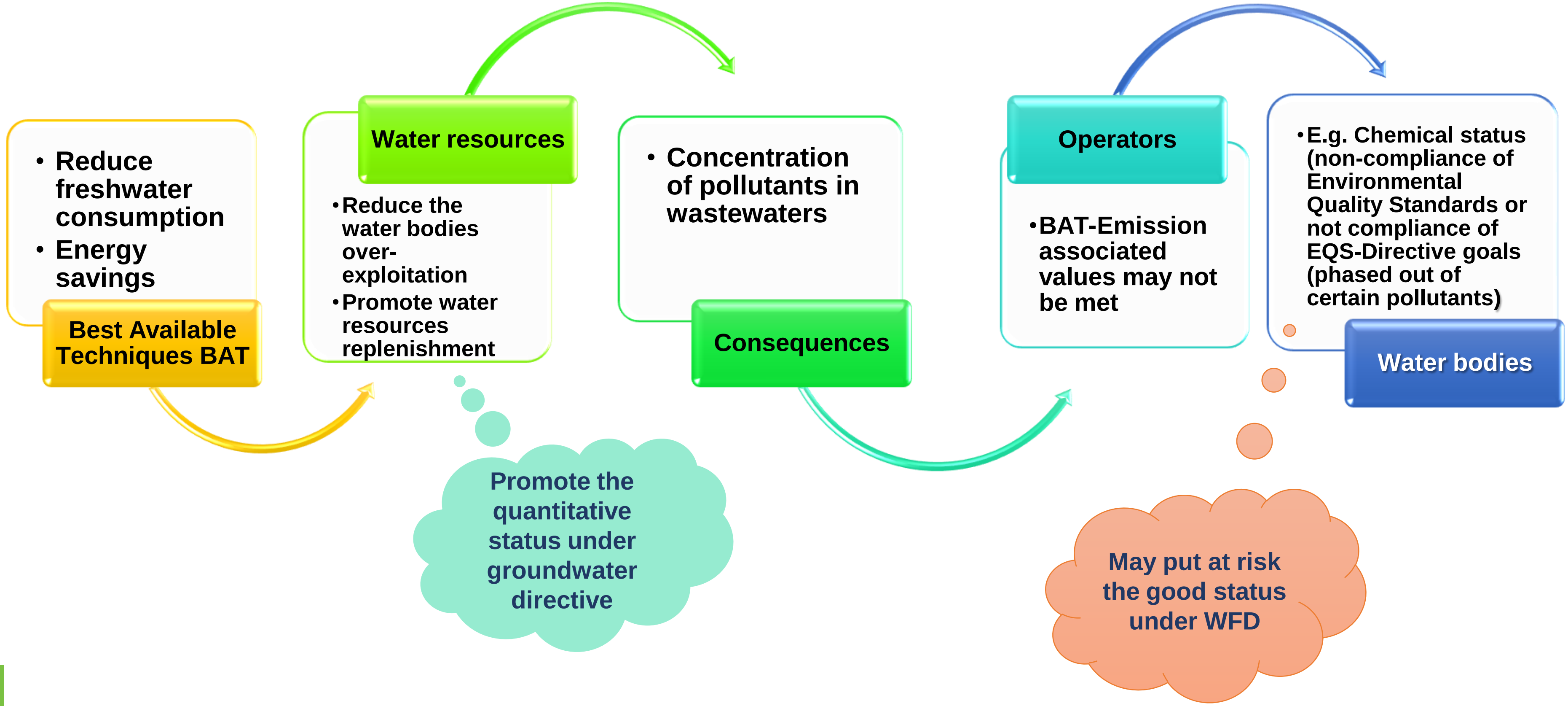
IMPEL

1st Phase 2017

Methodology: Collection of information from questionnaires from environmental authorities and operators

Selection of Case studies: Pulp & Paper and Oil refinery sectors

RESULTS: WATER USE EFFICIENCY



FIRST OUTCOMES (IED INSTALLATIONS – GUIDELINES)

Definition of a checklist for wastewater discharge permit writers to ensure the protection of the receiving water bodies status

Identification of good water management practices (at local and catchment scale) to avoid/to minimize going beyond BAT

2018: INTEGRATED WATER APPROACH UNDER INDUSTRIAL AND URBAN CYCLE

Support ecosystems

Recreational uses

Surface water

Goundwater

Water treatment (according uses and needs)

Water

Water Reuse

Urban use

Agriculture

Industry

other

Wastewater treatment

Wastewater

Thank you for your attention and if you want more information, please come to our presentation:

EGU2018-15617

Integrated Water Approach and Urban Water Reuse

Genève Farabegoli, Anabela Rebelo, Francesco Andreotti

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THE PROJECT

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RESUME

- **Integrated Water Approach (under IED installations)**
  - [Introduction]
  - [Outcomes of the 1st year Project]
  - [Project team]
  - [Methodology - Phase 1]
  - [Methodology - Phase 2]
  - [Methodology - Phase 3]
  - [Responses from the IMPEL members (case studies)]
  - [Responses from the IMPEL members (main findings)]
  - [Principles]
  - [Requirements]
  - [Drivers]
  - [Barriers]

RESUME (CONTINUE)

- Main questions
- Water Use Efficiency
- Emission Limit Values
- Check-List for water discharge permit writers
- Minimize ‘Go beyond BAT’
- Quantity versus Quality
- Solution: Integrated Water Approach under industrial and Urban cycle

INTRODUCTION

- Implementation of EU legislation on water and land is one of the top challenges in recent IMPEL research
- Aims of the project:
  - **1st Year (2017)**
    - **Collecting and comparing the procedures used within Europe** for water resources management and protection in the industry sector
    - Identifying new approaches for **reducing fresh water consumption and innovative technologies for industrial water treatment** able to provide **energy saving, sludge production minimization and water reuse for multiple purposes**
    - Using this information to develop a **guidance document (GL)** to share among IMPEL members and other non-IMPEL participants including for example the IPPC Bureau, European Environmental Agency and industry sector associations
  - **2nd Year (2018)**
    - Application of the previous guidelines to **real cases**

A survey used to collect the information on water management in industry

- **Principles, requirements, drivers and barriers** in the industrial water management sector identified and **case studies/experiences selected**
- **Industrial Emission Directive (IED)** requirements to **Water Framework Directive (WFD)** requirements for industrial water management compared
- **Check list and suggestions for IED permit writers** provided through a guidance document

PROJECT TEAM

- **Experts from several member states:**
  - Geneve Farabegoli, Francesco Andreotti, Alfredo Pini (IT)
  - Anabela Rebelo (PT)
  - Gabriel Dragoi (RO), Vasile Pintilie (RO),
  - Pinar Topkaya (TK)
  - Albert A. Bargués (SP)
  - Darko Blinkov (MK)
  - Peter Šimurka (SK)

METHODOLOGY - PHASE 1

- **A questionnaire divided in 6 different sections:**
  - Section A – General information
  - Section B – Regulation
  - Section C – Plant operational characteristics
  - Section D – Water usage
  - Water source
  - Water reuse
  - Section E – Wastewater treatment
  - Section F – Wastewater discharge

…and was **submitted to water and environmental agencies, industrial operators and associations, MS Competent Authorities**

METHODOLOGY - PHASE 2

Focusing the project and the GL on industrial sectors representing significant environmental issues for water consumption and discharge as well as for water reuse needs: refinery, pulp&paper, textile industry

- Addressing GL to permit writers in order to **set priorities for the permitting system when water management issues could be of major importance**

Including a check-list in the GL in order to specifically address the main water management issues such as water supply, water consumption, water saving, water reuse, wastewater treatment, etc., and suggest priorities to permit writers

- **Recirculating the questionnaire** and request it to be filled in with information, data and descriptions preferably at "case study" level related to the 3 selected sectors

METHODOLOGY - PHASE 3

Questionnaire Tuning:

Sections B and C attain to regulation as well as industry sectors description and here there should be an **overview of the legislation that regulates the field of interest** (sections B and C are basically thought for competent authorities or land planning authorities)

Some of the section B and the whole section C questions could be not applicable if a specific case study has been described

If an individual provides a **case study** (hopefully in the refineries, pulp&paper or textile sector) they are supposed to fill the following sections: A, B1a or B1b, B3, B5, the whole section D and E where applicable, F2 and F3

A representative of a competent authority should be able to answer all the questions

QUESTIONNARIE
31 questions

GL focused on refinery and pulp&paper sectors

Phase 1: 10 Filled Questionnaires from 7 Countries

Phase 3: 14 Filled Questionnaires from 7 Countries (Focus on Case Studies)

RESPONSES FROM THE IMPEL MEMBERS (CASE STUDIES)

- Among the 14 questionnaires 3 were related to the Refinery sector and 3 to the Pulp and Paper sector
- We received only 1 questionnaire related to the Tannery sector and anything from the Textile sector
- Consequently, we decided to focus this GL only on the Refinery and the Pulp & Paper sectors
- The case studies are presented on an anonymous basis

PRESENTATION OF THE CASE STUDIES

Oil Refinery

- Case Study A
- Case Study B
- Case Study C

Pulp & paper

- Case Study D
- Case Study E
- Case Study F

OIL REFINERY SECTOR

CASE STUDY A

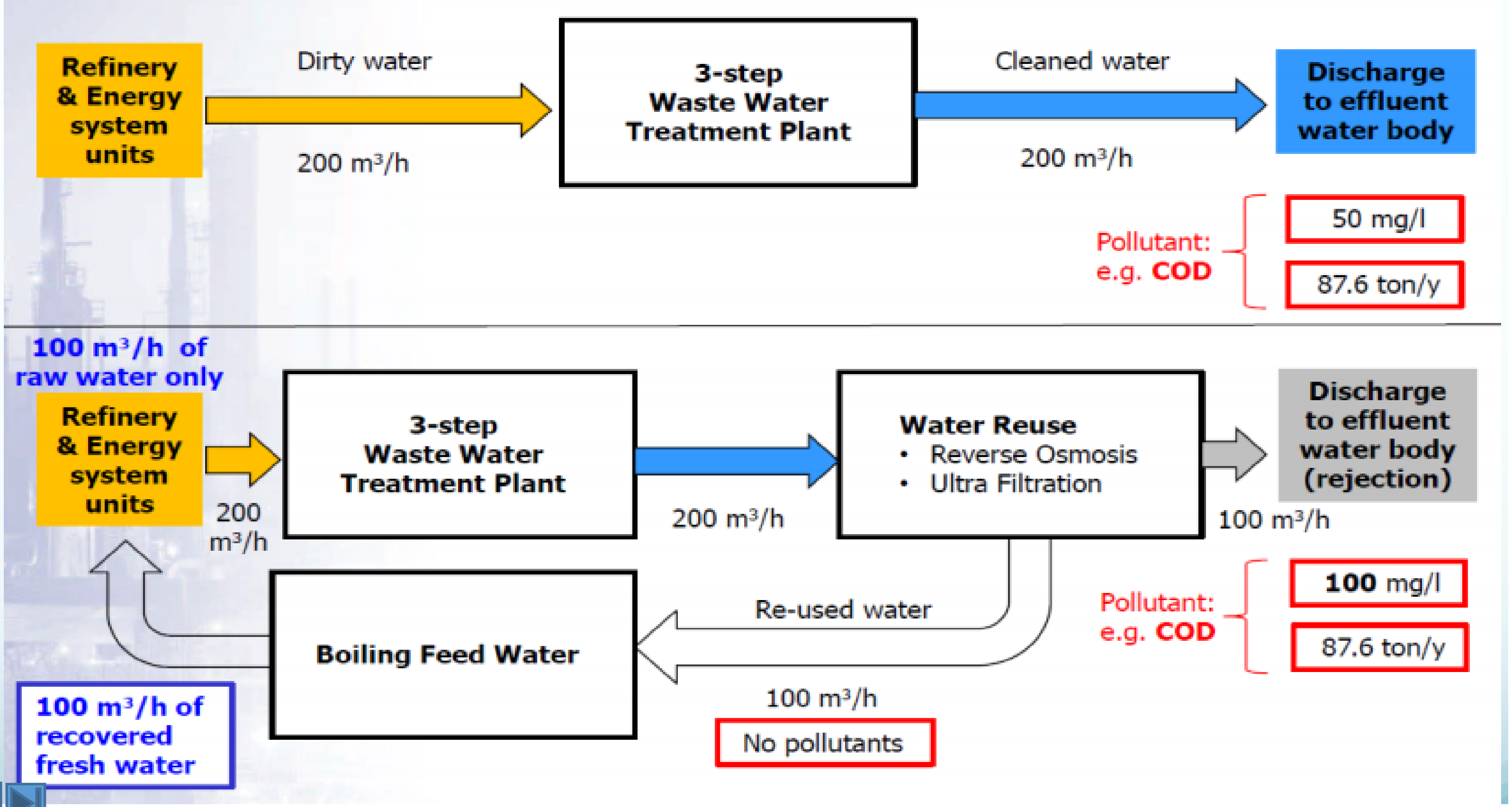
Water Usage

- The average amount of water supplied is 7.750.000 m^3/year of which the higher amount comes from the water pipe network: non potable water (98%) and equally distributed between groundwater (drilled wells/boreholes 42%) and surface water (58%). Water is mainly reused for industrial purpose (47%) and the other amount is discharged after use (53%)
- The industrial wastewater is collected to physical-chemical treatment of 4 step in order to produce process water and boiling feed water. Ion exchange resins, ultrafiltration and reverse osmosis techniques are often used for water reuse and boiling feed water make-up
- Refining sector has often implemented, where feasible, water reuse plants in order to reduce fresh water consumption
- One of the main water loss in the refining sector is the steam losses from process piping/equipment. In order to minimize water losses and save energy, refineries are consistently increasing the amount of recycled water by means of steam condensation recovery from pipes/equipment

Water Reuse

- The Water Reuse permit conditions derives from groundwater remediation prescriptions: the groundwater stream has expected to be treated and totally reused for internal needs
- The Water Reuse approach has then extended to the whole refinery streams after WWTP but before the effluent discharge
- Refining sector often adopts the following main technologies for water reuse:
  - Sand filters
  - Granular active carbons
  - Ion exchange resins
  - Ultrafiltration
  - Reverse osmosis

CASE STUDY A



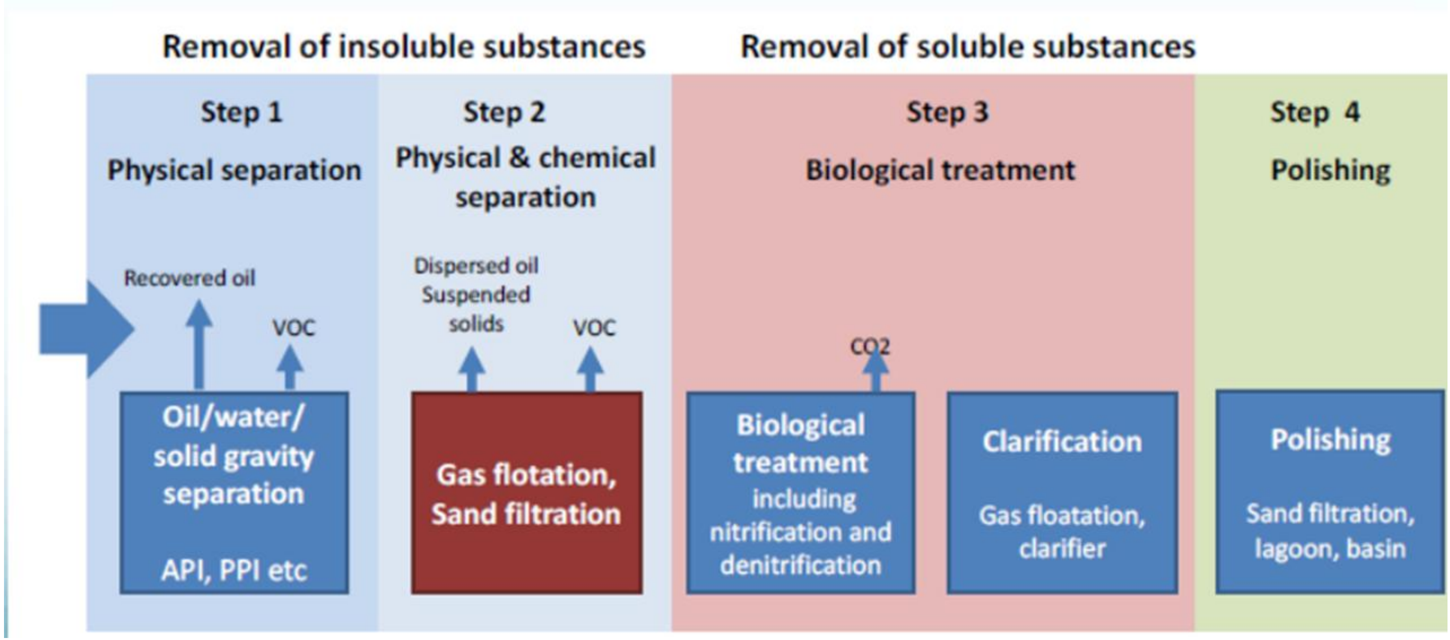
Refinery & Energy system units
Dirty water
200 m³/h
3-step Waste Water Treatment Plant
Cleaned water
200 m³/h
Discharge to effluent water body
Pollutant: e.g. COD
50 mg/l
87.6 ton/y
100 m³/h of raw water only
Refinery & Energy system units
200 m³/h
3-step Waste Water Treatment Plant
200 m³/h
Water Reuse
• Reverse Osmosis
• Ultra Filtration
Discharge to effluent water body (rejection)
100 m³/h
Pollutant: e.g. COD
100 mg/l
87.6 ton/y
Re-used water
100 m³/h
No pollutants
Boiling Feed Water
100 m³/h of recovered fresh water

Wastewater Treatment

- **Refining sector applies the BAT (Best Available Techniques) for Waste Water Treatment Plant (WWTP) which often involves the following main steps:**
  - **Primary treatment: API/PPI separators, IAF/DAF flotation, flocculation, clarification and settling system**
  - **Secondary treatment: active sludges, bio-oxidation, anaerobic, aerobic, nitrification, denitrification treatment**
  - **Tertiary treatment: sand filters + active carbon beds Water Reuse: reverse osmosis + ultrafiltration**
- **All wastewater treatment facilities meet the effluent quality targets required by law before discharging to the receiving water body**
- **The possible use of recovered material from any pre-treatment process is obtained throughout the following treatments:**
  - **Oily slop from API/PPI system has totally recovered as refinery feed that is reprocessed (e.g. Crude Distillation Unit inlet)**
  - **Oily sludge from thickening treatment has totally recovered as waste in order to produce energy by off-site incineration facilities**

CASE STUDY A

- **Flow diagram shows a typical 4-stage WWTP configuration of refineries**



CASE STUDY B

Water Usage

The average amount of water supplied is 6.180.000 m^3/year of which the lower amount comes from the water pipe network of potable water (6 %) and the higher is equally distributed between groundwater (drilled wells/boreholes 47%) and surface water (47%). Water is mainly used for industrial purpose (97%) and only 3% for domestic use	Water treatment is required upstream to any boiler or steam generator and hot water boilers to protect against corrosion and scaling	Water treatment process upstream to boiler or steam generators consist of filtering for iron removal, water softening by ion-exchange resins to remove calcium and magnesium, pre-heating and degasification for removal of dissolved oxygen to prevent corrosion, and additional demineralization with Clayton solution

Approaches implemented for reducing fresh water consumption

- Oil Parks electrical heating instead of steam heating
- High-energy, high-water losses pumps replaced by automated pumps, highly performing, at water stations and at water injection stations
- Old compressors with water-cooling replaced by new compressors with air cooling (or with glycol or hydraulic oil cooling)
- Increase use of desalinated sea water instead of freshwater from public supply, in offshore

Measures adopted for minimizing water losses	**Repairing of facilities with water or steam losses** (e.g. hydrant systems, cooling towers at old compressor stations, water transportation pipelines, steam pipelines at power stations, steam heating lines at oil parks)
	Working points switched from public water network to own water wells, which resulted in reduced water consumption by avoiding water losses from old pipelines

CASE STUDY B

Wastewater treatment

- The description refers to single-installation for produced water and wastewater treatment plant, with physical-chemical and biological treatment stages, with a fourth purification stage on activated carbon
- Physical chemical stage consists in coagulation, flocculation and flotation (Dissolved Air Flotation):
  - Coagulants and flocculants, respectively, are mixed with the produced water stream for improving the separation process of suspended solids and hydrocarbons. The coagulant solution has an acid character. A neutralization facility was not needed, as the alkalinity in the influent is high enough to ensure buffer for the maximum dosing quantity of coagulant
- From the flocculation tank, the wastewater flows by gravity to the Dissolved Air Flotation (DAF) Units. In the DAF units the produced water is clarified. The separation process is enhanced by recirculation and dissolving of compressed air. The suspended solids and oil are accumulated as a scum at the top of the unit, collected and conveyed by gravity to the sludge buffer tank. The clarified produced water flows from each unit, by gravity, directly to the biological stage

CASE STUDY B

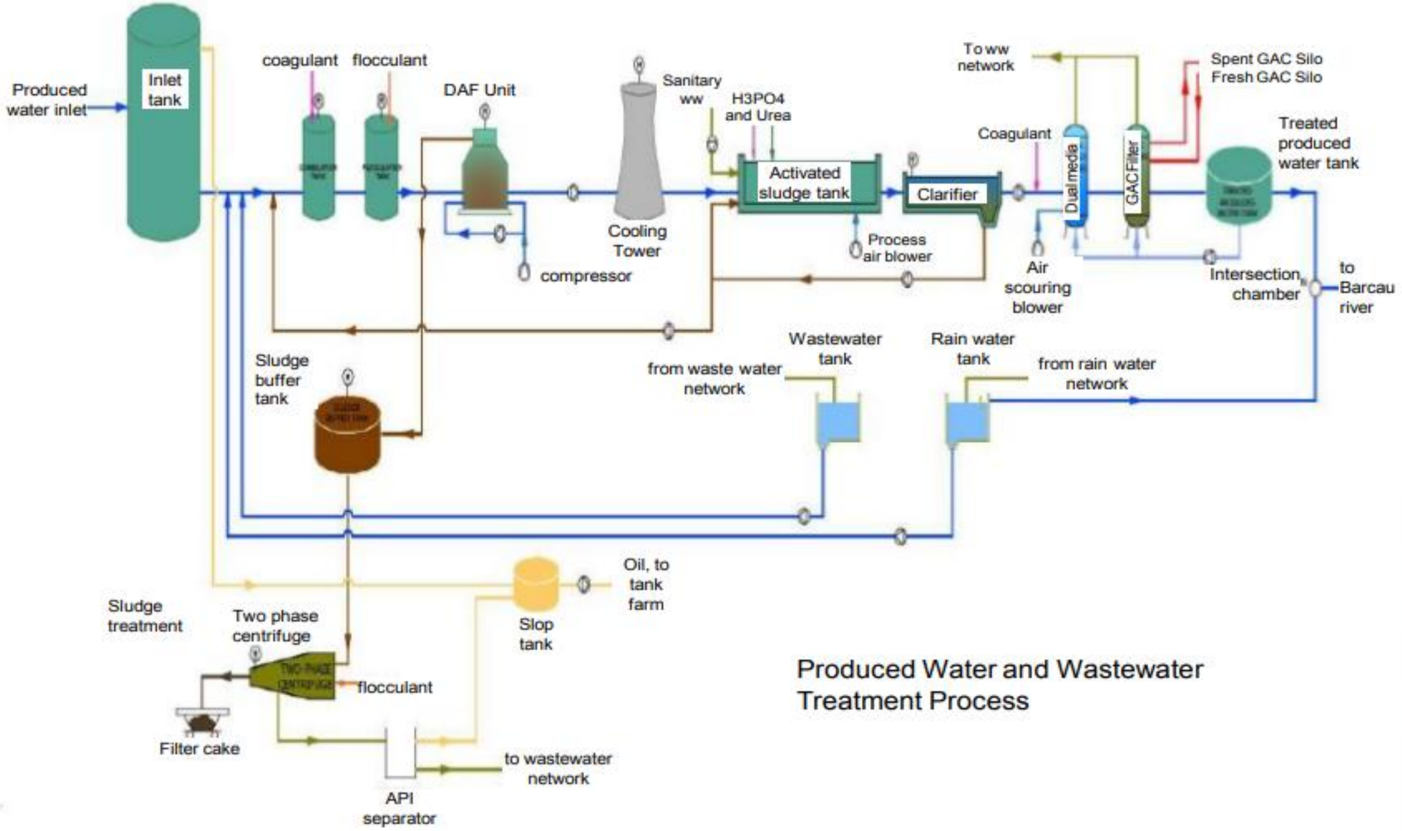
- **Biological stage with activated sludge system for aerobic carbon and nitrogen removal:**
  - **At this stage, carbon is further removed by specific adapted microorganisms working in aerated tanks with air diffuser system and optional nitrogen nutrient dosing for simultaneous nitrification and denitrification. If not sufficient nutrients for biomass growth are available and in order to create the adequate living conditions for the biomass, it is possible to dose urea and phosphoric acid as nitrogen, respectively phosphorus source**
  - **Clarification: After biological treatment, the mixed liquor of produced water and biomass flows by gravity to the downstream clarifiers. The settled sludge is collected by the bottom scrapper system and conveyed to the sludge pit constructed at the inlet of the clarifier. The collected sludge will be recirculated at the inlet of the biological stage, in the admission chamber, with a fixed flowrate. Part of the settled sludge is extracted from the biological system as excess sludge and pumped continuously upstream the coagulation tanks in order**
  - **Dual media filtering: In order to minimize the pollution load to the downstream GAC filters, dual media filters are installed upstream of the GAC final treatment step. The operation is done with pressure which is created by an upstream intermediate pumping station. Before entering the filters, a low quantity of coagulant is added to the produced water for coagulation and hence for improving the separation rates during dual media filtration. While passing the filtration media, the suspended solids are removed and the produced water flow to the last treatment stage – the granulated activated carbon filtration**

CASE STUDY B

The activated carbon adsorption has the goal to reduce the remaining COD and phenol to the required effluent limits. After passing the last treatment stage, the GAC filtered waste water is discharged to the river

Sludge treatment: All the sludge streams collected in the produced water / wastewater treatment plant are thickened in the DAF unit, from where the sludge flows by gravity to the sludge buffer tank. This tank acts as a feed tank for the downstream dewatering facility (two phases centrifuge for liquid – solid separation). In order to enhance the separation in the centrifuge, polyelectrolyte is added to be mixed with the sludge. The separated solids (filter cake) are sent to a container, and then transported for disposal. The liquid phase (oil-water) flows to an API separator where a further separation of the remaining oil takes place. The water flows afterwards directly to the wastewater tank, while the oil phase is sent to the slop oil tank

CASE STUDY B



Produced Water and Wastewater Treatment Process

CASE STUDY C

Water usage

- In this kind of industry the average amount of water supplied is 6.400.000 m^3/year of which the higher amount comes from the water pipe network of non-potable water (99 %) and mainly from surface water (99%). Water is used for industrial purpose (99%) and only 1% for domestic use. The water discharge after use is about 60%

New approaches to reduce fresh water consumption

- Reuse of rainwater in the fire fighting water supply network, minimizing the consumption of raw water for fire training and response to emergencies
- Reuse of process water from the amine units, to be used in desalters, that consequently reduces the consumption of raw water in this unit

CASE STUDY C

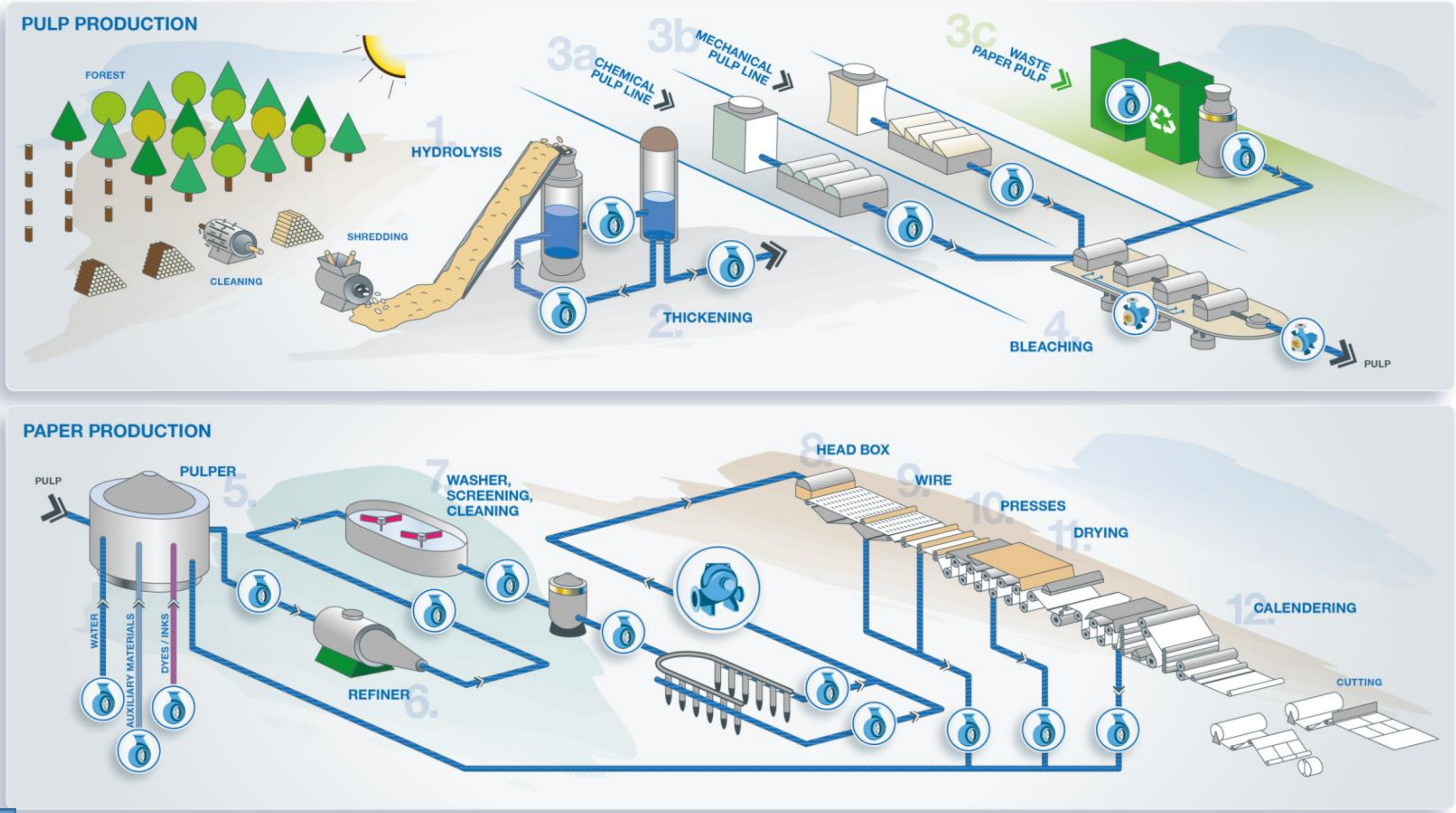
Water Reuse

- The total water reused/recycled in 2016 is 7,4x105 m^3. Improvements for water reuse have been made (e.g. at procedure level), however these improvements cannot be considered as processes/technologies

Wastewater Treatment

- The type of wastewater treatment consists of only pre-treatment at the site, before sending to an external facility for treatment and discharge:
  - Oil-water separation
  - Flotation and oxidation

PULP & PAPER SECTOR



CASE STUDY D

- The average amount of water supplied is 66.059.000 m^3/year of which the higher amount comes from surface water (66%). Water is totall used for industrial purpose (100%). The raw water treatment process consists of:
  - Decantation; Filtration, pH correction
  - Oxidation treatment – chlorination
  - Preparation and dilution of process chemicals
  - Consistency correction
  - Fiber washing

CASE STUDY D

Measures adopted for water losses minimization:

- Optimization of the use of the water resource - Closing of the circuits (ex: bleaching, evaporation, among others)
- Reuse of secondary waters for less demanding process steps
- Increased recovery of live steam condensates
- Modified cooking before bleaching
- High efficiency debarking and washing systems on wood preparation stage; cleaning and closed-circuit screening
- Partial Recirculation of process water through bleaching stages
- Effective spill monitoring and containment including recovery of substances and energy
- Separation, for reuse, of the less contaminated water used in the sealing of vacuum pumps
- Separation, for reuse, of the cooling water of contaminated water from the process
- Reuse of process water in substitution of raw water for recirculation and closure of water circuits
- In-line (partial) treatment of process water to improve its quality to allow recirculation or reuse

Water Usage

- The discharged water is about 97% of the water consumption (surface and underground)
- For the production of industrial process water and softened water required for the manufacturing process, raw water taken from the River is treated differently for its use for technological purposes and for the heating plant
- The raw water is introduced into two slurry decanters. Technological/industrial water is thus obtained
- In order to obtain softened water at the thermal power plant, the company owns a modern, automatic re-alkalinisation plant with softening and chemical conditioning

CASE STUDY E

For wastewater technology, the following categories of measures and techniques for preventing and minimizing emissions to water are applied:

- Measures / techniques BATC - PPI 2014 general and specific for the manufacture of recycled / scrap paper, namely BAT1, BAT2, BAT 42, BAT 5, BAT 43, BAT 44, BAT 10, BAT 13, BAT 14, BAT 15, BAT 16
- Measures / techniques of internal pre-treatment within technological processes
- Sewage treatment techniques in the treatment plant provided with physicochemical and biological treatment steps

CASE STUDY E

Water Reuse

Flotation and water recirculating plant at the paper machine for the manufacture of corrugated cardboard

- **In order to reduce the loss of fibrous material in the corrugated paper machine and to reduce the consumption of fresh water, the fatty water from the process is recycled to the paper machine and the maculation preparation plant, and the excess water in the secondary circuit is sent to the existing flotation system with dissolved air - DAF**

Internal circuit on the toilet paper machine, the fatty streams resulting from the dehydration steps of the paper pulp are used in the phases where dilutions are required and at the maculation preparation plant

Wastewater treatment

- The waste water resulting from the activity is collected through internal sewerage systems in each installation and then taken over by the sewage system (technological, domestic, rainwater) and directed to the sewage treatment plant. The wastewater treatment plant currently operates at a capacity of approx. 150 L/s and has components built and dimensioned adaptable according to the characteristics of the wastewater to be treated. The treatment plant consists of the following steps:

CASE STUDY E

- Wastewater treatment plant: Mechanical cleaning - removing coarse suspensions; Physical-chemical scrubbing with the phases: - dosing of flocculation agents; - sedimentation - removal of sludge; Biological purification with the following phases: - aeration - nutrient dosing -rinse - recirculating sludge
- Sewage treatment plant: 17 reservoirs (2 storage tanks, 3 denitrification tanks, 9 aeration tanks, 3 denitrification tanks) and 5 submersible pumps with grille and flow distributor, aeration system with air diffusers and air timing (4 pieces). Purified waters unite in the collector basin and are then discharged into the River
    - The mixture of primary and biological sludge in excess from the sewage treatment plant is deposited in two storage-discharge towers, where sludge settling occurs, increasing its consistency from approx. 6-8% at ca.9-13%. To achieve optimal settling time, the two storage towers are used intermittently. In order to optimize the settling process, flocculant (polyacrylamide) is dosed on the feeding pipes of the two towers. After chemical treatment with coagulant and flocculant, the sludge mixture is sent to the dewatering, drying and co-incineration plant

Water Usage

The average amount of water supplied is 196.000.000 m^3 year of which the higher amount comes from the water piped network potable water and equally distributed between groundwater (48%) and surface water (52%). Water is used for industrial purpose (100%), the water losses account at 7% for process evaporation during paper drying. The water discharged once used is about 93%	Inlet water is treated, depending on water quality, by grate and filters to remove large object and small particles. In few cases raw inlet water could also be disinfected

Water Reuse

- There are two main technology for treating water for reuse (flotation and biological treatment) but in papermaking there are many different ways and places to reuse it. There are two or three main water loops (white water circuits) and many different places where water is reused (as stock preparation, chemicals dilution, etc.). Fresh water is directly used only where it is strictly necessary
- In this way the partial reuse in the same industry is about 90%
- Water is so relevant for their process that each and any paper mill periodically makes its own analysis of the water circuits and optimization to reduce water consumption and to guarantee paper quality

CASE STUDY F

Wastewater Treatment

- 100% of paper mills have a primary WWTP (chemical- physical)
- 68% of paper mills have a secondary WWTP (aerobic or anaerobic)
- 24% of paper mills have a tertiary WWTP (filtration , ozone, etc.)
- 18% of paper mills send waste water to an external WWTP
- Chemical-physical sludges and biological sludge are used for land reclamation and agriculture (33%), brick and cement industry (8%), other paper mills (8%), other industries (3%)
- Sludges are pressed to remove water before reuse in other processes or sent to landfill. In few cases paper mill are able to reuse their own sludges. In this case sludges are reused directly without any treatment
- However the level of reuse of treated water is already very high (>90%). Water use could not be further reduced without increasing concentration of waste water pollutants
- Discharge mainly occurs in their own WWTP with natural outlet (82%) and in centralized WWTP or urban WWTP with natural outlet (18 %)

RESPONSES FROM THE IMPEL MEMBERS

Main findings

Inhomogeneous transposition of IED and WFD to national legislation	
In different countries different permitting and inspection procedures have been carried out	
The main categories of activities are Energy Industries (EI), Waste Management (WM), chemical Industry (CI) and others where the installations relevant in terms of:	water usage are: EI, CI, others water reuse and saving are: EI, WM, others wastewater discharge are: EI, others

RESPONSES FROM THE IMPEL MEMBERS – MAIN FINDINGS

Water usage:

- reuse in the same industry: 100%
- main technologies for water reuse processes: Bio-oxidation and bio-treatment, carbon and chemical treatment, filtration, settling, ion exchange, membrane separation, precipitation
- selection of the technology due to: process performance, meets requirements and cost
- main motivation for water reuse: cost savings and restricted water supply

The common wastewater treatment with the traditional primary, secondary and tertiary treatment, while innovative technologies implementation is not diffused

The common wastewater discharge is the own WWTP with natural outlet and waste are disposed in landfill

PRINCIPLES

- **Reduction of fresh water use is practiced to save money/save energy and for sustainability reasons**
- **Petroleum industry is definitely aware of the world-wide water shortages and its goal is to prevent critical possible supply restrictions in the future**
- **Petroleum industry is committed to implement environmental and water stewardships and community outreach through the integration of water resource management and risk assessment**

PRINCIPLES

- Reduction of fresh water use is practiced by recycling production waters as is common sense in paper production
- Water is the main “carrier” of the papermaking process. Water consumption minimization is at the center of the attention. There is not a new approach but a continuous fine tuning. Fresh water is directly used only where it is strictly necessary
- Water is so relevant for the process that each and any paper mill periodically makes its own analysis of the water circuits and optimization to reduce water consumption and to guarantee paper quality

REQUIREMENTS

- Italy: the permitting process derives directly from IED+WFD scheme of adoption and the Water Reuse target derives from groundwater remediation prescriptions. The Water Reuse approach is then extended to the whole refinery streams after WWTP but before the effluent discharge.
- Romania: in terms of water resources, any kind of use (abstraction, retention, discharges, etc..) requires permit according to the Water Law. The conditions of use are defined taking into account the requirements of the water resources used, namely the water bodies used as water sources and receivers of waste water discharges.
- Portugal. refineries are under IED and are obliged to comply with water/wastewater requirements; permits and water resources use authorization issued by Portuguese Environment Agency; periodically monitoring and performance report disclosure to this Agency

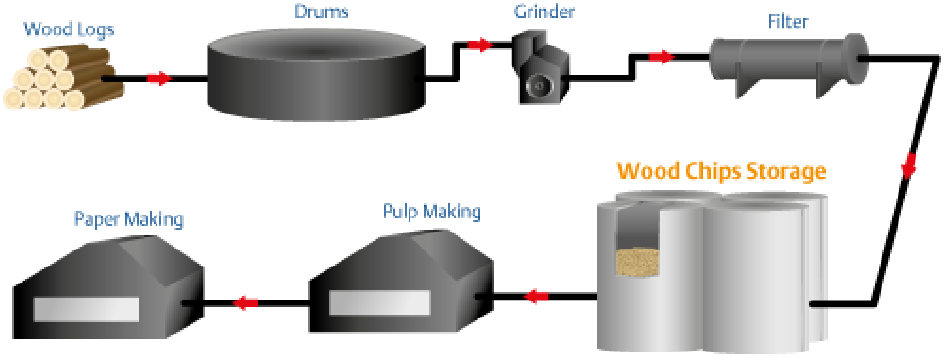
- Generally, effluent treatment targets of pulp and paper processors reflect regulatory requirements mandated by corresponding competent authorities. In some cases, effluent limitations for toxic pollutants are set in the wastewater stream discharged directly from the bleaching process and in the final discharge from the mills.
- Germany: the Authority for Industry approval is responsible for the monitoring and authorization of water authorities for the industry according to the German IED regulation. According to the IED regulation there are special monitoring plans, which go with programs for each wastewater treatment plant. Additionally, requirements of BAT are integrated into amendments of the regulation of sewage.
- Portugal: the companies/members are currently subject to strict environmental control resulting from the application of the IED which obliges them to comply with all requirements applicable. All member companies must follow the WFD in accordance with the guidelines of the river basin management plans of the regions where they are inserted

DRIVERS

- The reduction of fresh water use is a goal for most refineries because is becoming increasingly scarce and the future regulations about water supply will be more and more restricting.
- In Italy, the main driver for reusing water in the refineries is the environmental compensation to comply with permit emission limit values. Another driver is the environmental policy and its sustainability approach.
- In Romania, the main drivers are water reduction targets, water reporting – internal ("HSE Monitor") and external, rising awareness events, as water campaign, annual awards for best performance in water management.
- In Portugal, the wastewater pre-treatment occurs at the site before discharge. The operator has to comply with external entity regulation. This regulation sets discharge values for certain pollutants. The operator is taxed based on these values according to the wastewater quality.

DRIVERS

- **In Germany, the main drivers for reusing water are: Regulatory (state, regional or federal) Compliance: 100 % Cost Savings Corporate Policy**
- **In Portugal, the main drivers for reusing water are: Regulatory (state, regional or federal) Compliance: 100% Cost Savings Corporate Policy**
- **In Italy, the main drivers for reusing water are: Regulatory (state, regional or federal) Compliance: 0 % Cost Savings Corporate Policy**



BARRIERS

- Inconsistent or inadequate water reuse regulations/guidelines
- Inconsistent and unreliable methods for identifying and optimising appropriate wastewater treatment technologies for reuse applications
- Difficulties in specifying and selecting effective monitoring techniques and technologies for the whole system
- Significant challenges in reliably assessing the environmental and public health risk/benefit of water reuse across a range of geographical scales
- Poorly developed business models for water reuse schemes, and markets for reclaimed water
- Low levels of public and government enthusiasm for water reuse
- Limited institutional capacity to formulate and institutionalise recycling and reuse measures
- Lack of financial incentives for reuse schemes

MAIN QUESTIONS

How to ensure that current and future licensing and enforcement activities are both WFD and IED proof?

How to achieve both IED and WFD goals?

RESULTS: WATER USE EFFICIENCY

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IMPEL

European Union Network for the Implementation and Enforcement of Environmental Law

Best Available Techniques BAT

- Reduce freshwater consumption
- Energy savings

Water resources

- Reduce the water bodies over-exploitation
- Promote water resources replenishment

Promote the quantitative status under groundwater directive

Consequences

- Concentration of pollutants in wastewaters

Operators

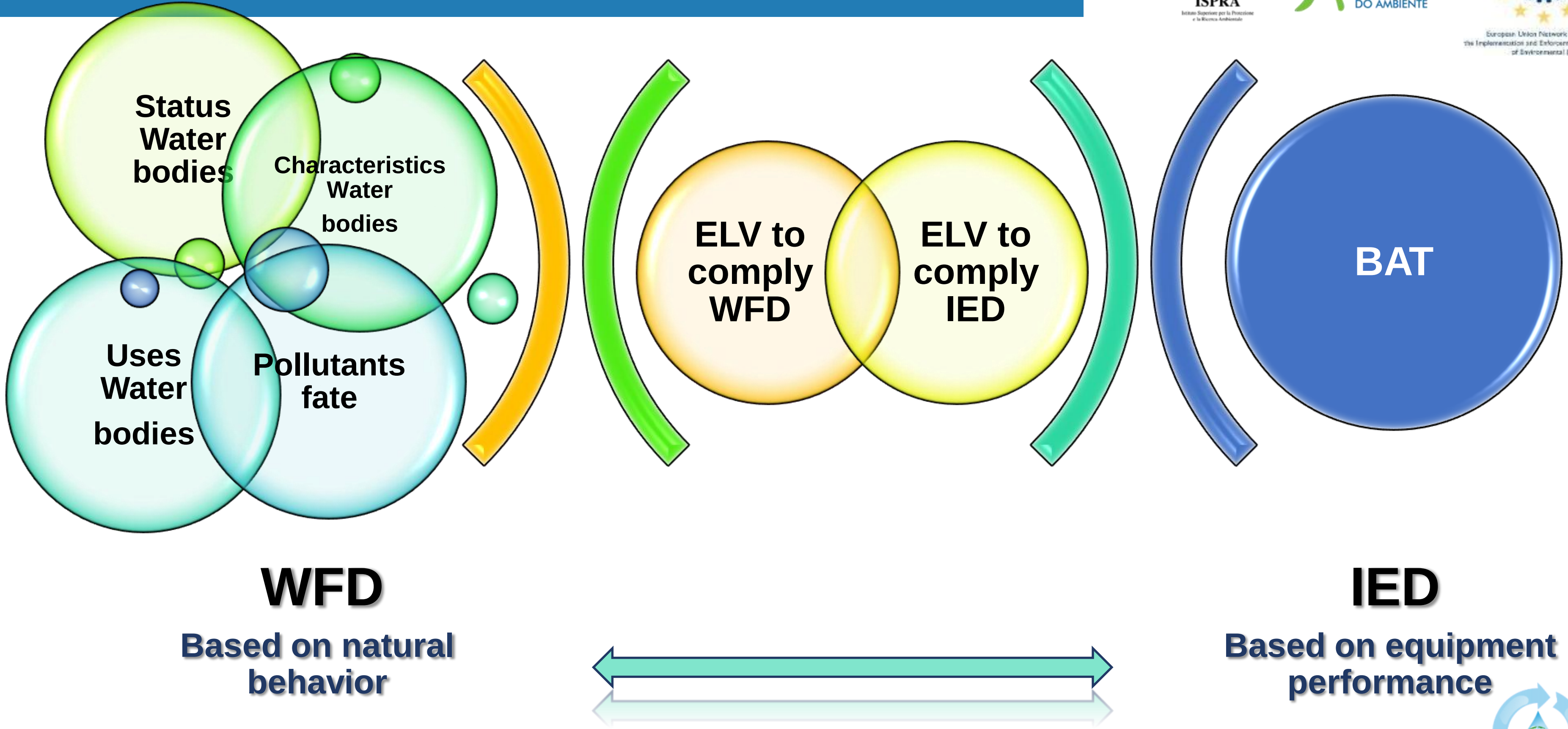
- BAT-Emission associated values may not be met

Water bodies

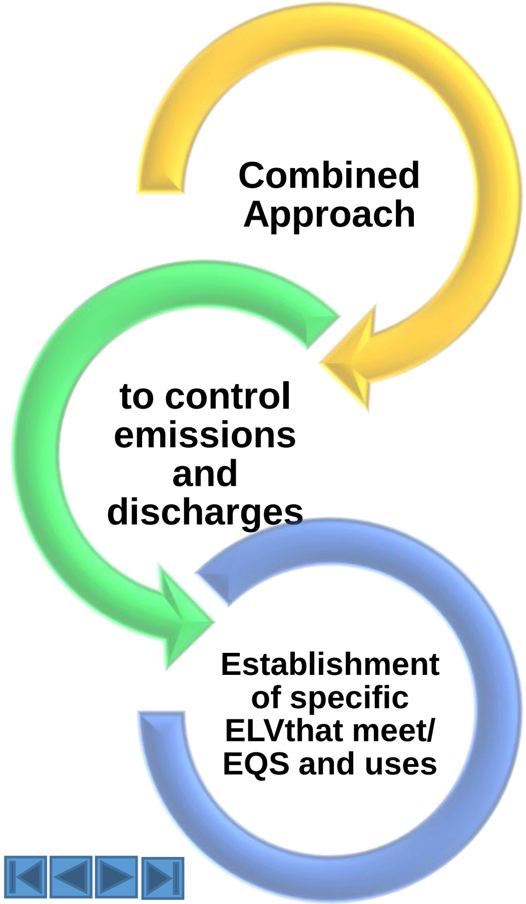
- E.g. Chemical status (non-compliance of Environmental Quality Standards or not compliance of EQS-Directive goals (phased out of certain pollutants)

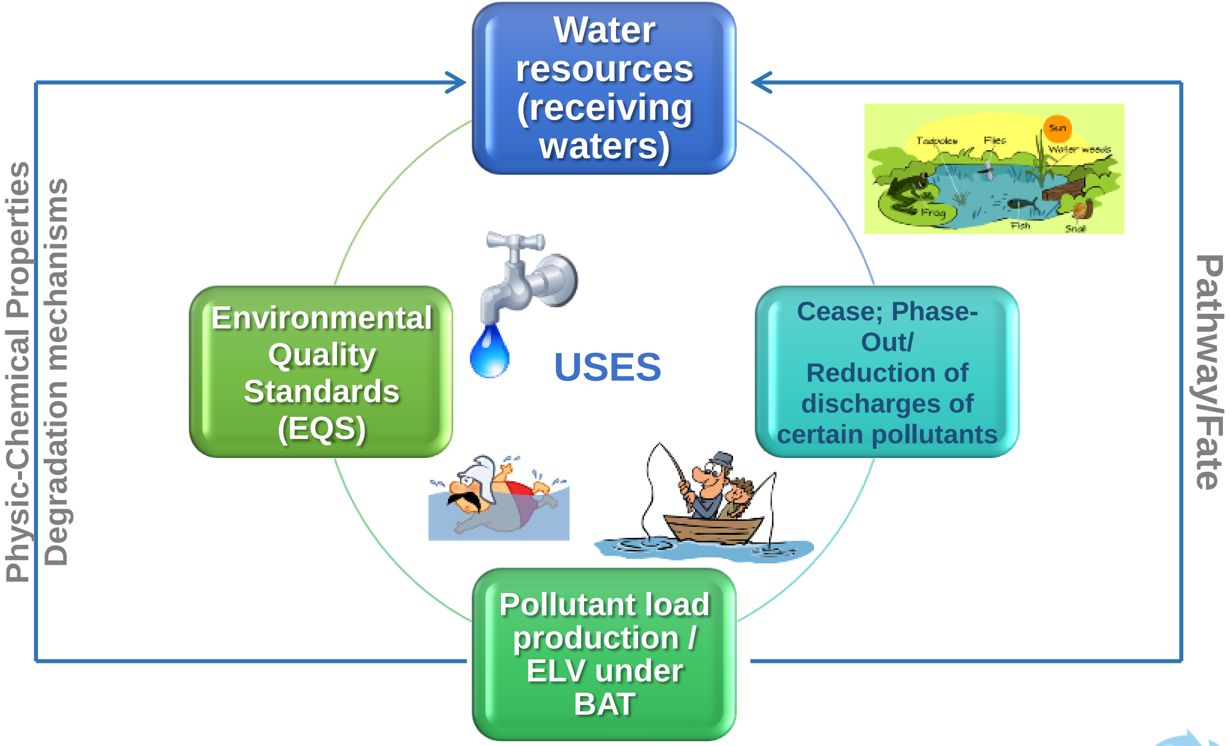
May put at risk the good status under WFD

EMISSION LIMIT VALUES



WASTEWATERS – COMBINED APPROACH (WFD)





RELATIONSHIP

IED

IED operators and regulators need to have accurate information on the objectives of the water Directives in order to make legally robust operational and regulatory decisions

WFD

IED permit conditions need to ensure installations operate so as not to threaten the objectives of the water Directives which may require going ‘beyond’ BAT

Catchment scale

There is significant complexity with multiple sources of pollutants to water (IED and/or non-IED)

Authorities (IED and Water) need accurately to assess the relative importance of the different sources regarding pressures of concern

ELV IN CONCENTRATION VS MASS LOADS

Concentration	• **Average values**: Promotes safety against chronic effects • **Maximum admissible values**: Promotes safety against acute effects
Mass loads per time	• **Average values without maximum admissible values**: Can put the receptors at risk due to the acute effects of some pollutants
Mass loads per units of production	• Do not ensure protection of the receptor water bodies (status and uses may be at risk)

ELV: FLAT VALUES VS FIT-FOR-PURPOSE VALUES

Flat values	Fit-for-purpose values
Are the same for all installations and locations	Ensures protection at local level
Can put at risk water bodies status and surrounding uses	Adequate installation compliance to local level requirements

Checklist

Wastewater discharges

BREF-BAT

Water Status and Uses

CHECK-LIST FOR WATER DISCHARGE PERMIT WRITERS

ISPRA

AGÊNCIA PORTUGUESA DO AMBIENTE

IMPEL

European Union Network for the Implementation and Enforcement of Environmental Law

1. Is the water status of the receiving water body less than good? If no go to the question 5

RBMP

2. If yes, which are the critical parameters for its achievement?

RBMP

3. Do the wastewaters of the installation contribute to the enrichment of the content of this (these) critical parameter(s)? If no go to the question 5.

Project

4. It was (were) defined a BAT–associated emission levels (BAT-AEL) for this (these) parameters on the respective BREF document? If yes, is(are) this(these) value(s) sufficient to contribute for the achievement of the good status? If yes go to question 6.

BREF

CONT.

5.

- **The BREF document defines BAT-AEL that allows the non-deterioration of the water status? If yes go to the question 7.**

BREF

6.

- **Refined Emission Limit Value(s) (ELV) according the need of achievement/maintaining the water good status was(were) defined?**

Water authority +Project

7.

- **The reducing of the water consumption and or promotion of water reuse is an obstacle for the ELV (or BAT-AEL) compliance?**

Project

8. Can a mixing zone be applied?

- 9. If no, is(are) the refined ELV achievable and or affordable? If no, please define a mixing zone.

10. Is there any possibility of discharges integration and or to be taken other measures that increase the dispersion of the discharges in the receiving waters?

- (If the all measures that could be applied to the discharge are not enough to ensure achievable/affordable ELV, then appropriate measures must be taken to reduce discharged loads to not jeopardize the goals for the water body under the WFD requirements.

CONT.

11. Was a monitoring program, upstream (if needed) and downstream, outside the exterior limit of the mixing zone defined? (This program will allow showing that the discharge is not contributing to the deterioration of the quality of the water body).

RESUME OF CHECKLIST (WASTEWATER)

Question 1: NO

Question 5: YES

Question 7: NO

BAT-AEL = ELV

WATER ABSTRACTION

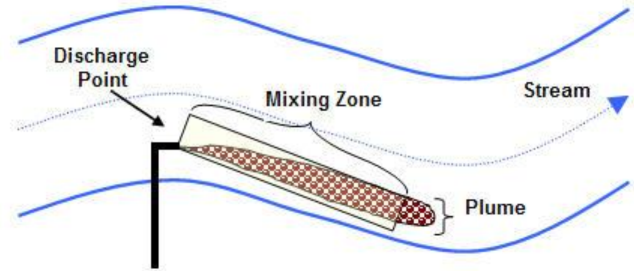
- **12. Regarding the freshwater consumption, is its abstraction contributing for endanger of ecological flows (surface water) or the quantitative status (groundwater). If yes, additional measures are needed to reduce water consumption and in this case return to question 7**

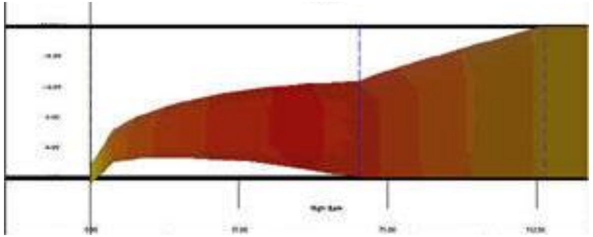
MINIMIZE ‘GO BEYOND BAT’

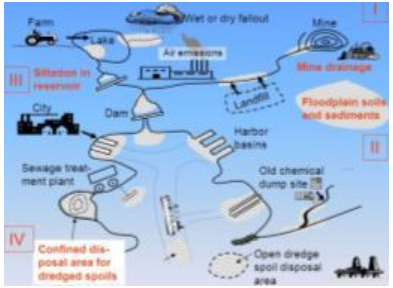
Definition of mixing zones

Promotion of plumes dispersion/ dilution on water resources: Find synergies among processes inside installations or synergies among installations/sectors

Catchment scale approach to find synergies among installations/sectors to reduce impacts on water bodies Downstream/Upstream synergies







QUANTITY VERSUS QUALITY

Freshwater consumption reduction

Water reuse

(intra/inter process/sector)

Quantity

Water use efficiency

Quality

Wastewater discharge management to prevent acute and chronic effects (Promote Good Status)

Discharge management: on-site measures and/or catchment scale measures, mixing zones, plume dispersion measures, fit-for-purpose ELV,

SOLUTION: INTEGRATED WATER APPROACH UNDER INDUSTRIAL AND URBAN CYCLE

Support ecosystems

Recreational uses

Surface water

Goundwater

Water treatment (according uses and needs)

Urban use

Agriculture

Industry

other

Water Reuse

Water

Wastewater treatment

Wastewater

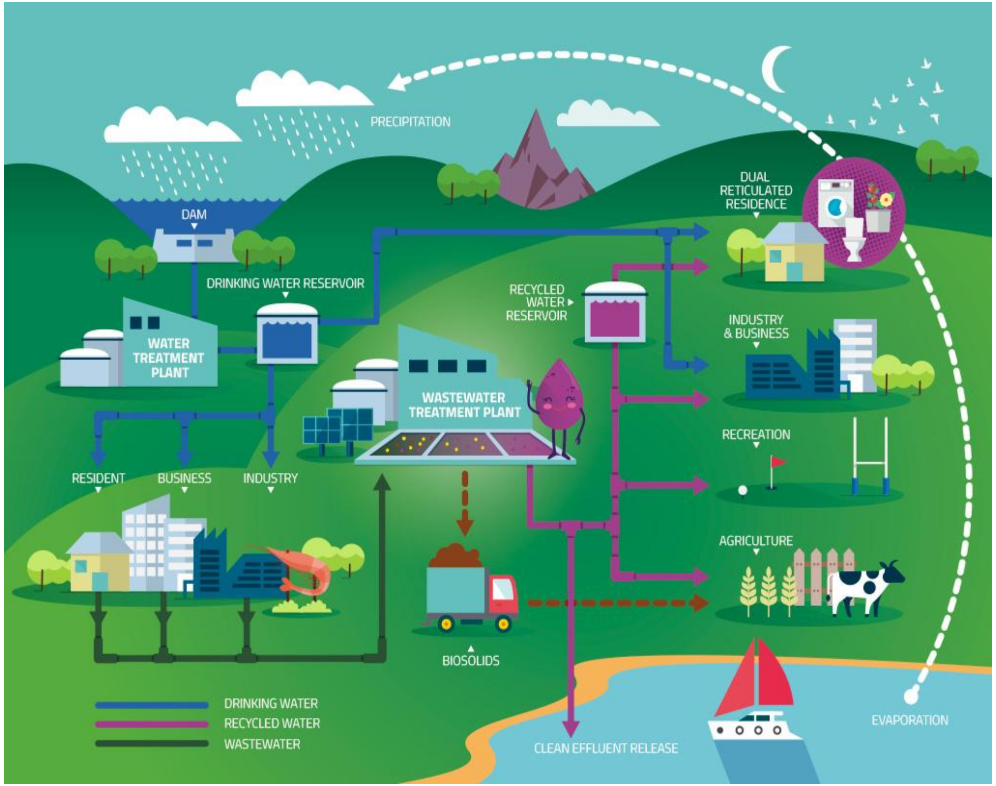
RESUME (URBAN WATER REUSE)

INTRODUCTION

The increasing water scarcity and water pollution control efforts in many countries have made treated municipal and industrial wastewater a suitable economic means of augmenting the existing water supply, especially when compared to expensive alternatives such as desalination or the development of new water sources involving dams and reservoirs

Water reuse makes it possible to close the urban water cycle at a point closer to cities by producing “new water” from municipal wastewater and reducing wastewater discharge to the environment.

WATER REUSE UNDER THE CIRCULAR ECONOMY



Integrated approach: The water cycle should be managed from catchment to consumer, back to catchment

Under the Circular Economy:

- **Considers the consumption and production of resources across this entire value chain, creating synergies within the water cycle for more efficient water management**
- **Promotes:**
  - **A cost-effective management**
  - **The reduction of pressures over waterbodies (e.g. over abstractions and reduces the discharged pollution loads)**
  - **The nutrients recovery**

WATER REUSE IN THE EUROPEAN CONTEXT

- European Commission is developing a legislative proposal for Water Reuse for agriculture irrigation
- Water sources: Treated wastewater under the Urban Treated Wastewater Directive (91/271/EEC)
- Purpose: Agriculture irrigation and managed aquifer recharge
- Are proposed minimum quality standards without jeopardizing a fit-for-purpose approach

WATER REUSE: WHAT DO WE WANT?

Be informed to take well supported decisions?

Live in the ignorance ?

or

AIMS OF THE PROJECT

- This project is an opportunity to learn how water can be used for different purposes (e.g. agriculture irrigation) with the complementary reduction of the direct discharge loads to water resources
- Is intended the exchange of information to identify:
  - Best practices;
  - Safe use approaches;
  - Permitting process among IMPEL members and possible constraints due to the new European legislative proposal
- Development of report aiming the use of water reuse as a tool to achieve the objectives of the Water Framework Directive (WFD) in certain areas

Final Remarks

2017 phase

Oil Refinery / Pulp & Paper (2018)

Urban Water Reuse (2018)

FIRST OUTCOMES (IED INSTALLATIONS – GUIDELINES)

Definition of a checklist for wastewater discharge permit writers to ensure the protection of the receiving water bodies status

Identification of good water management practices (at local and catchment scale) to avoid/to minimize going beyond BAT

PROJECT TEAM (2018)

- **In 2018 the project team as enlarged and IMPEL members involved are:**
  - Italy
  - Portugal
  - Turkey
  - Romania
  - Malta
  - Belgium
  - Ireland
  - Cyprus
  - Latvia
  - Netherlands
  - Austria
  - Slovenia
  - Finland
  - United Kingdom
  - Iceland
  - Republic of Macedonia

FINAL REMARKS

Integrated Water Approach

Enhance the guidelines on industrial water management best practices for two industrial sectors (Oil Refinery and Pulp & Paper) developed in 2017 and test the sectors in practice

Urban Water Reuse

Exchange current best practices with respect to water reuse of treated urban wastewaters for agriculture irrigation purposes

Methodology

Collection of information based on site visits

Thank you for your attention and if you want more information, please come to our presentation:

EGU2018-15617

Integrated Water Approach and Urban Water Reuse

Genève Farabegoli, Anabela Rebelo, Francesco Andreotti