# IMPEL Project
# "Integrated Water Approach & Water Reuse" (phase 2)

**1st Project meeting**
**Apeldoorn, NL**
**27-28th June 2019**

***Genève Farabegoli*** *– Italian Institute for Environmental Protection and Research*
***Anabela Rebelo*** *- Portuguese Environment Agency*

# YEAR 2017 – Project Team

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# YEAR 2017 – Project Team

First Project Meeting in Rome (Italy)

Second Project Meeting in Coimbra (Portugal)

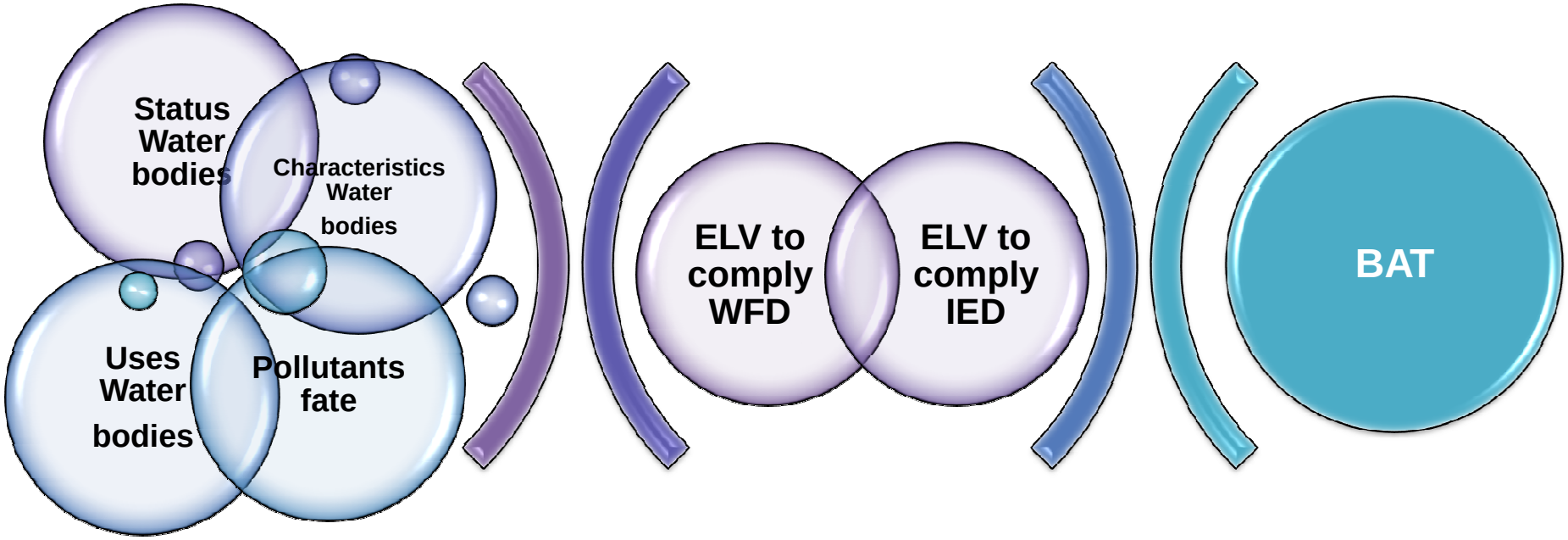
Final Workshop in Rome (Italy)

# Outcomes of the project year 2017

## 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

# Emission Limit Values




**WFD**

**Based on natural behavior**

**IED**

**Based on equipment performance**

# Check-List for water discharge permit writers

# Checklist

## Wastewater discharges

## BREF-BAT

## Water Status and Uses

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# YEAR 2018 - Working Group 1 (WG1)

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Stuart Gunput (NL)
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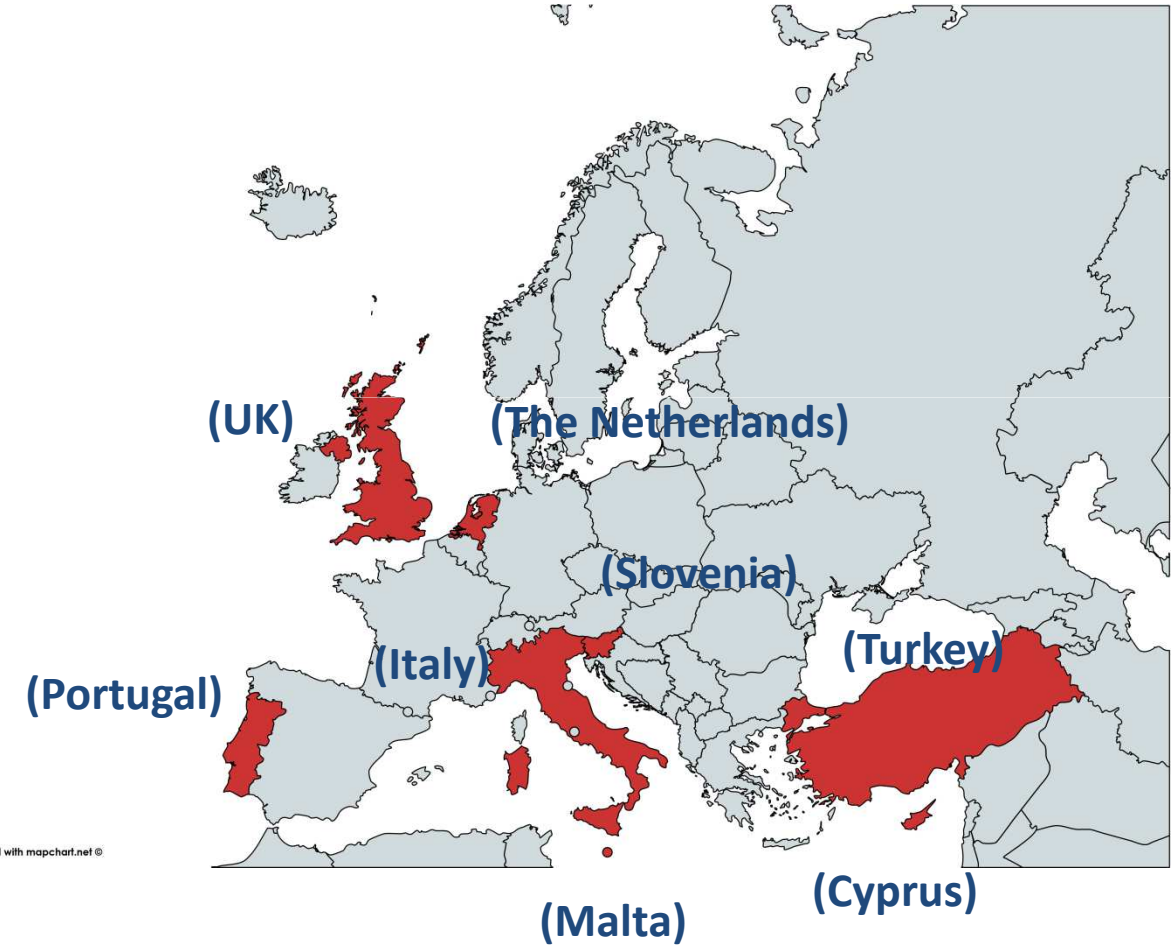

# YEAR 2018 - Working Group 2 (WG2)

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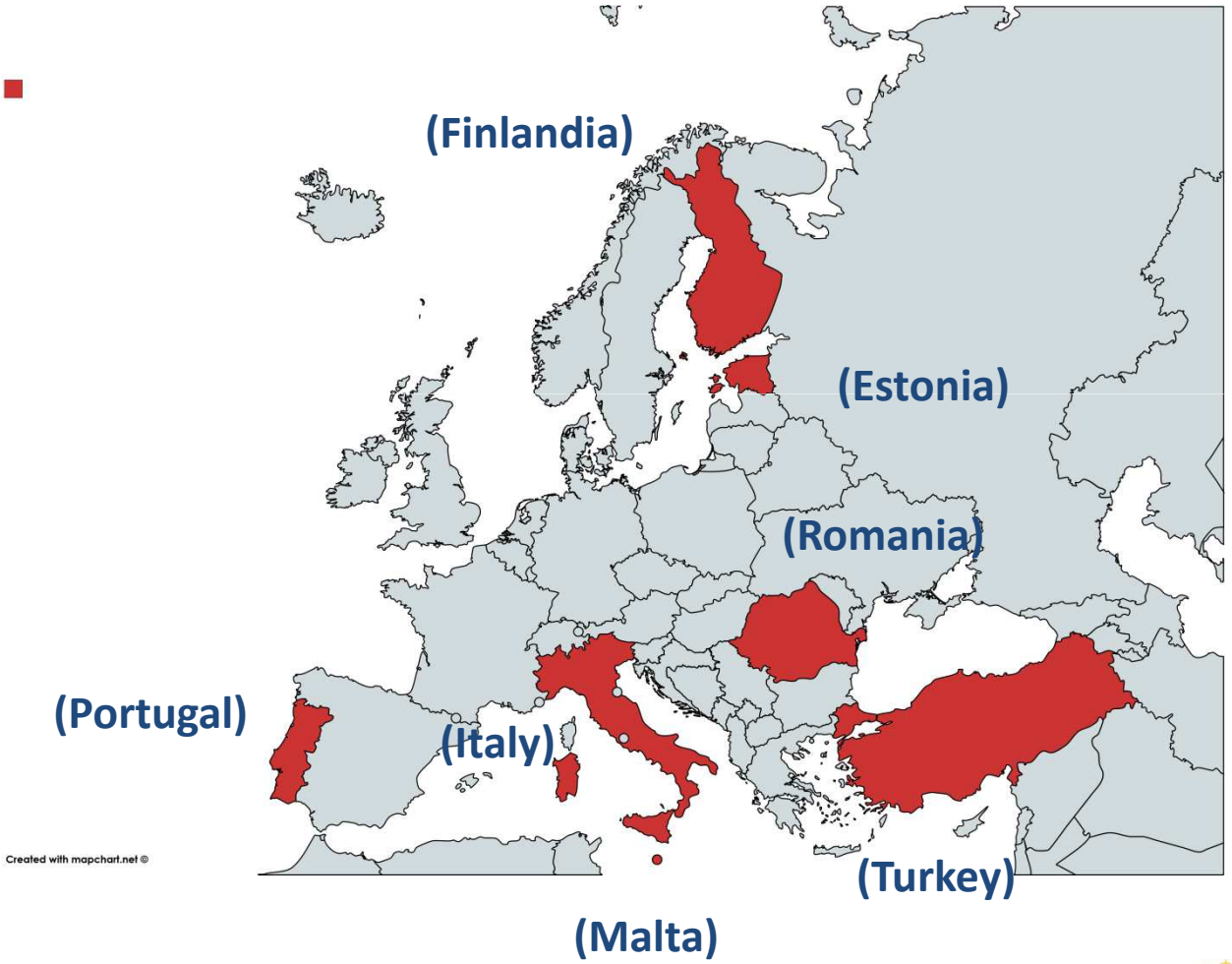

# YEAR 2018 - IWA&UWR Project meetings

**WG1** in Malta in May 2018 meeting & site visit to a wastewater treatment and polishing plant


**WG2** in Portugal in June 2018 meeting & site visit to Oil refinery in Porto and a Pulp & paper factory in Coimbra

# IWA&UWR WG2 Results

**WG2 Subgroup:** focus on the industrial reuse of wastewaters

**Development of a check-list to help permit writers** for wastewater discharges, that allows to verify the needs of going beyond Best Available Technologies (BAT) to not put at risk the receiving water bodies status.

**Case study:** Pulp mill for the production of bleached kraft located near a river bank

**Context:** water body status less than good, in 2017 a severe drought decreased significantly the water flow in the river and the effects of the treated wastewater discharges negatively affected the receiving water body quality.

# Case study description

The pulp mill is an **IED installation** and the respective environmental permit had attached a wastewater discharge permit with Emission Limit Values (ELV) supported exclusively on the BAT reference documents, namely on the emission levels associated with the use of BAT (BAT-AEL).

**Wastewater treatment plant:** a conventional biological treatment without additional nutrients removal.

| Parameter | ELV |
|---|---|
| pH | 6-9 |
| TSS | 1,05 kg/ADt |
| COD | 14,5 kg/ADt |
| $BOD_5$ | 2,5 kg/ADt |
| TN | 0,175 kg/ADt |
| TP | 0,02 kg/ADt |

The compliance of these values was accessed as *yearly average*, according the respective BREF.

ADt - Air Dry tonnes (of pulp) expressed as 90 % dryness.

# Application of Check-List

| A. Wastewater discharge assessment: | |
|---|---|
| 1. Is the water status of the receiving water body less than good? | Yes |
| 2. Define which are the critical parameters for water body status achievement | Dissolved oxygen |
| 3. Do the wastewaters of the installation contribute to the enrichment of the content of this (these) critical parameter(s)? | Yes |
| 4. Was (were) defined a BAT–associated emission levels (BAT-AEL) for this (these) parameters on the respective BREF document? | Yes |
| 4.a Is(are) this(these) value(s) sufficient to contribute for the achievement of the good status? | No |
| 6. Can an appropriate Emission Limit Value(s) (ELV) adjusted to the local conditions be defined, according the need of achievement/maintaining the water good status? | Yes |
| 7. Is the appropriate ELV, adjusted to the local conditions, achievable and/or affordable? | Yes |
| 7.b Is a mixing zone advisable? | Yes |
| 7.a Can a mixing zone be applied ? | Yes |
| 8. Was a monitoring program, upstream and downstream (outside the exterior limit of the mixing zone, when applicable) defined? (This program will allow to see that the discharge is not contributing to the deterioration of the quality of the water body). | Yes |

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# Application of Check-List

| B. Freshwater consumption assessment: | |
|---|---|
| 12. Regarding the freshwater consumption, is its abstraction contributing for endanger of ecological flows (surface water) or the quantitative status (groundwater)? | Yes (surface water) |
| 12.a Define additional measures are needed to reduce water consumption | Several measures, including internal reuse of specific wastewater streams, are already in place to reduce water consumption per ton of dry pulp produced |
| 5. Is the reducing of the water consumption and/or promotion of water reuse an obstacle for the ELV (or BAT-AEL) compliance? | Yes (Return to question 6) |

| Result: |
|---|
| Deliver wastewater discharge permit and assess water body quality evolution through the monitoring results. |

Application of the check-list → need of the definition of adjusted ELV.

A **new permit** was delivered with appropriate ELV.

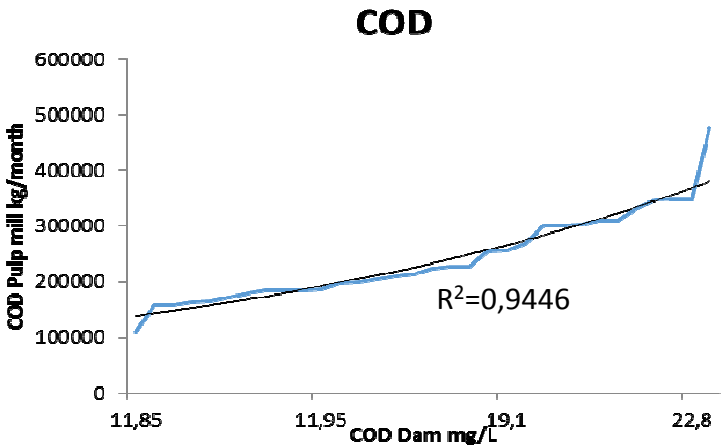
WWTP upgraded from a conventional biological treatment to a membrane bioreactor (MBR) system with ultra-filtration.

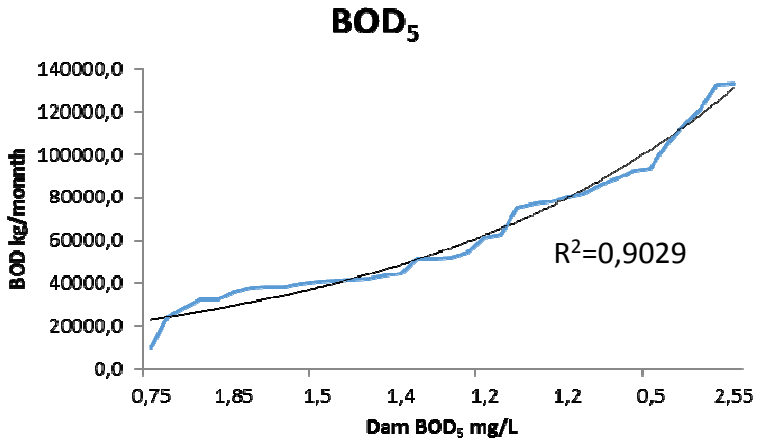
# Methodology

**Time period evaluated:** from 2012 to 2017

**Data:** Self-monitoring data from the installation + data from the water body (monitoring plan at the dam)

**Model**: Non-linear regression model. For the parameters COD, $BOD_5$, Nt and Pt a strong correlation (correlation coefficient, R superior to 0,70) was found, when data from discharges and from the water body was ordered by its magnitude

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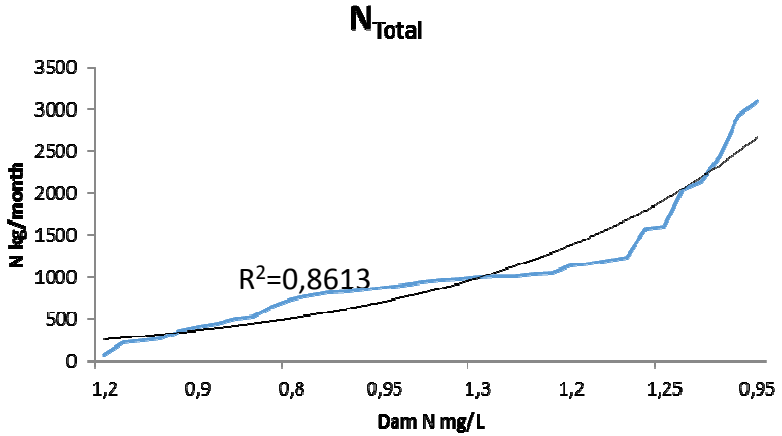
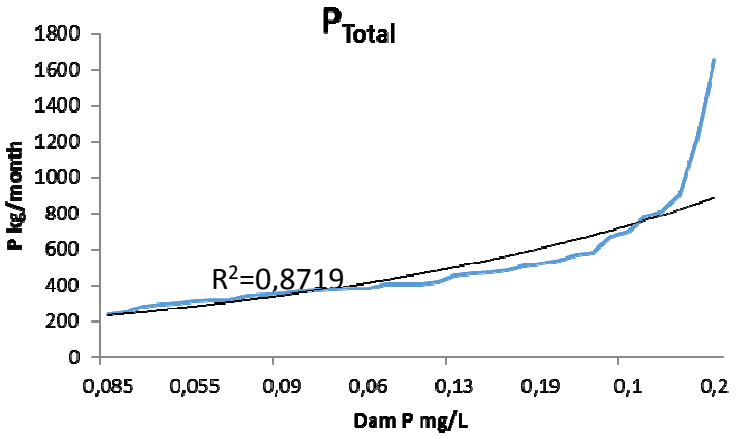
# Methodology




Final ELV were derived by the direct use of the mathematical expression of the respective regression model and refined according results from a surface water quality modelling exercise using the **model QUAL2.**

# New appropriate ELV

## TYPES OF ELV AND COMPLIANCE RULES – CASE STUDY: PULP MILL

**3 levels of ELV were defined:**

- Wet season (from 1st of October to 30th of April)
- Dry season (from 1st of May to 30th of September)
- Unusual conditions (e.g., severe droughts, low level of dissolved oxygen in the surface water…)

For each period, 3 ELV with specific goals were also defined:

| Type of ELV | Goal | Compliance Rule |
|---|---|---|
| **Punctual concentrations in mg $L^{-1}$** | Protection against acute effects over the water body (e.g. quick depletion of oxygen) | No grab sample can exceed this ELV |
| **Daily mass loads in kg/d** | Protection against chronic effects (increasing of nutrients in water body) | In 52 composite samples/year is allowed a maximum of five above this ELV, but not in samples collected during the same season |
| **Yearly averages in kg/ADt** | Compliance of BAT-AEL | Yearly average cannot exceed this ELV |

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# Final Remarks

**Conclusions**: This case study allows to validate the importance of definition of discharge permits that are simultaneously WFD and IED proof.

Wastewater streams intra and inter installation should be properly assessed to find matching uses that not compromise the quality of the discharged waters. This could present an **opportunity to a better closure of the loop of the water use.**

A comprehensive understand how water use can be integrated and managed inside and outside industries, taking into account several descriptors, such as reduction of water consumption, energy balance, $CO_2$ emissions, quality of discharged treated wastewaters and quality and status of the present water bodies, i.e., surface and ground waters, will support a **better transition to the circular economy**.

# YEAR 2019 - Working Group

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Ronald Van Tunen (NL)
Stuart Gunput (NL)

# YEAR 2019 – Project Team


First Project Meeting and site visit
in Apeldoorn (The Netherlands)

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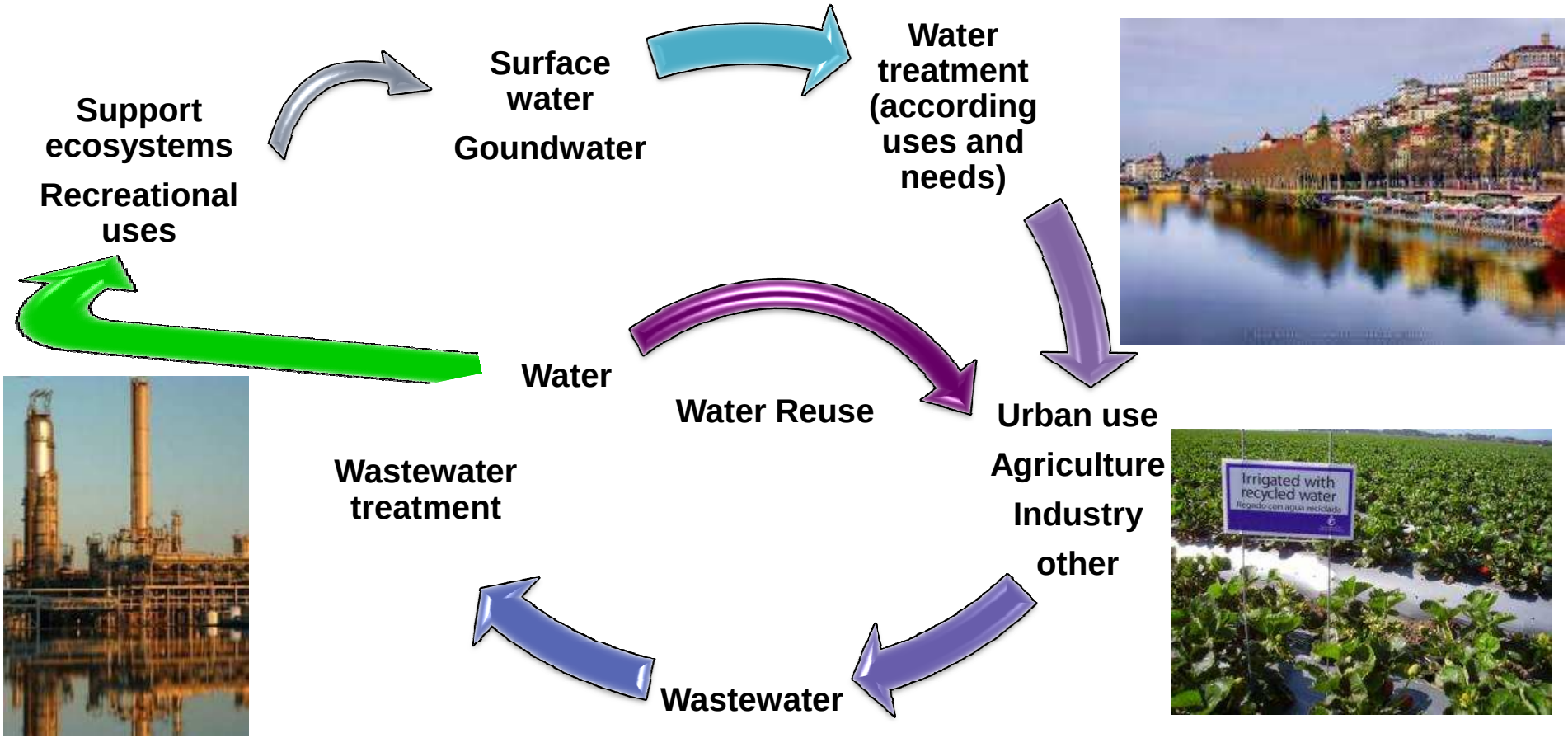
# New vision: Integrated Water Approach under industrial and urban cycle

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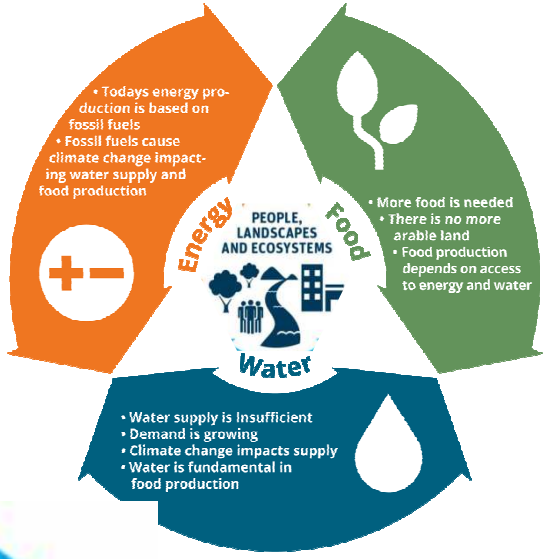
# Water & Circular Economy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# Project 2019 Aims

**Use 2017-2018 results to find best practices on water use cycle, including water reuse at industrial and urban level, that promote a more realistic transition to the circular economy**

**Improving professional training, spreading knowledge and provide compliance assurance in rural areas as required for the implementation of the ECA 9-point Action Plan (Environmental Compliance Assurance)**

**At industrial level is intended to access the water use inside recycling activities to develop a new indicator combining quality and quantity**

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# Examples of key factors

- Basin archetype characteristics
  - Water reuse as a key measure in arid lower plains
  - Low benefit for water reuse in lush green middle plains
  - Energy extraction as a key measure in upper highlands
- Biodiversity
  - Promotion of water reuse with negative impacts on biodiversity (water quality index)
  - Promotion of water reuse without negative impacts on biodiversity (water quality index)
  - Promotion of water reuse with positive impacts on biodiversity (water quality index)
- Freshwater consumption
  - Measures to reduce consumption without linking any impacts on the quality of wastewaters
  - Measures to reduce consumption with measures to reduce possible effects of effluents concentration

- Wastewater discharges
  - Compliance of BREF-ELV without link to the WFD
    - Situations where BREF-ELV can be equal to ELV, according check-list
    - Situations where ELV needs to be lower than BREF-ELV, according check-list
  - Compliance of ELV (ELV defined according WFD principles)
- Water Reuse
  - Promotion of water reuse with negative impacts on final concentration of the wastewaters discharged
  - Promotion of water reuse without negative impacts on final concentration of the wastewaters discharged
  - Promotion of water reuse with positive impacts on final concentration of the wastewaters discharged

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# Examples of key factors

- Recovery of nutrients
  - Removal of nutrients to prevent negative effects on water bodies without further nutrient uses
  - Removal of nutrients to prevent negative effects on water bodies with further nutrient uses
  - Just recovery of nutrients for further uses (without influence on water bodies)
- Energy consumption
  - Reduction of conventional sources by the use of reusable energies
  - Direct reduction of energy Consumption
- Technologies
  - Use of lower level than BAT
  - Use of BAT
  - Use of new technologies (go beyond BAT, wth promotion of new developments)
- Sludge
  - Minimization of sludge production, bio-thermal energy production from anaerobic digestion and reuse of treated sludge from aerobic digestion without impacts on final concentration of the wastewaters discharged

- Sludge
  - Minimization of sludge production, bio-thermal energy production from anaerobic digestion and reuse of treated sludge from aerobic digestion with impacts on final concentration of the wastewaters discharged
- Emission of $CO_2$
  - Promotion of management solutions to reduce $CO_2$ emissions
  - Use of management solutions without taking into account the $CO_2$ emissions
- Wastes
  - Promotion of recovery for recycling 2 or less types of wastes
  - Promotion of recovery for recycling 4 or less types of wastes
  - Promotion of recovery for recycling 6 or less types of wastes
  - Promotion of recovery for recycling more than 6 types of wastes

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# Examples of key factors

- Plastics
  - Promotion of management solutions to reduce plastic use on the unit
  - Without promotion of management solutions to reduce plastic use on the unit
- Natural values
  - Promotion of management solutions to improve natural values around the unit or neighbourhood
  - Without promotion of management solutions to improve natural values around the unit or neighbourhood
- Land take
  - Promotion of decreasing land take minimizing the WWTPs footprint using compact technologies
  - Just not taking into account land take minimization

- Industrial symbiosis
  - Promotion of integrated approach for competitive advantages through the exchange of water, materials and energy between industries.
  - Without promotion of integrated approach for competitive advantages.
- Citizen and industry mutualism
  - With water reuse as a key measure for increasing the value of land/house properties, the occupational rate, the perception of industry reputation
  - Without water reuse as a key measure for increasing the value of land/house properties, the occupational rate, the perception of industry reputation
- Incentive instruments
  - Adoption of regulatory instruments, economic instruments, certification and labelling rules, environmental management systems as measures towards the circular economy
  - Without adoption of regulatory instruments, economic instruments, certification and labelling rules, environmental management systems

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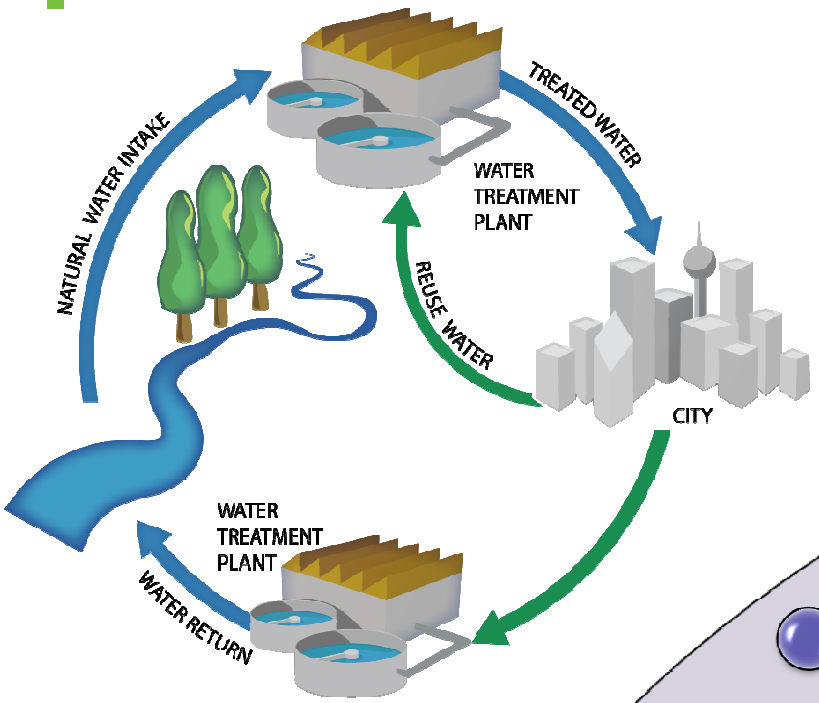
# What is needed ?




**Selection of key factors and sub-items**

**How to weight**

**Selection of scales**

**Development of algorithm**

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IMPEL
European Union Network for the Implementation and Enforcement of Environmental Law

# Thank you for your attention !

# Bedankt voor uw aandacht !