ISEC 2nd INTERNATIONAL SUSTAINABLE ENERGY CONFERENCE 2022

05 – 07 April 2022
Congress Graz
Austria

Water Europe
Technology & Innovation

Circular Water - Water Europe Vision, current policies and European eco-innovations

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Water and Waste Environmental Engineering LAB

Contents

- Water Europe and Circular Water
- EU policy context
- WEFEC nexus
- EU-funded eco-innovations to deliver Circular Water

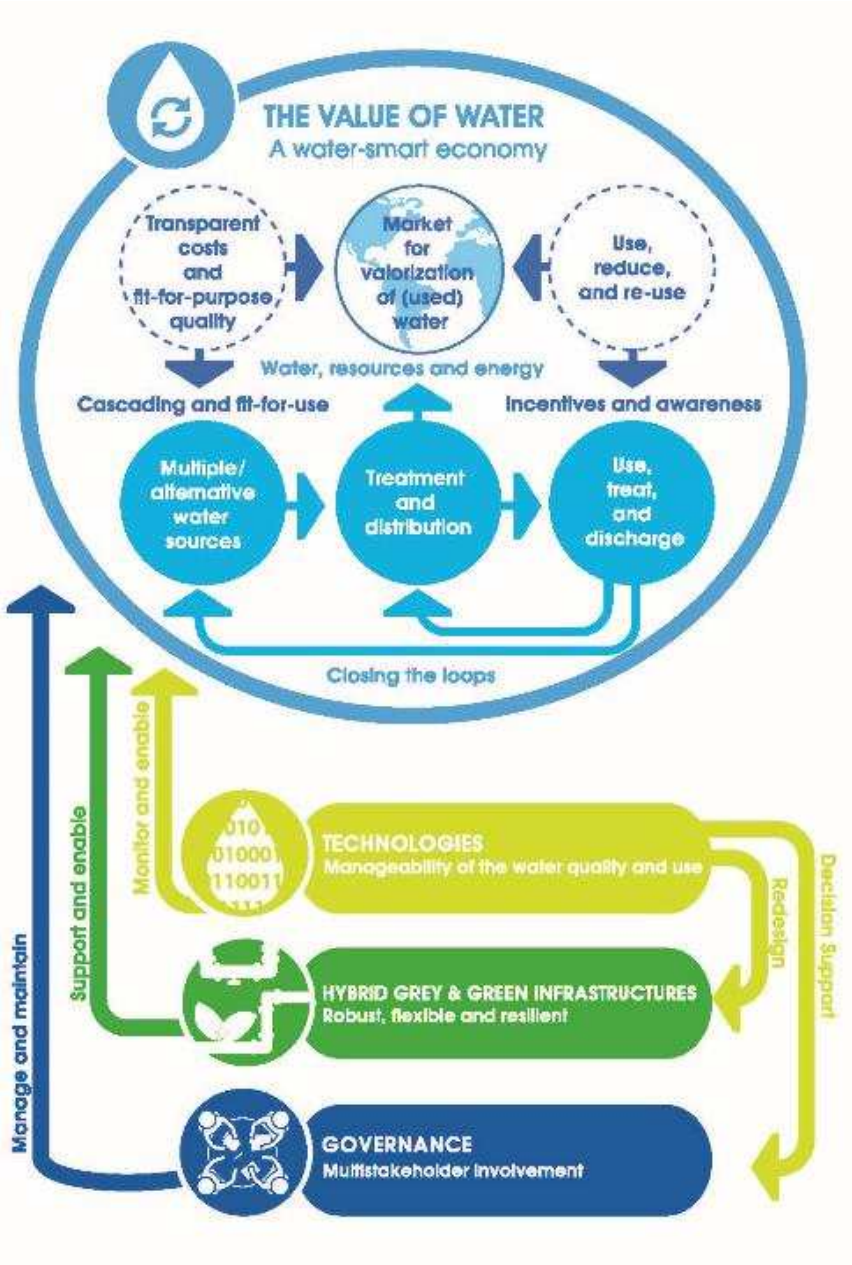
Water Europe Water Vision

Challenges:

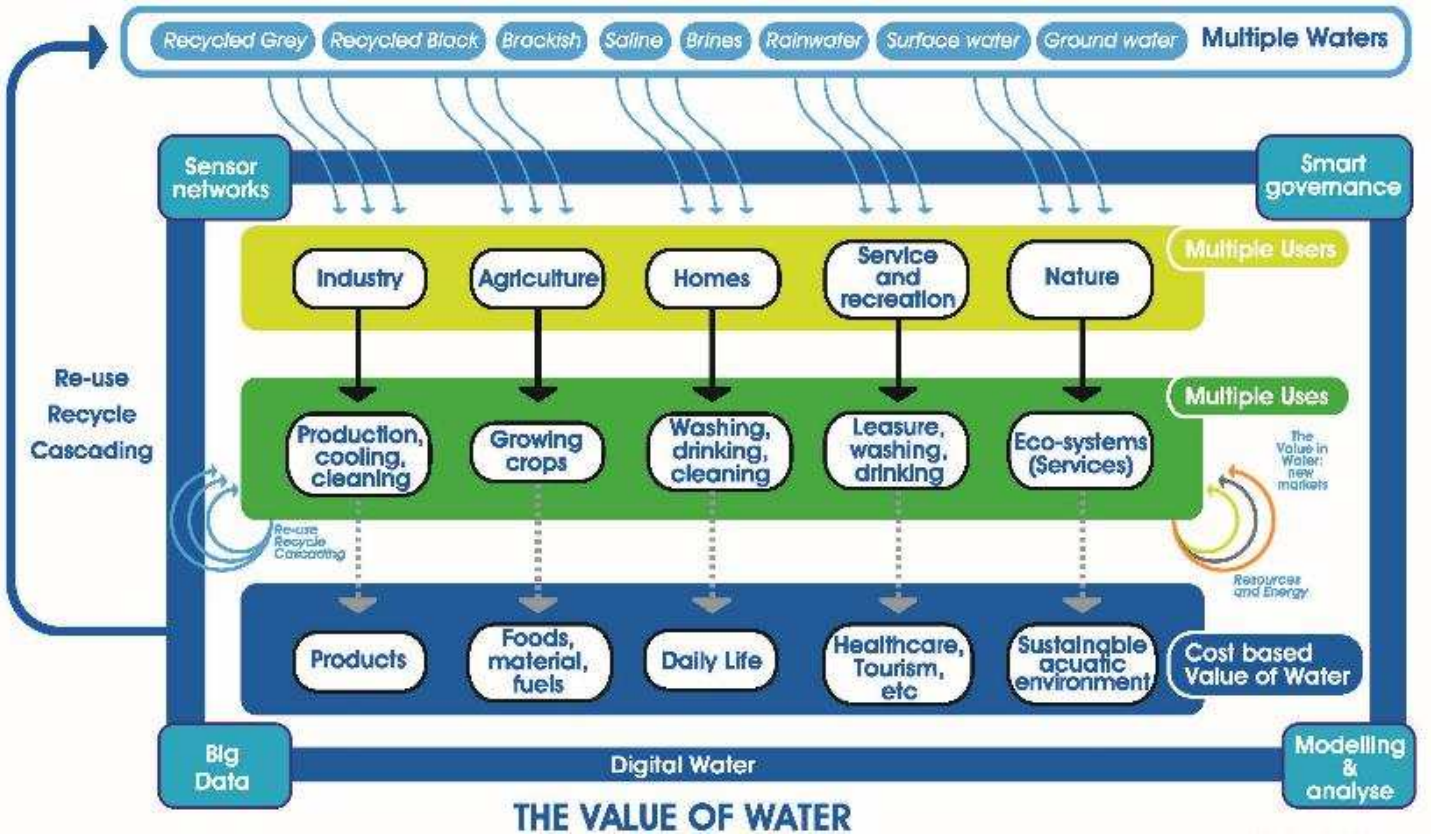
- Water scarcity
- Pollution of the environment
- Adaptation to climate change and extreme events

Water-Smart Society:

- a society in which the **true value of water** is recognised and realised;
- all available water sources are managed in such a way that **water scarcity and pollution of water resources** are avoided;
- Water and resource loops are largely closed to foster a **circular economy** and optimal resource efficiency,
- the water system is **resilient** against the impact of climate change events.
- A society in which **all relevant stakeholders** are involved in the governance of our water system.

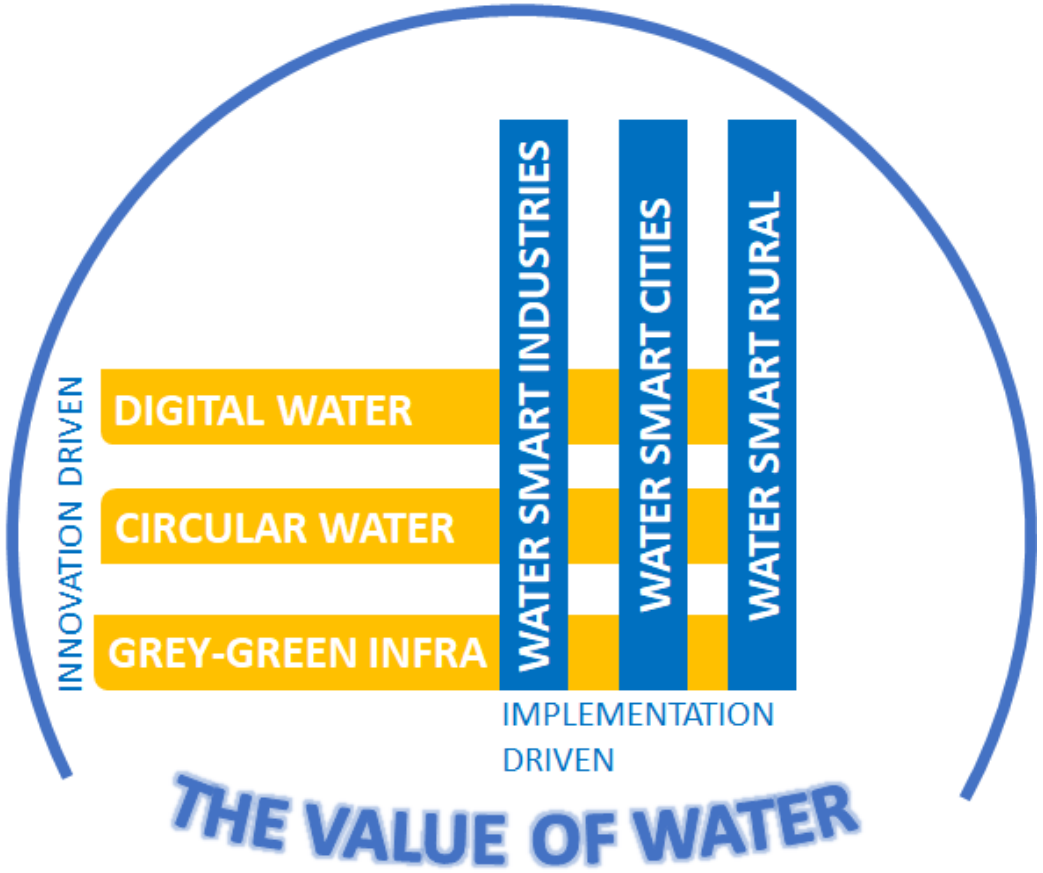


WE Innovation Areas



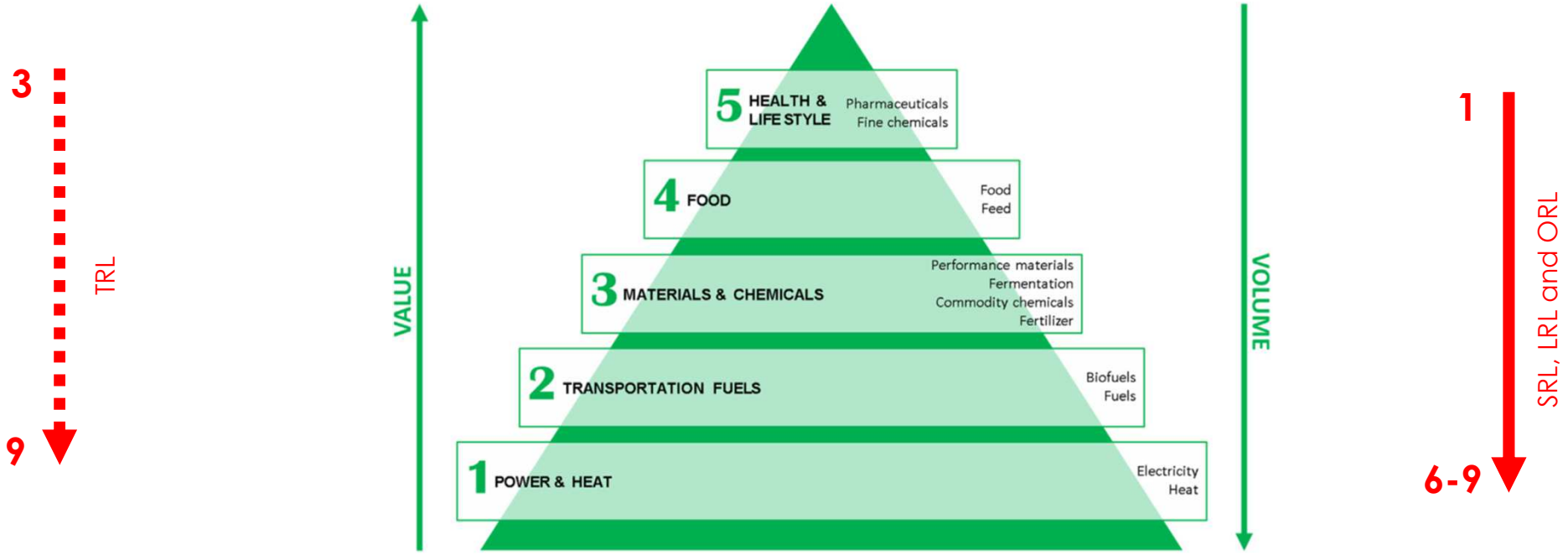
1. Multiple Waters
2. Digital Water
3. Value in Water
4. Hybrid Grey-Green Infrastructure

WE Water Vision Leadership Teams



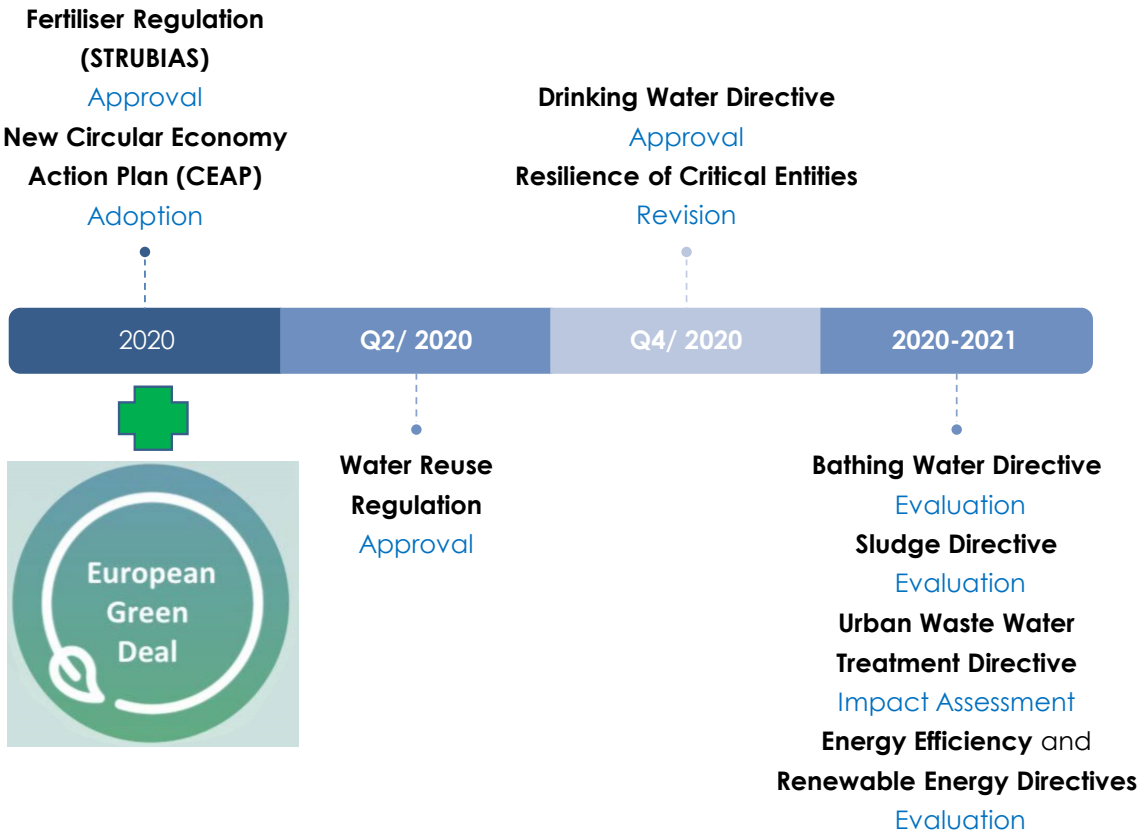
Circular Water

WATER



WATER

Crucial years for water (and energy) EU policies



Virtual workshop *on the 20-21st of April 2021, organised by the* ***European Commission*** *in the context of the impact assessment of the Urban Waste Water Treatment Directive (UWWTD) and the evaluation of the Sewage Sludge Directive (SSD).*

Waste water and sludge: how to integrate in the circular economy and support new energy and climate ambitions?

European Commission

Integrate wastewater and sludge management in the circular economy and support new energy and climate ambitions

1. *Addressing micropollutants in sludge and impact on soil where it is applied*
2. *Recovery of raw materials from wastewater and sewage sludge*
3. *Energy efficiency and production in UWWTPs and process chain*
4. *GHG emissions from urban wastewater and sludge*

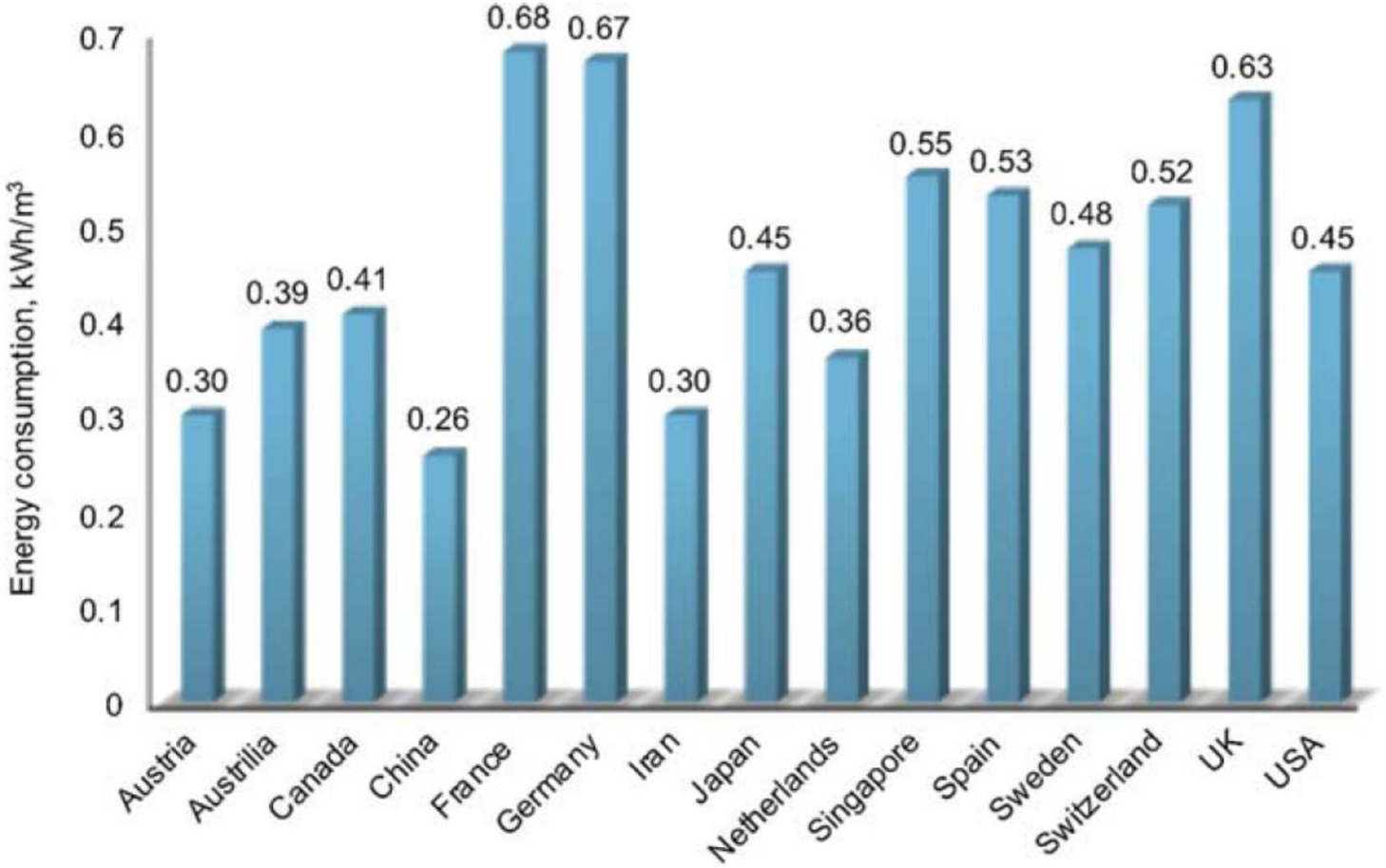


Figure 1.5 Geographic distribution of energy consumption in WWTPs. Data from Drechsel *et al*. (2015) and Zhou *et al*. (2013).

Definition of energy efficiency

$$\text{Efficiency} = \frac{Input(s)}{Output(s)} = \frac{\text{Electricity} + \text{Natural Gas} + \text{Diesel} + \text{Chemicals}}{\text{m3} + \text{COD} + \text{N} + \text{P} + \text{E. Coli} + \text{sludge}}$$

Resources (Input(s))

Energy service (Output(s))

converted into primary energy by CED method

WWTP energy efficiency cannot be described by a single indicator!

Enerwater project

The main objective was to develop, validate and to disseminate an innovative standard methodology for continuously assessing, labelling and improving the overall energy performance of Wastewater Treatment Plants (WWTPs).

TECHNICAL REPORT
RAPPORT TECHNIQUE
TECHNISCHER BERICHT

CEN/TR 17614

January 2021

ICS 13.060.30; 27.015

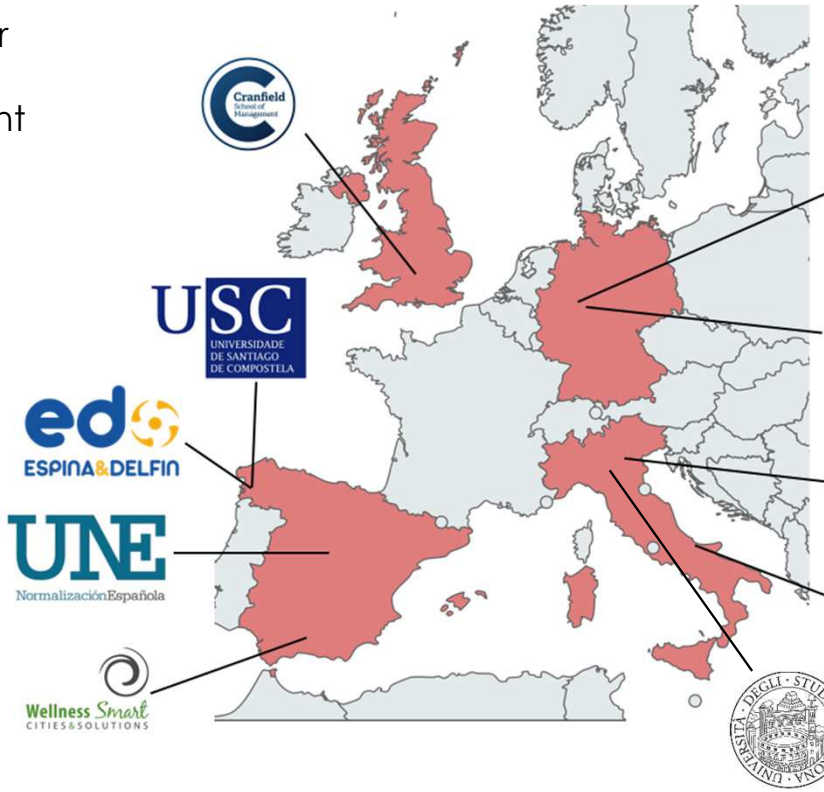
English Version

Standard method for assessing and improving the energy efficiency of waste water treatment plants

Méthode standard d'évaluation et d'amélioration de l'efficacité énergétique des stations d'épuration

Standardmethode zur Bewertung und Verbesserung der Energieeffizienz von Kläranlagen

This Technical Report was approved by CEN on 4 January 2021. It has been drawn up by the Technical Committee CEN/TC 165.



THE FINAL GOAL

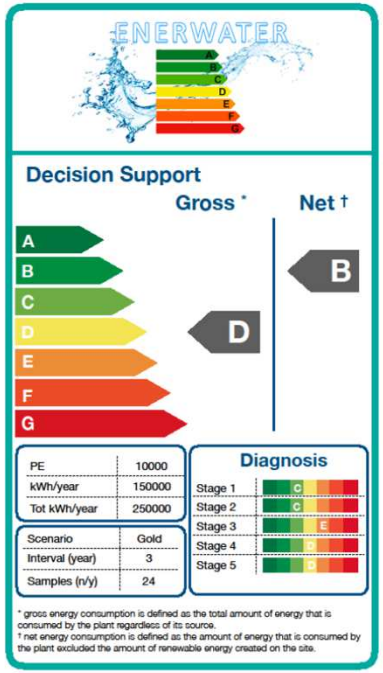
Universally understood energy label:

Water Treatment Energy Index (WTEI)

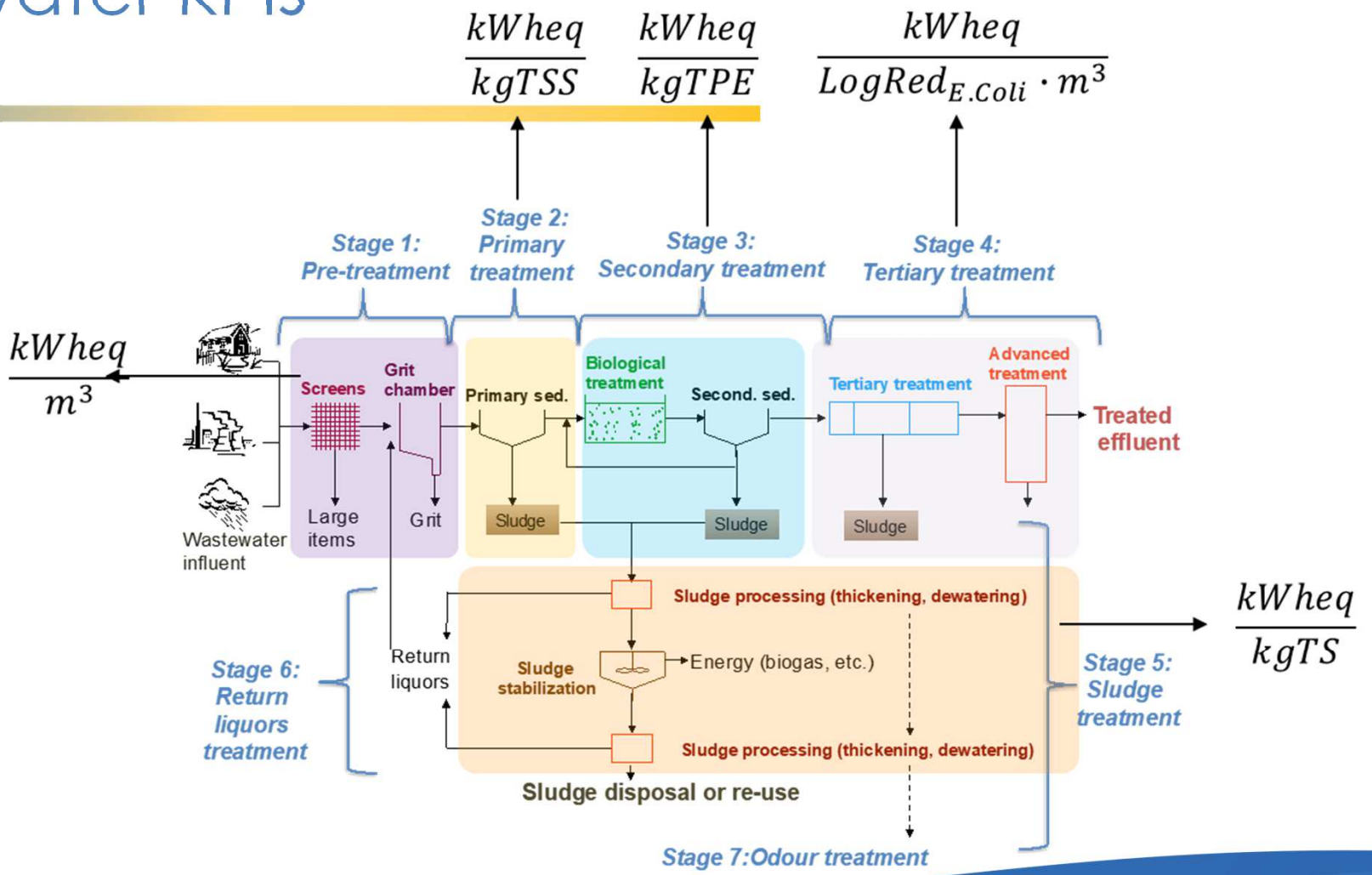
Standardized: to allow sound comparisons between different plants and operators

Generic: adapted to different typologies of WWTPs

Open: anyone must be capable of using it and understand how the results are obtained



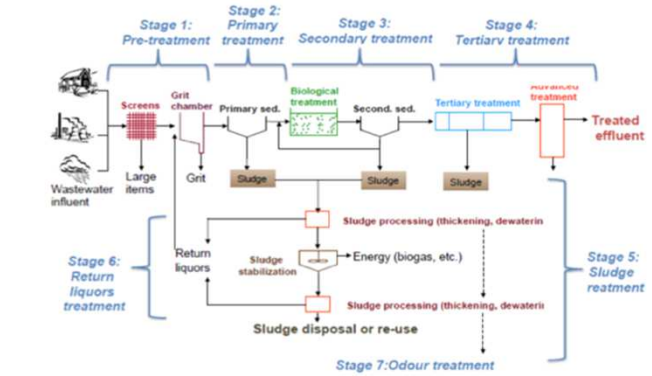
Enerwater KPIs



Enerwater methodology overview

Check the energy consumption and determine the KPIs

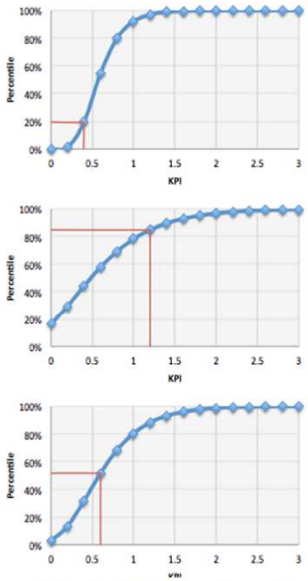
$KPI_1 = \frac{kWh}{m^3 \text{ of water treated}}$ $KPI_2 = \frac{kWh}{kg \text{ solids removed}}$ $KPI_3 = \frac{kWh}{kg \text{ pollutant removed}}$ $KPI_4 = \frac{kWh}{(m^3 \cdot \log \text{ reduction of pathogens})}$



$KPI_6 = \frac{kWh}{kg \text{ nitrogen removed}}$ $KPI_7 = \frac{kWh}{kg \text{ volatile organic compound}}$ $KPI_5 = \frac{kWh}{kg \text{ sludge treated}}$

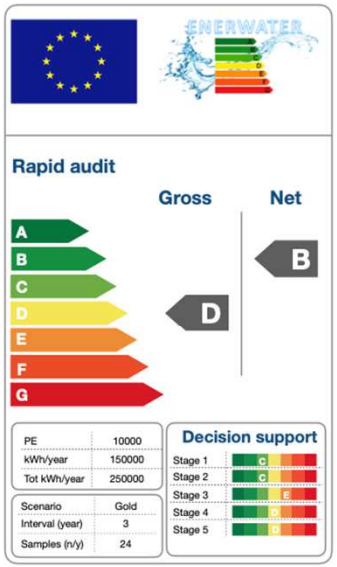
Adaptable universally to different plant layouts

Compare vs other WWTPs



Well-defined and established performance metrics

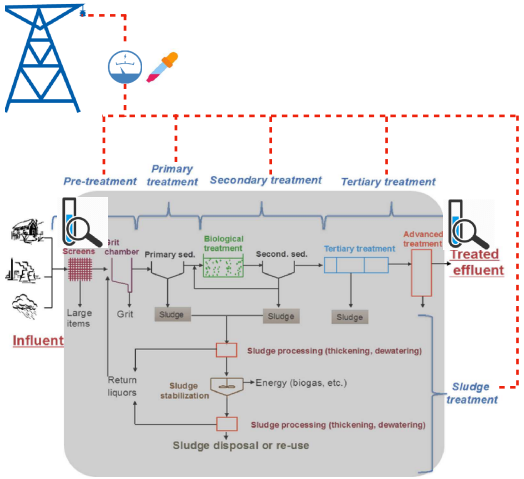
Get the energy label



Aggregated indicator that reflect plant complexity

Different needs, different data…

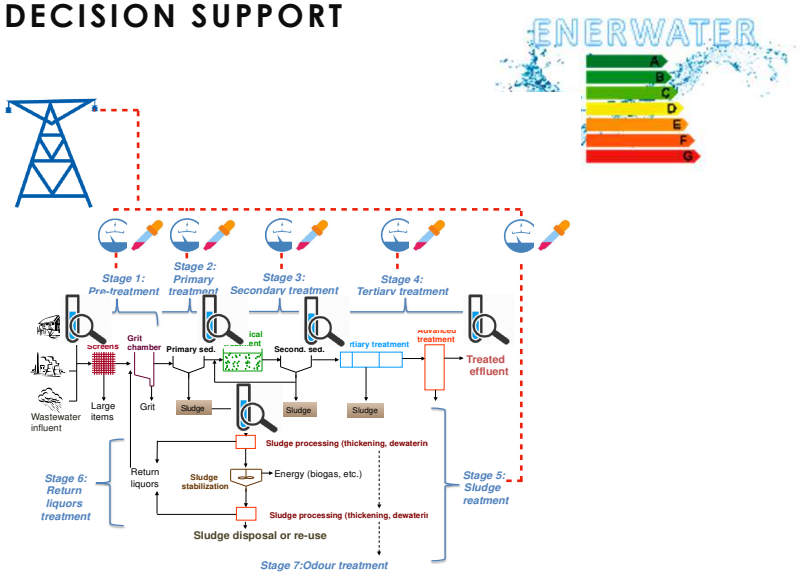
RAPID AUDIT



Legend:

- Energy sources
- Addition of chemicals
- Sampling + analysis

DECISION SUPPORT



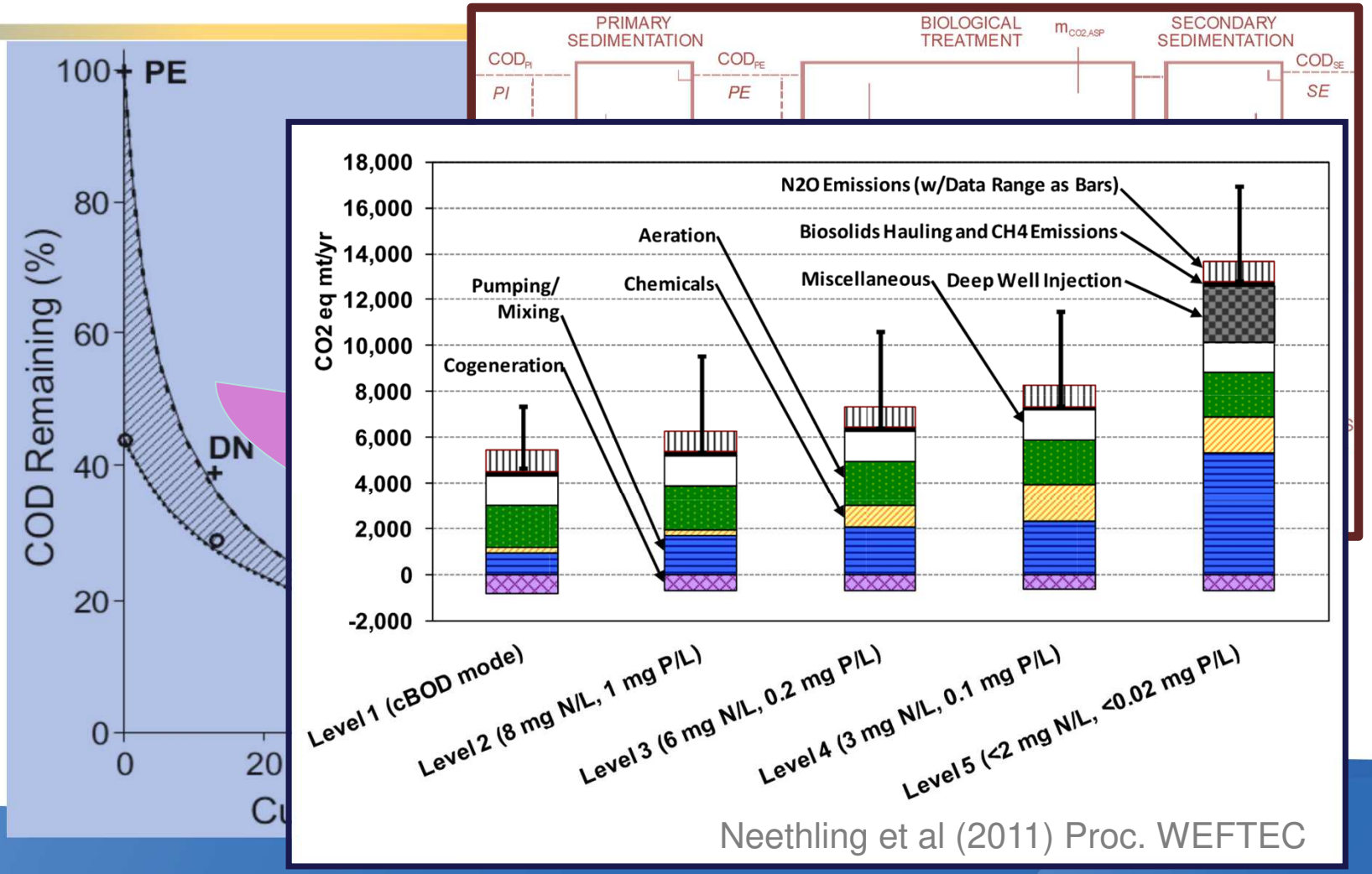
	RAPID AUDIT	DECISION SUPPORT
Energy consumption data	- Aggregated energy consumption from energy bills	- Disaggregated online data from energy meters on site
Operational data	- Routine influent/effluent analyses	- Per section influent/effluent analyses
Objective of the analysis	- Energy benchmarking	- Energy benchmarking - Diagnosis

The ENERGY PATHWAY
(to deliver circular economy)

Current TRL = 8-9

but
WATER-ENERGY-CARBON NEXUS!

Case Study:
Energy and Carbon footprint vs. Product Water Quality

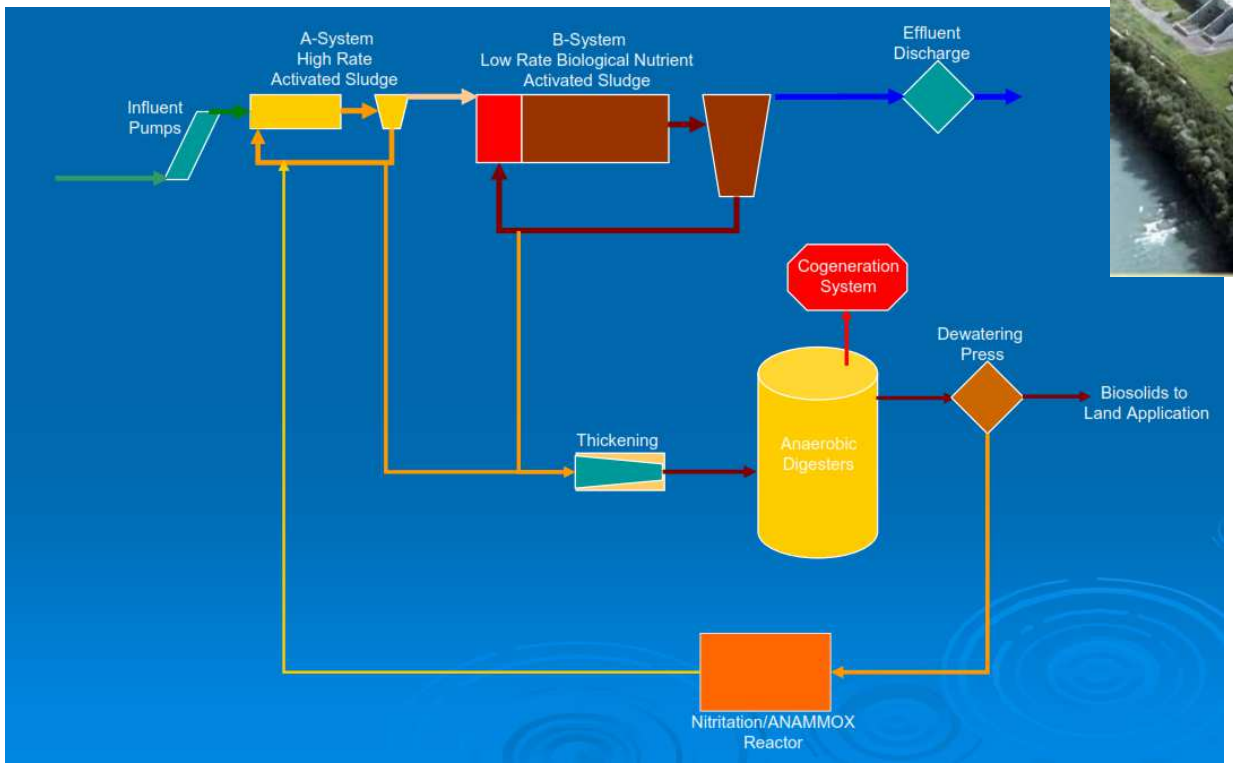


Neethling et al (2011) Proc. WEFTEC

Energy positive in full scale: how?

- Upstream diversion of more carbon to anaerobic digestion
- Separate short-cut treatment of the reject water
- Energy-efficiency in the mainline (e.g. short-cut (via-nitrite) processes)

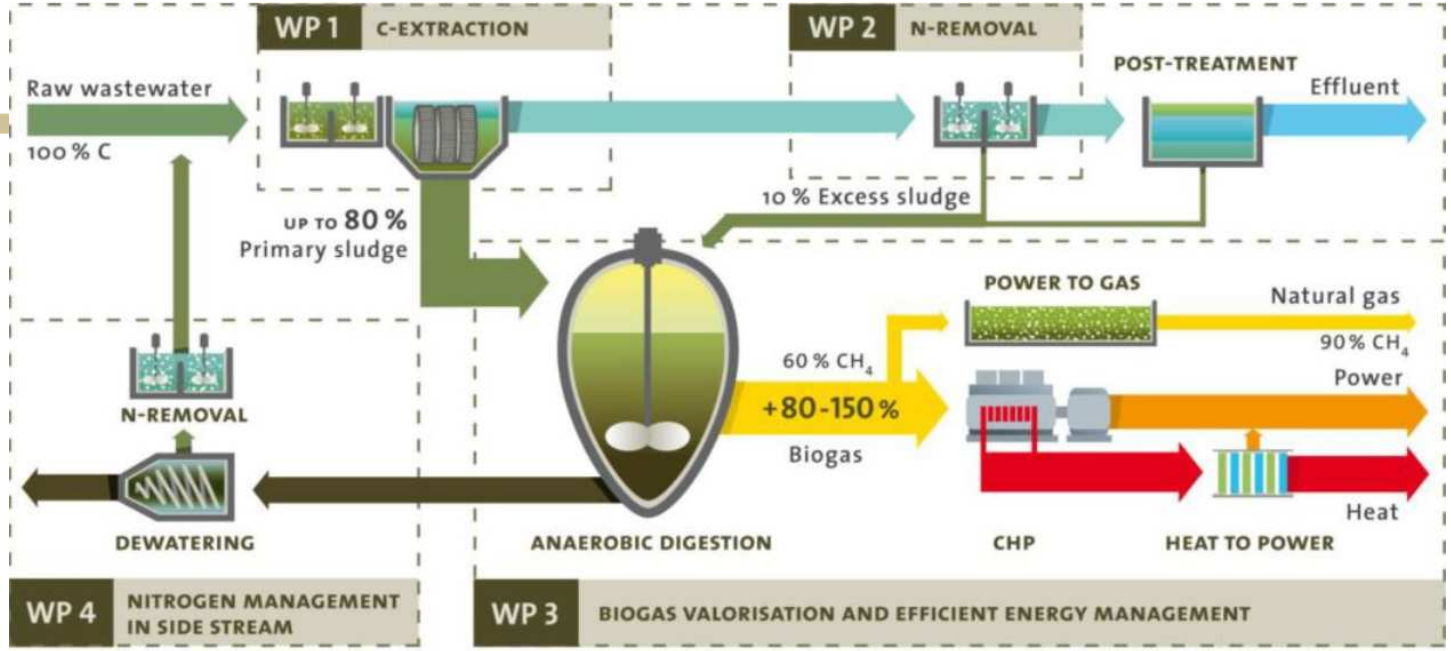
Strass WRRF: energy positive since 2005



In 2011:

- 250 000 PE
- 37 000 m3/d Inverno
- 23 000 m3/d Estate

Energy positive evolution: H2020 POWERSTEP



POWERSTEP modules *www.powerstep.eu*

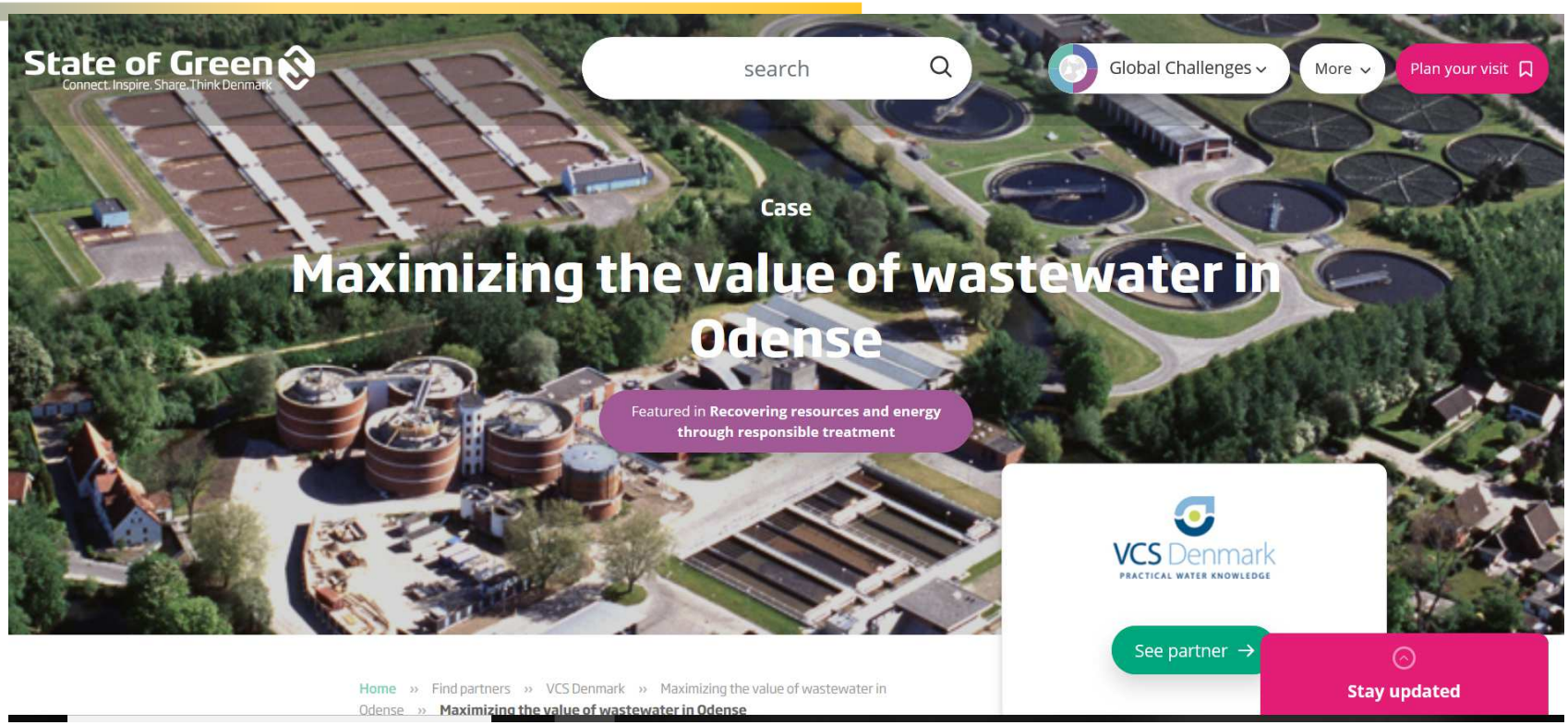
1- in mainline WWTP for A-stage (C extraction)

2- in mainline WWTP for B-stage (N removal)

3- reject water for N- removal or N-recovery

4- for best biogas valorisation

Odense WRRF >> energy positivity of 150 percent

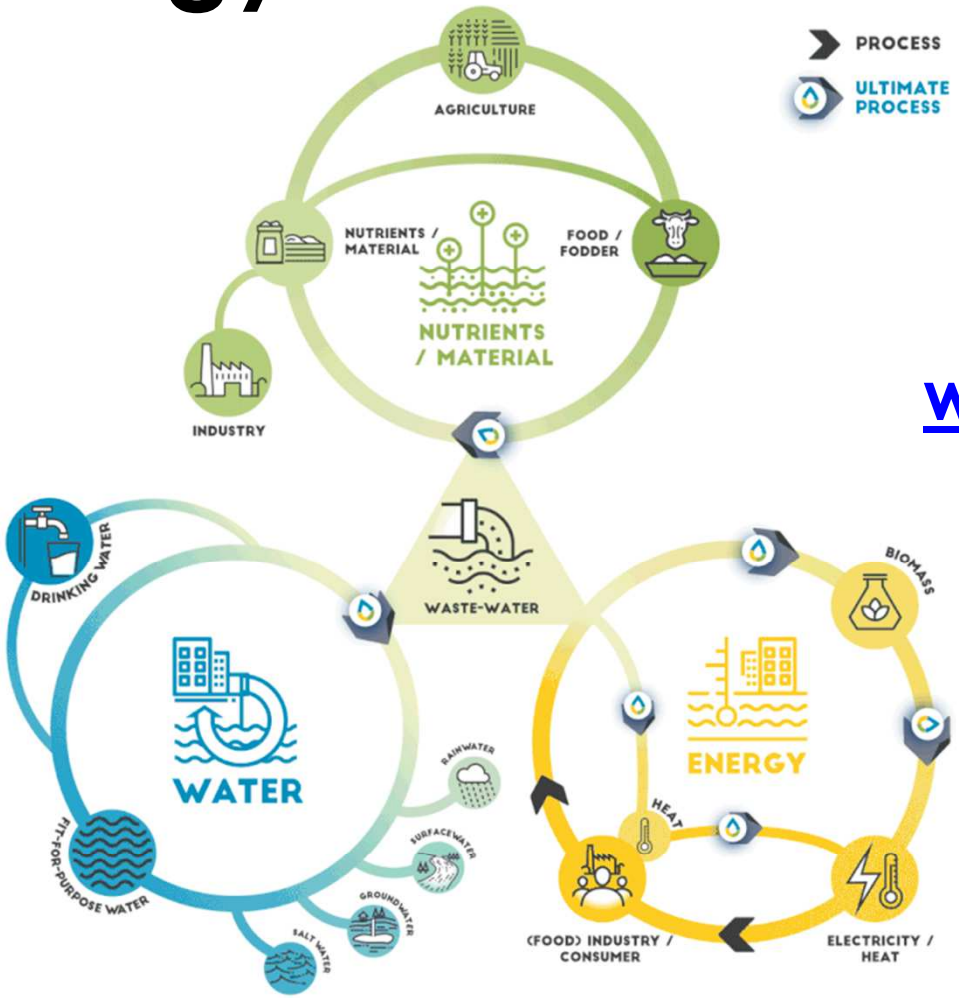


Resources from wastewater

Resource category	Resource	Recovery potential	Examples of potential end-use/market segment
Water	Water	100–400 L/capita/day (daily water consumption substantially fluctuates depending on country/region)	Irrigation, non-potable domestic use, industrial use, potable domestic use. Injection to mitigate saltwater intrusion and so on.
Inerts	Sand	In the order of 0.1–3 kg/capita/year [16]	Construction industry
Organics	Cellulose	In the order of several kg/capita/year [11]	Biochemical industry, construction material
	Biosolids	It is nearly impossible to provide accurate numbers on the recovery potential of these compounds as the latter depends on a multitude of factors. 'Ball-park' figures that can be used are in the order of several kilograms per capita per year for each of these resources	Agriculture
	Alginate like substances		Pharmaceutical and food industry
	Biochar		Agriculture
	Volatile fatty acids		Biochemical industry
	PHA		Bioplastics/Agriculture
Energy	Biogas, as electricity[a]	In the order of 250 MJ/capita/year (theoretical) In the order of 33 MJ/ capita/year (practical)	Reuse onsite, local power grid
	Thermal energy (heat)[a]	In the order of 760 MJ/capita/year (theoretical) In the order of 291 MJ/capita/year (practical)	District heating/cooling
Nitrogen	Ammonia (NH_3)	1.6–7.4 kg N/capita/year [10]	Power generation (Denox)
	Ammonium sulfate		Agriculture
	Microbial protein		Agrifood, aquaculture
	Biosolids		Agriculture, landscaping
	Struvite		Agriculture
Phosphorus	Biosolids	0.4–1 kg P/capita/year [10]	Agriculture
	Struvite:		Agriculture
	Calcium phosphate		Agriculture
Metals	Large variety of metals in biosolids/ash	In the order of several grams/capita/year (for the sum of all metals)	Metallurgy
Coagulants	Predominantly Fe and Al based	In the order of 1 kg/capita/year	Soil amendment, construction, sulfide removal and odor control

[a]Assuming a water consumption per capita of 125 liter per day and data from [17].

Energy-Water-Materials Pathways



www.ultimatewater.eu

Horizon 2020
European Union funding
for Research & Innovation

Water and Waste Environmental Engineering LAB

Water Europe
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ULTIMATE: indUstry water-utiLiTy symblosis for a sMarter wATer society

ITALIAN CASE STUDY >> ARETUSA-ROSIGNANO

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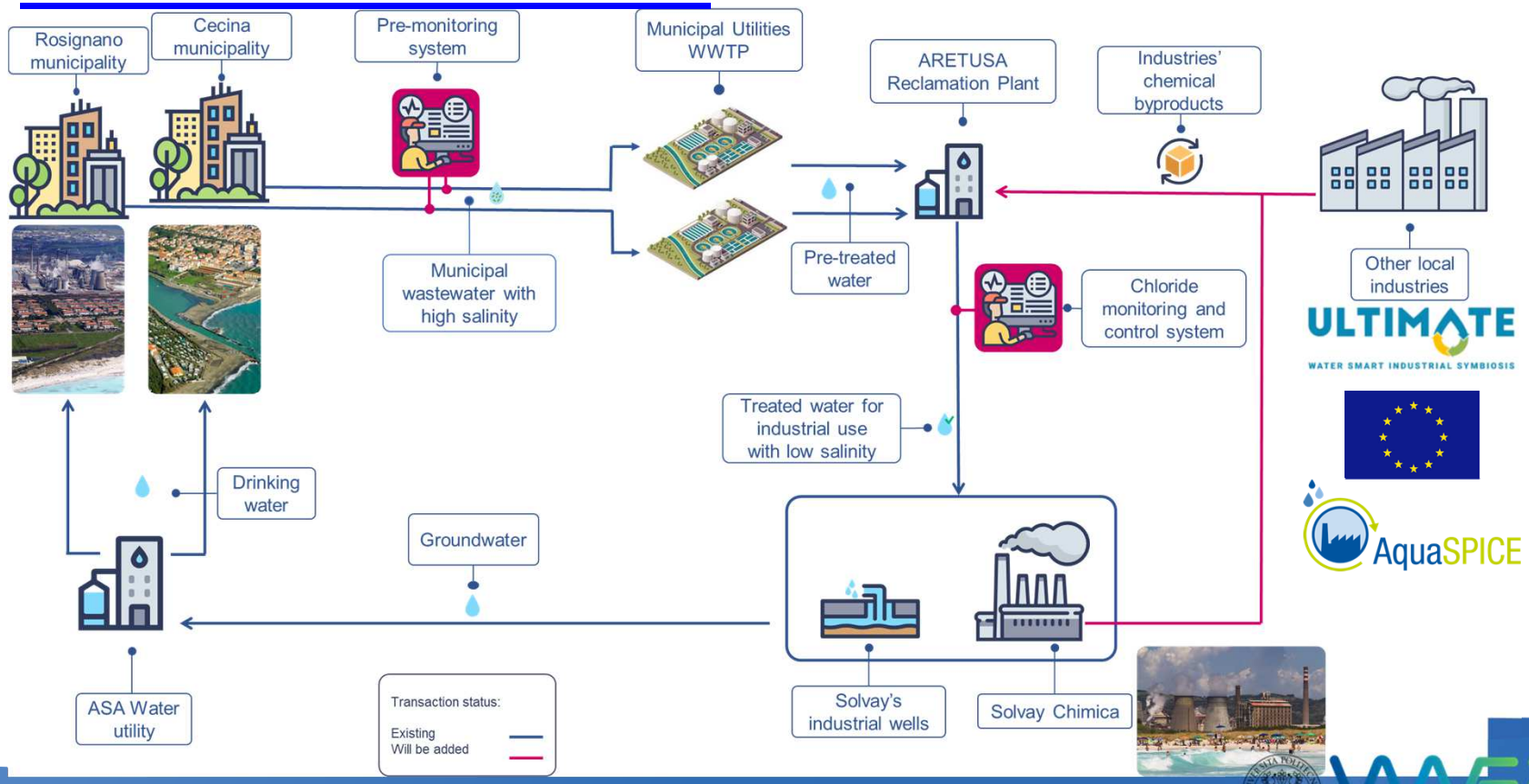

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Thank you

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