Drivers and barriers for market uptake of DEMEAU technologies

Results from WA 5

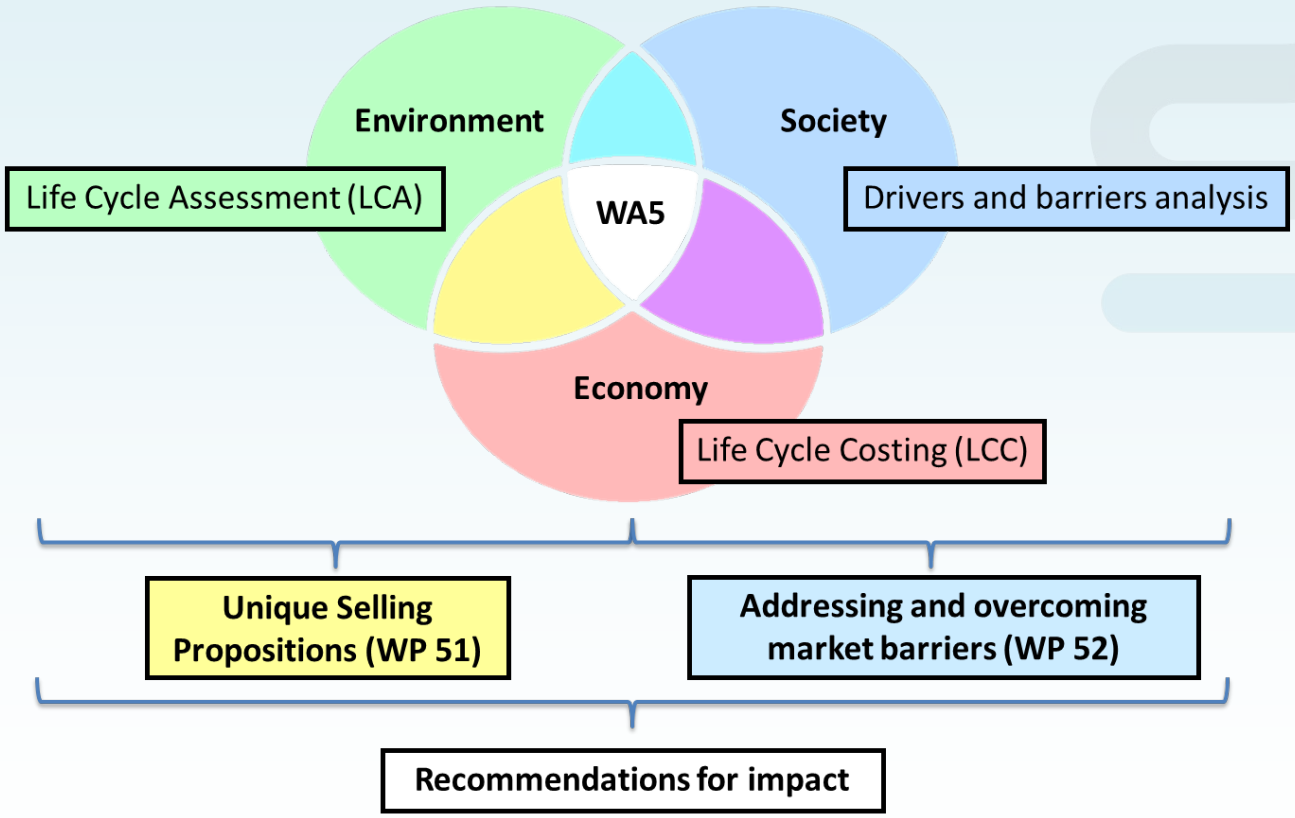
This project has received funding from the European Union's Seventh Programme for Research, Technological Development and Demonstration under Grant Agreement no. 308339.

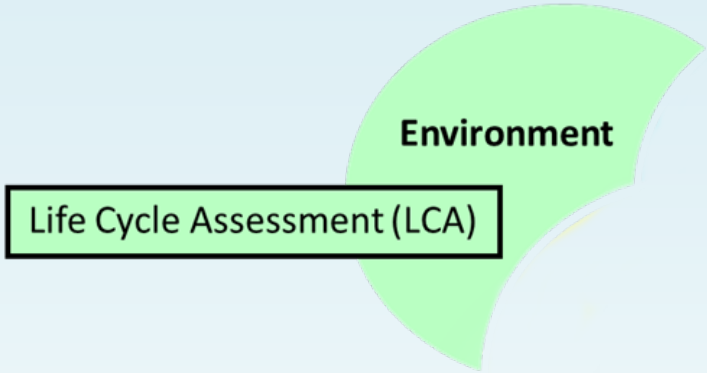
- **Aims and approach of WA5**
- Case studies in Demeau WA1-4
- Findings from the case studies
  - → WA1: MAR at Sant Vicenç dels Horts
  - → WA2: HCMS pilot at WWTP Birsfelden
  - → WA3: Ozonation at Neugut
  - → WA4: Bioassays at Waternet
- Overarching drivers and barriers

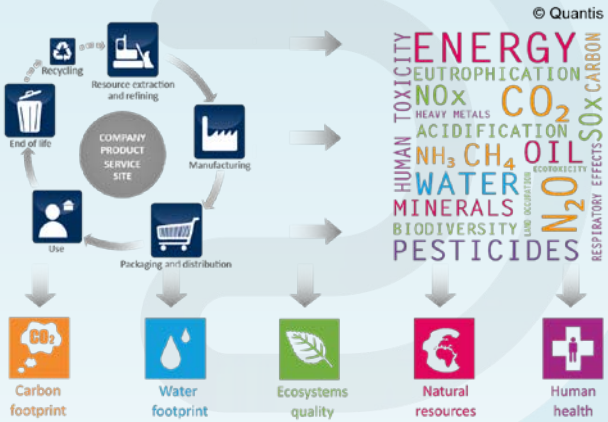
Focus of WA5 on the socio-technical system

Fostering the uptake of novel technologies in the water sector

A sustainability driven approach







- **Environmental and public health benefits (mostly local):** Avoided impacts from reduced concentration of emerging contaminants in WWTP effluent and drinking water

- **Environmental impacts (often off-site):** Induced impacts from increased resources demand (energy, chemicals, waste products etc.)

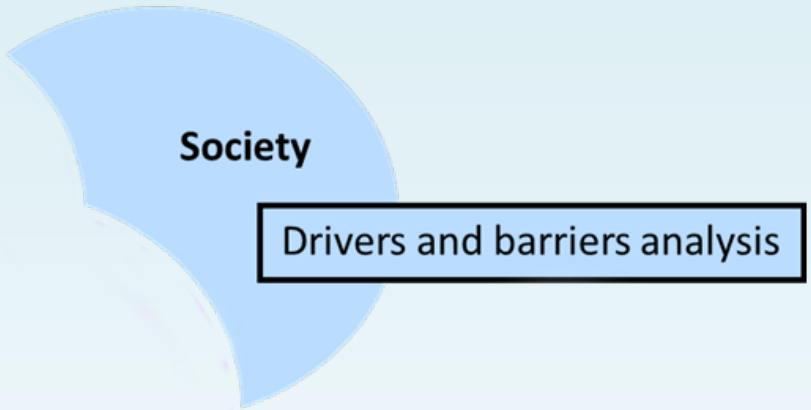
- **USEtox® tool:** LCA characterization factors for DEMEAU calculated and applied based on eco-tox and human-tox data

Economy

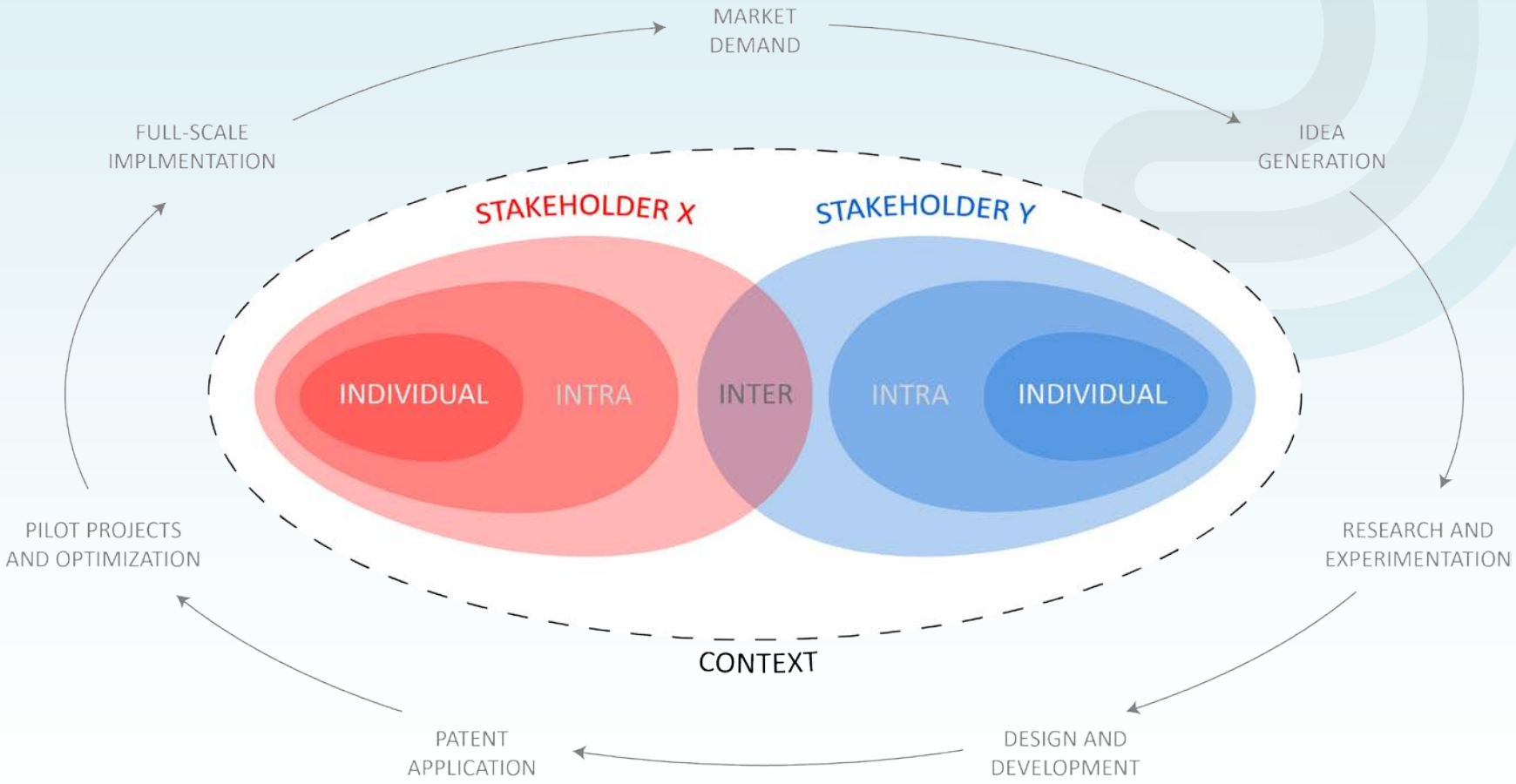
Life Cycle Costing (LCC)

- **Economic feasibility:** analysis of life cycle costs of innovative technologies/arrangements

- **Compared to alternative solutions:** estimation of the life cycle costs of the currently best-available competing technologies



- **Implementation drivers and barriers:** assessment of enabling and constraining factors that influence implementation of technologies
- **Zooming out to socio-technical system:** focus on interaction between society (stakeholders) and technology
- **Multi-step analysis:** preliminary inventory, extensive survey, interactive workshops/interviews.


MARKET DEMAND
IDEA GENERATION
RESEARCH AND EXPERIMENTATION
DESIGN AND DEVELOPMENT
PATENT APPLICATION
PILOT PROJECTS AND OPTIMIZATION
FULL-SCALE IMPLMENTATION
STAKEHOLDER X
STAKEHOLDER Y
INDIVIDUAL
INTRA
INTER
INTRA
INDIVIDUAL
CONTEXT

Throughout the innovation cycle…

	Research institute	Government (Nat.)	Government (Reg.)	Water utility	Engineering comp.	Consultant
Idea generation	■		■	■		
Research and experimentation	■	■		■		
Design	■		■	■	■	
Pilot projects and tests	■	■	■	■	■	■
Technology optimization	■			■	■	■
Up-scaling to full scale operation	■				■	■
Policy & guideline development	■	■	■			
Authorization, legal regulation, etc.			■			
Full-scale implementation				■		

Case studies across the four Work Areas

1. Preliminary inventory among WA leaders
2. Online survey among stakeholders
3. In-depth interactive workshops/interviews

   (ongoing for WA3 and WA4)

   - *Major barriers?*
   - *Expectations from various stakeholder groups?*
   - *Recommendations towards implementation?*

	BARRIERS	REQUIRED FROM SCIENTIFIC COMMUNITY	REQUIRED FROM ADMINISTRATION	REQUIRED FROM OPERATORS
		• Establishment of MAR communities, with special attention to the science-policy interface: exchange of knowledge, local options and consequences • Cooperate on realistic guidelines and regulations that consider the health and environmental effects in a measurable way • Willingness to communicate with each other, openness, transparancy		
TECHNOLOGICAL	• Well clogging • Lack of maintenance protocols • Quality of infiltration water • Effects on ecotoxicology of groundwater are unknown	• Model clogging effects and find solutions • Translate experiences from other countries to local projects • Stop solving problems that already have been solved somewhere else • Determine the boundary condtions under which MAR is an effective solution.	• Make existing technological questions explicit	• Make plants/playgrounds available for pilots and tests
REGULATORY	• Regulators still see too many risks • Regulation are inflexible • Conservative attitude of regulators • Regulation does not (yet) include the variety of water qualities (incl recycled water) • Lack of health and environmental parameters • Complex communication among various administrative levels	• Define health and environmental parameters to be able to make MAR practices measurable • Listing priority substances to monitor. • Dissemmination to and coordination with regulators	• Aim for regulations that are locally adaptable • Inlcude measurable parameters (also of emerging pollutants) in regulations that allow measurement of the effects on water quality (instead of being strict on the inflow water) • Consider water quality on basin level • Don't come up with new regulations, but improve existing ones • Improve communication among adm. levels • Adapt EU regulations to local circumstances	• Be transparent: show results, provide test data, real costs, reasons for failure, etc. to look jointly for solutions • Participate in discussions (especially local discussions regarding specific solutions) • Don't just 'assume' that regulations are and will always be a barrier.
FINANCIAL	• MAR competes with other water related solutions • High costs for pre-treatment of (recycled) water for well injection • Open question of who pays the bill • Viability of solution is questioned	• Conduct and communicate Lifecycle Costing and Lifecyle assessments to clarify the 'choices' and longer term effects	• Aim for public funding on a longer term (avoid limited subdidies) • Integrate costs of water reclamation in water bill (to allow for higher investments) • Consider also the (partly qualitative) savings done by reclaiming water • Extending exploitation period (for operators), redistribution of costs • Not "coffee for all" (refers to autonomous regions)	• Contribute financially to development and maintenance of technology and regulations (is already done by some) • Invest in tertiary treatment (which enables infiltration of cleaner water)
SOIAL	• Conservative attitude of consumers • Lack of dissemmination on local level	• Communicate findings (in understandable language) outside scientific community	• Start public dialogue about MAR, including various stakeholders	

- Aims and approach of WA5
- **Case studies in Demeau WA1-4**
- Findings from the case studies
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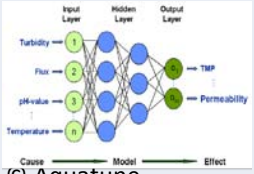
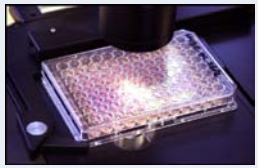
  - → WA4: Bioassays at Waternet
- Overarching drivers and barriers

Building upon case studies from the four DEMEAU work areas

WA1: Managed Aquifer Recharge		WA2: Hybrid Ceramic Membrane Systems & ANCS		WA3: Oxidative processes		WA4: Bioassays
Sant Vicenç dels Horts	Dunea	Birsfelden	WAG	Neugut	Dunea	Waternet
 © CETaqua	 © Dunea	 © Jan Svojitka	 © Aquatune	 © Neugut WWTP	 © Dunea	 © BDS
Aquifer recharge + potential water reuse	Drinking water treatment	Wastewater treatment	Drinking water treatment	Wastewater treatment	Drinking water treatment	Effects-based monitoring in DW treatment
Infiltration ponds + **organic layer**	**Dune infiltration** + AOP	**Ceramic UF** + PAC	treatment + **ANCS**	**Ozonation** + Sand filtration	Dune infiltration + **AOP**	**Bioassays**

- Aims and approach of WA5
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WA1: MAR at Sant Vicenç dels Horts

WA1: Managed Aquifer Recharge
Sant Vicenç dels Horts

Aquifer recharge + potential water reuse
Infiltration ponds + **organic layer**

Key application areas

- River water infiltration for aquifer recharge
- Potential for water reuse

Motivation for implementation at SVH

- MAR: Improving groundwater quantity and quality
- Organic layer: Potential for water reuse from WWTP effluent (multi-barrier approach)

WA1: Managed Aquifer Recharge

Sant Vicenç dels Horts

Aquifer recharge + potential water reclamation

Infiltration ponds + **organic layer**

PERCEIVED BARRIERS FROM WORKSHOP

- **Technological**

  Well clogging / lack of maintenance protocols

  Infiltration water quality (unknown effects on ecosystem)

- **Regulatory**

  Lack of differentiated approach for various infiltration qualities

  Complex mix of administrative responsibilities

- **Financial**

  High costs for wastewater pre-treatment (before infiltration)

  Competes with other (more feasible) solutions

- **Social**

  Conservative / risk averse attitude of stakeholders

  Lack of involvement of local level stakeholders (e.g. consumers)

WA1 – MAR at Sant Vicenç dels Horts

WA1: Managed Aquifer Recharge

Sant Vicenç dels Horts

Aquifer recharge + potential water reclamation

Infiltration ponds + **organic layer**

SCIENCE

- Model clogging effects
- Translate international experiences
- Determine boundary conditions
- Define health and environmental parameters
- List priority substances to monitor
- Coordinate with regulators
- Communicate findings outside scientific community

ADMINISTRATION

- Make explicit which questions still exist
- Regulations that allow for local adaption
- Improve current regulations (instead of extra)
- Improve coordination among adm. levels
- Consider water quality on basin level
- Long-term vision on funds and savings
- Start public dialogue

UTILITIES

- Open plants for pilots/tests
- Transparency, share data on costs and failures
- Participation in local discussions
- Don't 'assume' that regulations never change
- Invest in tertiary treatment

WA1 – MAR at Sant Vicenç dels Horts

WA1: Managed Aquifer Recharge

Sant Vicenç dels Horts

Aquifer recharge + potential water reclamation

Infiltration ponds + **organic layer**

SCIENCE **ADMINISTRATION** **UTILITIES**

OVERARCHING RECOMMENDATIONS FROM WORKSHOP:

- **Establish MAR communities (science – policy – practice – public)**
- **Cooperate on realistic measurable guidelines/regulations**
- **Transparent, open, constructive communication**

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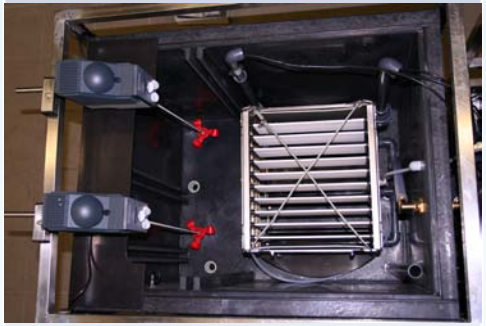
WA2: HCMS at WWTP Birsfelden

WA2: HCMS at WWTP Birsfelden

HCMS at WWTP Birsfelden



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Wastewater treatment

Ceramic ultrafiltration with powdered activated carbon

Key application areas

- Advanced wastewater treatment
- Wide spectrum of emerging contaminants removal

Motivation for pilot at WWTP Birsfelden

- **New regulations in Switzerland** to upgrade WWTPs with additional removal of emerging contaminants
- Experiments on **operating conditions** (PAC dosage, aeration, backwash etc.) and the removal efficiency for emerging contaminants

WA2:
HCMS at WWTP
Birsfelden

HCMS at WWTP
Birsfelden

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Wastewater treatment

Ceramic ultrafiltration with powdered activated carbon

PERCEIVED BARRIERS FROM WORKSHOP (membranes)

- **Technological**

  Expected increased energy demand

  Is it really feasible/possible in practice?

  Required raw materials for PAC (environmental impact)

- **Regulatory**

  -

- **Financial**

  Costs of upgrading existing treatment plant

- **Social**

  Unawareness (utilities) of benefits of ceramic membranes

WA2: HCMS at WWTP Birsfelden

WA2: HCMS at WWTP Birsfelden

HCMS at WWTP Birsfelden

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Wastewater treatment

Ceramic ultrafiltration with powdered activated carbon

Ceramic membranes

SCIENCE

- Communicating benefits
- Un-scientifying Outcomes/results (accessibility)
- Research on alternative raw materials (PAC)

ADMINISTRATION

- Facilitate exchange with other application areas
- Support pilot projects
- Developing guidelines on PAC production

UTILITIES

- Optimization to reduce energy demand
- Actively engage in knowledge transfer

Exchange experiences/knowledge with other application areas

WA2:
HCMS at WWTP
Birsfelden

HCMS at WWTP
Birsfelden

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Wastewater treatment

Ceramic ultrafiltration with powdered activated carbon

PERCEIVED BARRIERS FROM WORKSHOP (ANCS)

- **Technological**

  Not all operational conditions included in algorithm

- **Regulatory**

  Possible resistance by administration (water safety!)

- **Financial**

  Considerable initial investment required

- **Social**

  Lack of transparency of optimisation process (what is happening?)

  Fear of job loss due to automation

WA2: HCMS at WWTP Birsfelden

WA2: HCMS at WWTP Birsfelden

HCMS at WWTP Birsfelden

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Wastewater treatment

Ceramic ultrafiltration with powdered activated carbon

ANCS

SCIENCE

- Technical communication
- Visualization of results
- Interaction with administration
- Independent scientific validation

ADMINISTRATION

- Better implementation of national regulations (energy efficiency)
- Openness to innovation
- Cost and environmental conscious decision making

UTILITIES

- Include utility staff in ANCS introduction
- Transparency; show how it works in practice
- Knowledge sharing within organization
- Job security atmosphere
- Training of operators

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WA3: Ozonation at WWTP Neugut

WA3: Ozonation at WWTP Neugut
Ozonation at WWTP Neugut
 © WWTP Neugut
Wastewater treatment
Ozonation with subsequent sand filtration

Key application areas

- Advanced wastewater treatment
- Wide spectrum of emerging contaminants removal

Motivation for ozonation at WWTP Neugut

- **New regulations in Switzerland** to upgrade WWTPs with additional removal of emerging contaminants
- High micropollutant concentration in receiving water bodies

WA3: Ozonation at WWTP Neugut

WA3: Ozonation at WWTP Neugut

Ozonation at WWTP Neugut

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Wastewater treatment

Ozonation with subsequent sand filtration

From the online survey…

Mainly drivers:

- Efficient/effective cooperation between research, utility and local administration
- Third project with same group of stakeholders
- First full-scale ozonation for wastewater treatment in Switzerland: gaining experience for future plants

BUT: further investigation planned!

Valuable recommendations?

Interviews planned in June/July!

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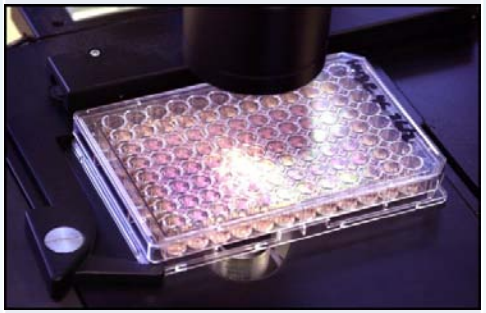
WA4: Bioassays at Waternet

WA4: Bioassays

Bioassays at DWTP Waternet



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Effects-based monitoring in DW treatment

Bioassays

Key application areas

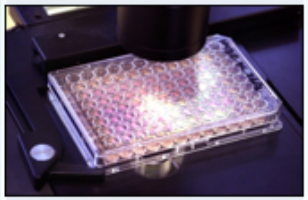
- Monitoring of water quality in different treatment steps of drinking water plants
- Measuring effects of complex mixtures of compounds

Motivation for bioassays at Waternet

- Interest in **actual (toxic) effects** instead of presence of separate compounds
- **Cost effective way** of monitoring impact of subsequent treatment steps on water quality

WA4: Bioassays

Bioassays at DWTP Waternet



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Effects-based monitoring in DW treatment

Bioassays

BARRIERS FROM ONLINE SURVEY

- **Technological**

  Which bioassays to use for which specific applications?

  Still investigating threshold values (req. for implementation)

- **Regulatory**

  Low involvement of policy makers (why?)

  Lack of regulatory pressure to measure effects of mixtures (focus on individual compounds)

- **Financial**

  Lack of financial support for required tests and pilots

  Perceived as 'extra' costs (does not replac

- **Social**

  Lack of awareness of benefits of bioa

Valuable recommendations?

Workshop planned in June/July!

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- **Overarching drivers and barriers**

OVERARCHING INSIGHTS:

- Regulatory pressure is a VERY important incentive
- Close cross-stakeholder communities with transparent communication!
- Explicate remaining questions on interface science – policy – practice
- Need for standards, BUT also sensitivity to local circumstances
- Effectively addressing risk perception (vital importance of water safety)
- Locally avoided eco-tox and human-tox impacts come with global trade-offs

Thank you for your attention!

AMPHOS 21

aquatune

eawag aquatic research

HYDOR

CETaqua WATER TECHNOLOGY center

CORDOUAN Technologies

eco logic

KWR Watercycle Research Institute

Quantis Sustainability counts

IWW

SIGRIST PROCESS-PHOTOMETER

BDS BioDetection Systems

n|w University of Applied Sciences and Arts Northwestern Switzerland School of Life Sciences

KOMPETENZZENTRUM Wasser Berlin

Van Remmen UV Techniek

VEOLIA ENVIRONNEMENT Recherche & Innovation

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