

➔ Progress full scale implementation program
for the removal of pharmaceuticals out of WWTP effluent

Implementation waiting
for innovation or..?

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Rijkswaterstaat
Ministry of Infrastructure
and Water Management



Outline

- Introduction
- Implementation program
- Progress
- Future perspective

About ten years ago: recognition of the problem

- Improved laboratory techniques (concentrations in $\mu\text{g/l}$, even ng/l)
- First scientific report (national Institute for Public Health and the Environment) in 2016 (second in 2020)
- Broad awareness in water sector and public
- Dutch Chain Approach, >2016 (health care and water sector!)
- Lot of questions left

Where is it a problem (all the WWTP's?)

What are standards,
Guidelines for pharmaceuticals?

Source approach or end of pipe?

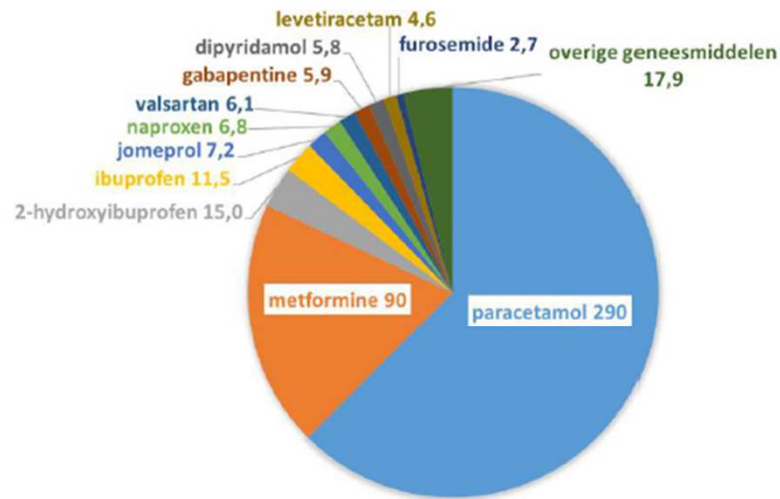
What technologies are available?

When (<2027 WFD, <2045 UWWD)?

(Investment) Costs?

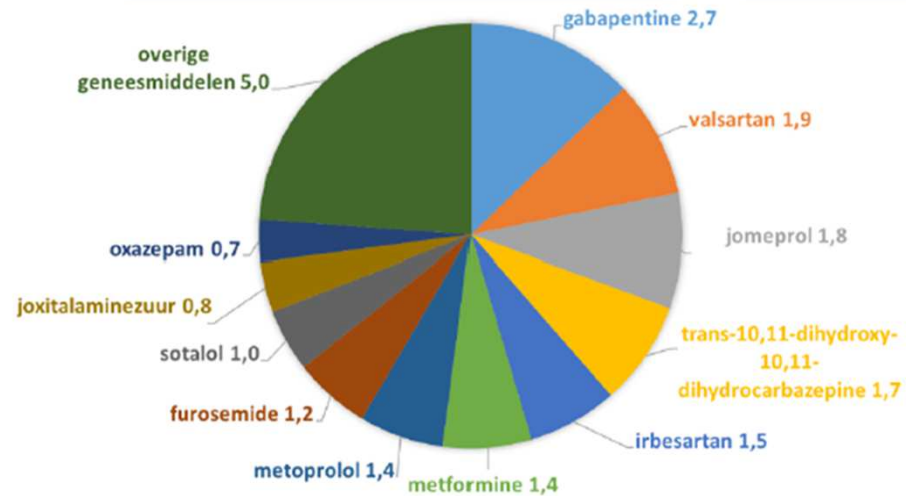


Presence of pharmaceuticals in urban waste water



IN: 0,46 mg per liter
paracetamol en metformine
bepalen driekwart vracht

UIT: 0,04 mg per liter
breed scala



Presence of Pharmaceuticals in water (examples, µg/l)

Pharmaceutical	Diclofenac	Metformine	Clarithromycine
Waste water	0,33-0,59	64-100	0,1-0,7
WWTP effluent	0,19-0,40	0,4-1,7	0,04-0,19
Surface water up	0,013-0,076	0,25-0,68	<0,01-0,04
Surface water down	0,06-0,22	0,30-1,04	0,01-0,13
Maas	0,04 (max)	< 0,5 (0,83 max)	0,12
Drinking water	< 0,01	0,3 (max)	< 0,01 (?)

Diclofenac: PNEC = 0,05 µg/l

Metformine: PNEC = 780 µg/l

Clarithromycine: PNEC = 0,04 µg/l

Not relevant for human toxicity !?

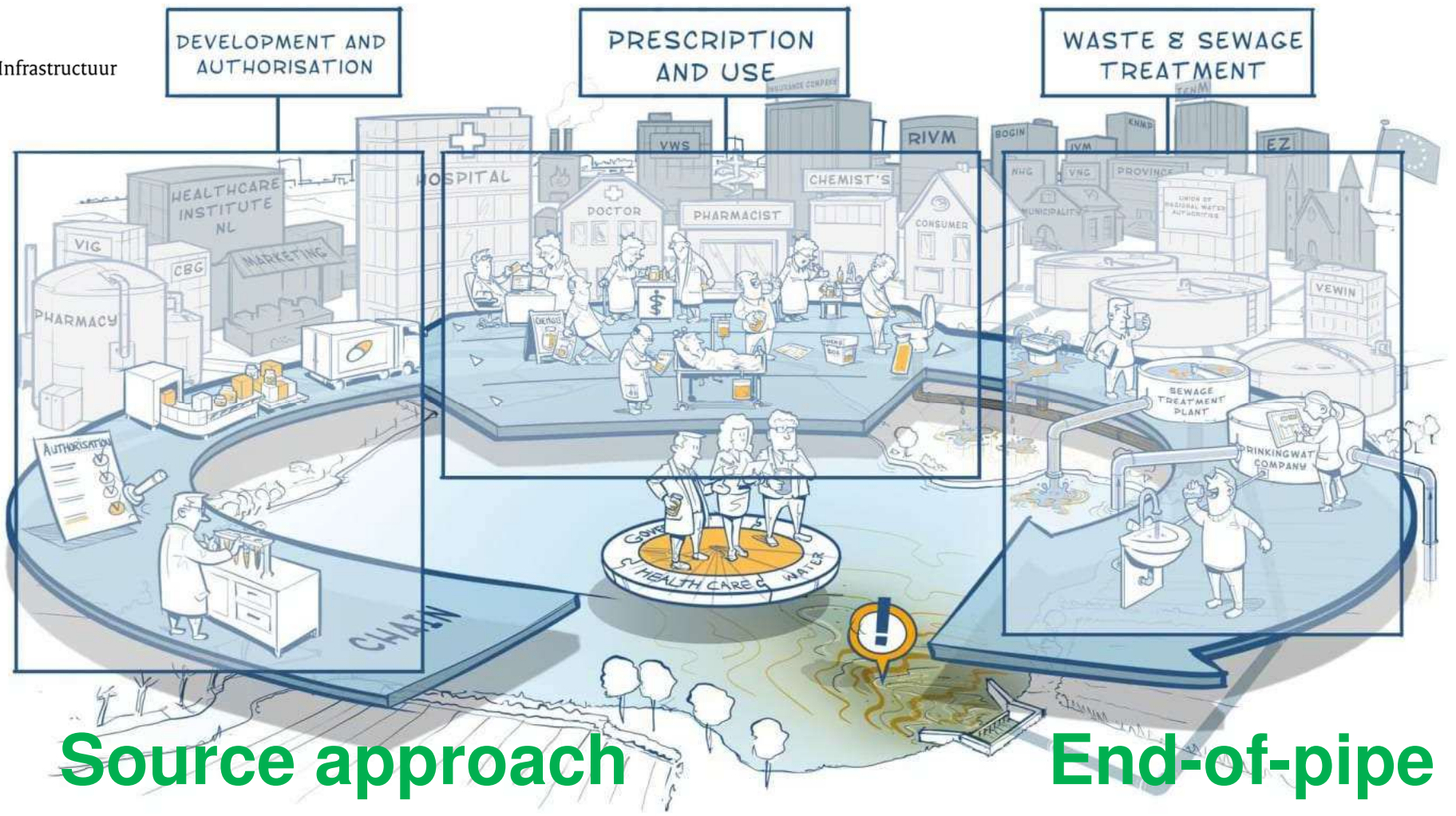
European River Memorandum: < 0,1 µg/l

Indicator parameter drinking water directive: 1 µg/l

The Dutch Approach (Chain approach pharmaceuticals in water)



Ministerie van Infrastructuur
en Waterstaat



Goal of the implementation program

- Source approach will not be sufficient to prevent emissions
- Part of the problem is to be solved by additional treatment
- Proven technologies (active carbon and ozone)
- Financial contribution (60 M€ program) >2020
Ministry of Infrastructure and Water Management
- Two tranches (2020-2024, 2024-2028)
- 70% removal of a selection of pharmaceuticals
(7 best out of a list of 11)
- Start with a selected number of WWTP's
- Not wait, just start: Learning by doing!

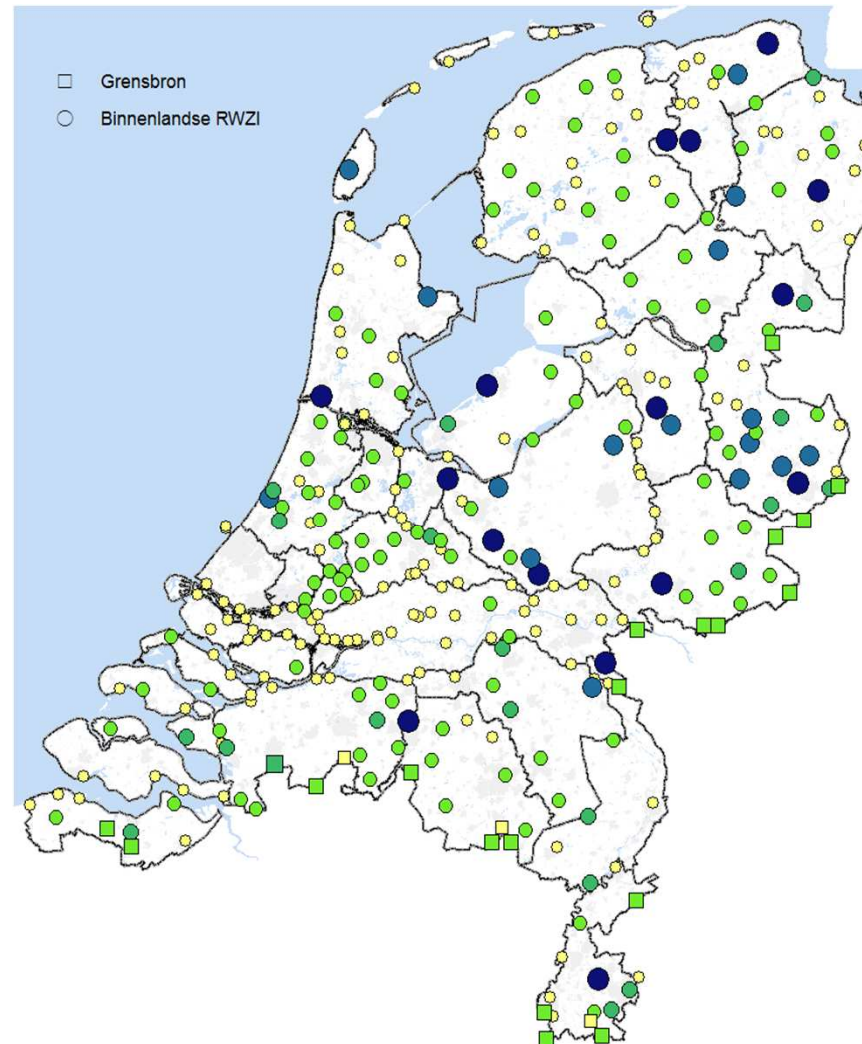
Stowa national hotspot analysis WWTP's (model calculation)

Criterion: Concentration increase receiving surface water

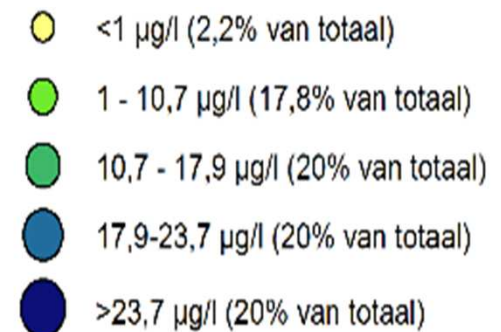
Conclusion: about 150 of
314 WWTP's
no significant effect

Assumption: below
1 $\mu\text{g/l}$ no effect
aquatic ecosystem

About 100 hotspots



Second criterion:
Drinking water source



Overview (proven) technologies (Stowa report 2017-36)

technology	removal	costs	Energy, GER	By-products
Powdered Activated Carbon (PACAS)	++	++	+/-	++
Active carbon filtration	++	+/-	+/-	++
Ozone + filtration	+++	+	+	- (bromate)
UV/H ₂ O ₂	+++	+	-	+/-
Membrane filtration	++(+)	+/-	-	- (concentrate)
Natural treatments	+	++	++	++

Remark: combination of PACAS and ozone might be attractive to remove a broad range of contaminants

Status quo (2023) first tranche

➤ PACAS (powdered active carbon)

- WWTP Leiden Noord (HH Rijnland) (in operation)
- WWTP Simpelveld (Ws Limburg)
- WTPP Oijen (W Aa en Maas) (in operation)
- WWTP Groesbeek (Ws Rivierenland)

➤ Ozone

- WWTP Wervershoof (HH Hollands Noorderkwartier) (in operation)
- WWTP Houten (HH De Stichtse Rijnlanden) (in operation)
- WWTP Hapert (Ws De Dommel)
- WWTP Woerden (HH De Stichtse Rijnlanden)?

➤ Ozone + Active carbon filtration

- WWTP Horstermeer (Waternet)
- WWTP Winterswijk (Ws Rijn en IJssel)
- WWTP Dinther (Ws Aa en Maas)

First full scale PACAS installation in operation in 2021 (Water board Rijnland)



Small footprint..



Opening, September 30th 2021

Monitoring and sharing experiences

- Extended monitoring program to assess effectiveness of additional treatment steps
 - Chemical analyses
 - Bio-assays (ecotoxicological effects)
 - Side effects: nutrients, disinfection, AMR
- Community of Practice and User Groups



Implementation depends on people (a lot of enthusiastic people involved)..



Tell your story..

Learning by doing..



In de doseerinstallatie, onder de grote opslagsilo,

New insights during the program

- ⇒ Introduction of a bromate standard for surface water (1 µg/l)
- ⇒ Debate on trade off between water quality and energy consumption, CO₂ footprint and costs
- ⇒ Experience with (for water boards) new technologies challenges getting installations in operation
- ⇒ Limited availability of companies for designing and building
- ⇒ Rising prices (lack of materials)
- ⇒ Debate on sampling and analysis
- ⇒ Change of list of 11 compounds (presence in waste water)
- ⇒ ..

Dilemmas and Challenges for further implementation

- Framework water quality directive
(pharmaceuticals not included yet, investments for nutrients <2027)
- Increasing number of (organic) contaminants will appear in WWTTP effluent, upcoming standards for individual compounds (eg diclofenac)
- Increased insight in presence and (eco)effects of contaminants in water
- Need for removal of a broad spectrum of organic micropollutants?
- Meet multiple goals: water quality, climate foot print, circular economy,...
- Opportunity: reuse of WWTTP effluent, business case!?
- Fit for purpose treatment (and flexible towards future developments)

Upcoming Urban Waste Water Directive: the next step

- ⇒ 80% removal (compared to 70%) of a selected (slightly different) group of pharmaceuticals, higher standard?
- ⇒ Treatment plants > 200.000 pe
- ⇒ Hotspots (location with increased risk), Dutch hotspot analysis?
- ⇒ Standards for priority compounds (eg diclofenac)
- ⇒ Proven technologies sufficient?
- ⇒ 2nd tranche: Implementation of technologies from the innovation program: future proof technologies!?
- ⇒ Fit for purpose treatment not one technology fits all..

Challenges for the water boards

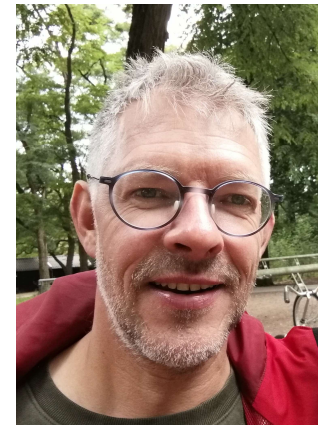
- ⇒ Focus on pharmaceuticals or other components as well?
- ⇒ Which WWTPs?
- ⇒ Which technology?
- ⇒ Investments?
- ⇒ Energy consumption and CO₂ foot print?
- ⇒ Availability of sufficient personnel and manufacturers
- ⇒ Planning for the next plan periods
(2028-2033, 2034-2039,..)

A major effort!



Thank you for your attention!

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stowa

**Tackling Micropollutants in Wastewater
Results of the Dutch Innovation and Implementation Program**

**November 8 and 9 2023
Aquatech Amsterdam**



*Ministry of Infrastructure
and Water Management*