Closing the water cycle in North-Holland

Beyond the ambition of 70% reduction of 7 out of 11 pharmaceuticals

HHNK, PWN and PWNT

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Dutch Innovation on Micropollutants Removal from Municipal Wastewater

November 7th 2019 Aquatech Amsterdam

Target compounds I&W

		Blank		Ozonation
Compound	**Unit**	**Regime 0**		**Regime 1**
Diclofenac	[ng/L]	1988		94%
Metoprolol	[ng/L]	2303		38%
Trimethoprim	[ng/L]	1738		84%
Sulfamethoxazol	[ng/L]	977		90%
Carbamazepine	[ng/L]	1546		86%
Sotalol	[ng/L]	2813		80%
Propranolol	[ng/L]	1701		78%
Hydrochlorothiazide	[ng/L]	10215		26%
Clarithromycine	[ng/L]	5120		75%
Benzotriazol	[µg/L]	21		39%
4-Methylbenzotriazol	[µg/L]	9		36%
5-Methylbenzotriazol	[µg/L]	8		38%
Ibuprofen	[ng/L]	39971		20%
17B Estradiol (E2)	[pg EEQ/L]	9264		NVT
Iopromide	[ng/L]	1453		4%
Metformin	[ng/L]	2486		16%

- Ozone uptake
  - 3.05 [mg/L]
  - 0.36 [mg O_3/mg DOC]
  - bromate formation 0.23 [µg/L]
- 7 of 11 compounds degrade with 70% or more

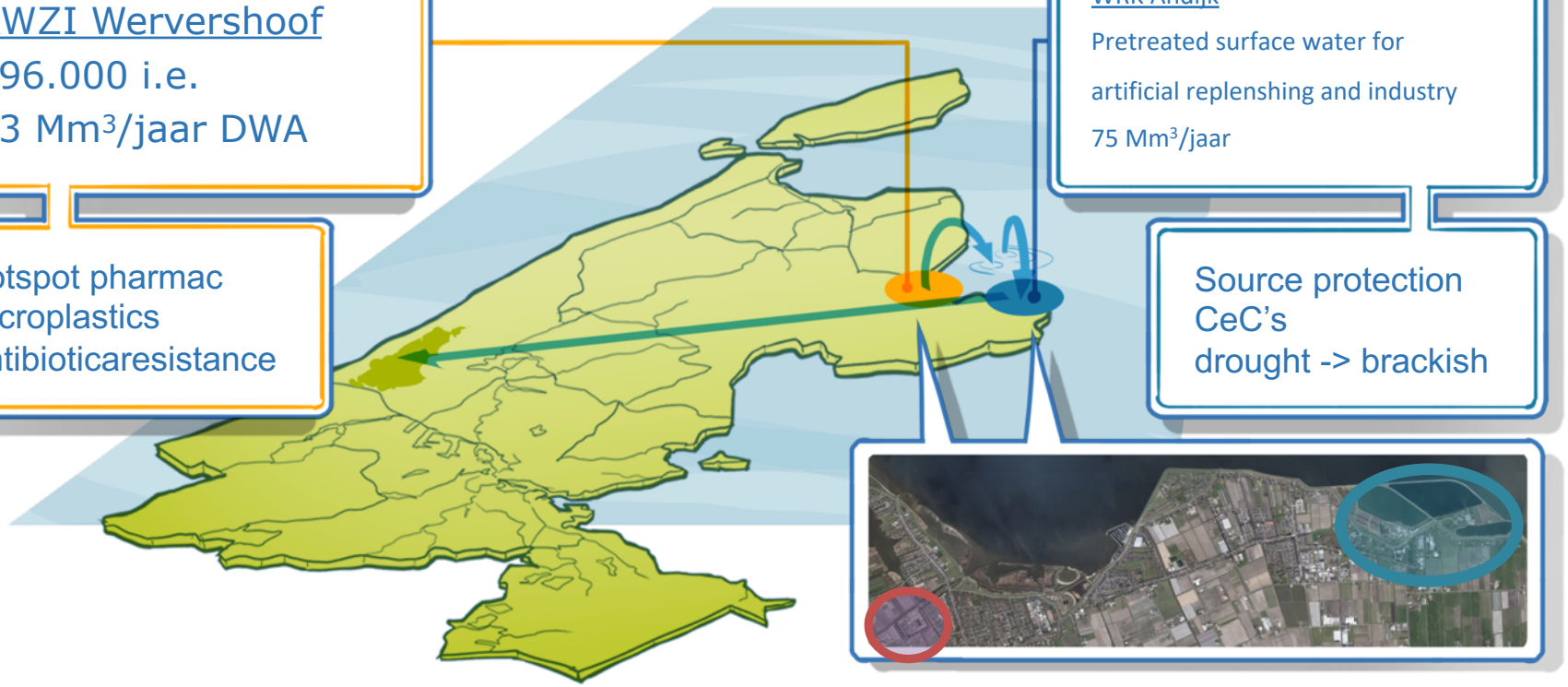
Unique situation

HHNK
RWZI Wervershoof
296.000 i.e.
13 Mm^3/jaar DWA

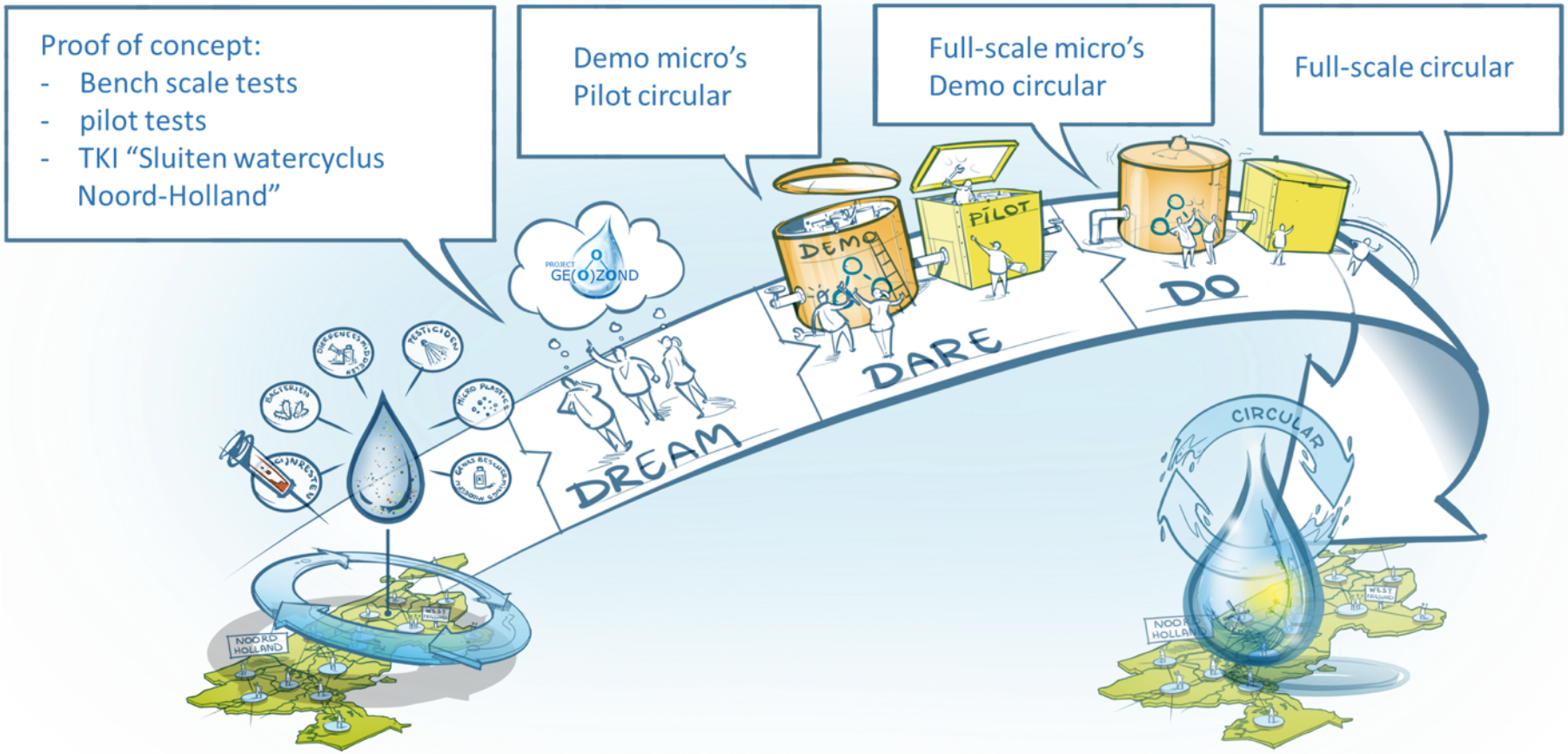
Hotspot pharmac
Microplastics
Antibioticaresistance

PWN
WRK Andijk
Pretreated surface water for
artificial replenshing and industry
75 Mm^3/jaar

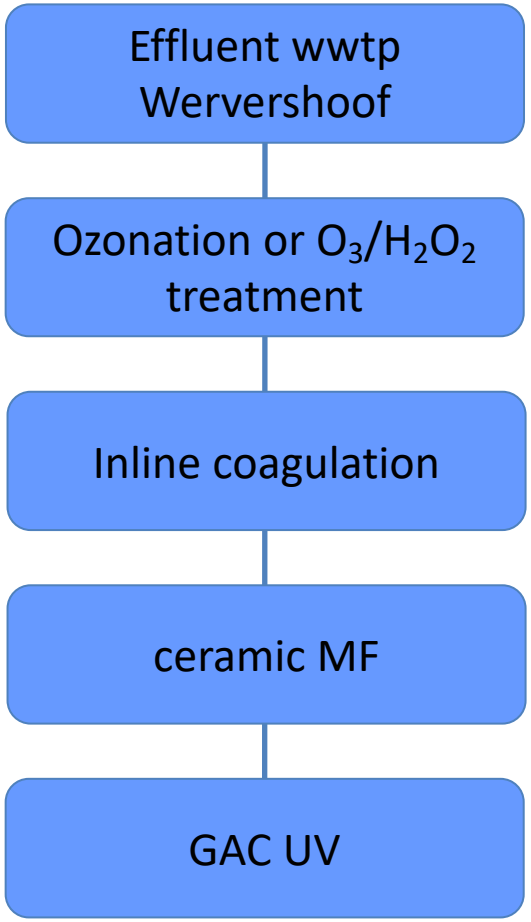
Source protection
CeC's
drought -> brackish



Roadmap towards reuse



Reuse scheme to meet WRK quality



Source for re-use, determine composition and quality variation

Oxidation of micropollutants and MF flux enhancement

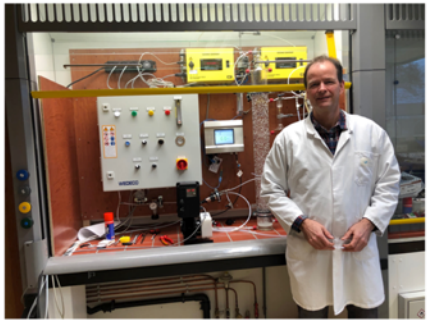
Enhance flux and membrane performance
Improve retention and provide NOM removal

Removal of suspended matter microplastics and bacteria

Post treatment

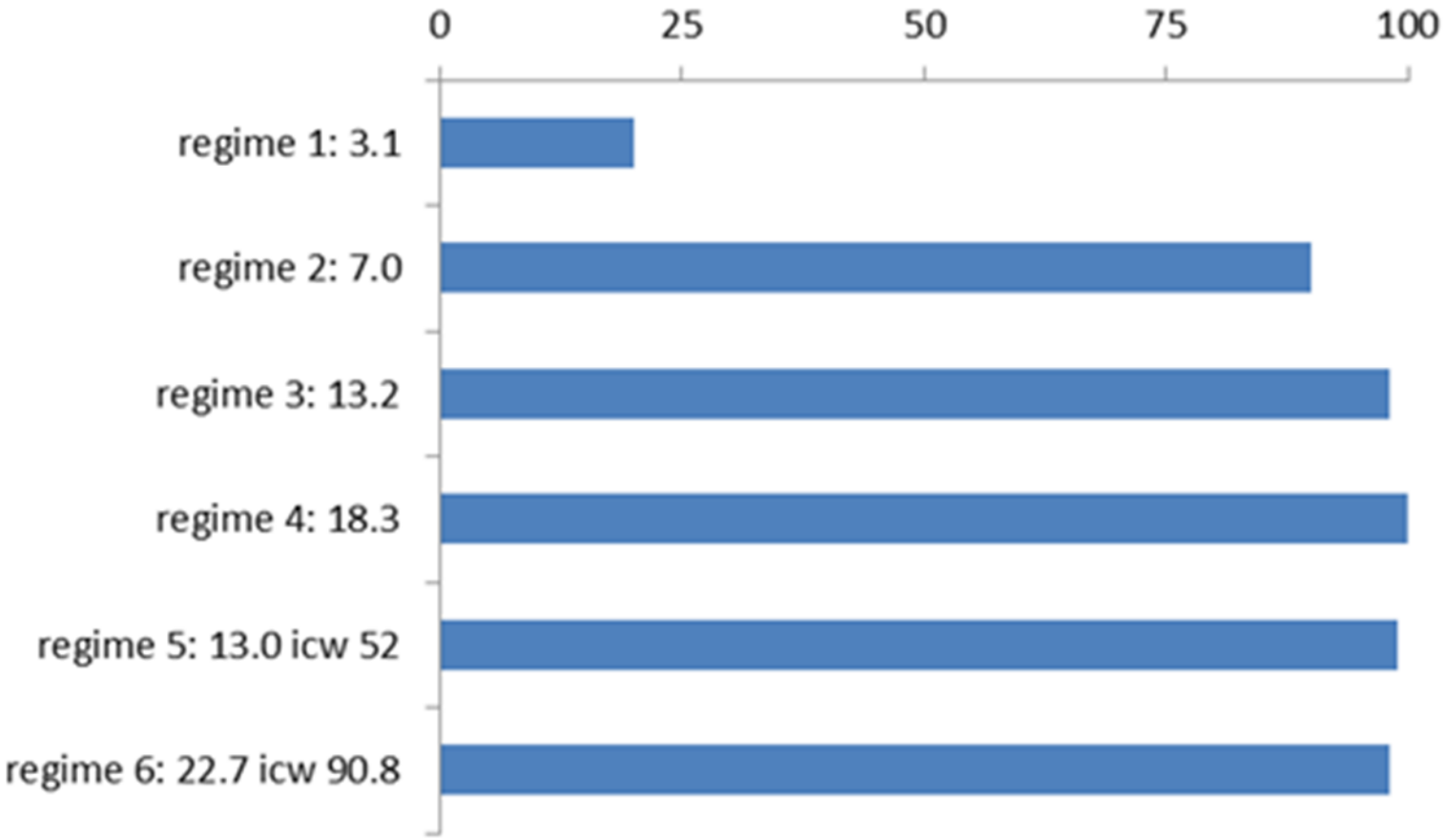
Feasibility research program

3 year's
and
€ 500.000,--

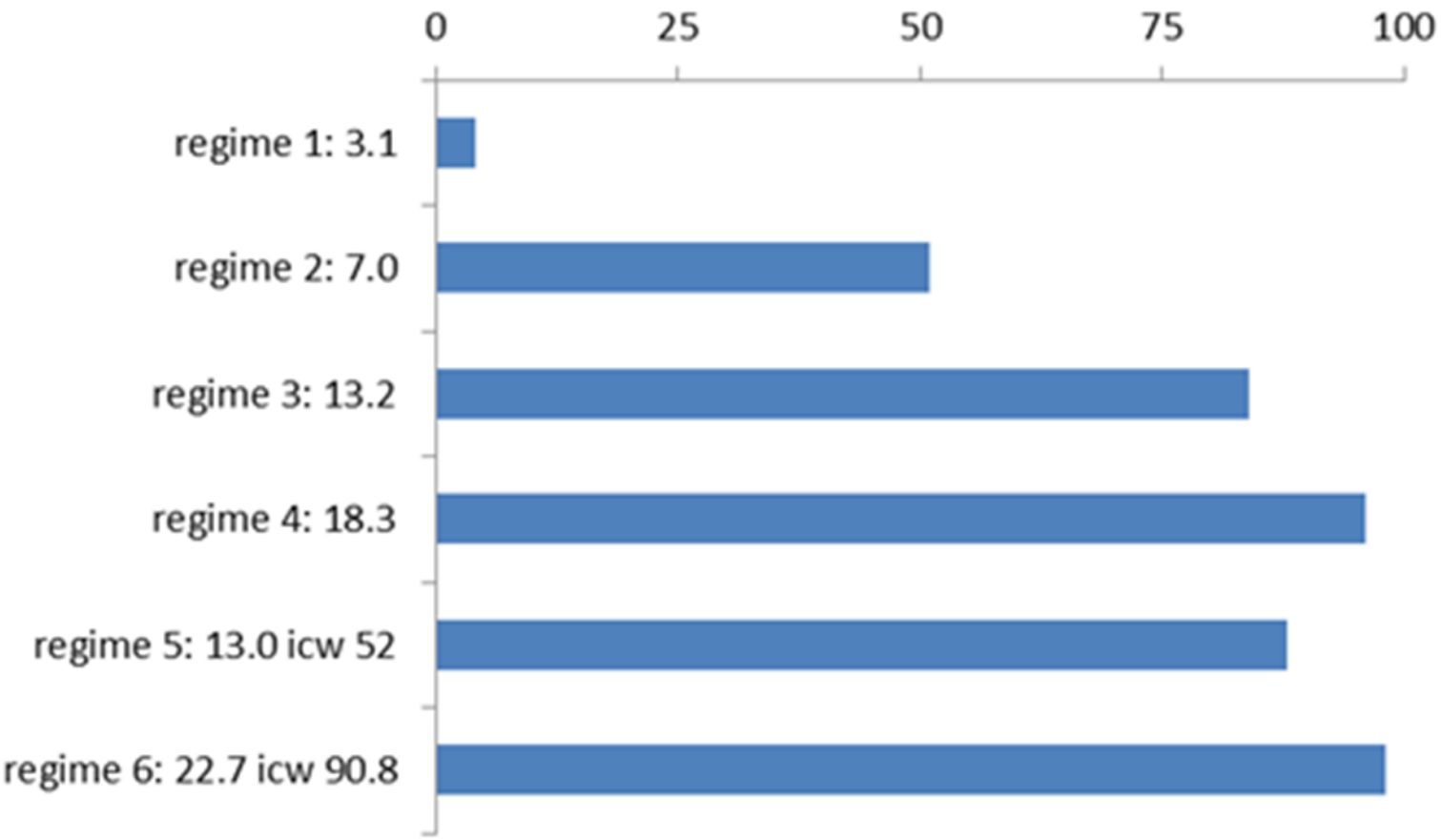


PROJECT
GE(O)ZOND

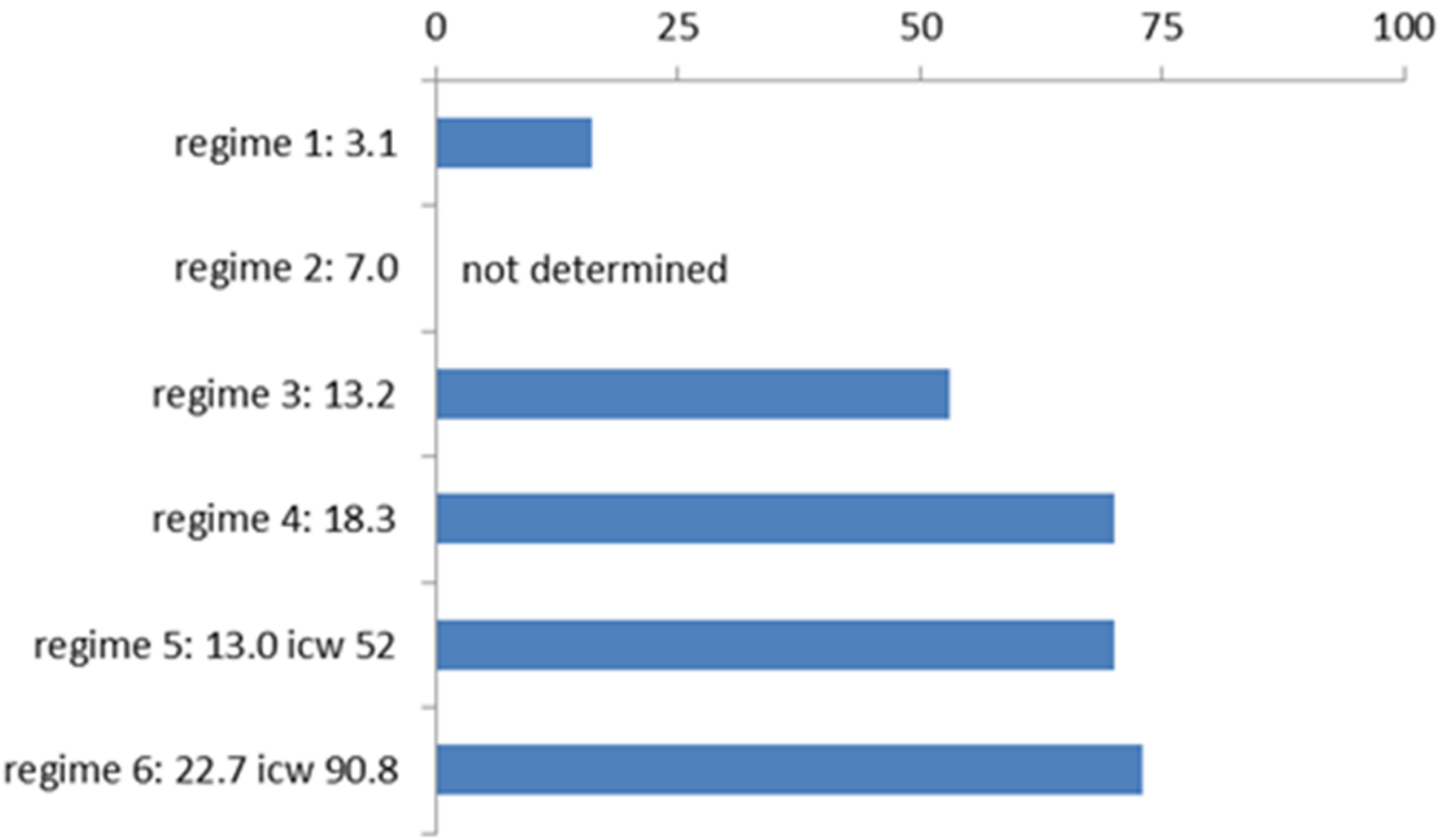
Ibuprofen degradation by O_3 and O_3/H_2O_2 treatment



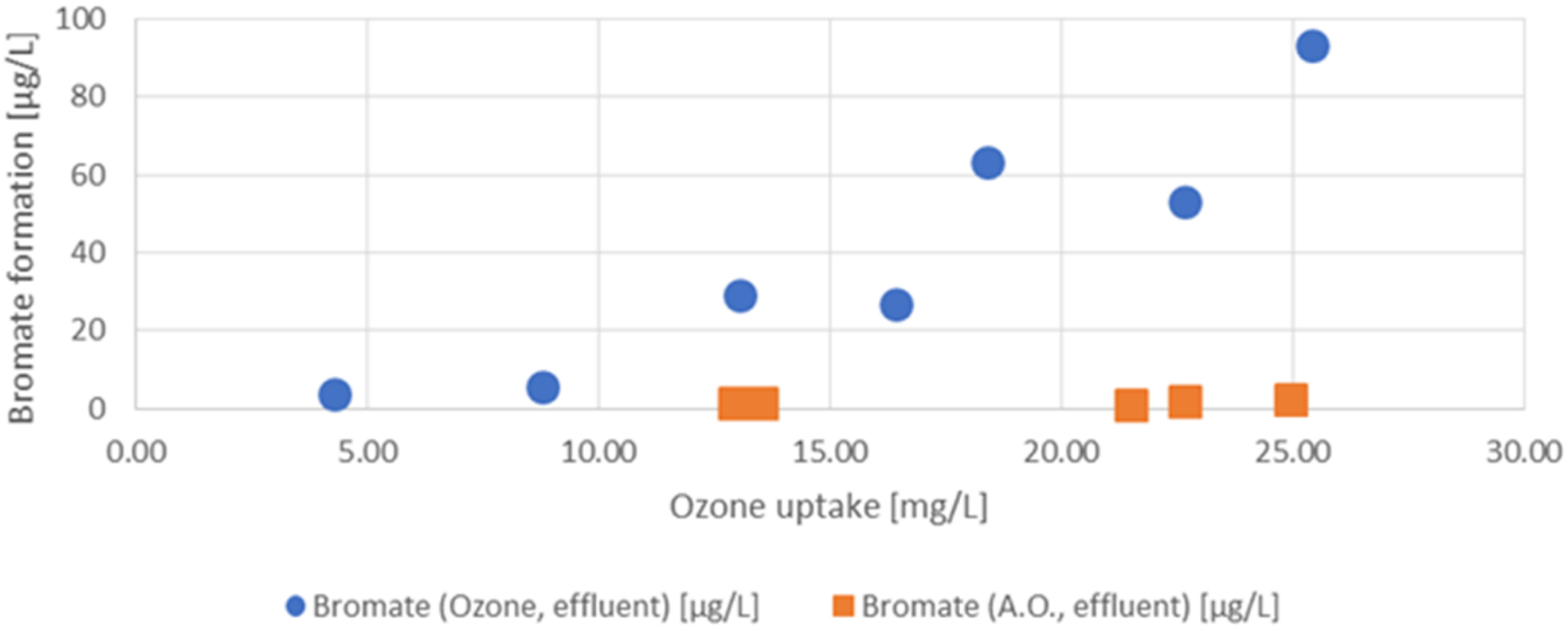
Iopromide degradation by O_3 and O_3/H_2O_2 treatment



Metformine degradation by O_3 and O_3/H_2O_2 treatment



Bromate formation as a function of ozone uptake by O_3 and O_3/H_2O_2 treatment



Results re-use investigations

Reuse feasible within North Holland context; WRK quality is treatment objective

Pilot required to determine the process conditions and confirm (economical) feasibility

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Evaluation

comparing apples to oranges to bananas

Evaluation

Criterium+	Score in respect to ozonation + sandfiltration or PAC in activated sludge
Removal of micropollutants	++
CO2 footprint	-
VALUE	+++
Ecotoxicity	0 / +
Microplastics	++
Antibiotic resistance	+++

Further research

1-5 m^3/h automated reuse pilot

- Determine design criteria reuse scheme
  - Flux 75 $l/m^2/h$ – 200 $l/m^2/h$?
  - Ozone (H2O2) dosage
  - Coagulant type and dose

- Confirm water quality for selected conditions
  - Determine necessity post treatment

- Evaluate waste streams

- Determine costs, CO_2 footprint, social acceptance

Thank you for your attention!

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