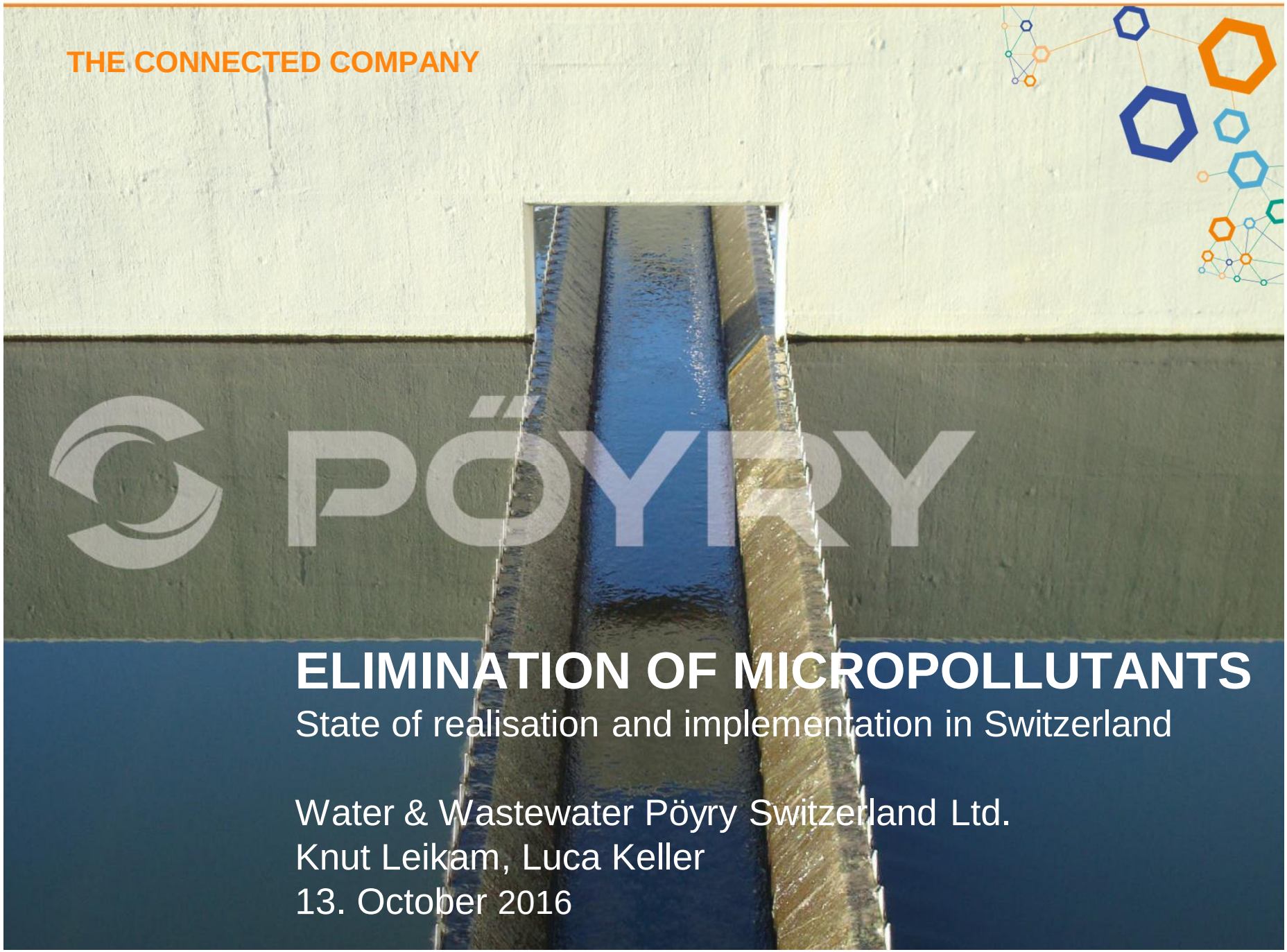
THE CONNECTED COMPANY



ELIMINATION OF MICROPOLLUTANTS

State of realisation and implementation in Switzerland

Water & Wastewater Pöyry Switzerland Ltd.
Knut Leikam, Luca Keller
13. October 2016

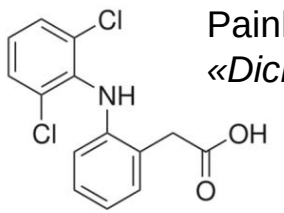
AGENDA

1. Reasons for action
2. Swiss legislation
3. Technical solutions
4. State of implementation in Switzerland
5. Capital and operating costs
6. Outlook
7. Experience Pöyry Switzerland

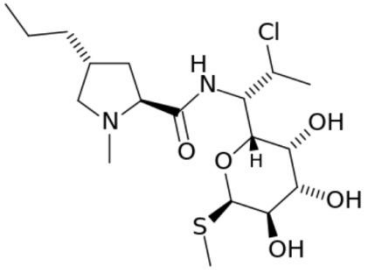
1. REASONS FOR ACTION

Micropollutants- a definition

- Mostly organic substances with toxic, persistent and bioaccumulative properties
- Present in multiple products of daily use:
  - Drugs
  - Cosmetics
  - Detergents
  - Biocides
- Several scientific studies show presence of micropollutants in the aquatic environment (tendency ↑)
- One of the main entry paths is municipal and industrial wastewater



Painkiller
«Diclofenac»

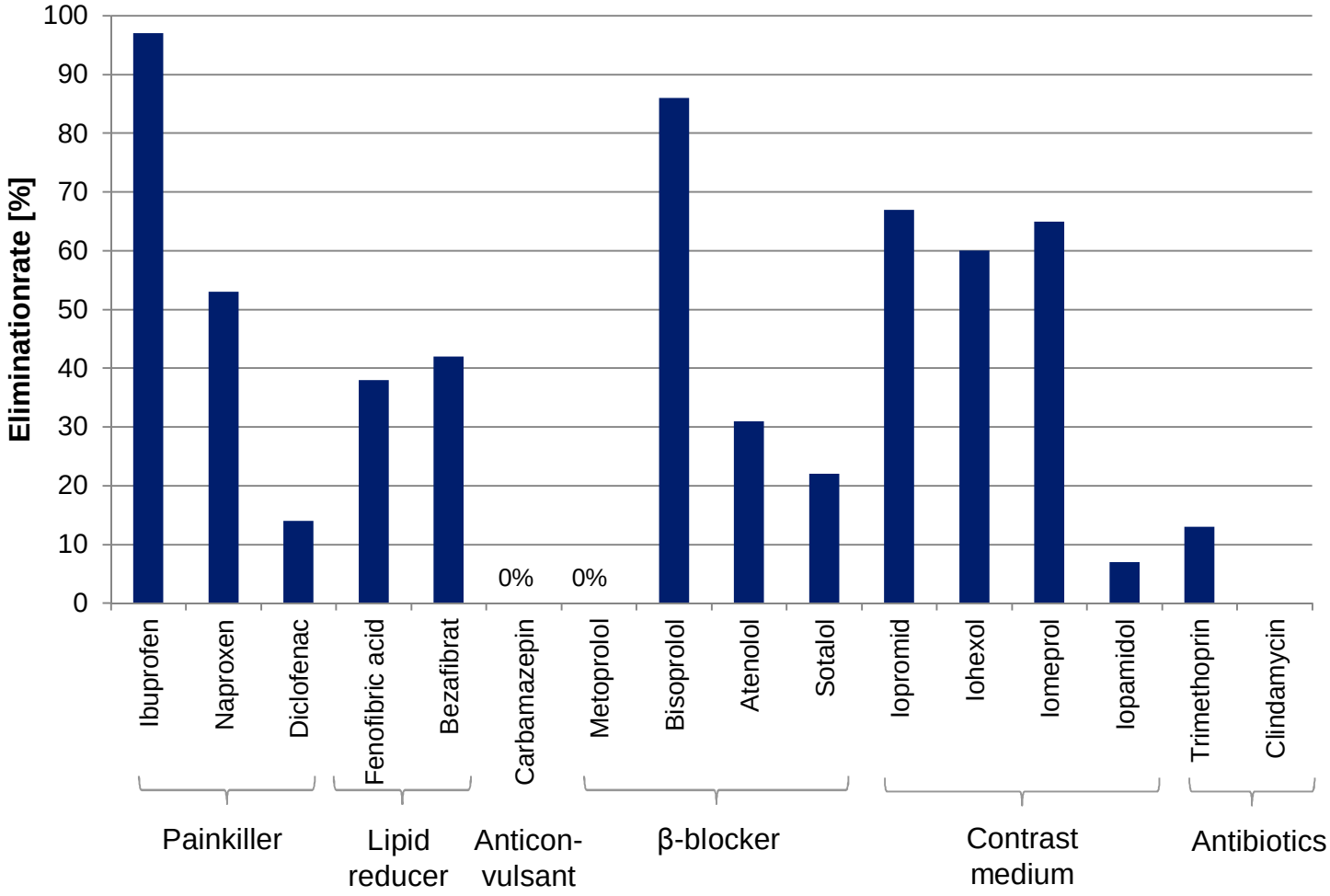


Antibiotic
«Clindamycin»

Stoichiometry: wikipedia.com

1. REASONS FOR ACTION

Elimination rates with conventional treatment
(biological activated sludge systems)



Data: Averaged 24h-composite samples from treatment plant of Steinhäule, Ulm, Germany

2. SWISS LEGISLATION

General requirements[1]

Mandatory actions for Wastewater Plants with:

- ≥ 80’000 connected residents
- ≥ 24’000 connected residents in the catchment area of lakes
- ≥ 8’000 connected residents that discharge into a watercourse containing more than 10 % waste water
- other plants with ≥ 8’000 connected residents, if the removal is required due to special hydrogeological conditions

Effluent requirements

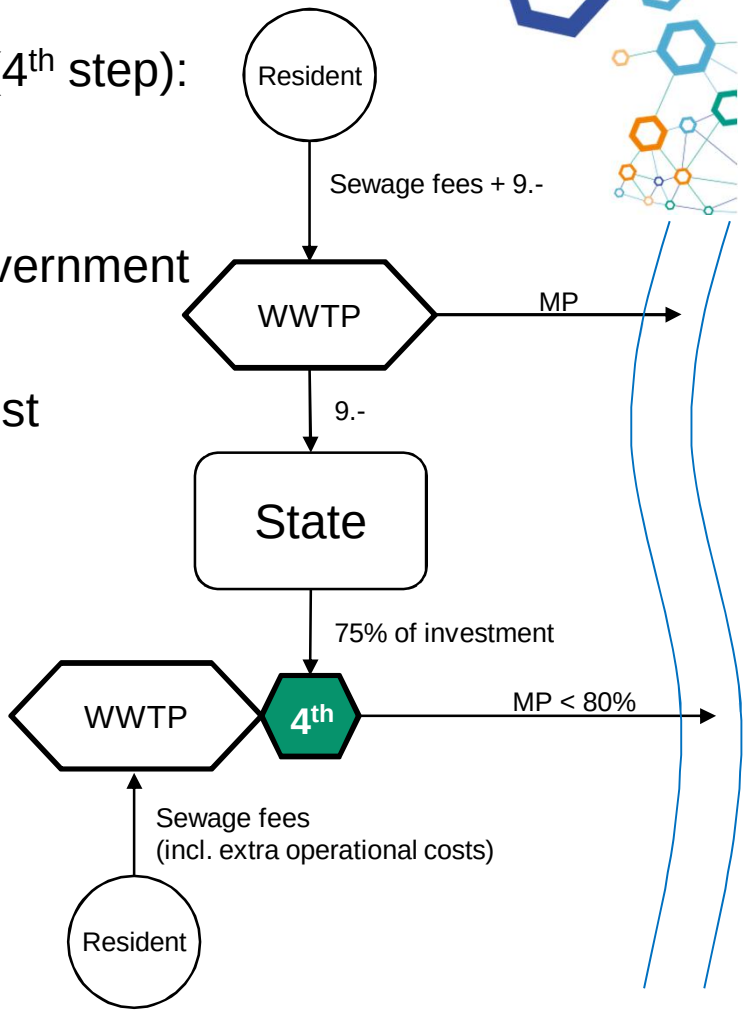
- Removal for selected trace substances ≥ 80%

[1]Water Protection Ordinance (WPO), Annexe 3.1, General requirements. Status 02.02.2016

2. SWISS LEGISLATION

Method of finance[2]

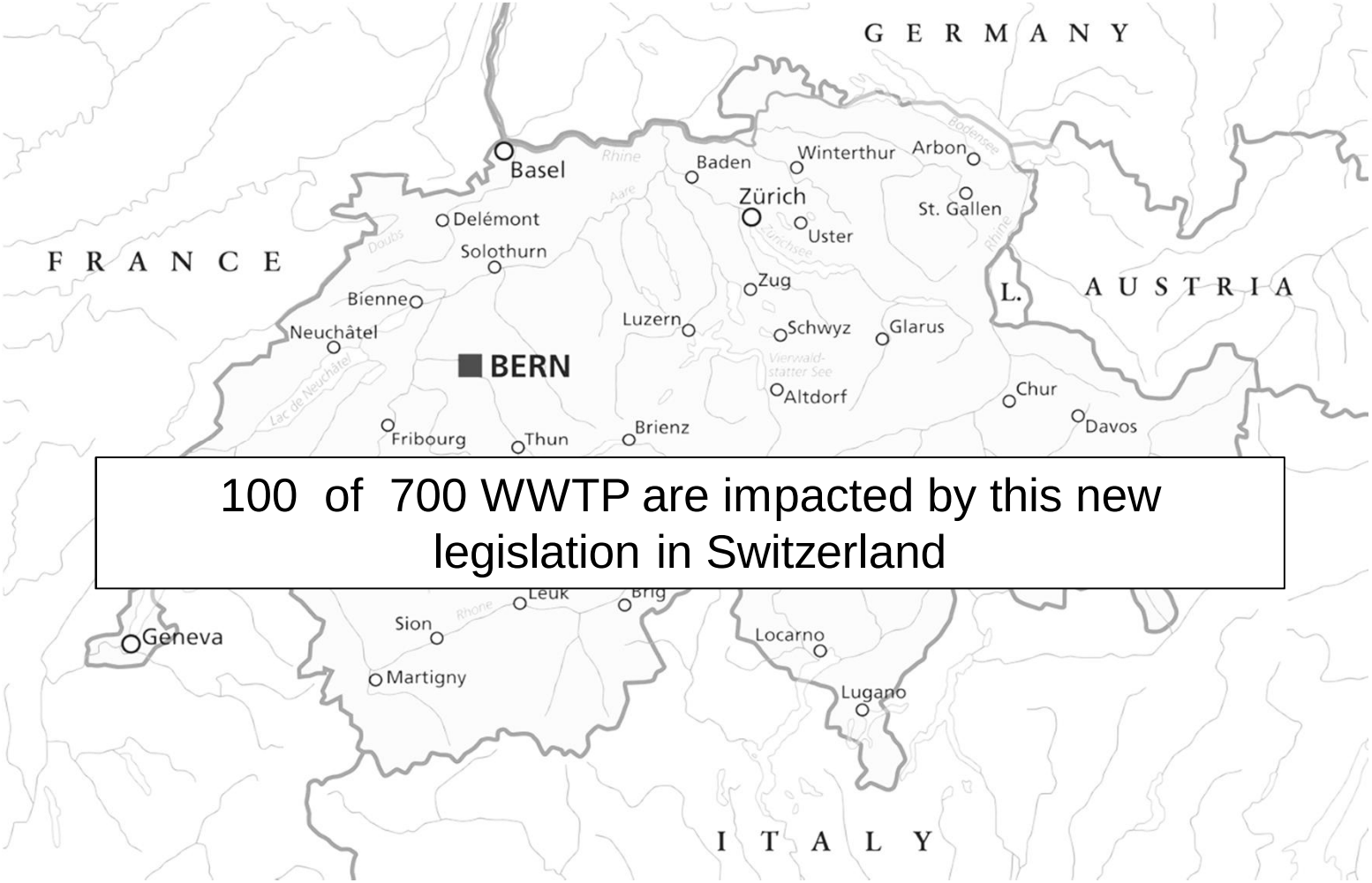
- Tax for plants without additional treatment (4th step): 9 CHF per connected resident per year
- Tax is deposited in a fond of the federal government
- Federal government grants 75% of the invest costs to operators paid from that fond
- Plants with 4th treatment step: No requirement for tax payments but additional OPEX
- Polluter pays principle: Inhabitants pay either the extra tax or the additional operation costs of the treatment step via sewage fees



[2]Federal Act on the Protection of Waters, Art. 60b. Status: 01.01.216

2. SWISS LEGISLATION

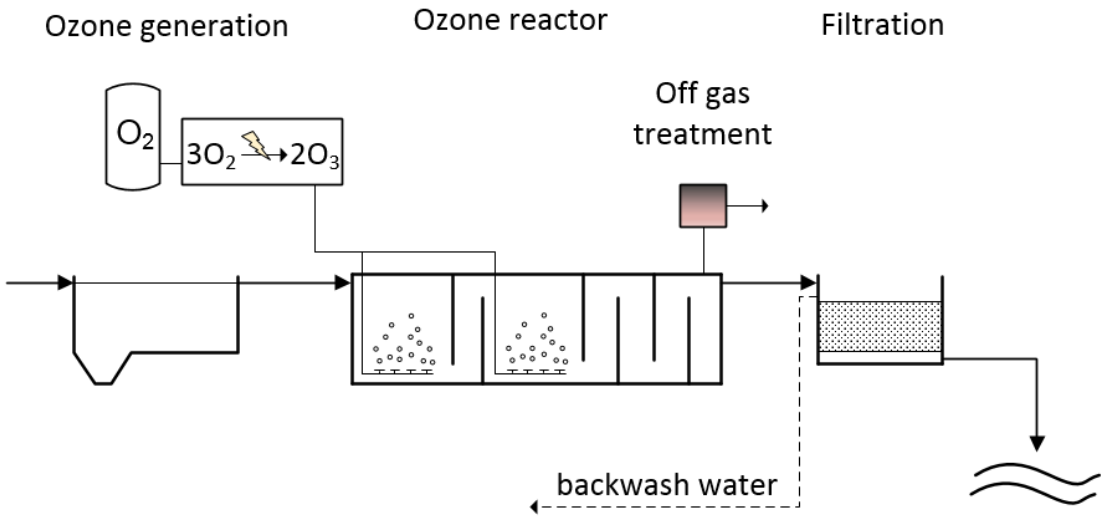
Impact



100 of 700 WWTP are impacted by this new legislation in Switzerland

3. TECHNICAL SOLUTIONS

Ozonification



Advantages	Drawbacks
Removal of a wide range of micropollutants	Oxidation by-products (e.g. Bromate)
No influence on the biological treatment	High requirements regarding work safety
Additional disinfection	High energy costs

3. TECHNICAL SOLUTIONS

Ozonification

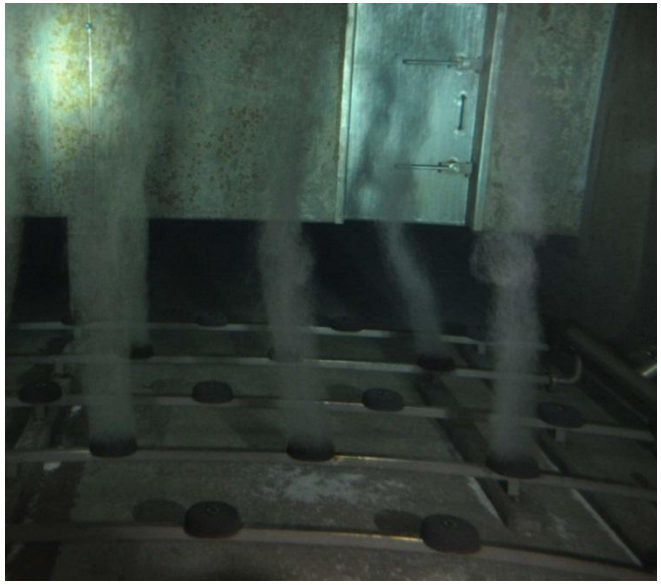
O_2-Storage

© pangas.ch

Ozon generation:

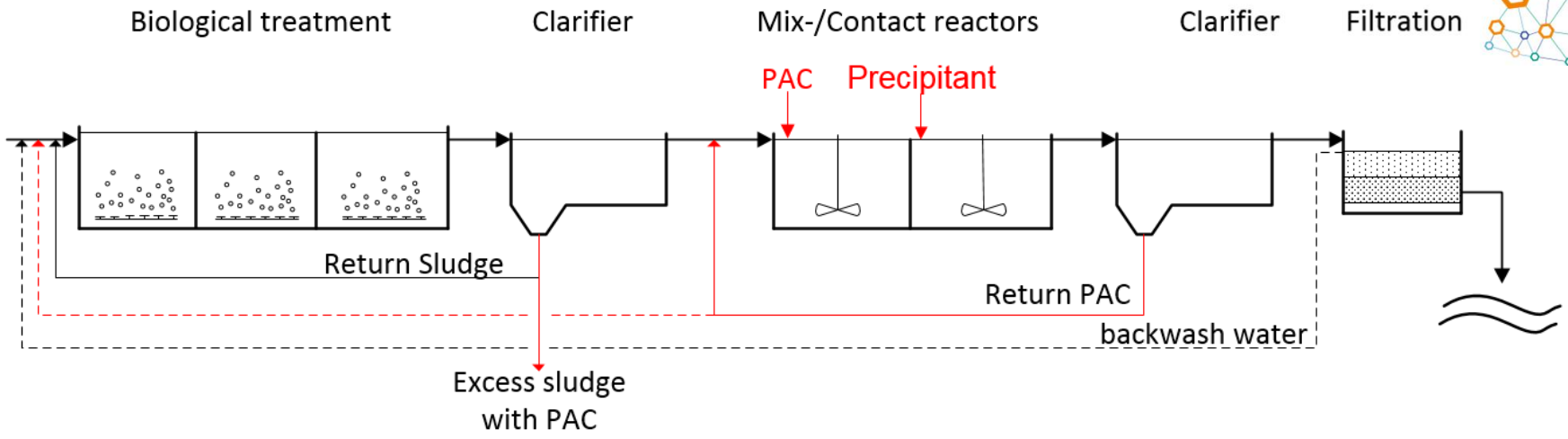
© ozonia.com

Reactorbasin + Diffusers:



3. TECHNICAL SOLUTIONS

Powder Activated Carbon (PAC) - Standard



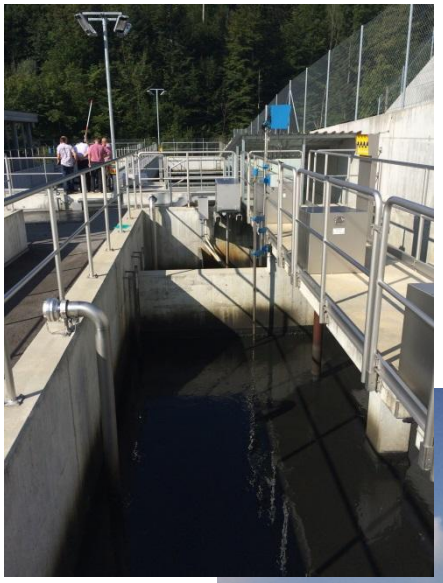
Advantages	Drawbacks
Flexible process	Higher sludge production
Removal of a wide range of micropollutants	Higher costs regarding sludge treatment
Improvement of further water parameters (DOC, Ptot, Color)	Higher space requirements

3. TECHNICAL SOLUTIONS

Powder Activated Carbon (PAC)

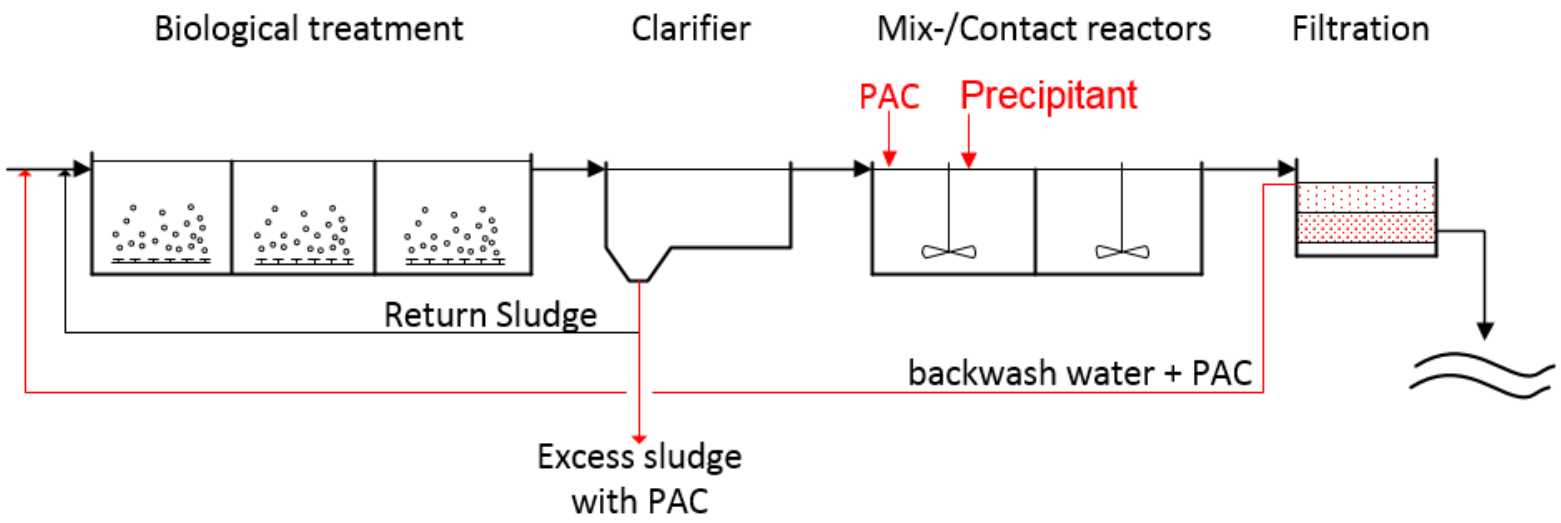
Silo Storage:

Reaction basins:



3. TECHNICAL SOLUTIONS

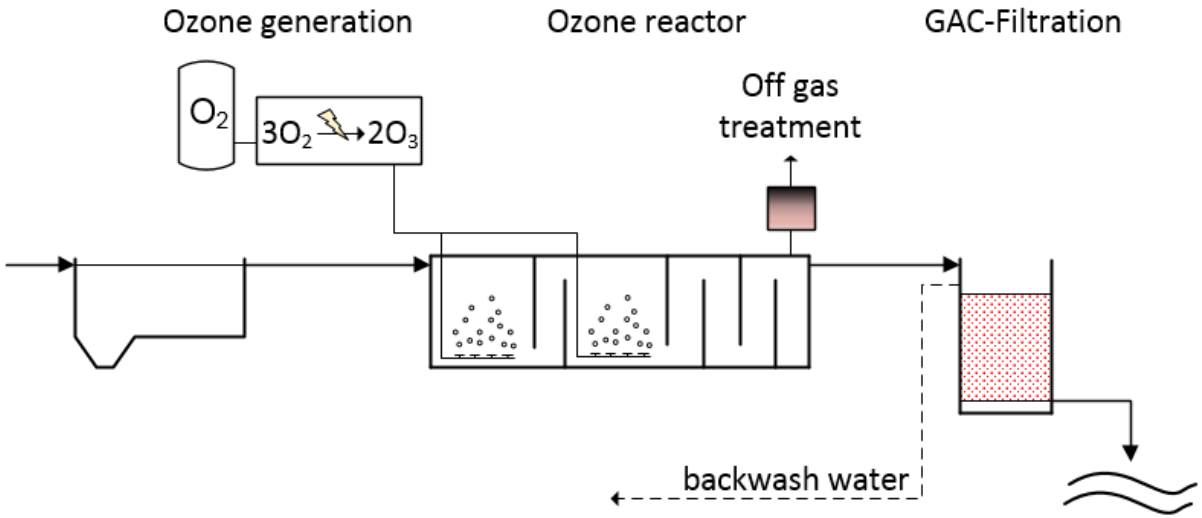
Powder Activated Carbon (PAC) – ”WTTP Schönau”



Advantages	Drawbacks
No PAC-sedimentation basins (i.d. smaller space and capital requirements)	Higher load to filtration
Eased integration in existing plants	Possibly more backwashing
Less pumping	2-layer filter necessary

3. TECHNICAL SOLUTIONS

Combined processes

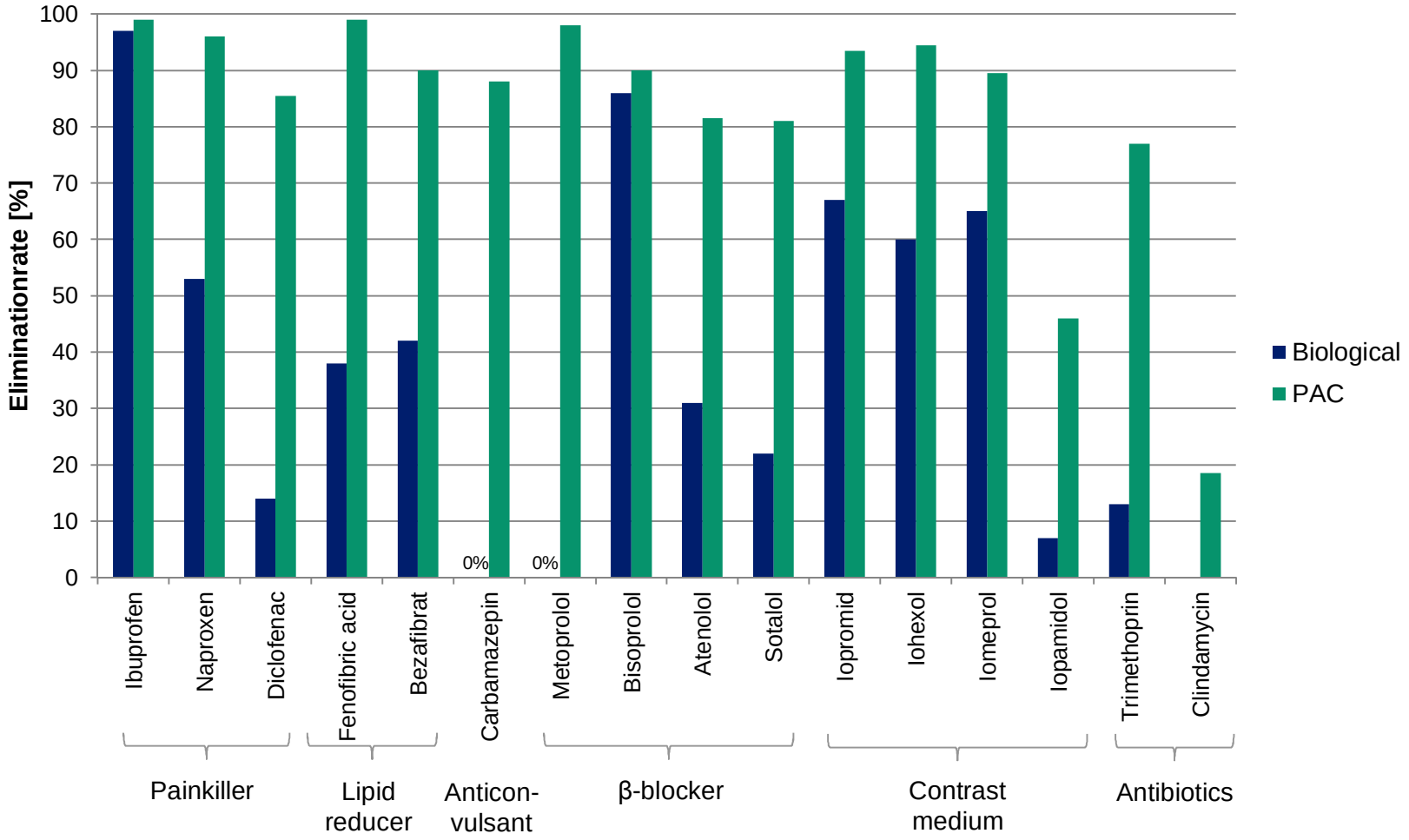


GAC: Granular activated carbon

Advantages	Drawbacks
Less oxidation by-products (e.g. Bromate)	Decreasing adsorption capabilities
Lower O_3-concentrations needed	Changing of GAC necessary
Smaller space requirements	High investment costs

3. TECHNICAL SOLUTIONS

Elimination rates



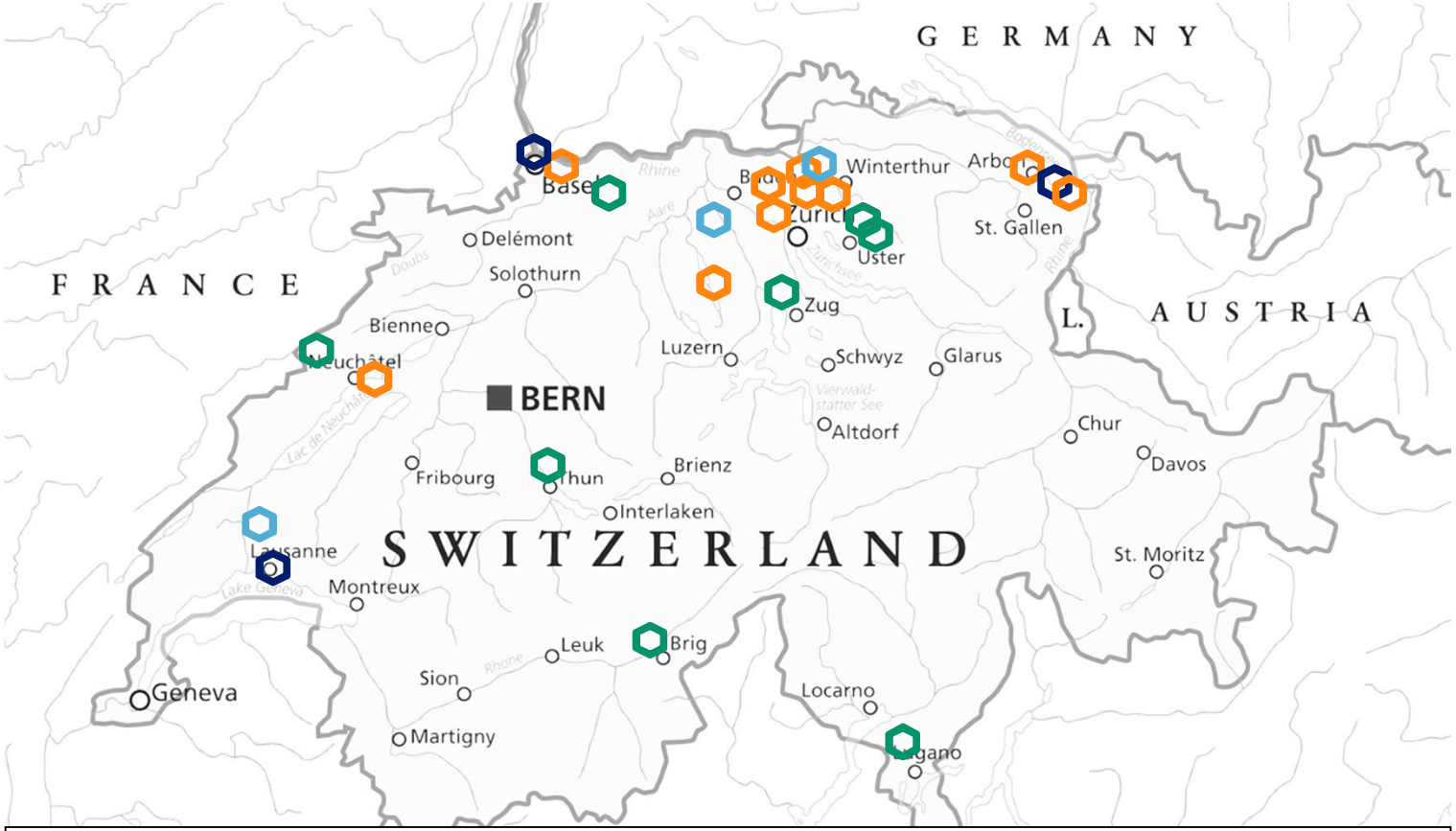
Data: Averaged 24h-composite samples from treatment plant of Steinhäule, Ulm, Germany

4. STATE OF IMPLEMENTATION

In operation

4. STATE OF IMPLEMENTATION

Research and evaluation phase



PAC	Combined processes
Ozonification	Granular activated carbon

5. COST

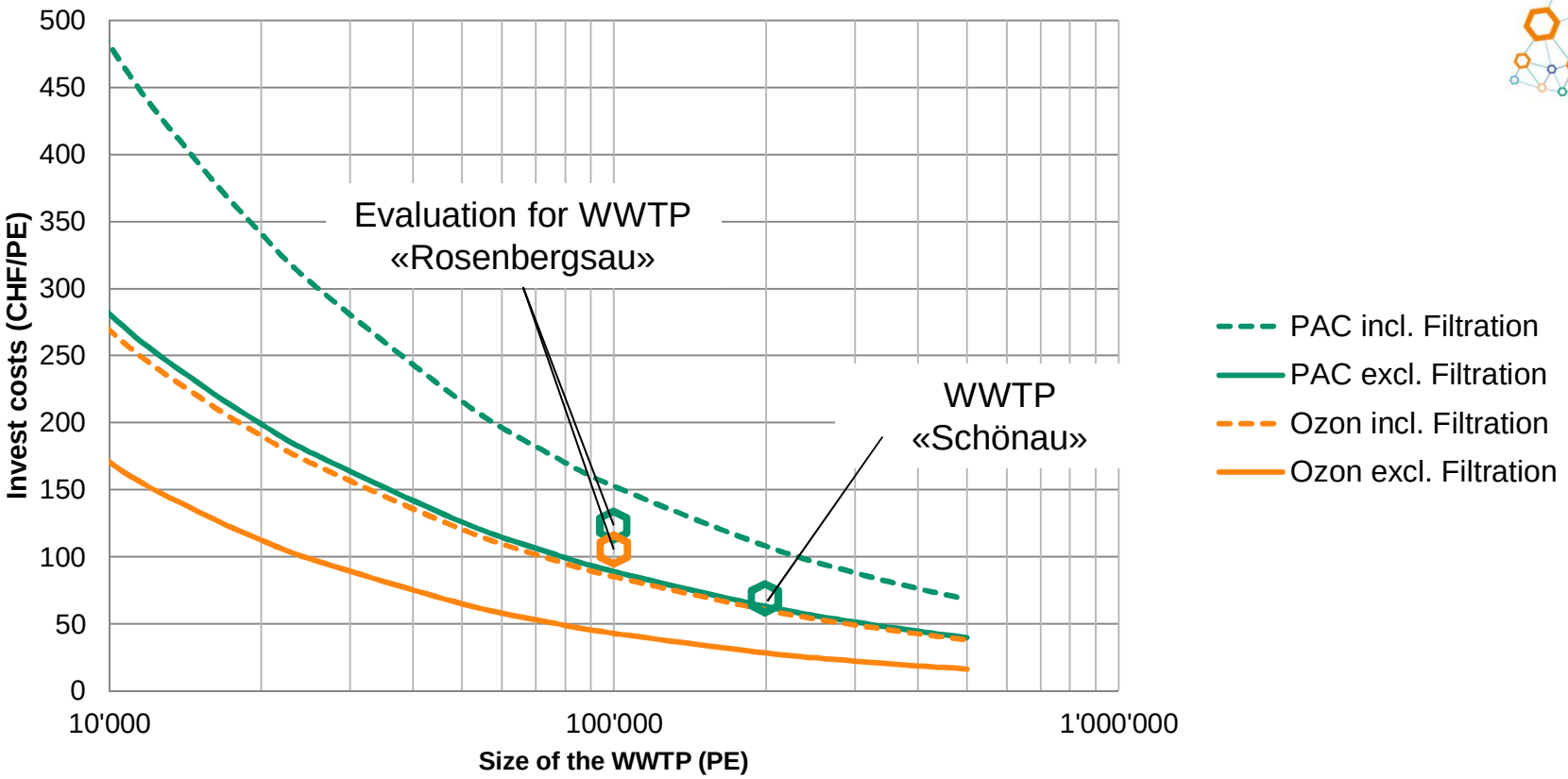
Pöyry Switzerland experience

WWTP:		Rosenbergsau		Schönau
Indicator	Unit	Ozon + new Filtration	PAC + new Filtration	PAC + existing Filtration
PE	-	101’000	101’000	180’000
Investment sum	mio CHF	11.3	12.3	11.3
	CHF/PE	112	122	63
Capital Costs	CHF/PE/a	7.2	7.6	4.0
Operating Costs	CHF/PE/a	3.6	5.3	4.5

1 EUR = 0.91 CHF

5. INVESTMENT SUM

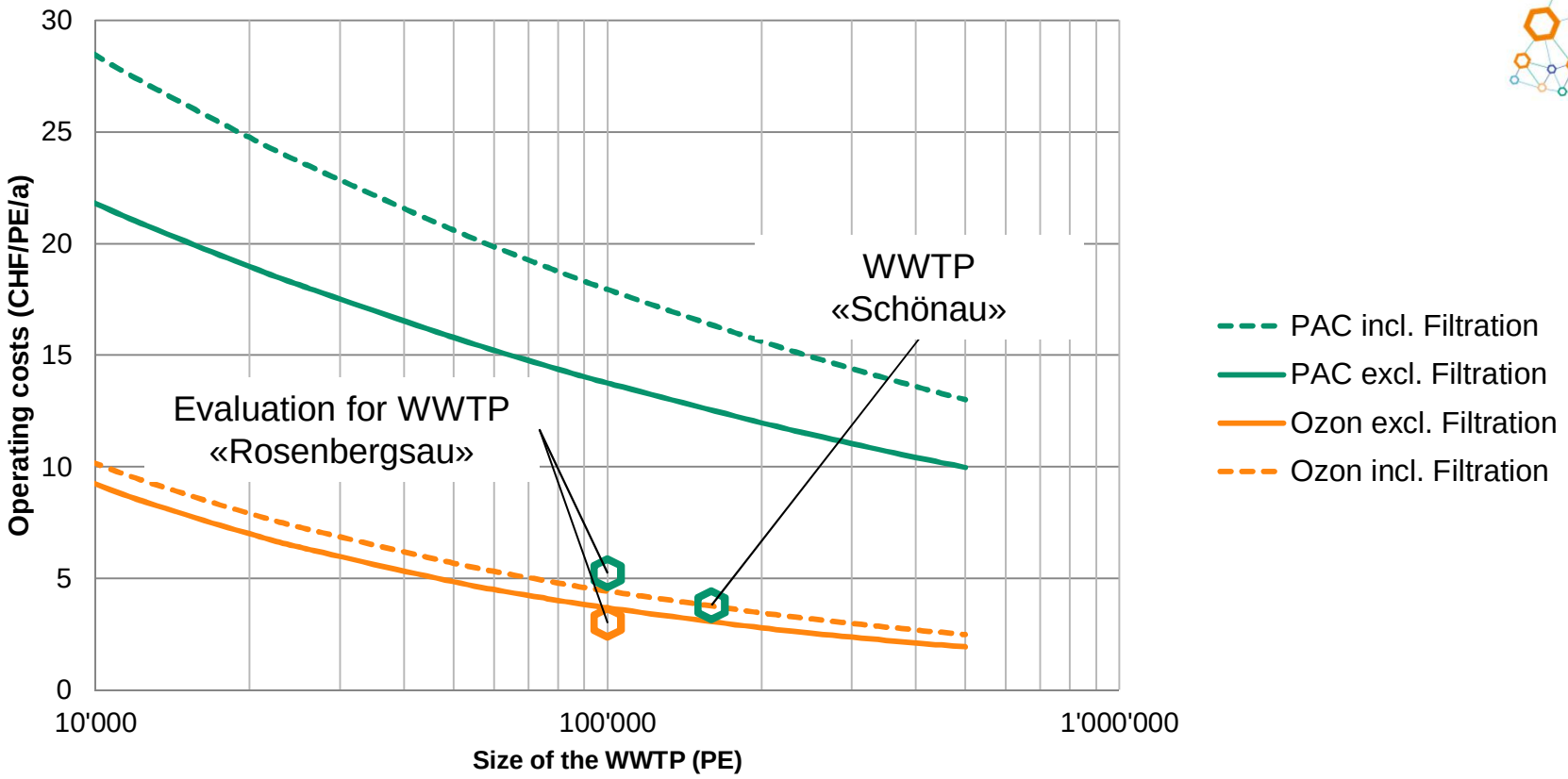
per population equivalent (PE)



Source: «Kosten der Elimination von Mikroverunreinigungen im Abwasser», BG Engineering and Consulting AG, on behalf of BafU, 02.04.2012

5. OPERATING COSTS - OPEX

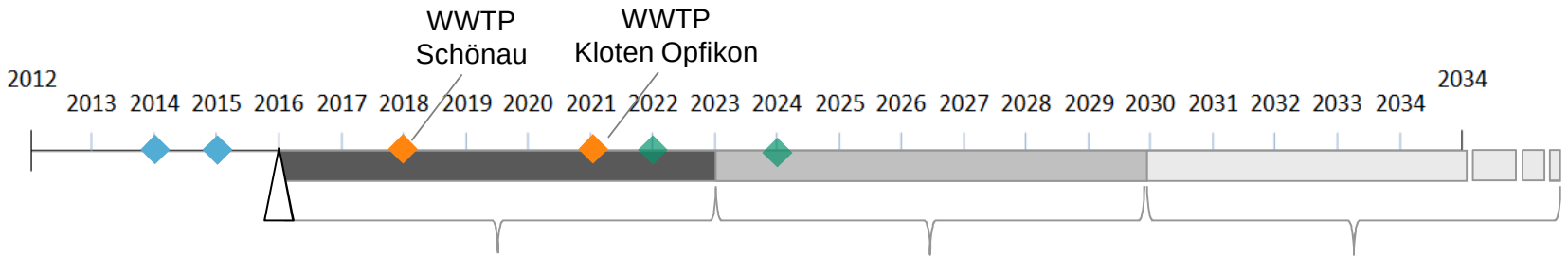
per population equivalent (PE) and year



Source: «Kosten der Elimination von Mikroverunreinigungen im Abwasser», BG Engineering and Consulting AG, on behalf of BafU, 02.04.2012

6. OUTLOOK

- Updated plants in operation
- Pöyry Switzerland projects (commissioning)
- Pöyry Switzerland projects in pipeline



Class	K1	K2	K3
Nr. of WWTP's	13	21	75
Capital costs:	291 mio. CHF	235 mio. CHF	560 mio. CHF

K1: WWTP ≥ 80'000 connected residents
K2: WWTP ≥ 24'000 connected residents in the catchment area of lakes
K3: WWTP≥ 8'000 connected residents that discharge into a watercourse containing more than 10 % waste water

Source: «Kosten der Elimination von Mikroverunreinigungen im Abwasser», BG Engineering and Consulting AG, on behalf of BafU, 02.04.2012

7. EXPERIENCE PÖYRY SWITZERLAND

Implementation

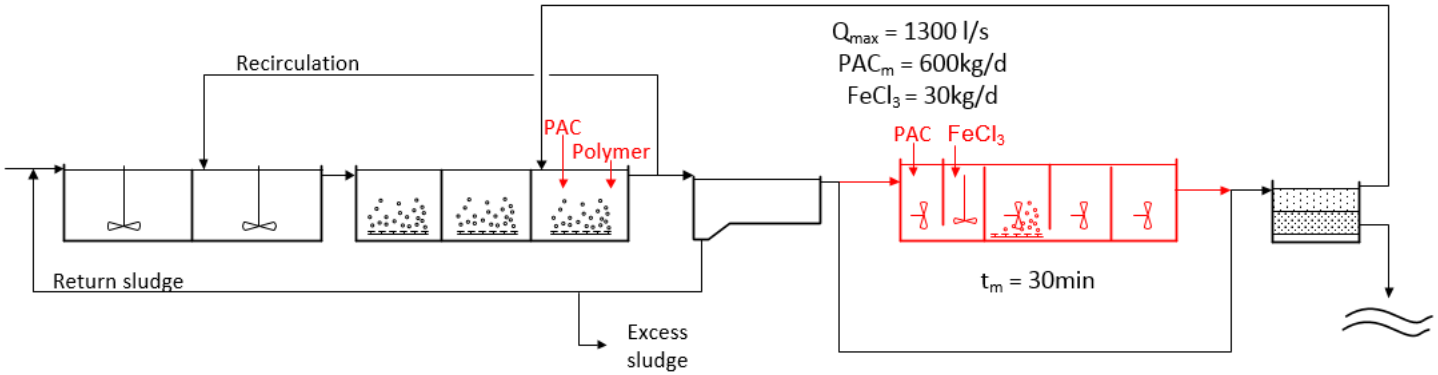
Client

Gewässerschutzverband der Region Zugersee-Küssnachtersee-Aegerisee (GVRZ)

Project

WWTP Schönau (ZG) Extension: removal of micropollutants with PAC

Service: EPCM
Commissioning 2018



7. EXPERIENCE PÖYRY SWITZERLAND

Implementation

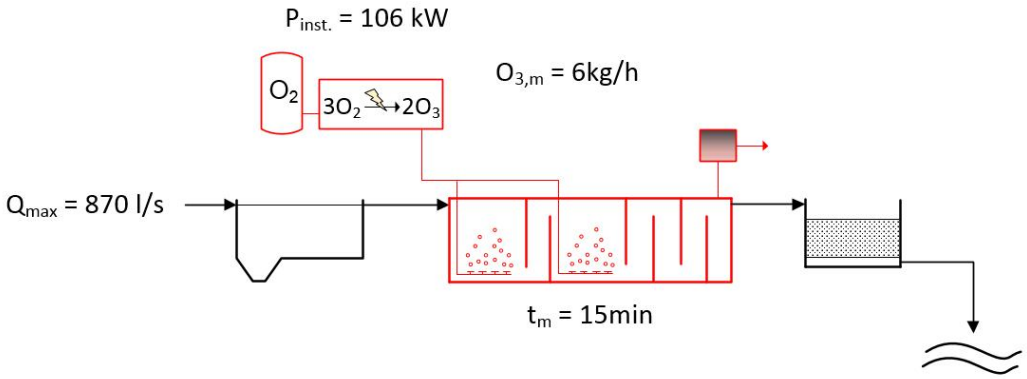
Client

AKO Abwasserreinigung Kloten/Opfikon

Project

WWTP Kloten Opfikon (ZH) Extension: removal of micropollutants with ozonification

Service: EPCM
Commissioning 2021



7. EXPERIENCE PÖYRY SWITZERLAND

Evaluations and Feasability studies

Clients

GVRZ / Municipality Hinwil / Abwasser Uri / Abwasserwerk Rosenbergsau

Projects

- WWTP Hinwil (ZH) extension: removal of micropollutants
- WWTP Andermatt (UR) extension: removal of micropollutants with ozonification
- WWTP Rosenbergsau (SG): pilot scale study for the removal of micropollutants with ozonification and filtration

Services + Engineering

- Feasibility study (PAC, Ozone, UF)
- Research projects with universities, EAWAG

THANK YOU FOR YOUR ATTENTION

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