The New European
Urban Wastewater Treatment Directive

- Updated Information -

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Urban wastewater Directive (91/271/EWG)

33 years ago!

1. Designation of sensitive areas
   - Designation where eutrophication appears, drinkingwater extraction etc.
   - Revision each 2 years
   - In the beginning coastal areas were forgotten
2. Sewer system
   - Implementation of generally accepted standards of technology
3. Industrial wastewater - setting limit values
4. Requirements for discharge from WWTP
   - BOD 25 mg/l
   - COD 125 mg/l
   - Additionally suspended solids 35 mg/l
5. Surveillance –German speciality
   - EU-practice (24-h-mix sample) → 2-h or qualified random sample
6. Situation reports
   - Every 2 years to EU

Requirements for sensitive aeras EU Directive (91/271/EWG)

Table 2: Requirements for discharges from urban waste water treatment plants to sensitive areas which are subject to eutrophication as identified in Annex II.A (a). One or both parameters may be applied depending on the local situation. The values for concentration or for the percentage of reduction shall apply.

Parameters	Concentration	Minimum percentage of reduction (1)	Reference method of measurement
Total phosphorus	2 mg/l P (10 000 - 100 000 p. e.) 1 mg/l P (more than 100 000 p. e.)	80	Molecular absorption spectrophotometry
Total nitrogen (2)	15 mg/l N (10 000 - 100 000 p. e.) 10 mg/l N (more than 100 000 p. e.) (3)	70-80	Molecular absorption spectrophotometry

- Results from German DWA-efficiency comparison 2022 (yearly)
  - COD: Inlet 601 mg/l ➔ Outlet 26 mg/l
  - Nitrogen: Inlet KA 55 mg/l ➔ Outlet 8,7 mg/l
  - Phosphorus: Inlet KA 8,2 mg/l ➔ Outlet 0,52mg/l

Reduction of BOD Loads (t/a)

Achieved elimination according old UWWTD

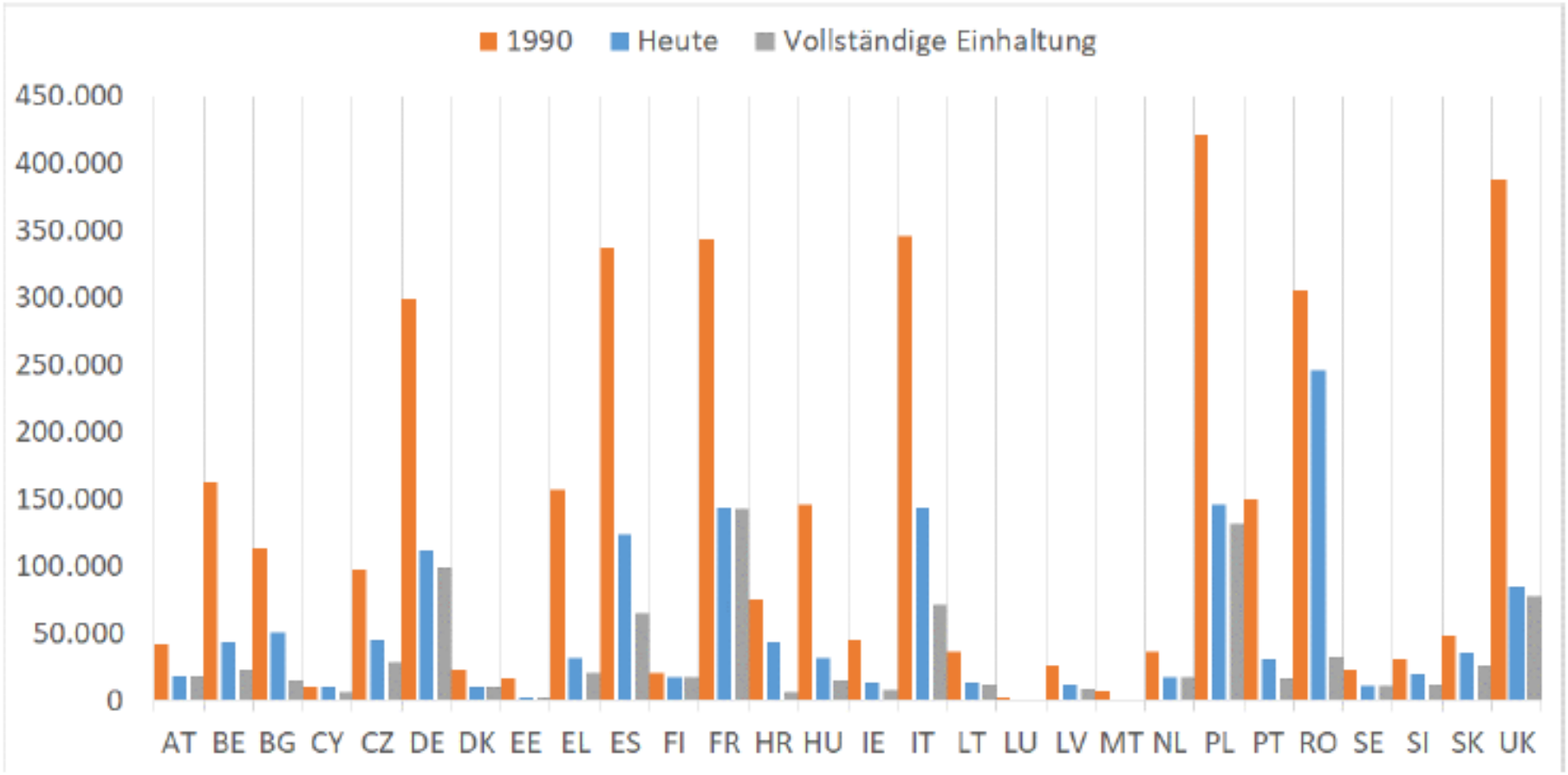


Abb. 11 – Verringerung der BSB-Frachten (Tonnen/Jahr) in behandeltem Abwasser.

Development of phosphorus concentration in European Rivers



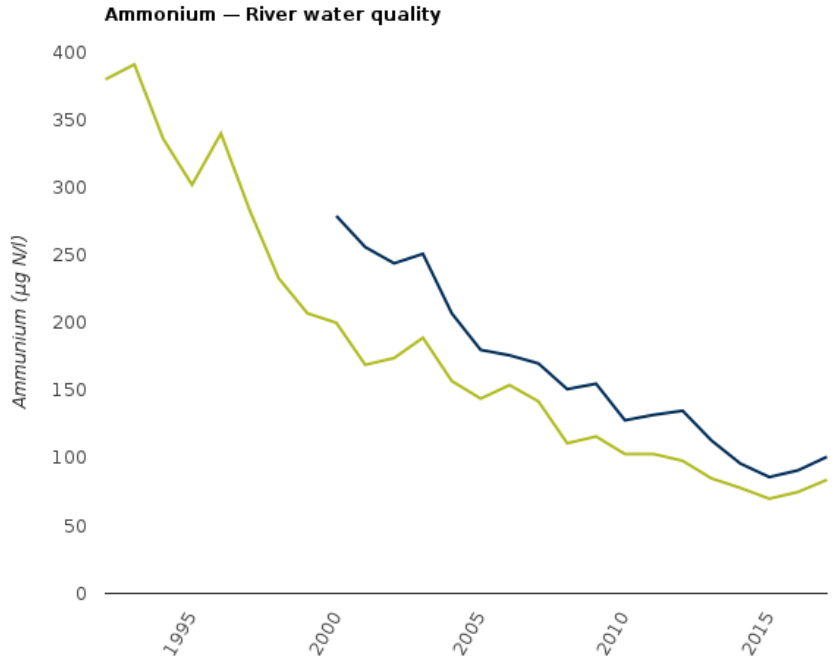
Elbe



Note: The data series are calculated as the average of annual mean concentrations for river stations in Europe. Only complete series af
The number of river stations included per country is given in parentheses:
1992-2017: Europe (799), Belgium (30), Bulgaria (46), Czechia (8), Denmark (39), Estonia (38), Finland (71), France (171), Germany (105), Ireland (4), Latvia (15), Lithuania (24), Norway (44), Slovakia (8), Slovenia (9), Spain (43), Sweden (110), Switzerland (6), United Kingdom (28).
2000-2017: Europe (1163), Belgium (36), Bulgaria (71), Croatia (23), Czechia (8), Denmark (40), Estonia (41), Finland (80), France (245), Germany (108), Iceland (1), Ireland (33), Latvia (18), Lithuania (24), Norway (44), Romania (98), Serbia (31), Slovakia (9), Slovenia (11), Spain (56), Sweden (112), Switzerland (15), North Macedonia (18), United Kingdom (41).

Data sources:
Waterbase - Water Quality provided by European Environment Agency (EEA)

Development of ammonia concentration in European rivers



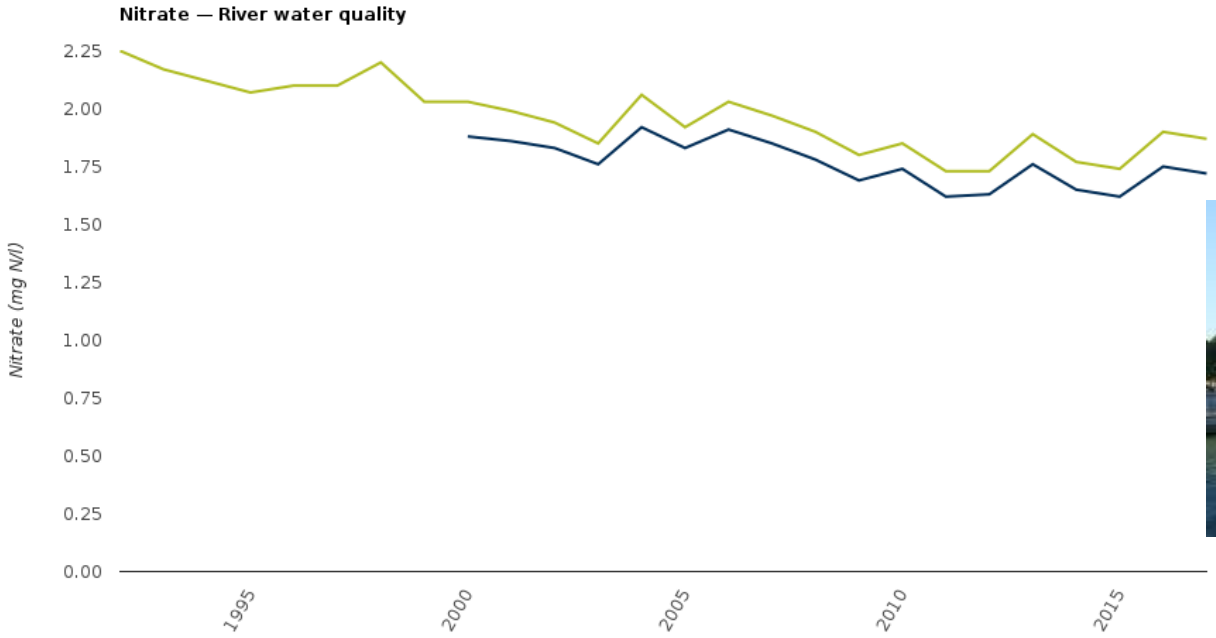


Odra

Note: Concentrations are expressed as annual mean concentrations. Only complete series after inter/extrapolation are included (see indicator specification). Two time series are depicted — the longer time series with fewer stations and the shorter time series with more stations.
The number of river monitoring stations included per country is given in parenthesis.
1992-2017: Europe (783), Austria (46), Belgium (28), Bulgaria (50), Estonia (38), Finland (70), France (162), Germany (120), Ireland (4), Latvia (15), Lithuania (24), North Macedonia (9), Norway (44), Slovenia (9), Spain (41), Sweden (110), United Kingdom (13).
2000-2017: Europe (1138), Austria (48), Belgium (35), Bulgaria (70), Croatia (23), Estonia (41), Finland (80), France (240), Germany (123), Iceland (1), Ireland (33), Latvia (18), Lithuania (24), North Macedonia (19), Norway (44), Poland (1), Romania (101), Serbia (31), Slovenia (11), Spain (70), Sweden (112), United Kingdom (13).

Data sources:
Waterbase - Water Quality provided by European Environment Agency (EEA)

Development of nitrate concentrations in European rivers





Note: The data series are calculated as the average of annual mean concentrations for river stations in Europe. Only complete series after inter/extrapolation are included (see indicator specification).

The number of river stations included per country is given in parentheses:

1992-2017: Europe (846), Belgium (28), Czechia (19), Denmark* (37), Estonia (36), Finland** (69), France** (187), Germany (120), Ireland** (4), Latvia (15), Lithuania (24), Norway (62), Poland (8), Slovakia (12), Slovenia (9), Spain** (59), Sweden** (110), Switzerland (6), United Kingdom** (41).

2000-2017: Europe (1213), Belgium (36), Croatia (22), Cyprus (13), Czechia (19), Denmark* (38), Estonia (38), Finland** (80), France** (245), Germany (123), Iceland (1), Ireland** (49), Latvia (18), Lithuania (24), Norway (63), Poland (11), Romania (99), Serbia (31), Slovakia (12), Slovenia (11), Spain** (93), Sweden** (112), Switzerland (15), North Macedonia (19), United Kingdom** (41).

(*all data total oxidised nitrogen, **some data total oxidised nitrogen)

Renewal of the Directive 91/271/EEC

- Amendment of the Municipal Wastewater Directive 91/271/EEC from May 1991 with requirements for WWTP
  - Adaptation to the state of the art after more than 30 years
  - Proposal from the EU COM on October 26, 2022
  - political agreement at the trilogue meeting on January 29, 2024; the directive is scheduled to appear in the EU Official Journal this year (Oct/Nov 2024?)
  - Implementation within 30 or 36 months in national Right
- Embedded in the European Green Deal and Zero Pollution Ambition of the EU,
- Comprehensive approach in the draft directive that goes far beyond pure wastewater treatment

Overview of the essentials new regulations

The main regulations

- Art. 5 Integrated plans for Wastewater management
- Art. 7 Third-party treatment (Nutrients P/N) – Limit values) in conjunction with Appendix 1 AbwV
- Art. 8 Fourth treatment stage –removal of micropullutants
- Art. 9/10 Advanced Manufacturer responsibility
- Art. 11 Energie neutrality
- Art. 15 (1) Water reuse
- Art. 17 Monitoring Health parameters
- Art. 20 Sewage sludge and resource recovery
- Art. 24 Information of the Publicity

Specifications for stormwater overflows (“combined sewer overflow”)

New UWWTD

- Integrated municipal wastewater management plans
- Reduction of water pollution caused by stormwater overflows



  - ➡ Non-binding target:
    no more than 2% of the annual wastewater load in dry weather runoff
  - ➡ Target achievement by 2039 (≥ 100,000 PE) or 2045 (≥ 10,000 PE)
- Gradual reduction of microplastics





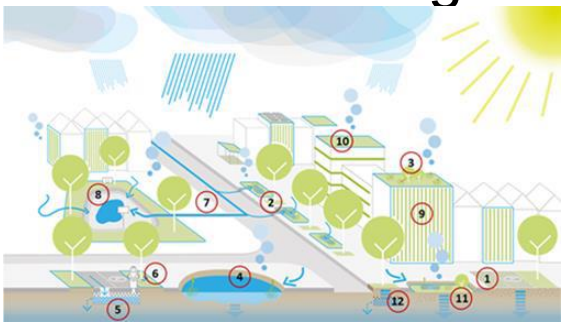


- Measures, among others
  - ➡ optimized use of existing infrastructures
  - ➡ Implementation of the measures for rainwater as before

Specifications for rainwater

Annex V (numbers 1 to 4): Requirements/Measures

- Reducing water pollution from municipal runoff and **preventing unpolluted municipal runoff** from entering the sewerage system
- Promotion of natural water retention,
  - Creation of **green and blue areas**;
  - Reduction of surface sealing, rainwater use



Benden, 2020

- Appropriate treatment of polluted municipal runoff
  - Optimized use of existing infrastructure to minimize the discharge of polluted municipal runoff
  - Monitoring discharges of precipitation water with regard to **microplastics** and relevant **micropollutants** through representative sampling

UWWTD „2. Treatment Stage“ (Art. 6)

Concentration value and Elimination of **carbon compounds**

- **2030 1.000 bis 2.000 PE** 2. Treatment stage
- New Parameter TOC

Table 1: Requirements for discharges from urban waste water treatment plants subject to Article 6 of the Directive. The values for concentration or for the percentage of reduction shall apply.

Parameters	Concentration	Minimum percentage of reduction ▌ *(see Note 4)*	Reference method of measurement
Biochemical oxygen demand (BOD_5 at 20 °C) without nitrification (see Note 1)	25 mg/l O_2	70-90 40 under Article ▌ *6(3)*	Homogenized, unfiltered, undecanted sample. Determination of dissolved oxygen before and after five-day incubation at 20 °C ± 1 °C, in complete darkness. Addition of a nitrification inhibitor
Chemical oxygen demand (COD) (See Note 2)	125 mg/l O_2	75	Homogenized, unfiltered, undecanted sample Potassium dichromate
Total Organic Carbon (See Note 2)	37 mg/l	75	EN 1484
Total suspended solids	35 mg/l (see Note 3)	90 (see Note 3)	– Filtering of a representative sample through a 0,45 µm filter

Nitrogen and Phosphorus
EU urban wastewater directive (new)

- Phosphorus:
  - Effluent concentration < 0.5 mg/l for WWTP > than 150,000 PE (and/or an elimination of 90%)
  - 0.7 mg/l for WWTP > 10,000 PE (and/or an elimination of 87.5%)
  - *Earlier 2 mg/l and 80 % elimination for 10,000 – 100,000 PE*
- Nitrogen:
  - Effluent concentration < 8 mg/l for WWTP > 150,000 PE
  - and < 10 mg/l for WWTP > 10.000 PE (and/or an elimination of 80%)
  - *Earlier 15 mg/l an 80 % for 10,000 – 100,000 PE*

    10 mg/l WWTP > 100,000 PE and 70 -80% elimination

Timeline to implement the 3. treatment stage

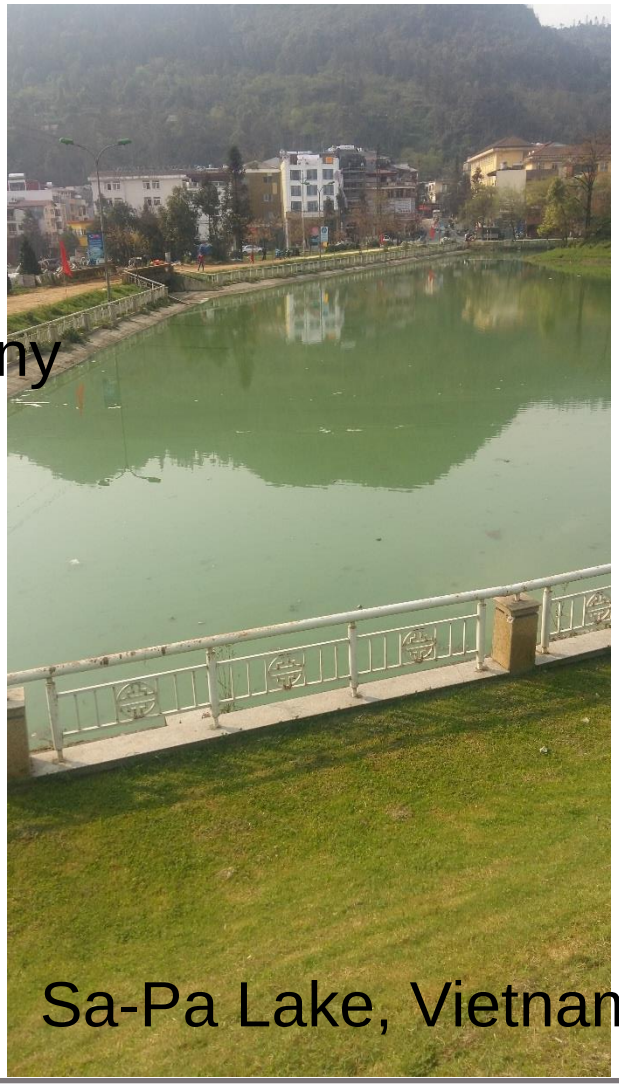
- Regarding Parameter N und P
  - WWTP larger 150,000 PE:
    - until end of 2033 30 %,
    - until end of 70 % und
    - **until end of 2039 100 %**
- Emissions from settlements 10,000 -150,000 PE into sensitive areas (list until bis 2027)
  (one or both parameter (depending on area), concentration or elimination):
  - until end of 2033 20%,
  - until end of 2036 40%
  - until end of 2039 60%
  - **until end of 2045 all**
  - eventually exceptions

Eutrophication
Exampels


Isle Usedom, Germany

,


Helsinki Bay Finland


Sa-Pa Lake, Vietnam


Korfu, Grecce

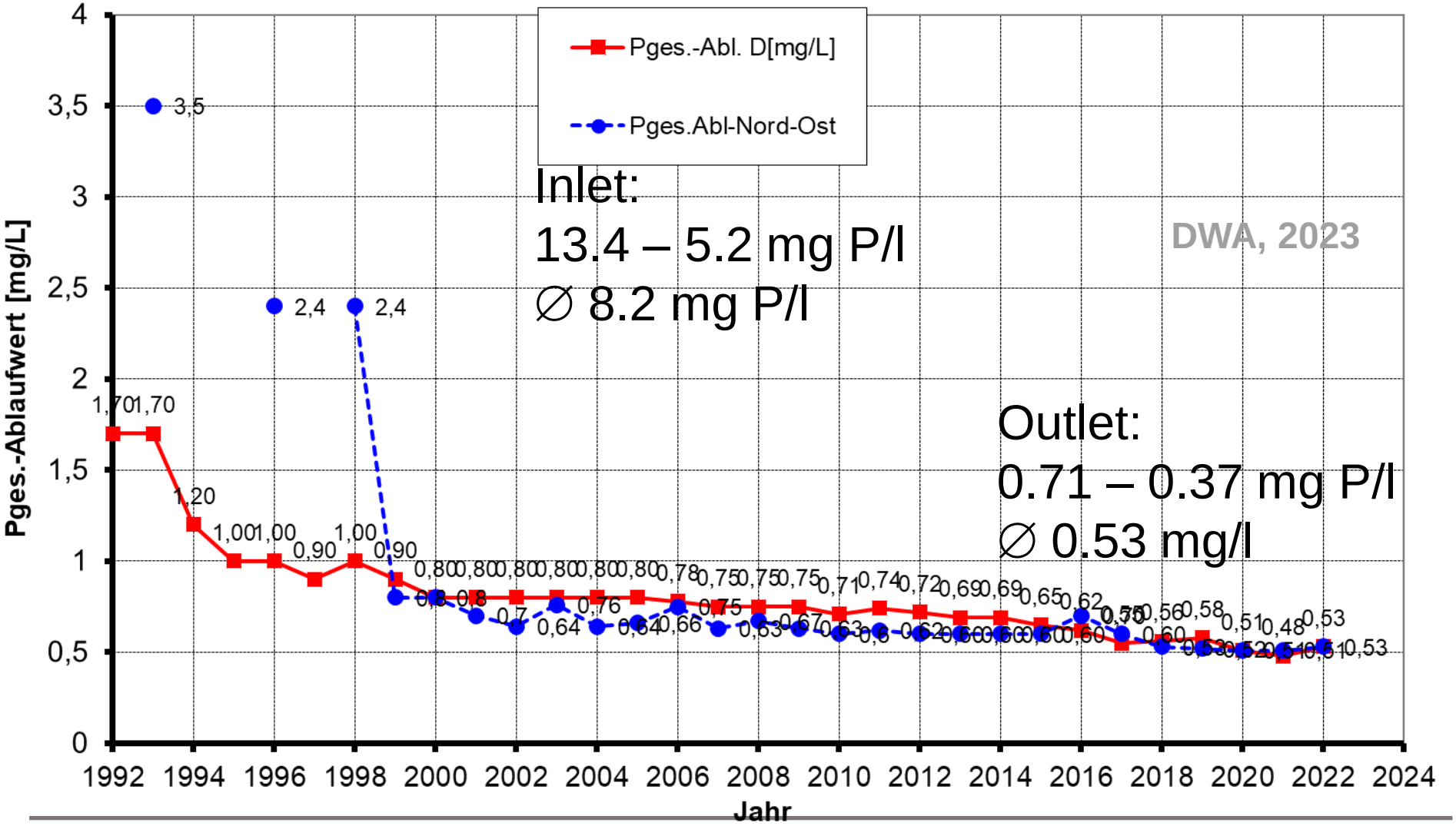
Modelling of P-Emission pathways in Germany (UBA 2022)

Eintragspfad	Neuer Eintrag in t/a	Anteil am Gesamt-eintrag in %	Bisheriger Eintrag in t/a	absolute Differenz in t/a	relative Differenz in %
Municipal WWTP	5.810	38	5.810	0	0
Industrial direct discharge	250	2	250	0	0
Sewer systems	3.830	25	4.120	-290	-7
Atmosperic depostion	200	1	200	0	0
Surface runoff	1.420	9	1.460	-40	-3
Erosion	1.640	11	2.900	-1.260	-43
Groundwater	1.250	8	5.100	-3.850	-75
Drainage	1.010	7	1.080	-70	-6
Total	**15.400**	**100**	**20.910**	**-5.510**	**-26**

Umwelt Bundes Amt
Für Mensch und Umwelt

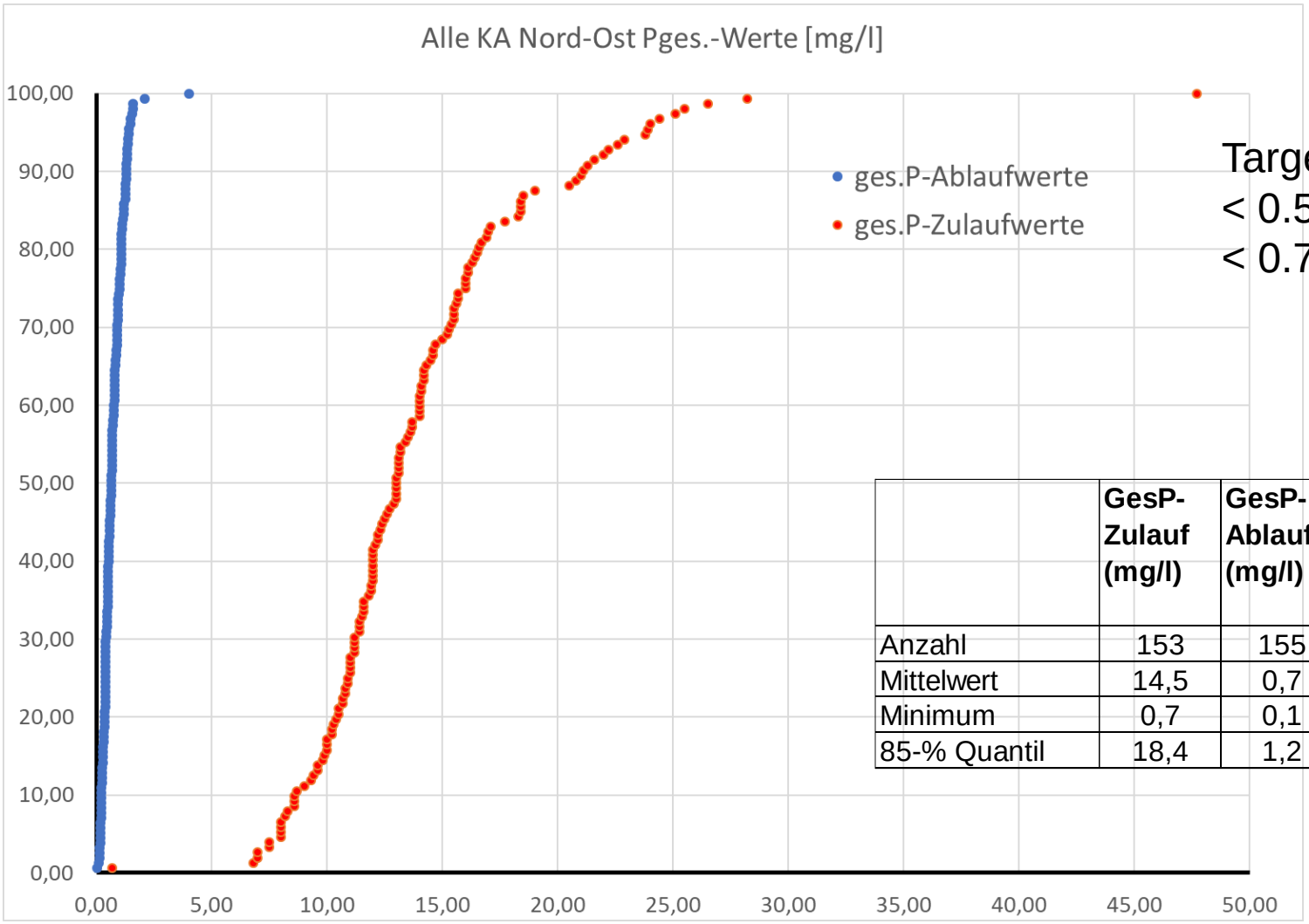
Status of P-Elimination in Germany

P_{tot}-average values in the ffluent of WWTP 1992 to 2022



Status of P-Elimination

DWA North-East –emission to the Baltic Sea



Target UWWTD
< 0.5 mg/l
< 0.7 mg/l

	GesP-Zulauf (mg/l)	GesP-Ablauf (mg/l)	P-Elimination
Anzahl	153	155	153
Mittelwert	14,5	0,7	94,0
Minimum	0,7	0,1	7,1
85-% Quantil	18,4	1,2	97,8

Protection of human health and environment
Fourth treatment stage

- Upgrading of many WWTP to remove micropollutants
  - Micropollutants in water bodies **influence ecology** and **raw water quality for drinking water production**.
  - **Wastewater** and wastewater treatment plant discharges represent a **main entry route**.
  - Precautionary expansion of large sewage treatment plants in combination with a risk-based approach
- Enhanced manufacturer responsibility to finance the 4th treatment („EPR“) (Art. 9 und 10 i.V.m. Anhang III)
  - Manufacturers should carry 80% of the costs (investment and operating)
  - Mainly pharmaceutical and cosmetics
  - 92% of the harmful effects / 70% of the load from these sectors
- **Ambitious target** in combination with of energy neutrality 2045

Requirements for the fourth treatment stage

Art. 8, in conjunction with Part B and Table 3 Annex I

- Reduction of inlet load of **80% by the 4th Stage**
- Based on **6 indicators** from **categories 1 and 2**
  - ➡ **1s Substances**
  - ➡ Number of substances **Category 1** should be **twice** as much be high as in **category 2**
  - ➡ The **average of the percentages** of the individual substances used in the calculation is **decisive.**
  - ➡ **PFAS is not included**

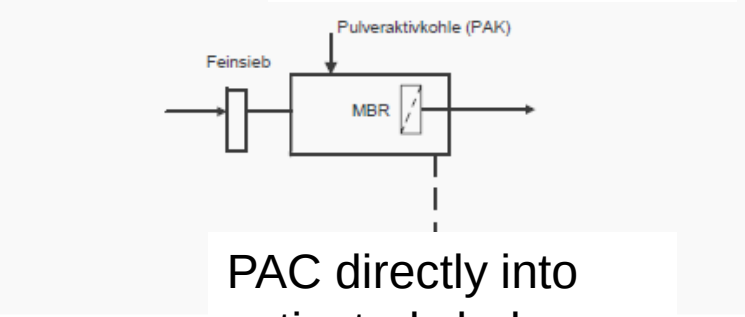
Category 1 substances, "easily" be treated	Category 2 substances "simply" be removed
Amisulpride (antipsychotic)	Benzotriazole (corrosion protection
Carbamazepine (antiepileptic drug	Candesartan (blood pressure lowering drug)
Citalopram (antidepressant)	Irbesartan (blood pressure lowering drug)
Clarithromycin (antibiotic)	Mixture of 4-methylbenzotriazole and 5-methyl-benzotriazole (corrosion protection)
Diclofenac (pain killer)	
Hydrochlorothiazide (blood pressure)	
Metoprolol (beta blocker)	
Venlafaxine(antidepressant	

Timeline to implement the 4. treatment stage (EU- UWWTD Art. 8)

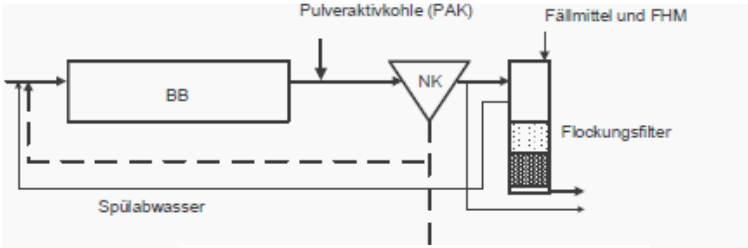
- Grading up the requirements WWTP > 150,000 PE
  - 20 percent by the end of 2033,
  - 60 percent by the end of 2039 and
  - **100 percent by the end of 2045**
- By the end of 2030, create a **list of areas** in which **micropollutants from WWTP pose a risk** to health or the environment. E.g. Drink water catchment areas, possibly also bathing waters (review 2033, update every 6 years)
- Municipalities between 10,000 and 150,000 PE that have to discharge into these areas
  - 10 percent by the end of 2033
  - 30 percent by the end of 2036
  - 60 percent by the end of 2039 and
  - **100 percent by the end of 2045**

Overview of applied process technology

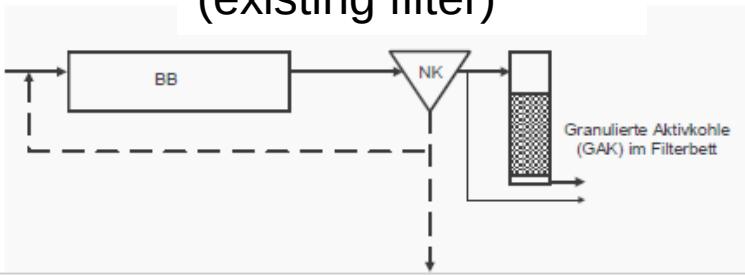
MBR + PAC



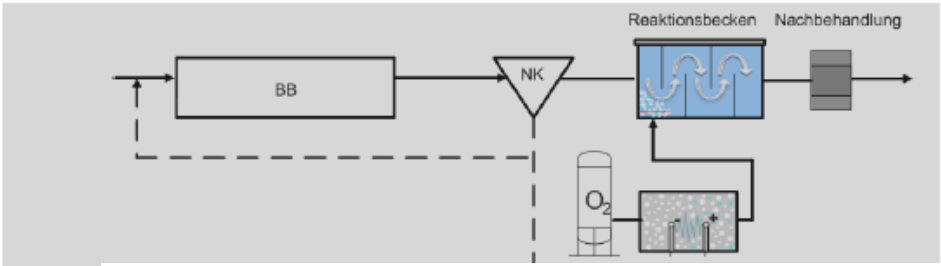
PAC directly into activated sludge



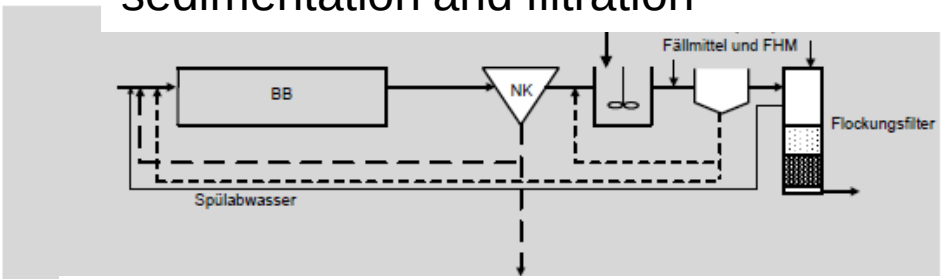
GAC filtration (existing filter)



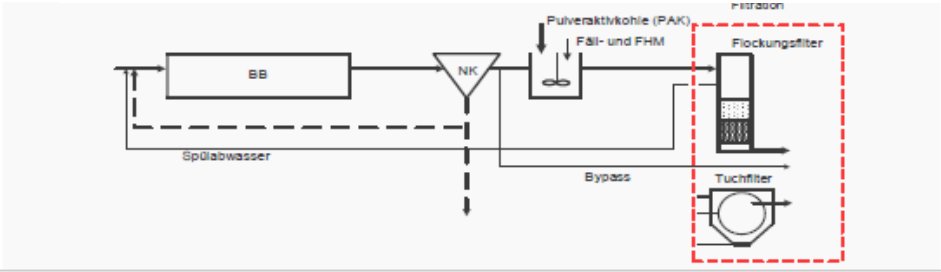
Ozonisation



PAC into contact reactor plus sedimentation and filtration



PAC into contact reactor direct filtration



Example of fourth treatment stage

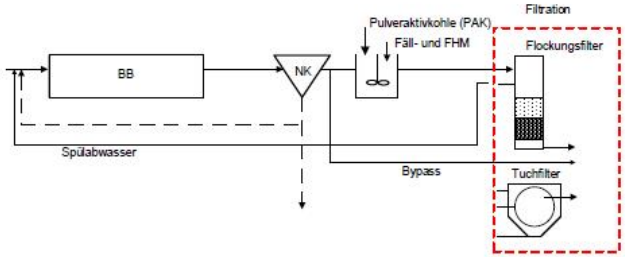


KA Dortmund-Deusen

PAC with cloth filtration

Vollständige Inbetriebnahme Frühjahr 2025

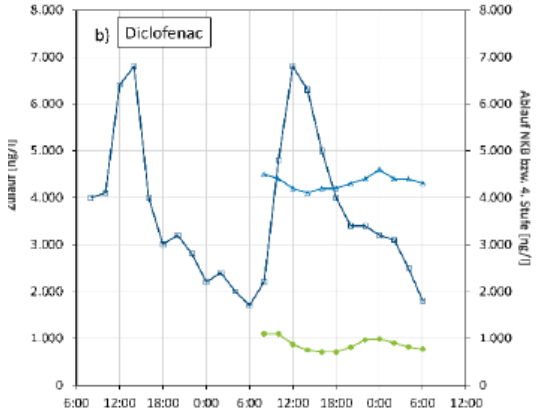
- 705.00 PE
- Direct PAC doasge in the main stream
- Separation of PAC ny cloth filter
- Post aeration



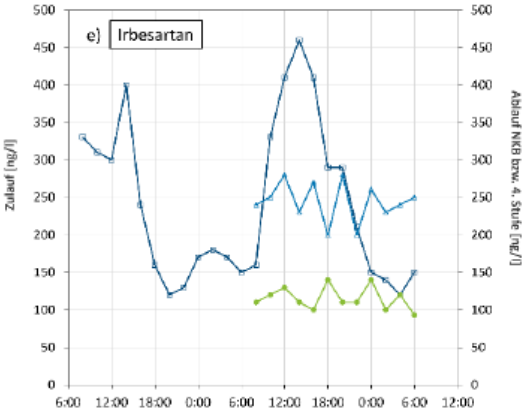
Frank Obenaus, 2024

Results with PAC and Filtration (55,000 PE)

Category 1

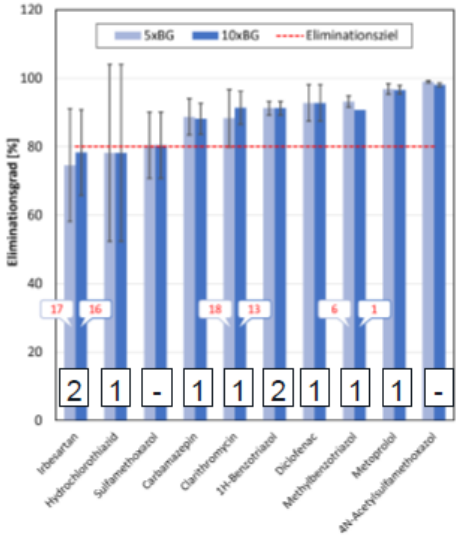


Category 2



inlet Oulet 3 stage Oulet 4 stage

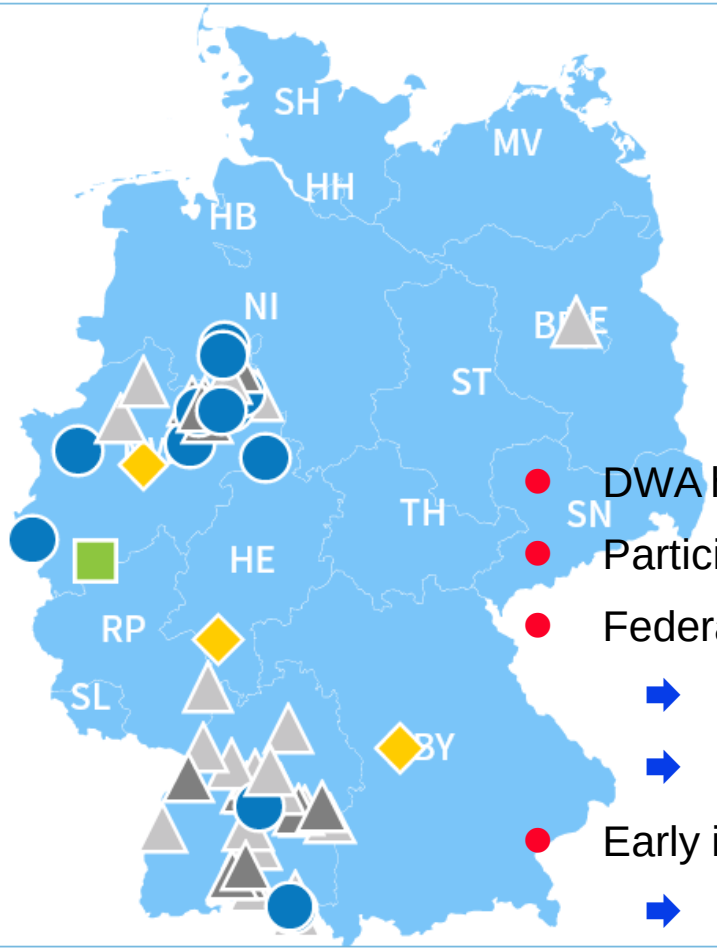
Grundlage für Mittelwertbildung



Emschergenossenschaft
Lippeverband

Obenaus 2024

WWTP‘s with quaternary treatment for micropollutant removal - Germany



More than 50 WWTP
with 4. treatment stage
In operation

Technologies

- Adsorption - GAC
- Adsorption - PAC
- Oxidation
- Combination
- Special procedure

- DWA has been coordinating the activities for years
- Participation in the federal micropollutant dialogue
- Federal micropollutant strategy
  - ➡ Political position papers
  - ➡ Tracking and supporting the expansion in Germany
- Early involvement in specialist and regulatory work
  - ➡ Establishment of three DWA working groups
  - ➡ Specialist publications (work reports, topic volumes, fact sheets)

DWA, 2024

Energy neutrality for WWTP up to 2045
UWWTD

- WWTP are the largest public energy consumer.
  - approximately 0.8% of total energy consumption in the EU
- The energy requirement Art. 11 of WWTP ≥ 10,000 PE
  - Every four years energy audit
  - Gradually **renewable energies** that are produced at the WWTP (photovoltaics, digester gas from sludge, heat from wastewater etc.)
- Timeframe
  - By the end of 2030, 20% of energy demand should be achieved
  - 40% energy demand by the end of 2035,
  - 70% energy demand by the end of 2040
  - **By the end of 2045, all the energy** required will be generated from self-produced renewable energies
- Challenge: More effective use of energy with constant or higher treatment performance and operating costs!

Water re-use
Article 15 (1)

- The reuse of treated wastewater from all WWTP's in **Water stressed areas** and for **all suitable purposes** *shall* be promoted
- The potential for reuse of treated wastewater is taken into account according to
  - the Water Framework Directive 2000/60/EC
  - according management plans drawn up (Regulation (EU) 2020/741)
- The **ecologically required minimum amount** of water in the **receiving waters** must not ensured and that this has no negative impact on the environment and human health.
- If treated wastewater is reused for agricultural irrigation regulation (EU) 2020/741) has to be considered

Sewage sludge and recovery Resources Article 20/1

- The recovery of valuable resources from the sludge shall be promoted regarding the Sewage sludge management framework and the waste hierarchy Directive 2008/98/EC
- Through these paths should
  - waste avoidance is maximized,
  - reuse, recycling and other **recovery of resources**, **especially phosphorus and nitrogen**, are prepared, taking into account national or local recycling options,
  - the harmful effects on the environment and human beings Health can be minimized.
  - A recovery rate shall be fixed after three years



Summary

- The requirements of new EU wastewater directive pose a huge Challenge for the European Water Utilities
  - Elimination of **micro pollutants** (12 substances at ratio to 80%)
  - **Phosphorus Elimination**

    < 0,5 mg/l P_{tot} for WWTP > 150,000 E (and/or an Elimination of 90%)

    < 0,7 mg/l P_{tot} for WWTP > 10,000 E (and/or an Elimination of 87,5%)
  - **Nitrogen Elimination**

    < 8 mg/l N_{tot} for WWTP > 150.000 E

    < 10 mg/l N_{tot} for WWTP > 10.000 E (and/or an Elimination of 80%)
  - **Energy neutrality** for all WWTP upto 2045

Let us start the Challenge for a better environment and lower carbon emissions

