

Fund-based solution for trace element reduction



Fund-based solution as an economic instrument for a financing of trace element reduction measures according to the polluter-pays principle

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Wastewater disposal, trace substances, fourth treatment stage, financing, funds, adherence to polluter-pays principle

The problem of trace substances is one of the most-discussed topics in the wastewater industry. In order to solve this urgent environmental issue, action should be directed, in particular, at the source of the problem, i.e. the polluters involved, instead of merely at the removal of trace substances in wastewater treatment plants, according to the “end-of-pipe” principle. If, irrespective of the necessity of the polluters to avoid the input of substances in the first place, a fourth treatment stage is required, this could only be justified from an economic perspective if financing on the basis of the polluter-pays principle could be secured. Moreover, the desired steering effect can only be achieved if the polluters are obliged to make an adequate contribution to the costs incurred as a result of their conduct. This is where the fund-based solution proposed by BDEW (German Association of Energy and Water Industries) comes into play: it imposes an obligation on manufacturers and importers of products which cause harmful trace substances to be input into waters. This article sheds a light on the economic aspects of this fund-based solution.

1. The political discussion around trace substance pollution

The pollution of waters by trace substances is currently a topic of great importance for the water industry. Whilst trace substance pollution has not yet entered the public consciousness as deeply as nitrates pollution has in many groundwater bodies, the problem is no longer only being discussed among scientists but is now also a current topic of political debate. The catalyst for this has been the fact that German waters have repeatedly fallen short of the good chemical status stipulated in the EU WFD (EU Water Framework Directive).

It seems beyond dispute that the trace substance problem demands urgent action and only a raft of different measures can be successful. In light of this, the BMU (German Federal Ministry for the Environment) and the UBA (German Environment Agency) have initiated a “stakeholder dialogue on the trace substance strategy of the German Federal Government”. After two phases of discussions (November 2016 to June 2017 and February

2018 to March 2019) involving around 130 stakeholders, specific measures and recommendations for action have been proposed, which are intended to serve as the basis for the trace substance strategy of the German Federal Government. In total, 15 higher-level measures were devised in four different working groups [1].

In addition, a “Financing symposium” took place in January 2019. In essence, the two already known financing options were looked at, and their advantages and disadvantages as well as their legal limits, were discussed – these options being a product specific levy and the use of funds from the wastewater levy. In addition, BDEW raised the notion of a new financing instrument in the form of a fund-based solution, as devised by BDEW’s representative Prof. Dr.-Ing. Dietmar Schitthelm (chief executive of the Niersverband, NRW, Germany) [3]. The basic elements of the fund-based solution were described in the issue 04/2019 of gwf-Wasser|Abwasser [4].

Despite a wide range of voices calling for a financing model based on the polluter-pays principle, the final

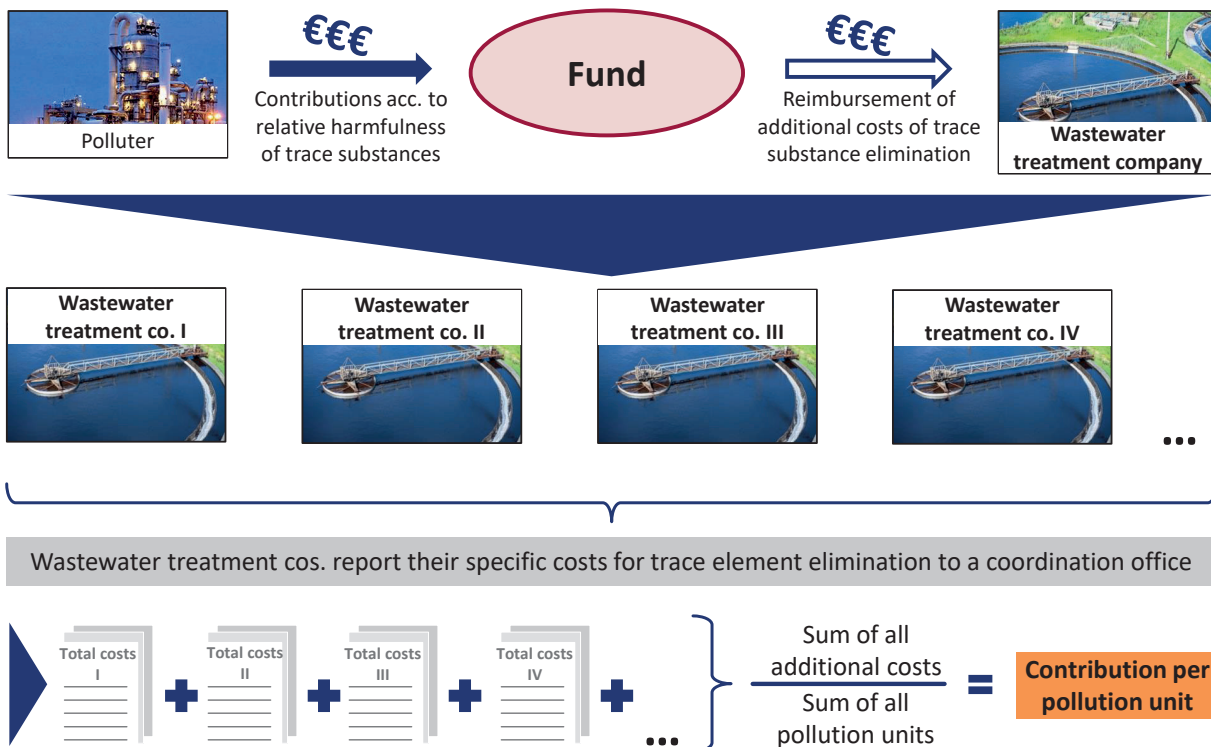


Figure 1: Basic concept of the fund-based solution.

report of the second phase of the stakeholder dialogue mentioned above took up the declaration of intent from the Coalition Agreement of the CDU, CSU and SPD: “The German Federal Environment Ministry proposed course of action – on the basis of the Coalition Agreement of 2018 and separate from the stakeholder dialogue – to produce a proposal to reform the German Wastewater Levy Act which would be intended to make a contribution to the financing of expanded wastewater treatment techniques for the elimination of trace substances in treatment plants.” In contrast, the participants at the Environment Ministers’ Conference on 10 May 2019 in Hamburg, returned the focus to the polluter-pays principle. The environment ministers concluded in their resolution that it was “necessary for the producers and distributors of those chemical products to be held to account and for an expanded scope of product liability to be established”. In the further course of the resolution, the German Federal Ministry for the Environment is asked to illustrate possible regulatory perspectives in the scope of the pilot phase of the trace substance strategy and in doing so to assess the conceivable national and European instruments [5].

2. Allocation of costs according to the polluter-pays principle with the help of a fund-based solution

In light of this, the aforementioned fund-based solution became relevant once more, hence BDEW com-

missioned an expert opinion to investigate the economic dimensions of this proposal [2]. The key benefit of the fund-based solution is that the polluter-pays principle is observed to a particularly high degree through the involvement of all manufacturers and distributors of trace substances which can potentially contaminate waters. **Figure 1** illustrates the basic concept.

In detail, the fund-based solution can be described as follows:

- A fund is set up, whereby the financial resources are provided by contributions from all polluters (manufacturers and importers) responsible for causing the trace substance problem.
- A polluter is any manufacturer or importer that brings products onto the market which contain trace substances – irrespective of whether an environmental quality standard is exceeded in the catchment area where the polluter is based or not. The polluter’s “responsibility for trace substances” – and thus its obligation to pay – refers to the entire country.
- Payments into the fund are calculated on a polluter-pays basis according to the relative harmfulness of the trace substances. The determination of the pollution units and thus of the level of harm caused is calculated by multiplying the load with the reciprocal EQS value (so-called harmfulness coefficient).

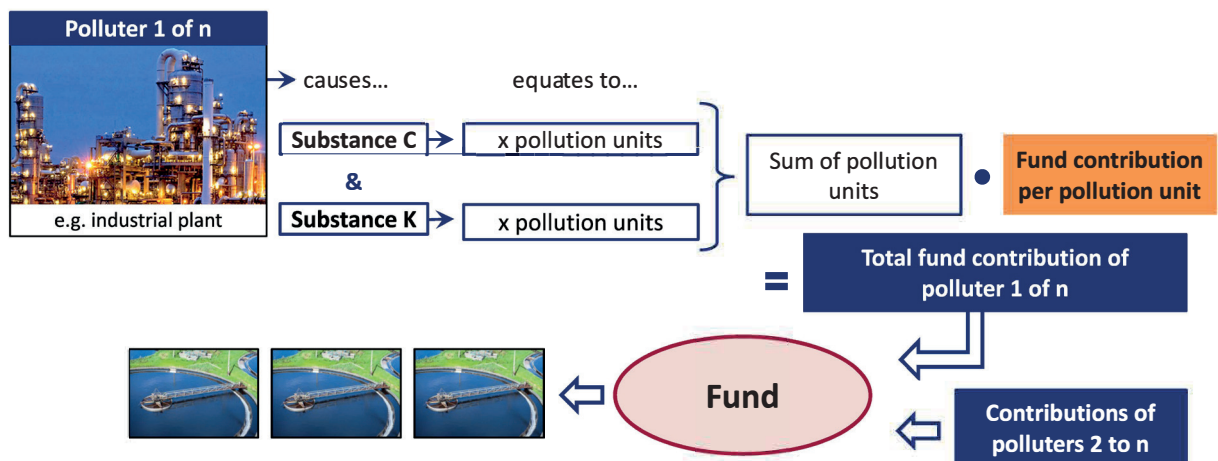


Figure 2: Determination of the fund contribution of a polluter.

- On the basis of continuous testing of waters, taking into account both diffuse and point sources, the payments will be dynamically adjusted according to the changing levels of trace substance inputs – both in relation to currently detectable and relevant trace substances as well as in relation to new trace substances which may be identified in the future (further development of EQS). The (international) upstream-downstream problem is also completely accounted for.
- The fund-based solution is technology neutral, hence polluters can decide independently which measures they wish to take to reduce trace substances.
- Wastewater treatment companies expand, subject to certain requirements, their wastewater treatment in order to eliminate trace substances. Any costs incurred specifically in this regard are reimbursed from the fund.
- The system can also be applied to the drinking water supply in the event that a supplier has to carry out measures to reduce trace substances in the scope of drinking water treatment.
- Likewise, the fund will cover the costs of practical measures whose central objective is to sensitize professional and private users to the issues in order to induce them to handle the substances and products in question in a manner as to minimize contamination.

With the fund-based solution, the costs per pollution unit are identical for all substances. This may initially be unexpected, however it is logical since the relative harmfulness of a substance is taken into account when calculating its pollution units due to the fact that the EQS value is used as the “degree of harmfulness”. Accordingly, two substances at the same load will cause different levels of pollution units (and

therefore require different levels of contribution to the fund) if their EQS values and thus the harmfulness coefficients differ from one another.

The contribution to the fund which a polluter has to pay for the emission of a substance is calculated by multiplying the number of pollution units the polluter causes with the cost per pollution unit. If a polluter (manufacturer or importer) is responsible for the emission of a number of different substances, its total contribution to the fund will be calculated by adding together the individual contributions due for each of the substances involved. The sum of all contributions will, by definition, correspond to the total costs of all wastewater treatment companies for the elimination of the trace substances. Payments into and out of the fund are balanced using the contribution per pollution unit: if the total number of all pollution units nationwide increases (decreases), under the presumption of a fixed level of total costs, then the contribution per pollution unit will fall (rise). The adjustment of the amount of the contribution per pollution unit will be decided by the coordination office. The context is illustrated in **Figure 2**.

3. Similarities between fund-based solution and emissions trading

Many advocates of financing the fourth treatment stage via the wastewater levy (and thus via the wastewater charge) use the argument that a polluter-pays solution would involve high transaction costs when operated in practice. There are two counterarguments to that position: firstly, the trace substance problem is to a large degree caused by a manageable number of substances and their producers or importers (see Part 4). Thus, there is less information required to effect a polluter-pays allocation of costs than might initially be assumed. Secondly, there are considerable similarities between the fund-based solution and the

emissions trading scheme for greenhouse gases, as outlined below:

- Polluters are able to decide, each independently, whether they purchase emission allowances in the form of certificates and then emit greenhouse gases, or instead invest in (process-optimizing) technological solutions to reduce emissions. This freedom to choose also exists in the fund-based solution.
- Due to the fact that the solution is technology neutral, polluters can independently choose the reduction measures employed. In connection with the first aspect, this means that the reduction of emissions occurs at the lowest cost to the economy – this applies just the same to the proposed fund-based solution.
- Those who emit greenhouse gases, together with the volume of emissions, are recorded in a national register in order to reconcile the emission allowances and the emissions. With the fund-based solution also, the polluters have to be recorded centrally together with the quantities brought into circulation.
- The sum of the emission allowances issued is reduced over time meaning that it is a dynamic instrument in which the price for the certificates is decided endogenously. The fund-based solution is also characterized by a number of different dynamics: increase in the active involvement of the wastewater industry as a result of the exceeding of EQS limits, manufactures reacting, etc. As a consequence, the amount of the fund contribution per pollution unit is reached endogenously.

The emissions trading scheme for greenhouse gases has been organized since 2005 by the German Emissions Trading Authority (DEHSt). Due to the similarities with that scheme, considerable synergy effects could be achieved by also locating the fund coordination office within the DEHSt, in order to keep the administrative costs as low as possible.

4. Testing of waters and example application of the fund-based solution

In order to check the viability of the fund-based solution in practice, tests have been conducted with four water associations with special legal status from North Rhine-Westphalia (NRW), in selected cross-sections of waters.¹ A total of around 6.47 million people live in the catchment area of the four associations. That represents around 36.1% of the population of NRW and 7.8% of the population of Germany.

In connection with the fact that NRW (and especially the Ruhr region) is one of the most important economic and in particular industrial regions in Germany, the investigation area is well-suited due to the different pollution effects for the waters involved, to serve as an example of the contexts and the system of the fund-based solution.

With the help of the average discharge, the load levels can be ascertained and, in connection with the respective EQS, also the (potential) pollution units of specific substances in the various waters. The determination of the pollution units is calculated by multiplying the load with the so-called harmfulness coefficient (the reciprocal value of the respective EQS value of a specific substance). The water tests were conducted for a total of 151 trace substances. These included the substances regulated under the German Federal Surface Water Ordinance (OGewV) (as per Schedules 6 and 8) as well as those regulated under the German Drinking Water Ordinance (TrinkwV) (as per Schedule 2). Medicinal products for human use are as yet not treated as priority substances on an EU-wide basis and as far as pollutants specific to a particular river basin are concerned, there are as yet no stipulations in the OGewV. In light of their relevance for the quality of waters, however, EQS proposals have been developed at a European and national level for eleven medicines for human use, some of which are also on the EU Watch List to support the prioritization process in future.² These were also taken into account in the water tests.

The tests show that of the 151 analyzed trace substances, 51 wastewater-borne substances (trace substances discharged from domestic and industrial connections) can be detected in at least one of the investigated catchment areas. For each of those 51 trace substances, the number of pollution units is determined by multiplying the harmfulness coefficient (reciprocal EQS value) and the load. In this context, the pollution unit serves as a criterion for determining the (relative) harmfulness of a specific trace substance: the higher the sum of the pollution units, the higher the degree of harm a trace substance has on waters. For the investigation period, the result in the investigation area was 86,022 pollution units across all detected trace substances. **Table 1** shows the ten trace substances with the highest level of harmfulness.

The primary use or source of the top 10 trace substances above in the investigation area is shown in **Table 2**.

¹ Tests of water bodies from Emschergerossenschaft, Lippeverband, Niersverband and Ruhrverband were included. The authors thank those associations for allowing them to use the findings.

² These include 17 α -ethinylestradiol, 17 β -estradiol, azithromycin, bezafibrate, carbamazepine, clarithromycin, diclofenac, erythromycin, ibuprofen, metoprolol and sulfamethoxazole.

Table 1: Top 10 wastewater-borne trace substances in the investigation area

#	Trace substance	EQS value	Harmfulness coefficient	Sum Load	Sum Poll. unit	Relative harmfulness
1	Ibuprofen	0.01	100.00	260.14	26,014	30.24%
2	Perfluorooctanoic acid + derivatives (PFOS)	0.00065	1,538.46	15.98	24,580	28.57%
3	Diclofenac	0.05	20.00	964.17	19,283	22.42%
4	17 β -estradiol	0.0004	2,500.00	2.04	5,096	5.92%
5	Imidacloprid	0.002	500.00	3.84	1,921	2.23%
6	Triclosan	0.02	50.00	27.53	1,377	1.60%
7	Carbamazepine	0.5	2.00	603.40	1,207	1.40%
8	Clarithromycin	0.13	7.69	139.59	1,074	1.25%
9	Selenium	3	0.33	2,481.47	827	0.96%
10	Flufenacet	0.04	25.00	19.29	482	0.56%
				Subtotal		95.16%


Four conclusions can be drawn from the investigative findings:

- The top 3 trace substances account for a total relative harmfulness of over 81%.
- The group of top 10 trace substances accounts for a total of over 95% of the relative harmfulness; expanding this to the top 20 rises this total figure to over 98%.
- Five of the top 10 trace substances (or eight of the top 20) are pharmaceutical active ingredients.
- Two of the top 10 trace substances (or six of the top 20) are used as pesticide agents (herbicides or insecticides).

These findings directly affect the question as to the level of transaction costs in relation to the fund-based solution: firstly, the trace substance problem found in the investigation area can be attributed mainly to relatively few trace substances. Secondly, seven of the top 10 trace substances (or 14 of the top 20) are contained in products of two industrial sectors, namely pharmaceutical and pesticides (as a part of the chemical industry). One must therefore expressly expect that the information needs for the fund-based solution will be much lower than might initially be expected in relation to a financing instrument for the trace

Table 2: Primary use or source of the top 10 trace substances

#	Trace substance	Relative harmfulness	Primary use or source of the trace substance
1	Ibuprofen	30.24%	Pharmaceutical active ingredient
2	Perfluorooctanoic acid + derivatives (PFOS)	28.57%	e. g. impregnating products, fire extinguishing agents, electroplating
3	Diclofenac	22.42%	Pharmaceutical active ingredient
4	17 β -estradiol	5.92%	Pharmaceutical active ingredient
5	Imidacloprid	2.23%	Pesticides (insecticides)
6	Triclosan	1.60%	Antiseptic (e.g. disinfectant, cosmetic)
7	Carbamazepine	1.40%	Pharmaceutical active ingredient
8	Clarithromycin	1.25%	Pharmaceutical active ingredient
9	Selenium	0.96%	e. g. nutritional supplements, semiconductor
10	Flufenacet	0.56%	Pesticides (insecticides)
Subtotal		95.16%	

Economic and ecological features: 

Benefit 1	Costs allocated according to polluter-pays principle and financial incentives created to modify production processes/develop more sustainable substances and substance groups.	X	X
Benefit 2	Dynamic design through flexible contributions per pollution unit and resulting securing of long-term financing of wastewater industry involvement.	X	
Benefit 3	Economic efficiency by sending a price signal for pollution units	X	
Benefit 4	Financial incentives adjust flexibly to meet the changing conditions.	X	X
Benefit 5	Changes made as a reaction to financial incentives mean that the quality of all waters improves - even those where no EQS limit has been exceeded.		X
Benefit 6	Financial incentives are expected to lead to a fall in trace substance concentration, which, dependent on the treatment process, reduces energy inputs and supports climate targets.	X	X

Figure 3: Benefits of the fund-based solution, classified by economic and/or ecological nature

element problem which is in line with the polluter-pays principle.

5. Economic and ecological benefits of the fund-based solution

The proposed fund-based solution is, under the demarcation of funding policy instruments, a special levy characterized by a particular degree of adherence to the polluter-pays principle. This ensures the direct involvement of the relevant polluters, in the form of those companies and importers which directly contribute, through the distribution of the products in question, to the trace substance problem. The solution creates financial incentives for those companies to invest in production processes which are less harmful as well as in the development of new product formulations. For this reason, it makes more economic and ecological sense for the producers – and not the consumers – to be held accountable for the relevant financing. In many cases, consumers are only able to a very limited extent to make their consumption behavior dependent on a possible effect on trace substance inputs. Firstly, they simply cannot be expected to correctly judge the trace substance relevance from the huge variety of products available and secondly, there is sometimes no substitution option, in particular in relation to medicines. In contrast, companies are aware of the components of the products and have certain options at their disposal for reducing the levels of harm to water posed by the products they bring into circulation. Apart from this added value, referred to as “Benefit 1”, there are further economic and ecological benefits to the fund-based solution, an overview of which are presented in **Figure 3**.

Overall, when establishing the fund-based solution, it must be ensured that the financial incentive effect

for manufacturers and importers (who bring the relevant products into circulation) are, from a natural scientific perspective, looked at as a whole – both in relation to already existing EQS and in respect of the possible EQS determination for other trace substances. At first glance, there appear to be two reasons for this:

- Firstly, manufacturers can look at whether a fund contribution they have to pay means that it makes sense to develop and switch to a new chemical substance. Therefore, in the environmental impact assessment in the scope of the authorization procedure for a new substance, there should be an analysis, in particular, of any potentially harmful effect on water in order to prevent the original trace substance from being substituted by a new, similarly problematic one.
- Secondly, manufacturers could try and substitute the trace substance, for which an EQS has been set or is planned, by another already authorized substance for which no EQS yet exists but which would similarly have to be categorized as harmful to water. In light of this, it may be advisable, from a natural scientific perspective, to analyze already existing, legally binding EQS, and established EQS which will be relevant in the future for potential substitution possibilities within the substance group in order to prevent a potential switch by manufacturers which could be harmful for water.

6. Summary

The fund-based solution proposed by BDEW places the focus on the polluter-pays principle called for by the Environment Ministers' Conference and places the obligation on manufacturers and importers who directly contribute, by bringing the products in ques-

tion into circulation, to the trace substance problem. This seems to be the logical step above all because in many cases consumers are only able to a very limited extent to make their behavior dependent on a possible effect on trace substance inputs – on the one side due to (certainly understandable) lack of knowledge and on the other side due the lack of substitution options. In contrast, companies are aware of the components of the products and have certain options at their disposal for reducing the levels of water pollution caused by the products they bring into circulation. Moreover, the fund-based solution also delivers other economic and ecological benefits.

The concern about high transaction costs of such a financing instrument can be dispelled to a large extent: firstly, there are significant similarities to the emissions trading scheme, such that directly locating the fund coordination office within the German Emissions Trading Authority could lead to considerable synergy effects, in order to minimize administrative costs. Secondly, the application of the fund-based solution in a number of exemplary catchment areas showed that over 95% of the water pollution is caused by just ten trace substances, of which seven are contained in products of two industrial sectors, namely pharmaceutical and pesticides (as a part of the chemical industry). One can therefore expressly expect that the information needs for the fund-based solution will be much lower than might initially be anticipated in relation to a financing instrument for the trace element problem which is in line with the polluter-pays principle.

Literature

- [1] BMU/UBA (Ed.) (2019): "Ergebnispapier – Ergebnisse der Phase 2 des Stakeholder-Dialogs »Spurenstoffstrategie des Bundes«, Berlin.
- [2] Oelmann, Mark and Czichy, Christoph (2019): "Möglichkeiten einer verursachergerechten Finanzierung von Maßnahmen zur Reduktion von Spurenstoffen", expert opinion produced on behalf of BDEW available online at: <https://www.bdew.de/media/documents/Pub_20190930_Spurenstoff-Gutachten.pdf>; accessed: 1 October 2019.
- [3] Rechenberg, Jörg (2019): "Bericht über das Finanzierungssymposium am 22./23. Januar 2019 in Berlin", speech at the controlling event 3 of the Stakeholder Forum on 24 January 2019, available online at: <https://www.finanzierungssymposium-spurenstoffe.de/thema-wAssets/docs/beitraege/17_Rechenberg_20190123_Finanzierungssymposium_Ergebnisse.pdf>; accessed: 6 February 2019.
- [4] Schitthelm, Dietmar (2019): "Vorschlag zur Finanzierung von Maßnahmen zur Verringerung des Spurenstoffeintrags in Gewässer", in: gwf-Wasser|Abwasser, Vol. 160, No. 4, pp. 89-92.
- [5] UMK – Umweltministerkonferenz (2019): "Endgültiges Ergebnisprotokoll zur 92. UMK am 10.05.2019 in Hamburg", meeting chaired Jens Kerstan (Senator of the Environment and Energy Authority of the Free and Hanseatic City of Hamburg).

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