Funding the elimination of trace substances on the basis of the polluter pays principle

Trace substances continue to present a pressing issue for the German water sector. Fortunately, research in this area has made much progress in recent years, and the results of various discussion rounds (e.g., within the National Dialogue on Water) as well as the implementation of initial measures are encouraging. Crucially, however, the question as to how the elimination of trace substances is to be funded remains unresolved One viable option which has already been presented a while ago, is the use of a fund-based solution. This proposal incorporates the polluter pays principle in order to facilitate a steering effect This article will present the findings of a second expert opinion commissioned by BDEW on the fund-based solution. It shows that the fund-based solution is complex but would, in light of other environmental policy instruments, still be viable.

1. Background

How to deal with the increasing input of trace substances into bodies of water has been a major concern of the German water sector for some years. The German Federal Government's Trace Substances Centre within the Federal Environment Agency, a brainchild of the Stakeholder Dialogue on the "German Federal Government's Trace Substances Strategy" in 2021, performs a coordinating and integrating function in the debate. The Trace Substances Centre was preceded by a number of different initiatives from individual German *Länder*, including the creation of the Competence Centre for Micropollutants in North Rhine-Westphalia in 2011, the setting up of an equivalent institution in Baden-Württemberg in 2012, and the passing of a trace substance strategy for the Hessian Ried region in 2018. Alongside such initiatives, many scientific studies were conducted and findings published, including on the costs of the elimination of trace substances through means of a fourth treatment stage [1].

The many diverse steps taken at various levels are, in the interests of the (preventive) protection of waters, very welcome. That said, it should be noted that there is one crucial question which political decision makers seem to find extremely difficult to answer, as clearly shown, for example, in the discussions held within the National Dialogue on Water: How should the elimination of trace substances be funded in line with the polluter pays principle? The intrinsic significance of this principle to EU environmental policy was underlined by a special report from the European Court of Auditors in autumn 2021, which also highlighted the fact that the Member States are failing to fully apply the principle. In addition, a proposal for funding the elimination of trace substances based on the polluter pays principle has been in circulation for some time: At a funding symposium held within the German government's stakeholder dialogue in January 2019, mentioned above, BDEW raised the notion of a fund-based solution, as devised by BDEW's representative Prof. Dr.-Ing. Dietmar Schitthelm (former chief executive [Vorstand] of the Niersverband, NRW). The findings of an expert opinion commissioned by BDEW on the economic benefits of that fund-based solution were already outlined in an article in the 11/2019 edition of gwf-Wasser|Abwasser [3] [4]. Building on that, this article describes the central details of how the solution works as well as steps for implementing the funding mechanism in practice.

2. Key elements of the fund-based solution

The key elements of the fund-based solution are summarised below and graphically illustrated in **Figure 1**.

- A fund is set up, the financial resources of which are provided by contributions from polluters (manufacturers and importers) whose products are ultimately responsible for creating the need for a fourth treatment stage for improved trace substance elimination.
- Treatment plant operators upgrade their facilities, under certain conditions, through the addition of a fourth treatment stage for the elimination of trace substances. The investment and operation costs are reimbursed from the fund.
- A coordination office collects the contributions from the polluters and organises the reimbursement of the treatment plant operators' costs.
- The coordination office could, for example, be set up within the newly created Federal Centre for Trace Substances at the German Environment Agency (UBA). Due to significant similarities with the emissions trading system, synergy effects could be leveraged since the German Emissions Trading Authority also resides within the UBA.
- Any manufacturer/importer of products containing trace elements which cause a need for a fourth treatment stage to be installed is considered to be a polluter. This applies irrespective of whether a limit has been exceeded in the catchment area where they are based. A polluter's "responsibility for trace substances" - and thus their obligation to pay - thus relates to the whole of Germany.

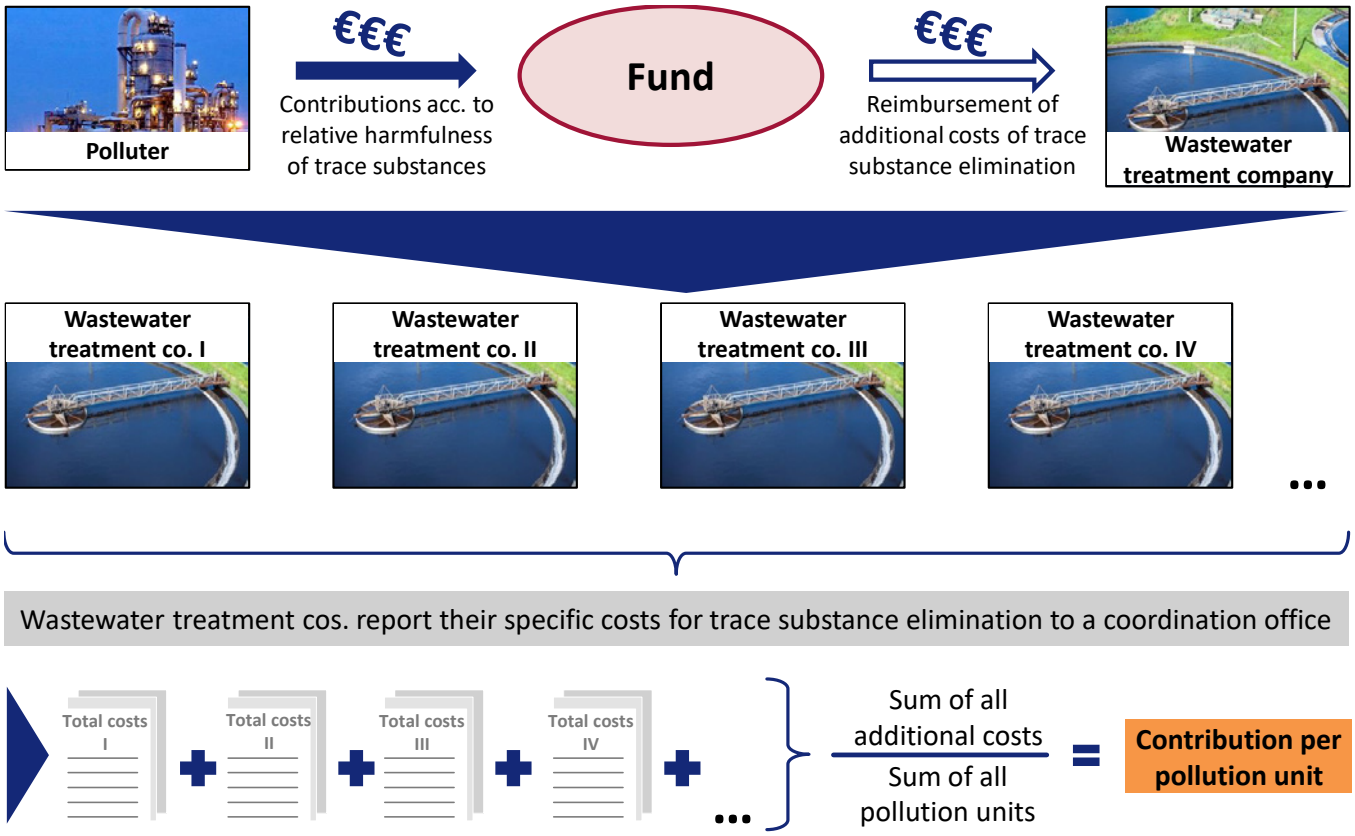

Figure 1: *Basic concept of the fund-based solution*

- The contributions to be paid into the fund by individual polluters will be calculated according to the relative harmfulness of the trace substances which that polluter has placed onto the market. The harmfulness of a trace substance will be determined on the basis of environmental quality standards or other comparable measures (e.g. PNEC values).
- The fund contributions will be dynamically adjusted according to changes in trace substance inputs, as ascertained through continuous testing of water bodies for each of the substances to be recorded on a uniform, nationwide list while considering both diffuse sources and point sources. This applies both for trace substances which are currently relevant and detectable, as well as for new trace substances identified in the future and added to the substance list. The system fully factors in the (international) upstream problem because only the trace substance emissions which are inputs in Germany are taken into account.
- The fund-based solution is technology neutral, enabling polluters to decide independently which measures they wish to take to reduce inputs.

3. Political discussion on which approach to pursue

Recently, there has been progress in the political discussion concerning the right approach to a fair funding instrument based on the polluter pays principle. In order to produce a study requested by the Environment Ministers' Conference, the German Working Group on Water Issues of the Federal States and the Federal Government (LAWA) and the German Federal Environment Ministry (BMU) set up an ad hoc federal government/Länder working group named "AG Producer Responsibility". This working group evaluated existing studies while also developing its own ideas. In March 2021, the working group provided the BMU with a report on its findings, in which it recommended that the following three solutions be pursued:

- levy on plant protection products, where appropriate expanded to include a levy on animal medicines,
- plant protection products fund, along the lines of the sewage sludge compensation fund, where appropriate expanded to include additional chemicals such as PFC,
- European rule on funding, for example in the Urban Waste Water Directive combined with a European basis for the calculation, as part of the environmental risk assessment upon registration and approval.

The original request for a study from the Environment Ministers' Conference sought to include only diffuse trace substance inputs. The working group Producer Responsibility nevertheless expanded the analysis in the course of its work, to all trace substances and thus also to inputs via point sources. It is therefore even more surprising that the first two recommendations exclusively target diffuse inputs in the form of plant protection products. As a result, there are two main problems.

Firstly, this fails to produce any steering effect for medicinal products and industrial chemicals, the trace substances of which primarily end up in our water via point sources, such as waste water treatment plants. Secondly, the approaches will not raise funds, as the working group itself states, for a fourth treatment stage, despite there being a general consensus that there is a local necessity to do so. Nevertheless, the Environment Ministers' Conference acknowledged and accepted the BMU report in its circular resolution No. 17/2021 and asked the Ministry to review the constitutionality of and further develop the three proposed solutions.

In light of this situation, BDEW commissioned a follow-up opinion on the feasibility of the fund-based solution, which should be regarded as a legitimate alternative to the recommendations and as a verified proposed solution [5]. That follow-up opinion served two main purposes: firstly, to address frequently asked questions about the design and effects of the fund-based solution and secondly, to illustrate how the manufacturers would contribute to funding the elimination of trace substances, using the example of diclofenac. The following section looks at both of these aspects.

4. Specific design and effects of the fund-based solution

The aforementioned follow-up opinion for BDEW described the fund-based model in detail, while answering 18 frequently asked questions as to its design and its effects. These are listed in **Table 1** below.

Three of these questions are addressed below, namely the questions which the authors see as being of key relevance to the implementation of the fund-based model. Comparable situations in other areas or other sectors are also presented as further illustration. The answers underline the conclusion that an environmental policy instrument like the fund-based solution is admittedly complex but nevertheless generally feasible – an important message that should give political decision makers the encouragement they might need.

Question f: What limits could be used to determine the harmfulness coefficient?

An important point of discussion around the determination of the harmfulness coefficient is what limits to use as the basis for the assessment. For some substances, limits are

Table 1*: Questions addressed in the follow-up opinion*

Questions on the specific design and effects of the fund-based solution
a) On what basis must a decision regarding an upgrade of a wastewater treatment plant be made?
b) How will the fund-based solution deal with direct polluters?
c) How will the fund-based solution address the technical limits of trace substance elimination at the fourth treatment stage?
d) How can the different degrees of effectiveness of the fourth treatment stage for different trace substances be compatible with the fund-based model?
e) Why is the relative harmfulness of a trace substance a suitable basis for determining, in line with the polluter pays principle, the level of contribution to the fund of each party bringing relevant products onto the market.
f) What limits could be used to determine the harmfulness coefficient?
g) Which trace substances should be taken into account in the fund-based model and what would be the process by which substances can be added to the list?
h) What makes the exceeding of limits a suitable pricing basis?
i) How exactly will the fund-based model produce a steering effect?
j) What about situations in which a producer switches to a different trace substance to circumvent the fund-based model?
k) Which measurement data needs to be collected for the fund-based model to work?
l) How can the desire for planning certainty be reconciled with the dynamic nature of the fund-based model?
m) How can inputs from rainwater be taken into account?
n) How can it be ensured that the necessary data is available?
o) What about the requirement that a close connection must exist between the party placing the product on the market and the specific water protection measure in the form of a fourth treatment stage?
p) What significance does the dynamic nature of the fund contributions have?
q) How can the import of products containing trace substances be adequately taken into account under the fund-based model?
r) How can it be ensured that the funds are distributed through an uncomplicated process?

set by the EU as environmental quality standards (EQS). EQS are based on eco-toxicologically derived Predicted-No-Effect-Concentrations (PNEC), i.e. if a PNEC is set as an EQS. If no EQS has been set for a substance, a PNEC may be taken as a limit accordingly. As, for many substances, different PNECs have been scientifically determined, a committee (e.g. Working Group 1 of the Trace Substance Dialogue, the Federal Government's Competence Centre for Trace Substances, the German Federal Environment Agency, ...) will have to decide which PNEC should be used as the limit. In this context, one must take into account that EQS and PNECs may change over time, for example, if new eco-toxicological findings emerge.

Comparable situations in other areas or other sectors

The scientific findings regarding the harmfulness of substances relative to one another may change over time – a situation which arises time and again with other environmental goods. A corresponding legislative underpinning could provide a basis from which to react to newly acquired knowledge. For example, the German Greenhouse Gas Emissions Trading Act (TEHG) allows the German government to determine greenhouse gas equivalents according to international standards by issuing a legal ordinance (Section 28(1) No. 1 TEHG).

Question h: What makes the exceeding of limits a suitable pricing basis?

Through the inclusion of payment obligations for parties that place trace substances onto the market, the fund-based model represents an approach that is based on the exceeding of limits of substances in waters. Limits are set at a level beyond which adverse effects on the aquatic environment are probable. Therefore, utilising official limits, such as EQS, which are also used by the EU and its Member States as the basis for various measures and sanctions, would seem to provide a good degree of legal certainty. Especially when compared to other blanket approaches (e.g. a levy on all medicines), proof of a limit being exceeded has the advantage of providing certainty that the production or use of a substance has led to a serious adverse effect on a body of water and on the aquatic environment.

Alternatively, a water usage charge could be considered, although the original study did not analyse this option in greater detail. Such a charge would mean that all substances detected in bodies of water would have to be analysed and their relative harmfulness calculated. This process would also have to consider concentrations below the relevant limits, as they impose a burden on the bodies of water, not least due to possible, as of yet unknown, "cocktail effects". However, in light of the underlying intention of the fund-based solution, namely to secure the funding of the fourth treatment stage, a water usage charge would not come without problems, primarily because it would also take into account trace substances input in a diffuse manner. The parties that place such products on the market would therefore have to contribute to the funding of the fourth treatment stage despite that treatment stage not making any direct contribution to the elimination of the substances concerned.

Comparable situations in other areas or other sectors

Due to the expected steering effect, it is recommended to incorporate a large number of substances. Fees and Seeliger have collated studies, such as for the Clean Air Act, which identify cost savings of the certificate system compared to a (hypothetical) levy-based solution [6]. They explain that the low prices and trading volumes experienced, especially in early stages, result from overestimated marginal abatement costs. It was not rare for polluters to be able to achieve environmental improvements much more easily and at much lower cost than was expected and alleged by the affected industries. Creating incentives which encourage engineers "to think freely and have innovative ideas", has the potential to unlock efficient environmental solutions.

The desire to include a large number of substances and thus involve a large number of industries in the raising of funds must be balanced against potentially high transaction costs. It is conceivable – as in the case of the German Greenhouse Gas Emissions Trading Act (Section 27 TEHG) – for individual, small polluters to be granted some leeway. Similarly, as is the case for the regulation of network charges for electricity or gas, it is possible to set up simplified procedures for regulated electricity and gas network operators. De minimis rules could be the preferred solution in cases where it becomes apparent that the application of standard cost models leads to excessive bureaucratic costs.

When weighing up whether to include more or fewer substances, the smart solution in the German Fuel Emissions Trading Act (BEHG) could also serve as an example. Under that Act, passed in December 2019, an evaluation report will be produced initially every two years and later every four years (Section 23 BEHG). Experience and insight garnered in the specific implementation will therefore swiftly lead to meaningful adjustments, in light of, among other things, the desire for the lowest possible transaction costs.

Question n: How can it be ensured that the necessary data is available?

On the one side, the implementation of the fund-based model requires water quality data and, on the other, data on the products placed on the market that contain the relevant trace substances. The fund-based model envisages the creation of eleven sampling points in Germany, each of which would see a measuring device installed to take 24-hour composite samples as well as a device to measure flow rates. The findings of a research project conducted on the Niers river, that took samples on working days and involved analysis at several testing points, including outward flow measurements, are very promising and support the chosen approach of taking measurements of the fund-based solution. Generally, for the larger, first-order catchment areas, the substance-specific load is calculated and placed in relation

Table *2: Top 3 trace substances in the investigation area by relative harmfulness*

#	Trace substance	EQS value	Harmfulness coefficient	Total load	Total poll. units	Relative harmfulness
1	Ibuprofen	0.01	100.00	260.14	26,014	30.24 %
2	Perfluorooctanesulfonic acid/derivatives (PFOS)	0.00065	1,538.46	15.98	24,580	28.57 %
3	Diclofenac	0.05	20.00	964.17	19.284	22.42 %
...						

to other substances. In the case of cross-border catchment areas, like that of the Rhine river, there is not simply a measurement taken at the outlet (ocean or country border), rather the load at the river's entry to Germany is subtracted. This means that only water pollution that originates within Germany is taken into account. If it should be determined that due to a high degree of dilution or the long flow paths at the outlets only a few substances which are otherwise detected in catchment areas in Germany can be confirmed to be present, then second order streams (e.g. the Ruhr river) should also be examined. In addition, regular composite samples, taken from the flow gauges at the second order catchment area outlets could be analysed.

The relative harmfulness and thus the fund contributions per pollution unit can be calculated from the water quality data. In order to be able to collect payment from the polluters responsible for the trace substances liable to contributions, information is needed not only about the parties that place the products on the market, but also data regarding the quantity of a trace substance placed on the market by each of those parties. In the study area covered by the report on the fund-based model, around 98.5% of the relative harmfulness was caused by just 20 trace substances (from a total of 151 analysed trace substances). While it is to be expected that the expansion of the analysis to cover the whole country will lead to a higher number of trace substances, it is unlikely that the number will jump to a level which would make collecting the relevant data impossible. Until now those placing the relevant products on the market have had no obligation to disclose their production or import quantities of products (or intermediate products) containing trace substances. The provision of such data for the purpose of governmental regulation has, however, been established in other sectors, hence it is reasonable to assume that this would also be feasible for the fund-based model.

Comparable situations in other areas or other sectors

The study illustrates, through the example of diclofenac, the complexity of collecting the relevant data. The basis of data was no less complex in all other environmental areas at the time environmental policy rules were first created, hence a corresponding reporting obligation was introduced. In each case, the legislative basis for the environmental regulations cited in the expert opinion stipulates who has to provide information and how often and in what format it must be transmitted. In many cases today, electronic communication is mandatory (Section 52(2) of the German Waste Management Act (KrWG)). Audit bodies are also created which verify the reported emissions (Section 21 TEHG or Section 15 BEHG).

5. Funding contributions from manufacturers, using the example of diclofenac

The first expert opinion utilised tests from four water associations with special legal status from North Rhine-Westphalia (NRW) which were conducted in selected cross-sections of waters [3]. Of the 151 trace substances analysed, a total of 56 different substances or substance groups were detected in at least one of the studied water catchment areas. From the findings, a list was produced containing the relative harmfulness of the substances. To do so, firstly the so-called harmfulness coefficient of a substance (reciprocal value of the EQS) was multiplied by its load in order to find the number of pollution units for the substance in question. Then, the substance's relative harmfulness was calculated by dividing this value by the sum of all pollution units. For the example substance, diclofenac, the figure reached, on the basis of its EQS (= 0.05 µg/l) and a load of 964.17, was 19,284 pollution units (= [1/0.05] ▪ 964.17). In light of the total number of pollution units of 86,022, the relative harmfulness for diclofenac was found to be 22.42% (= 19,284 / 86,022). **Table 2** shows the top 3 trace substances by relative harmfulness.

Under the fund-based solution, the relative harmfulness equates to the proportion of the total costs of trace substance elimination in Germany which all manufacturers and parties placing that trace substance on the market have to bear. In the follow-up report, the annual costs of upgrading a waste water treatment plant in Germany were calculated based on a study produced by Hillenbrand et al. for the German Federal Environment Agency [1] starting from certain assumptions. The total costs estimated over a period of 30 years amounted to € 5.85 billion (see **Figure 2**).

Based on the relative harmfulness of diclofenac in the investigation area of 22.42% the financial contribution which all manufacturers of diclofenac and all parties that place diclofenac on the market in Germany would have to pay can be derived. In this context, the question still arises as to whether this proportion can be seen as representative for the whole of Germany and can therefore be used for the further calculation of the cumulative fund contribution for diclofenac.

Total costs p.a. (assuming upgrading of treatment plants ≥ 5,000 p.e.)	Percentage of plants to be upgraded	Final costs p.a. (including additional treatment)	Time to completion
€1.229 bn*	25% (= approx. 750 plants)**	€307.2 m	15 years

Costs for testing of waters***	Costs for coordination office***
€3.9 m p. a.	€3.0 m p. a.

Upgrading of 50 plants p.a.

* Basis: Hillenbrand et al. (2016) [1]
** Basis for calculation: In Germany, there are approx. 3,000 plants >5,000 p.e. (size classes 3 to 5)
*** Basis: Estimates according to expert opinion produced on behalf of BDEW [3]

Year	Number of upgraded plants	Costs p. a. [in €m]	Year	Number of upgraded plants	Costs p. a. [in €m]	Year	Number of upgraded plants	Costs p. a. [in €m]
t_1	50	20.5	t_6	300	122.9	t_{11}	550	225.3
t_2	100	41.0	t_7	350	143.3	t_{12}	600	245.7
t_3	150	61.4	t_8	400	163.8	t_{13}	650	266.2
t_4	200	81.9	t_9	450	184.3	t_{14}	700	286.7
t_5	250	102.4	t_{10}	500	204.8	t_{15}	750	307.2

excl. inflation and discounting!

from t_{15} =€307.2 m p.a.

Total costs over a period of 30 years: €5.85 bn

incl. inflation (2.0%*) and discounting (3.3%**)!

* ECB inflation target
** Ø-yields on debt securities outstanding over the last 30 years (based on figures from German Bundesbank)

Figure 2: *Total costs of upgrading wastewater treatment plants in Germany over a period of 30 years*

Upon closer examination, four factors could affect the extrapolation of the diclofenac share to the whole of Germany:

- The number of residents in the investigation area of the four water associations with special legal status should be seen as a neutral factor in the extrapolation because a higher absolute diclofenac usage due to the higher number of residents will also be accompanied by a larger volume of waste water, hence the diclofenac load will likely remain unchanged.
- The "waste water treatment plant set up" of the four water associations already includes a relatively higher number of plants with a fourth treatment stage than on average across Germany. For that reason, the share of diclofenac would likely tend to be underestimated in the extrapolation, as one can assume that a relatively higher amount of diclofenac will have been eliminated by the treatment plants in the investigation area.
- The concentration of industry/commerce in the investigation area is higher than in Germany as a whole, hence one must assume a higher incidence of PFOS inputs in the study area. Conversely, the diclofenac share will tend to be underestimated in the extrapolation.
- Diffuse pollution from agriculture will usually tend to be neutral as far as the extrapolation of the diclofenac share is concerned. While there are detectable discharges in the study area, their relative proportion is so small that including more intensively farmed regions than those in the study area would not have any significant impact on the diclofenac share.

If one stipulates, on the basis of the considerations from above, a range for the relative harmfulness of diclofenac of 20-25%, as well as total costs of €5.85 billion over a period of 30 years, the cumulative fund contributions across all manufacturers of diclofenac and parties placing diclofenac on the market would be between €1.17 billion and €1.46 billion. The average annual fund contribution of all manufacturers and parties placing diclofenac on the market would therefore be between €39.0 and €48.8 million. In 2019, the revenues from prescription drugs and medicinal products only available from pharmacies containing the single agent diclofenac were, according to IQVIA data, around €242 million (sales via pharmacies and mail order). The share of revenues which all manufacturers and parties marketing medicines containing the single agent diclofenac would be required to contribute, would be between 16.1% and 20.2% (on the basis of 2019 revenue figures). These fund contributions would be allocated by the coordination office to the respective manufacturers of diclofenac and parties placing diclofenac on the market (in Germany, this would mean, according to the "Yellow List", 42 manufacturers).

6. Conclusion

The fund-based solution being presented here is centred on the polluter pays principle and thus differs fundamentally from all other approaches being discussed to finance the elimination of trace substances. The analyses in the scope of the follow-up reports produced for BDEW have shown that the fund-based solution is indeed complex but would

nevertheless be viable, in comparison to other environmental policy instruments. It would seem that a political breakthrough has so far been prevented by the fact that the polluter pays principle is all too often discussed from the perspective of fairness. Sadly, however, this diverts our view from its true economic rationale, which is that polluters should bear the costs of pollution not for fairness reasons but to enable the polluters to internalise such costs in their (production) strategies. This is how the desired steering effect can unfold which would ideally satisfy the economic efficiency criteria and minimise the costs to the economy as a whole. This means that it would not be the patients taking medicines containing the active ingredient diclofenac who are the polluters, but rather the parties placing diclofenac on the market or "processing" that ingredient.

Literature

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Authors

Christoph Czichy, M.Sc. VWL
MOcons GmbH & Co. KG, Mülheim an der Ruhr (Managing Partner), Germany
christoph.czichy@mocons.de

Prof. Dr. Mark Oelmann
MOcons GmbH & Co. KG, Mülheim an der Ruhr (Managing Partner), Germany
Hochschule Ruhr West, Mülheim an der Ruhr (Prof. of Water and Energy Economics)
mark.oelmann@mocons.de

Kristina Wencki
IWW Rheinisch-Westfälisches Institut für Wasserforschung gGmbH, Mülheim an der Ruhr (Research Coordinator), Germany
k.wencki@iww-online.de

Dr. Tim aus der Beek
IWW Rheinisch-Westfälisches Institut für Wasserforschung gGmbH, Mülheim an der Ruhr (Department Head, Water Resource Management), Germany
t.ausderbeek@iww-online.de