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Executive Summary

This case study analyses the policy mix of economic and regulatory instruments introduced in Germany to reduce point source pollution.

The policy mix consists of the following instruments[1]:

- Discharge Permits (Federal Water Act, implemented in 1957)
- Effluent Tax (Effluent Tax Act; implemented in 1976)
- Discharge limits and technological standards (Waste Water Ordinance; implemented in 1997)

While all of the above mentioned instruments are considered in the analysis, the focus lies on the effluent tax.

Definition of the analysed EPI and its purpose

All discharges of effluent require a permit. This permit is issued only if the effluent to be discharged is kept as low as possible for the required process and with the best available technology. In 2004, the emission-related requirements, such as pollutants limits and technical standards, were further specified for 57 areas of origin and production sectors by enforcing the Waste Water Ordinance. Permits can be granted temporarily or permanently and can be withdrawn if concerns regarding water protection and management arise (Kraemer, 1995).

The effluent tax is based on these permits, rather than on actual measurements. The tax rate is based on damage units, which are calculated as the equivalents of pollutants in the discharged effluent. Measured pollutants include phosphorous, nitrogen, organic halogen, mercury, cadmium, chromate, nickel, lead, copper, and indicators on the chemical oxygen demand and the toxicity for fish eggs.

The effluent tax should implement the "polluter pays principle", i.e. lead to the internalisation of external costs. In conjunction with direct regulations on the discharge of effluents, the effluent tax shall provide an economic incentive to avoid or reduce harmful effluent discharges. The revenue of the effluent tax is earmarked for investments in water quality programs by the *Länder*, such as the construction of municipal sewage treatment and the administration of water quality programmes tax's incentive effect in improving water quality.

[1] Federal Water Act (Wasserhaushaltsgesetz); Effluent Tax Act (Abwasserabgabengesetz); Waste Water Ordinance (Abwasserverordnung).

Introduction

The exceptionally high growth in pollution-intensive sectors (such as energy, chemicals, and construction) in the post-war period caused serious environmental problems as the construction of wastewater treatment facilities did not keep pace. Compared to other industrial nations, such as the UK and Japan, Germany did not have the option to dispose wastewater from its industrial areas directly to the sea, which led to highly polluted river systems. Under invariable conditions, a future acceptable water supply as well as other water uses would have been under a serious threat (SRU, 1974).

The inception of the federal Effluent Tax Act in the early 70s occurred during a re-orientation period in the political life of the Federal Republic of Germany, following the election of the first government of the German Social Democratic Party (SPD) and the Liberal Party (FDP) in 1969. This government identified protection of the environment as a major new policy area and initiated measures to establish the institutional framework for environmental policy, notably at the federal level

The effluent charge was introduced in 1976 as a reaction to the insufficient implementation of direct regulation (Federal Water Act, WHG) of effluent discharges by the water management administrations of the Federal States of Germany (*Länder)* and the resultant non-compliance with prescribed discharge standards in the private and municipal sectors.

Legislative setting and economic background

Given the federal nature of Germany, a distinction needs to be made between laws passed at federal level and those passed at *Länder* level. In Germany, two federal laws determine essential elements of water management: the Federal Water Act (WHG) of 1957 and the Effluent Charges Act (AbwAG) of 1976. These laws are obligatory for the *Länder*.
The Federal Water Act and Federal Effluent Charges Act were passed as framework laws, which had to be transposed into the federal state legislation before coming into force. [2] Most Länder introduced the effluent charge in 1981, with others following in 1982-83. After the German reunification of the Federal Republic of Germany and the German Democratic Republic (GDR) in 1990, the five new federal states adopted the tax as of 1991. The Waste Water Ordinance concretises the technical standards which are stated in the Federal Water Act into regulations for effluent discharges from various sources. It transposes the EC Urban Wastewater Directive (Council Directive 91/271/EEC).

[2] As part of the Federalism Reform in 2006 the framework law of the Federal Water Act was amended and is now partially replaced by full regulations controlled by the federal government (concurrent legislation).

Brief description of results and impacts of the effluent tax

While the policy mix makes it difficult to single out the impact of the effluent tax, it can be stated that the policy mix as a whole was instrumental in achieving most of its targeted objectives:

- The quantity of overall discharges of pollutants into water ways was reduced by 4%, while discharges of private emitters were decreased by 18%. The harmfulness of effluents was decreased substantially. Mercury discharges were reduced by 99% from industrial dischargers and by 65% by municipal treatment plants in 2003-2005, when compared to the baseline of 1987. Nitrogen discharges from point sources were reduced by 76% in 2003-2005 when compared to the baseline of 1987
- The quality of water bodies increased substantially, with 65% of all surface water bodies achieving a water quality II status. The concrete objective, however, of improving all water bodies to water quality II status by 1985 failed.
- Waste water treatment plants were upgraded to the state of the art. In 2007, 92.6% of effluents in Germany underwent tertiary treatment–a percentage which, when compared to other Western European countries, makes Germany a frontrunner of advanced wastewater treatment standards
- Industries, such as the paper industry, developed production processes which required less wastewater development. Others, like the chemical industry, invested in effluent abatement measures and considerably reduced the discharge of pollutants
- The costs to mitigate, eliminate, and balance damage to water bodies were distributed among the polluters, which reflects a successful implementation of the polluter pays principle.

In addition, the effluent charge contributed significantly to capacity building in the water management administration.

Conclusions and lessons learnt

This case study illustrated that a policy mix consisting of regulatory and economic instruments can be very powerful in implementing and enforcing policies to address direct effluent emissions.

However, it has also shown the importance of creating the right incentive structure to achieve the targeted objectives – it was found that the effluent tax rate has been set too low since its introduction in 1979. In addition, the effluent tax rate has not been adjusted to inflation. As the cost of measures for abatement have increased with inflation, and as the standards for BATs in the Waste Water Ordinance have become more stringent, the effluent tax could not develop its full potential for setting innovation incentives to abate residual pollution. While goods results have been achieved in terms of environmental outcomes, the policy mix has been deprived of the effluent tax's essential contribution to achieve its objectives.

The reasons for the lack of adjustment can be explained by the influence of dominant interest groups in the policy implementation process and by external shocks, such as an economic crisis, which aggravates the potential to increase tax rates. On the other hand, external shocks such as the algae bloom in German waters, which led to a widespread decline in seal populations, raised public awareness in water pollution. On the basis of this political climate, the effluent tax rate was increased slightly.

A further finding of this case study shows that the incentives created by the effluent tax may be different for private and public dischargers. As such it was found that mainly the private sector changed their behaviour in order to reduce the effluent tax as much as they could as part of their profit-maximizing behaviour. Municipalities, on the other hand, focused on complying with the regulation and thus forewent reductions in the effluent tax.

Finally, the introduction of the effluent tax led to significant capacity building in the water management administration.

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List of Acronyms

AbwAG	Abwasserabgabengesetz
AbwV	Abwasserverordnung
AOX	adsorbable organic halogen compounds
BAT	Best Available Technology
BDEW	Bundesverband der Energie- und Wasserwirtschaft
BMU	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit
BMF	Bundesministerium der Finanzen
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
DM	Deutsche Mark
DWA	Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V.
EEA	European Environment Agency
EEG	Erneuerbare Energien Gesetz
EPI	Economic Policy Instrument
FDP	Freie Demokratische Partei
FRG	Federal Republic of Germany
GDP	Gross Domestic Product
GDR	German Democratic Republic
LAWA	Bund/Länder-Arbeitsgemeinschaft Wasser
OECD	Organisation for Economic Co-operation and Development
SPD	Sozialdemokratische Partei Deutschlands
SRU	Sachverständigenrat für Umweltfragen
UBA	*Umweltbundesamt*
VKU	Verband kommunaler Unternehmen
WFD	Water Framework Directive
WHG	Wasserhaushaltsgesetz

1. EPI Background

This case study analyses the policy mix of economic and regulatory instruments introduced in Germany to help manage point source pollution.

The policy mix consists of the following instruments:

- Discharge Permits (Federal Water Act, implemented in 1957)
- Effluent Tax (Effluent Tax Act; implemented in 1976)
- Discharge limits and technological standards (Waste Water Ordinance; implemented in 1997)

While all of the above mentioned instruments are considered in the analysis, the focus lies on the effluent tax.

Since 1981, the Federal States (*Länder)* of Germany have levied an effluent tax on all direct discharges into water bodies from industrial and municipal sources (BMF, 2003:25). Upon German reunification in 1990, the Effluent Charge Act was extended to the five new *Länder* and came into force in 1991 (Ecotec, 2001: 83).

In conjunction with direct regulations on the discharge of effluents, the effluent tax shall provide an economic incentive to avoid or reduce harmful effluent discharges (BMU, 2003:26) The size of the tax is based on damage units, i.e. quantities and concentrations of pollutants, and the quantity of discharged effluent (§ 3 AbwA), for which permits must still be obtained (§7 WHG). Indirect dischargers are affected indirectly by having to pay waste water charges (*Abwassergebühren)*.

1.1. Policy objectives

The effluent charge was introduced as a reaction to the insufficient implementation of direct regulation (Federal Water Act, WHG) of effluent discharges by the water management administrations of the Federal States (Kraemer, 1995) and the resultant non-compliance with prescribed discharge standards in the private and municipal sectors (Ecotec, 2001:84). Direct regulation did not lead to an internalization of external costs caused by untreated effluent discharges (SRU, 1974). The effluent tax should thus address the "polluter pays principle," leading to the internalisation of external costs and incentives to reduce efficiently the quantity and damage units of discharged effluent (e.g. Rahmeyer, 2001). As such, the overall objective was to complement direct regulation and by these means achieve "slightly burdened" status for all water bodies by 1985 (*Gewässergüteklasse II*) (UBA, 2011; SRU, 1974).

The objectives of the effluent charge include (1) mitigating and avoiding the discharge of pollutants into waterways, soil, and drainage systems; (2) maintaining clean water bodies; (3) keeping water treatment plants consistent with the state of the art; (4) developing production processes with less or no wastewater development; (5) and appropriately distributing the costs to mitigate, eliminate, and balance damage to water bodies (Sächsisches Staatsministerium für Umwelt und Landwirtschaft).

As the effluent tax implements the polluter pays principle (UBA, 2011), the prior competitive advantage of polluters, i.e. not paying for the pollution caused despite benefiting of the resource, should be reduced (Schröder, 2005).

In addition to its incentive function, the effluent tax should help solve the "implementation deficit" of the states' administrations because part of the revenue can be used for capacity building activities (Kraemer, 1995:8).

1.2. Design of the effluent tax

The discharge of effluent requires a permit (§ 10 WHG). This permit is issued only if the effluent to be discharged is kept as low as possible for the required process and with the best available technology (§ 57 WHG). In 2004, the emission-related requirements, such as pollutants limits and technical standards, were further specified for 57 areas of origin and production sectors by enforcing the Waste Water Ordinance (*Abwasserverordnung, AbwV*). Permits can be granted temporarily or permanently and can be withdrawn if concerns regarding water protection and management arise (Kraemer, 1995).

The effluent tax (*Abwasserabgabe)* is based on these permits, rather than on actual measurements. The tax rate is based on damage units, which are calculated as the equivalents of pollutants in the discharged effluent. Measured pollutants include phosphorous, nitrogen, organic halogen, mercury, cadmium, chromate, nickel, lead, copper, and indicators on the chemical oxygen demand and the toxicity for fish eggs. A detailed overview of the thresholds of concentrations and annual discharge of these pollutants can be found in Annex 1 –Table A1.1. It was decided to increase the effluent tax per damage unit stepwise between 1981 (EUR 6.1) and 1986 (EUR 20.5).

Charges can be reduced by 50% (75% before 1998) if abatement measures are introduced or sewage treatment plants are constructed or improved. Furthermore, dischargers have the option to "offset the costs of investments in pollution control equipment against their charges," which in the case of municipalities can take the shape of 3-year exemption from the tax (OECD, 1997:41, Smith and Vos 1997:41). During the first decade of the tax, a hardship clause "allowed for a reduction or even annulment of the tax." This provision was removed in 1989 (UCD, 2008).

If the permitted discharge is exceeded in quantity or concentration, disproportionately rising charges apply (BMF 2003: 26). Should this occur more than once, the water authorities of the *Länder* impose additional fees (ECOTEC et al. 2001, 84). The standard fiscal code regulates fines for non-compliance, although levels for regulatory offenses are capped at EUR 2,500.

The Federal Effluent Tax Act has been amended several times, leading to substantial revisions with respect to the calculation of damage unit rates (Table 1.1), inclusion of pollutants, and regulations designed to promote investments in water pollution abatement (Kraemer, 1995). [3] Despite these amendments, the character of the effluent charge has not fundamentally changed over the years (Ecotec, 2001: 84).

Table 1.1 Increase in effluent charge per damage unit, 1981-2002

Year (January)	Effluent charge per damage unit (annual)	
1981	12 DM	EUR 6.1
1982	18 DM	EUR 9.2
1983	24 DM	EUR 12.3
1984	30 DM	EUR 15.3
1985	36 DM	EUR 18.4
1986	40 DM	EUR 20.5
1991	50 DM	EUR 25.6
1993	60 DM	EUR 30.8
1997	70 DM	EUR 35.8

Source: AbwAG, 2005

While indirect discharges into municipal treatment systems are not covered, the sewage charges imposed by municipalities and other (public) operators of sewerage systems allow that effluent charges are passed through to indirect emitters (Gawel and Ewringmann, 1994).

The revenue of the effluent tax is earmarked for investments in water quality programs by the *Länder,* such as the construction of municipal sewage treatment and the administration of water quality programmes (§13, AbwAG). The earmarking is intended to complement the tax's incentive effect in improving water quality.

1.3. Monitoring

The monitoring and enforcement of effluent charges is the responsibility of the water management authorities. Besides the legal requirement of the operators of water pollution abatement facilities to monitor themselves (*Eigenkontrolle)*, an activity

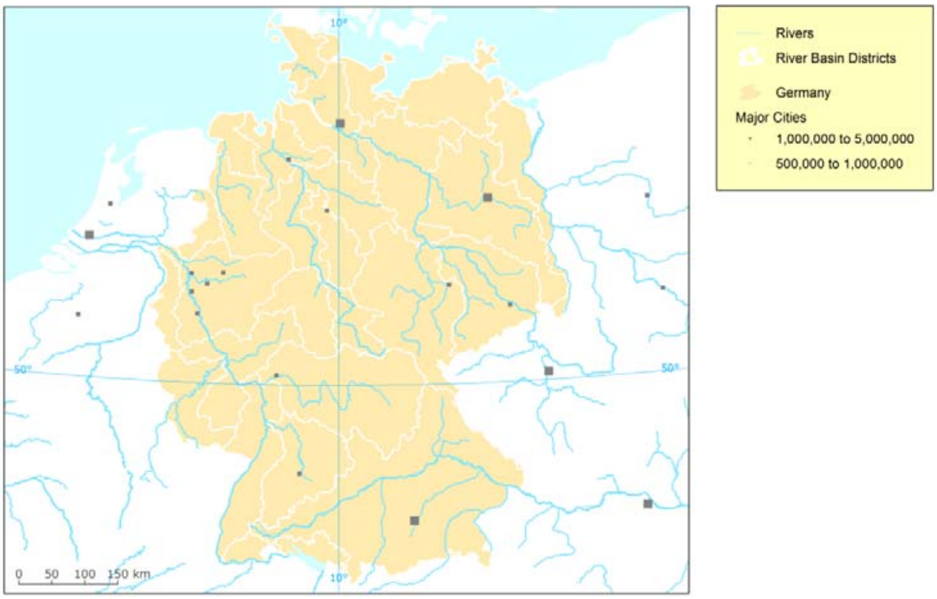
[3] Amendments were made in 1984, 1986, 1990, 1994, 1996, 1997, 1998, 2001, 2004, 2009, and 2010. For more information, please consult Kraemer, 1995: 12-20; Kloepfer, 2004, UMWR (2010), Bundesministerium der Justiz (2005).

which can be contracted out to accredited institutions, the water management authorities "monitor the self-monitoring"(Kraemer, 1995).

1.4. Public participation process

In Germany, policy formulation usually involves a high degree of openness and is reported in the media. Public scrutiny in the case of the highly politicised federal Effluent Tax Act also involved the main environmental associations. Expert hearings are used regularly to provide scientific input for policy formulation (or evaluation and adaptation) (Kraemer, 1995).

2. Characterisation of the Case Study Area



Map 2.1 Geographical representation of Germany
Source: EEA Database, 2011

With only 18.9% of the long-term annual average of renewable water (188 billion m^3) being used annually, Germany is a relatively water-rich country (OECD, 2008). In addition, Germany's Water Exploitation Index fell from 25 to 20% between 1990 and 2004 (EEA, 2010), which indicates an increasingly rational use of water. Germany thus sits at the dividing line between low and medium water stress; however, the country is predicted to fall into the low water stress category by 2030 (Footitt and EEA 2007: 15).

The analysis of the River Basin Management Plans showed that the main pressures to Germany's river basins arise from nutrient and pollutant input into surface and groundwater from point and diffuse sources as well as surface water hydromorphology (BMU, 2010). Mainly due to excessively high nutrient loads and radical changes to the surface water's hydromorphology, only 9.5% of the 9,900 surface water bodies have achieved a "good status" according to the WFD. Sixty two percent of the 1,000 groundwater bodies in Germany have achieved "good status" according to the WFD. Failure to achieve "good quantitative status" was mainly due to local mining activities, while excessive nitrate values caused mainly by intensively farmed land was the predominant reason groundwater bodies did not reach "good chemical status" (BMU, 2010).

Agriculture is the predominant land use in Germany (~52%), followed by forests (~30%) and developed areas (~14%). Water bodies and wetlands amount to 2% of the land area. While the land cover being analysed increased in 1990 with the German unification, the distribution of land use has remained stable over time (1966-2009). [4]

2.1. Pressures

Following re-unification in 1990, only 75% of the population from the former GDR *Länder* in contrast to 94% of the FRG population, were connected to the public sewage system. By 2007, 96% of the total population was connected. (Destatis, 2009)

Between 1975 and 2001, wastewater discharges from public sources increased smoothly by 74%. Private wastewater discharges, however, reached their peak in 1987 following an increase of 70% between 1975 and 1987. Between 1987 and 2001, private wastewater discharges decreased by 18%. Total effluent discharges decreased by 4% between 1983 and 2001. (see Figure 2.1 and Annex 2 Table A2.2).

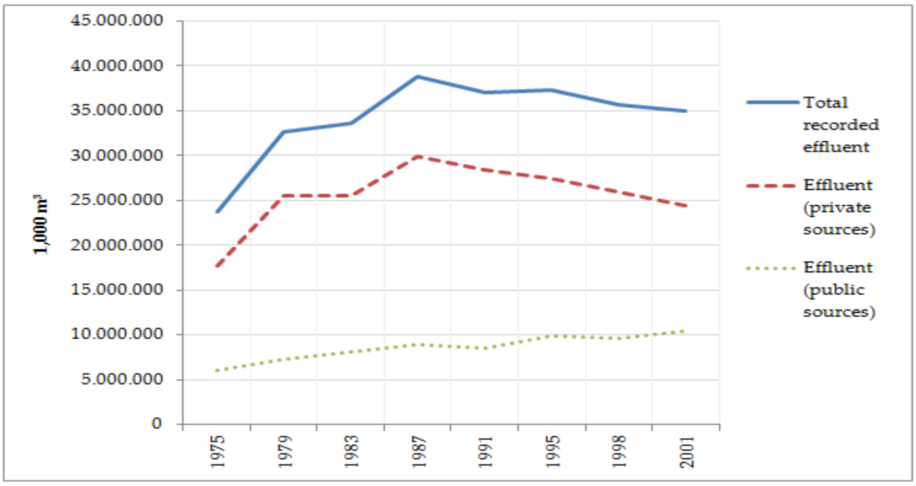


Figure 2.1 Wastewater discharges by private and public dischargers in Germany, 1975-2001

Source: UBA (1975-2001)

[4] Detailed statistics, including the development over time can be found in Annex 2 (Table A2.1)

Note: Data before 1990 only include *Länder* of the Federal Republic of Germany, from 1990 onwards; data from the *Länder* the former Democratic Republic of Germany are included.

Regarding industrial wastewater, only 14.3% is discharged indirectly, i.e., into municipal wastewater treatment plants. The remaining 85.6% is discharged directly into water bodies. The main industrial sectors *directly* discharging wastewater into water bodies include the chemical industry (49%), mining of coal and lignite (22%), quarrying earth and other mining (7%), and the paper industry (6%). The sectoral breakdown remained stable between 1991 and 2007 (Destatis, 2011a).

2.2. Economic characterisation

Germany's GDP per capita increased from EUR 8,912 in 1975 to EUR 30,600 in 2010 (Eurostat, 2011). Since 1975, Germany's population has grown by 5% and currently totals 81,471,834 inhabitants (Destatis, 2011c), which results in a population density of 229 people/km² (SÄBL, 2011).

Most economic activity in 2001 and 2010 was in the financial, leasing, and business services sector, closely followed by public and private services. The manufacturing sector contributes around 24% to generated GDP. While the aforementioned sectors showed the highest increases between 2001 and 2010, agriculture, as the only declining sector, decreased by 25%.

Table 2.1 GDP Generation per sector , 2001 and 2010

	2001	2001	2010	2010	% change 2001-2010
	€ B	% of GDP	€ B	% of GDP	
Finance, leasing, business services	533.83	28.03%	682.13	30.46%	28%
Manufacturing without construction	473.68	24.87%	531.88	23.75%	12%
Public and private services	432.44	22.71%	528.02	23.58%	22%
Processing trade	434.6	22.82%	463.74	20.71%	7%
Trade, hospitality and transport	347.1	18.23%	385.55	17.22%	11%
Construction	91.5	4.80%	92.49	4.13%	1%
Agriculture, forestry, fisheries	25.94	1.36%	19.48	0.87%	-25%
Total	1904.49	100.00%	2239.55	100.00%	18%

Source: Destatis, 2011d

2.3. Baseline

Figure 2.2 and Figure 2.3 present the discharges of mercury and nitrogen into surface water bodies from diffuse and point sources over the years 1983-2005. Mercury and nitrogen are chosen as representatives for heavy metal and nutrient pollutants. Additional pollutant discharges can be found in Annex 2 (Figure A2.1)

For the baseline it is assumed that only discharges from industrial and municipal treatment plants for the case of mercury and point sources for the case of phosphorous will change due to the introduction of the policy mix. Discharges from diffuse sources are assumed to remain at their 2003-2005 level.

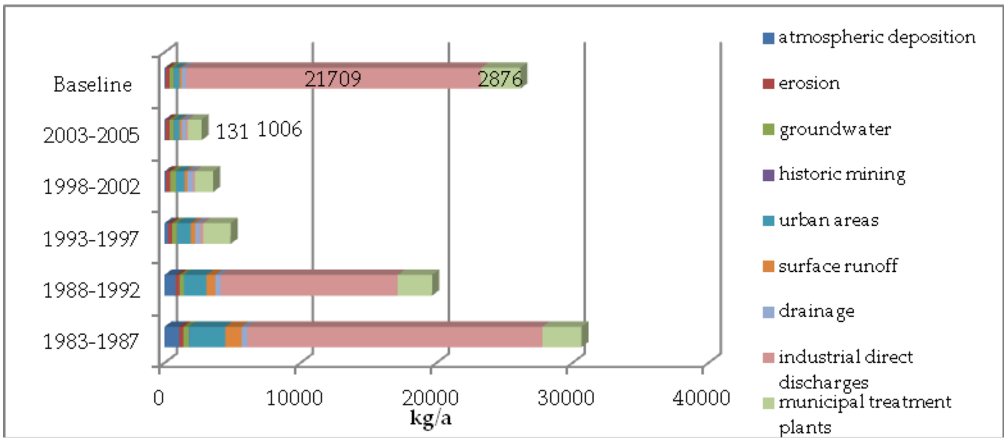


Figure 2.2Discharge of mercury from diffuse and point sources into surface water bodies, 1983-2005 including a baseline

Source: UBA, 2010; authors' estimation

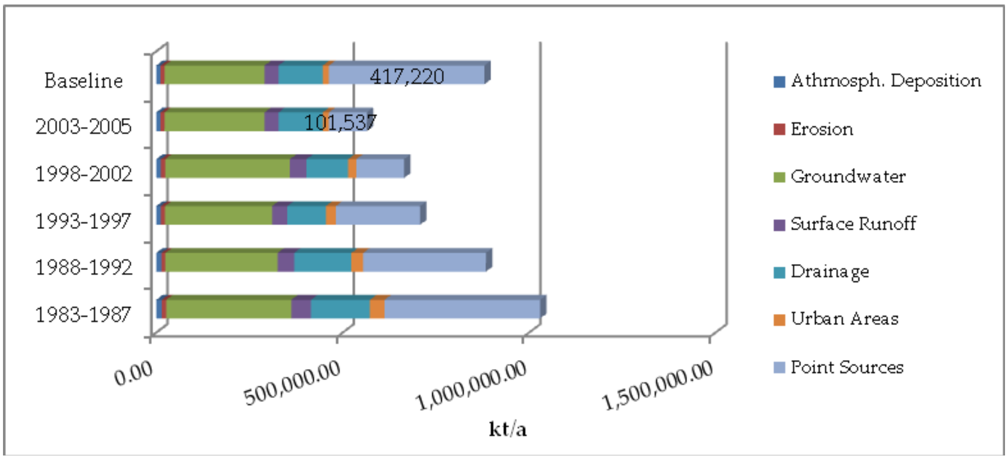


Figure 2.3 Discharge of nitrogen from diffuse and point sources into surface water bodies, 1983-2005, including a baseline

Source: UBA, 2010; authors' estimation

3. Assessment Criteria

3.1 Environmental outcomes

The economic agents' effective responses to the effluent tax

The effluent tax sent a signal to effluent dischargers that the government is determined to achieve the objectives set out in the direct regulation. This along with the announcement of the increasing effluent tax rate led to changes in economic agents' behaviour.

Following the introduction of the effluent tax, polluters had the option to choose between investing in pollution abatement, either through effluent treatment or by changing production processes, or paying the effluent tax (Kraemer, 1995).

A survey carried out following the announcement of the tax - but before its implementation - found that three-quarters of private enterprises and two-thirds of municipalities had increased, accelerated, or modified their abatement measures for water pollution in anticipation of the charge (Barde, 1997). Investments in equipment for water pollution abatement increased markedly more than three years before the effluent charge was instituted (Erwingmann et al, 1980). Barde (1997) notes that, in this case, even the announcement of an economic instrument was useful for inducing pollution abatement. It increased awareness of the need and potential for water pollution control (Kraemer, 1995).

It is generally accepted that the option to offset the effluent tax with investment expenditures in abatement measures has promoted the construction and extension of effluent treatment installations because industrial direct emitters were incentivized to maintain or reduce their number of permits (e.g. Deutscher Bundestag, 1994, Kraemer, 1995). Following the announcement effect described above, it can be said that most investments made before or shortly after the implementation of the effluent tax were triggered by the effluent tax. Investments in later periods cannot be clearly attributed to the effluent tax, as the direct regulation has meanwhile been made more stringent.

The independent Council of Advisors on the Environment (*Sachverständigenrat für Umweltfragen)* determined the marginal abatement cost curve for wastewater treatment plants to assess the optimal effluent tax rate before its introduction (SRU, 1974). The costs include capital and operational costs for the treatment of wastewater only, i.e., not for the transport to and from the wastewater treatment facility. From Figure 3.1 it becomes clear that costs to remove pollutants of the equivalent of 33% (standard mechanical treatment) - 70% of BOD remain rather constant. Costs increase exponentially beyond the removal of pollutants of an equivalent of 70% BOD. A full removal of all pollutants (100% ŋ[BOD]) was either not possible in 1974, or was not considered due to the high costs involved.

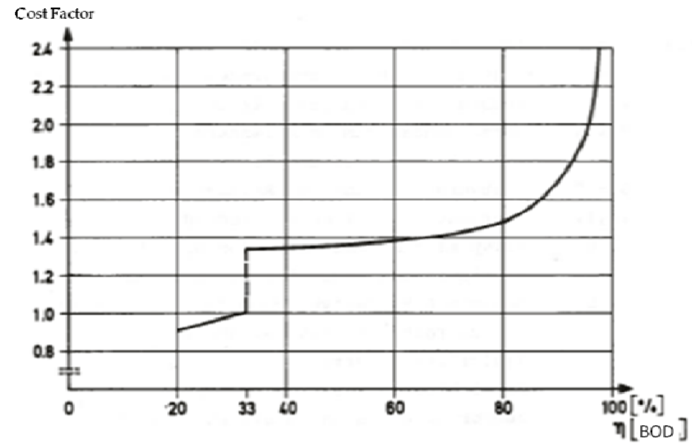


Figure 3.1 Marginal Abatement Cost Curve for Wastewater Treatment Plants

Source: SRU, 1974

It can be assumed that the effluent tax was high enough during its introduction phase to make abatement efforts profitable in the area between the removal of 33 and 70% of BOD-pollutant-equivalents.

As can be seen in Figure 3.2**Errore. L'origine riferimento non è stata trovata.**, the percentage of effluents undergoing secondary and tertiary treatment has increased substantially over the years, with tertiary treatment first being introduced in 1991. It is interesting to note the lower treatment standards of effluents in the former GDR (1991-centre column). In 2007, 92.6% of effluents in Germany underwent tertiary treatment a percentage which, when compared to other Western European countries, makes Germany a frontrunner (Figure 3.3).

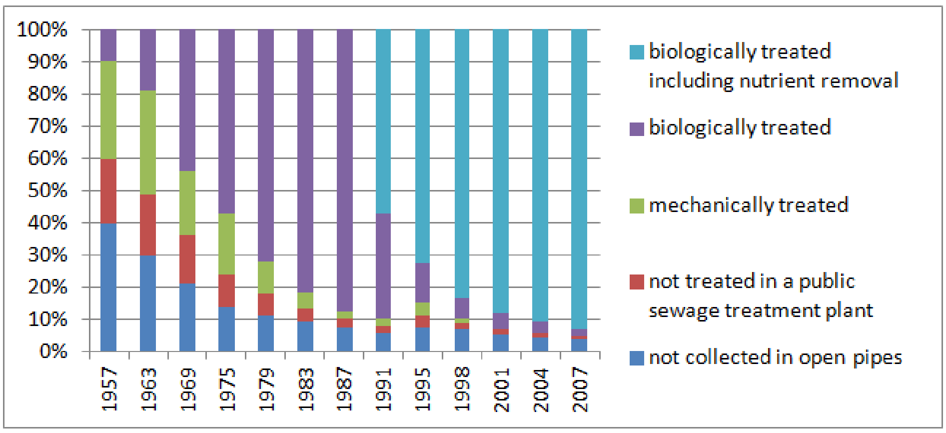


Figure 3.2 Public Effluent Disposal per Treatment Technology in Germany, 1957-2007

Source: BMU, 2011

Note: Data before German unification in 1990 only includes *Länder* of the Federal Republic of Germany. Values for 1991 represent values for the FRG (left), the *Länder* of the former GDR (centre) and the average (left).

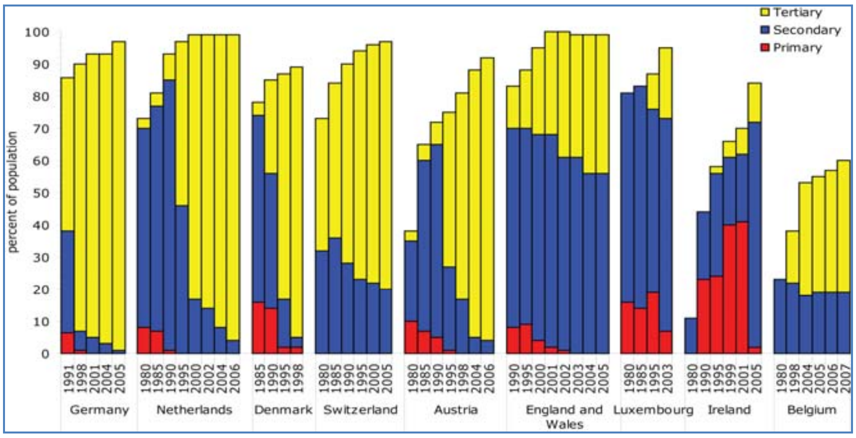


Figure 3.3 Percentage of population connected to different types of wastewater treatment technologies in Western Europe, 1980-2007
Source: EEA (2010)

As the main (direct) effluent discharger, the chemical industry introduced abatement measures that led to significant reductions in discharged pollutants between 1995 and 2006. Reduced pollution discharges included, for example, AOX (-74%), COD (-55%), phosphorous (-50%), and nitrogen (-57%) (VCI, 2006).

The paper industry, Germany's fourth largest (direct) effluent discharger, changed production processes to reduce the average waste water volume needed to produce one ton of paper. Opinions on the reasons for these investments, however, diverge. While Hamm and Schabel (2007) state that this substantial decrease in waste water volume was mainly driven by the introduction of the effluent charge, Jass (1990) finds that regulatory restrictions were the main drivers. Jass (1990) based his conclusion on interviews with paper industry representatives and financial data that revealed that companies were not aware of their marginal abatement costs, and that their investment costs to reduce damage units exceeded the effluent tax rate reductions. The flattening of the curve around 1988 allows us to assume that either the area of exponentially rising marginal costs had been reached or that all necessary technological measures were taken and could not be further improved upon.

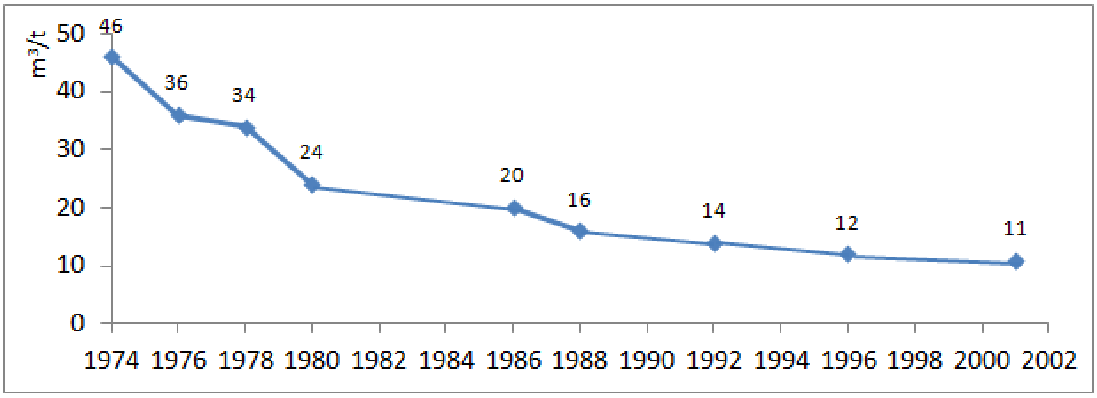


Figure 3.4 Average specific waste water volume for the production of paper (m³/t) of the German paper industry, 1974-2001

Source: Hamm and Schabel,2007

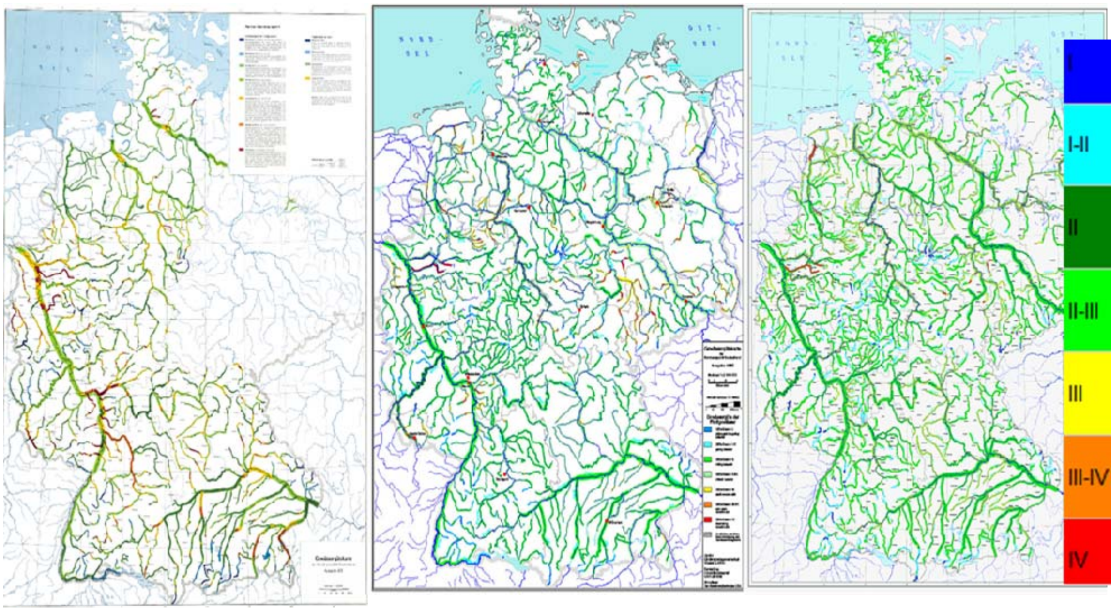
Investments for effluent treatment by the government, privatised wastewater treatment facilities, and industry totalled EUR 16 billion in the year 2000. Of this, around 56% were used to cover operational expenditures while 44% covered capital expenditures. As such, expenditures for effluent treatment exceeded the total investments in waste removal, air pollution prevention, and noise abatement. (Destatis, 2003). A European comparison by the BDEW (2010) revealed that Germany's average investments relating to wastewater (1.18€/m³) are higher than in the Netherlands (0.93€/m³), France (0.97€/m³), and England and Wales (1.03€/m³). Only Austria showed higher investment levels with 1.44 €/m³. Investments for water protection exclusively by enterprises have been decreasing constantly from EUR 914,454,000 in 1992 to EUR 568,005,000 in 2002 (-38%) (Destatis, 2011b). While it cannot be assumed that these investments are exclusively used for effluent abatement measures, it does indicate that abatement measures have achieved the state of the art within the limits of the marginal abatement function of enterprises. The DWA (2006) recognized this and stated that the extensive development of industrial and municipal waste water treatment plants reduced the incentive function of the effluent tax.

Consequent lower pressures on water-related ecosystems

The discharge of heavy metals has been reduced so significantly since 1983 that their direct discharge to surface waters is only of subordinate concern. These reductions were mainly due to the decrease in direct point source effluents (e.g., 99% of all mercury reductions). While discharges from treatment plants still contribute to the influx of nutrients, diffuse pollution, e.g., from agriculture, posed the dominant pressure in 2003-2005. (UBA, 2010)

As can be seen in Figure 2.2 and Figure 2.3 the discharges of mercury and nitrogen to surface water bodies have been reduced significantly from point sources. When compared to the baseline, discharge of mercury could be reduced by 99% from direct industrial dischargers and by 65% from municipal treatment plants in 2003-2005. Nitrogen discharges have been reduced by 76% from point sources in 2003-2005 when compared to the baseline. [5]

The lower pressure arising from effluent discharges and its complementary regulatory instruments contributed to a substantial improvement in water quality between 1975 and 2000. Comparing the classifications of water bodies between 1995 and 2000, the percentage of water quality II (slightly burdened) increased from 47% in 1995 to 65% in 2000. The objective of the policy mix to achieve the water quality status II for all water bodies by 1985, however, failed.



Map 3.1 Water Quality Classes of German Surface Water Bodies, 1975 (left), 1995 (center) and 2000 (right)

Source: UBA, 2009

Note: The map illustrating the water quality classes in 1975 does not include the water bodies located in the *Länder* of the former GDR. Water quality class I is the best. For information on the classification, please consult Annex2 – Table 2.3.

Overall the effluent tax has proven to be environmentally effective. In combination with the enhanced regulatory instruments, it provided a major impetus to achieve the high level of wastewater treatment. (BMF, 2003). However, as the aforementioned regulatory instruments follow the same objectives as the effluent tax, the definite impact of the effluent tax cannot be singled out.

[5] Further reductions are listed in Annex 2 – Figure A2.1

3.2 Economic assessment criteria

The effluent charge functions complementary to regulatory instruments, i.e., the Federal Water Act and the Waste Water Ordinance, as described in Section 1. As the individual elements of this policy mix are all designed to achieve the same objectives, the real impact of the effluent tax is difficult to disentangle.

While no alternative economic policy instruments were considered, a number of rival concepts were discussed relating to the design of the effluent tax (Roth, 1988). The proposed concepts were characterised by the "hallmarks of economic thinking,", i.e. included strong economic incentives that were to operate independently of the regulatory instruments, a tax calculated on the basis of measured pollution rather than on permits, and a higher tax rate (Kraemer, 1995). The adopted effluent tax, however, was marked by political compromise and considerations of administrative reality (see section 3.5).
As such, to reduce administrative, monitoring, and measuring costs, the basis for assessing the effluent tax was defined as the permit system (Art. 4, AbwAG), rather than on the actual effluents emitted (Gawel and Fälsch, 2011). Consequently, the effluent charge is not seen as a pollution tax that follows the standard price approach, but rather as a combined EPI and regulatory scheme. It could be said that the combination with the regulatory scheme reduced the (perceived) risk of the impact of a (potentially) ill-designed effluent tax. Given natural information asymmetries of e.g. the abatement cost curves of the polluters as well as political realities (see section 3.5) the optimal design of EPIs does pose a challenge.

Gawel et al (2011) state that the effluent charge has been set too low to fulfil its incentive function since its introduction in 1976, despite frequent increases. They base this statement on a study undertaken by the SRU (1974) which found that the optimal tax rate was 80 DM (EUR 41.03) per damage unit, while in practice it only amounted to 12 DM (EUR 6.1) per damage unit.

The continuously increasing standards of the BAT in the Waste Water Ordinance and the Federal Water Act have led to advances in the wastewater treatment techniques; however, these developments may also have reduced the dynamic efficiency of the effluent charge, i.e., the ability of economic agents to adapt quickly and at low cost to changing economic conditions (e.g., Linscheidt and Ewringmann, 1999; Rahmeyer, 2001).

Further, this increase in the requirements of state of the art technologies and the consequent increase in required effluent abatement have not been matched with an appropriate increase in the effluent tax rate to maintain an innovation incentive to abate residual pollution (Gawel et al, 2011:10). In addition, the charges were not adjusted to inflation, while the costs of measures for mitigation and avoidance increased with inflation–the effluent charge should have at least increased proportionally to the costs of measures to uphold its incentive function (Gawel et al, 2011: 143). The stagnation of the nominal discharge fee in combination with clauses which allowed polluters to offset tax payments over time, led to a real depreciation of the tax burden.

Ecotec (2001323-234) found that public sewage treatment plants and industries react differently to the incentives created by the effluent charge. As public sewage treatment plants do not follow the objective of profit maximisation, they are unlikely to improve compliance beyond technological guidelines (i.e., the regulation). They are, however, incentivized not to exceed the thresholds mentioned in the technological guidelines to avoid being penalized (i.e., forego the 50% reduction of charges which is granted with compliance and be forced of pay a fine). Industries on the other hand, are profit maximisers and, as such, keen to remain in compliance with the technological guidelines on the one hand, and in addition to reduce discharges where the marginal costs of abatement are less than or equal to the effluent charge. This can be corroborated by the fact that despite the higher volumes of effluent discharged by private dischargers (Figure 2.1), it is estimated that 60% of the revenues from the effluent tax are derived from municipalities (RIZA, 1995:107).

One common criticism regarding the incentive alignment of the effluent charge is that it neither differentiates between regions nor between different water quality levels of the water bodies (e.g. Scholl, 1998 in Rahmeyer, 2001). However, regional differentiation has been included in the concept of the effluent tax; the legislator is simply not applying it (Gawel et al, 2011).

Gawel et al,.2011) conclude that the intentional reduction of the tax payable for residual pollution (e.g., by reduction of the effective tax rates, offsetting clauses, and freezing of nominal taxes) deprived the effluent tax of its essence (dynamic innovation incentives) in its interaction with the regulatory instruments.

The revenues of the effluent charges flow into the budgets of the *Länder*; the federal government cannot access these revenues, nor are the *Länder* obliged to report on the height and use of these revenues. The revenues, however, are earmarked for investments in water quality improvements such as municipal sewage treatment and the administration of water quality programmes. The administrative costs relating to the effluent charge are subtracted from the revenues (Gawel et al, 2011:152). Section 3.6 illustrates the great deviations between the administrative costs in the *Länder.*

Figure 3.5 illustrates the development of revenues from effluent charges since 1983. In 1983, the revenues amounted to between EUR 110-205 million in the *Länder* of the FRG. While no data is available for the years between 1985-1991, it can be assumed that the revenues increased, as the effluent charge was increased steadily. In 1993 (following reunification), the revenues of the *Länder* of the FGR, i.e. the "old *Länder*", amounted 3.8 times the revenues back in 1981. The latest increase of the effluent charge in 1997 has not resulted in an increase of revenue–rather the contrary; the revenue has decreased constantly with the exception of a slight increase in revenues between 2000 and 2003. The revenue from the new *Länder,* i.e., the former *Länder* belonging to the GDR, does not show any noteworthy trend. (Gawel et al, 2011:104). Lower revenue from effluent taxes are expected to indicate the effectiveness of the effluent tax (Kraemer, 1995:34). Other things equal, a low revenue signals lower water pollution on the one hand (Figure 2.1) and high investment levels in water pollution abatement on the other, as has been described above.

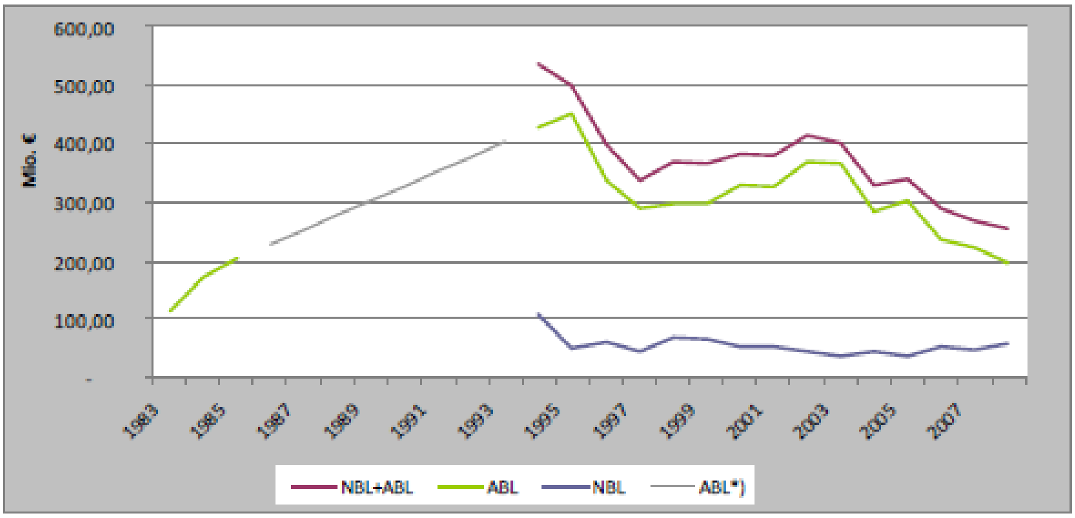


Figure 3.5 Revenue from effluent charges, 1983-2007

Source: Gawel et al, 2011: 104

Note: Data before 1991 only includes the *Länder* of the FGR. From 1991 onwards, revenue from the ne *Länder* is included. *.Red line: GDR and FRG; green line: FRG, i.e. old Länder; blue line: Länder of the former GDR, i.e. new Länder; grey line: estimation of FRG before 1990*

3.3 Distributional effects and social equity

This section sheds light on the distributional effects and social equity caused by the policy mix. Based on interviews with industrial representatives (main stakeholders concerned) and a literature review, mainly the effects relating to profits and competitive position of companies (security), as well as capacity development are expanded upon. Further interviews would be required to address impacts on health, employment, personal activities and political voice.

Distributional effects relating to profits and material living standards

A study by RIZA (1995) found that municipalities pay 60% of the revenue of the effluent tax – suggesting a disproportionate burden on municipalities. As fees for water and wastewater are set to recover financial costs fully, this burden is shifted to the consumers. However, as the effluent tax only makes up 4% of the annual wastewater charges to consumers, little or no difference has been noticed by the general public (ATT et al, 2011). This is exacerbated by the fact that the additional costs are not set out separately in the generally high wastewater bill in Germany in European comparison. [6]

Effluent-intensive industries, such as the chemical industry, were disproportionally affected by the introduction of the effluent tax and the increase in regulatory requirements.

While the increasingly stringent regulation may have led to considerable disadvantages in comparison to foreign competitors with lower additional costs for waste water treatment (Rudolph, 2001), the effluent tax as such had only a small effect on competitiveness, as the charge was reduced by 75% (only 50% since 1998) when the dischargers complied with the technological guidelines (Ecotec, 2001). In addition, investment costs for abatement measures can be offset from the effluent charge.

A case study analysing the effluent treatment of a paper mill illustrated that 39-50% of the cost of the total investment was deducted from the effluent tax, thus reducing the tax rate by at least 20% for three years preceding the operation of the new abetment measure (Helble and Möbius, 2009).

While no reliable figures could be found, it was stated that the effluent tax had no significant impact on the profits or the competitiveness of the paper industry, as the cost of water, when compared to other cost factors (raw materials, energy, personnel costs) is rather low (PTSPaper, 2011). On the other hand, the chemical industry, Germany's main effluent discharger, sees the effluent tax as a "pure penalty tax," which only absorbs capital via costly administrative procedures and thus harms the industry's global competiveness (VCI, statement).

As the basis for the permits, the Waste Water Ordinance outlines the limits for pollutants according to the area of activity producing the effluent. The association for local public utilities in Germany (VKU) has noted that this places an imbalanced pressure on communal effluent management actors. For a more equal distribution of the tax and an improved steering function, the association calls for the reflection of the polluter pays principle (VKU, 2011). Although improving the equitable distribution of the tax burden may be desirable, the internalisation of additional social costs in the waste water sector is both difficult and risks maximising revenues rather than optimising the steering effect of the effluent charge (Rahmeyer, 2001).

However, with time, these initial (subjective) disadvantages have produced a positive effect. The constant need to adapt to abatement requirements and the

[6] The comparison of European water and wastewater prices undertaken by the BDEW (2010) showed that England and Wales paid with 122€/cap/year the highest bills for sewage disposal. This is closely followed by Germany with 116€/cap/year. France (98€/cap/year), the Netherlands (114€/cap/year), Austria (93€/cap/year), and Poland (32€/cap/year) all pay less than German consumers.

incentive to innovate [7] has brought greater technological development and efficiency improvements to German industry, in turn strengthening its global competitive advantage in this area (Rudolph, 2001).

The introductions of the hardship clause, which allowed for a reduction or even annulment of the tax and was removed in 1989, as well as the stepwise increase of the tax rate were intended to minimise the negative effects caused to economic agents.

Capacity Development

In the late 70s and early 80s, it became more and more evident that the water management administration could not fulfill their implementation tasks. Nunes Correia and Kraemer (1997:66-68) found that the introduction of economic instruments, such as the effluent charge, contributed significantly to capacity building in the water management administration. As the regulatory instruments, i.e., the Waste Water Regulation, are administered by the same authorities who administer the economic instrument, i.e., the effluent charge, the revenue from this is partly used to cover administrative costs and to employ additional staff. The increased information requirements, such as surveying and modeling water bodies, and the documentation of effluent discharges allowed for the development of a solid basis of information with which administrative functions could be improved. The introduction of effluent charges further led to increased coordination between the water management administration and the water dischargers, improving conflict resolution mechanisms and intervention capacities. Furthermore, Nunes Correia and Kraemer (1997:68) state that this positive side-effect of economic instruments depends on the existence of regulatory instruments that are complemented by economic instruments.

A certain degree of capacity building can also be witnessed in the private sector. As the economic agents are required to assess the damage units of their effluents and present the accompanying paperwork to the authority in charge (§11, AbwAG, 2005), it can be assumed that a specific level of education and experience is required. Helbe and Möbius (2009) state that, for example, the amount and concentrations of effluents in aquaculture differ substantially–too infrequent sampling may lead to high damage unit measurements that may threaten the competitiveness of such industrial plants. This highlights that expertise in measuring the damage units of effluents is necessary to avoid too high values. This may result in the need for additional employment.

[7] The innovation incentive, however, could have arguably been stronger (see section 3.2).

3.4 Institutions

Framework of external factors

Since the end of the Second World War in 1945, Germany was divided into the western Federal Republic of Germany (FRG), which had a multi-party democratic system and a social market economy, and the eastern German Democratic Republic (GDR), which was ruled by the communist party and adhered to a planned economy.

The inception of the federal Effluent Tax Act in the early 70s occurred during a re-orientation period in the political life of the Federal Republic of Germany, following the election of the first government of the German Social Democratic Party (SPD) and the Liberal Party (FDP) in 1969. This government identified protection of the environment as a major new policy area and initiated measures to establish the institutional framework for environmental policy, notably at the federal level (Kraemer, 1995).

This re-orientation was mainly necessary due to the exceptionally high growth in environmentally intensive sectors (such as energy, chemicals, and construction) in the post-war period, which caused serious environmental problems, as the construction of wastewater treatment facilities did not keep pace (SRU, 1974). Compared to other industrial nations, such as the UK and Japan, Germany did not have the option to dispose waste water from its industrial areas directly to the sea, which led to highly polluted river systems (e.g., the Rhine was called "Germany's sewer") (BMU, 2001:6). Under invariable conditions, a future acceptable water supply as well as other water uses would have been under a serious threat (SRU, 1974). In addition, the reactor accident at Chernobyl caused a nation-wide increase in environmental awareness which contributed to this re-orientation (Jänicke, 2005)

Since the decision to introduce the effluent tax, external factors have influenced its design. As such, the recession following the oil shock in the mid 70s resulted in a reduction of the planned tax rate and a deferral of its introduction (Annex 3 – Table 3.1). The third amendment of the effluent tax occurred at the same time as the massive algal blooms in German coastal waters and the consequent widespread decline in seal populations in the North Sea and thus benefited from an intense public interest in water pollution. In this climate, nitrogen and phosphorous were included in the damage units and the effluent tax rate was increased substantially – the last point was revoked in the fourth amendment (1994) in the face of increased investment needs in the *Länder* of the former GDR[8] following reunification and an economic recession (Kraemer, 1995).

[8] In the former GDR, sewage systems were in a very poor condition, if they existed at all, and were not widely available. At the time of unification in 1990, the heavily contaminated water bodies in the GDR required substantial and sustainable sanitation measures. As such, more than 2,000 treatment plants were constructed and complete industrial sectors were improved to match Western German standards (BMU, 2001).

Legislative frameworks

The effluent charges were first proposed by the independent Council of Advisors on the Environment *(Sachverständigenrat für Umweltfragen, SRU)* in 1974. In 1976, the Federal Effluent Tax Act (AbwAG) was passed as a framework law that had to be transposed into the federal state legislation before coming into force. Most Länder introduced the effluent charge in 1981, with others following in 1982-83. After the German reunification in 1990, the five new federal states adopted the tax in 1991, with the exceptions for industries not subject to previous GDR waste water taxes; they then joined in 1993. As described in section 1, the effluent tax is strongly linked to the Federal Water Act and the Waste Water Ordinance.

Water management administrations

As stated in section 1, the effluent charge was introduced against a background of insufficient implementation of direct regulation as a result of capacity deficits in water management administrations. This fact had a considerable influence on the design of the effluent tax – the decision to base the effluent tax on permits rather than on measured pollution was aimed to facilitate administration and enforcement (Kramer, 1995).

3.5 Policy Implementability

Flexibility of the effluent tax

The effluent tax is a rather flexible economic instrument and was changed before and after its implementation.

As stated in section 3.4, the unexpected recession following the oil shock in the mid 70s led to an ex-ante reduction of the effluent tax rate.

As the Effluent Act is a framework law and had to be transposed by the *Länder* into federal state legislation, the *Länder* had the power to adapt a number of aspects such as treatment of rainwater run-off, schedules or exemptions for small emitters, procedures relating to indirect emitters, and administrative procedures. Thus *Länder* could influence the level, and thus the economic impact, of effluent charges (Kraemer, 1995).

Additionally, the effluent charges were amended several times–mainly to adjust the calculation of damage unit rates, inclusion of pollutants, and regulations designed to promote investments in water pollution abatement.

When the effluent tax came into force in the *Länder* of the former GDR, industries that were not expected to pay charges previously were subject to the tax first in 1993 instead of in 1991 (Ecotec, 2001).

It can be assumed that the reduction of the effluent tax rate, its stepwise increase and the hardship clause increased the acceptance of the introduction of the effluent tax.

Public Participation

The independent Council of Advisors on the Environment first proposed the effluent charge in 1974. In this original proposition, they recommended an EPI designed to replace the current regulatory regime under by the Federal Water Act, following a standard price approach with a strong incentive function (Rahmeyer, 2001).

Michaelis (1996) states that certain *Länder* were against the introduction of an effluent tax, arguing that the administrative costs would be too high–particularly regarding the measurement of pollutants. These *Länder* appear also to have the highest administrative charges following the enforcement of the Effluent Charge Act.

Following the introduction of the effluent charge, several industries were concerned about how these additional costs would harm their competitiveness; in Cologne a survey showed that 10% of the companies feared that the effluent charge would threaten their future existence (Ecotec, 2001: 86). The chemical industry particularly expressed its discontent with the effluent tax (VCI, Statement).
Between 1981 and 1989 several industries requested the application of the hardship clause for their companies, which allows reduction or, in certain cases, even an annulment of the charge. For example, the fish processing, paper and pulp, kali industry, and the pectin industry all applied (Ecotec, 2011:86). This illustrates the general aversion of the industry towards the introduction of the effluent charge.

Troja (1998:81) states that the participation of the dominant players, i.e., the *Länder* municipalities and industry, led to the rejection of the design of the effluent tax that would have led to maximal economic efficiency and impact. He further states that the influence of these dominant players during the phases of amendment had a negative impact on the government's intention of increasing the steering function of the effluent charges–despite the amendments, the effluent charge did not reach its allocative potential (Troja,1998 :82).

To conclude, it can be said that the original proposal of the effluent tax had to give way to political compromise and administrative realities in order to achieve its implementation (Kraemer, 1995).

Cooperation and coordination of administrative levels

As the framework law on Effluent Charges had to be transposed by the *Länder* to federal state level, it can be assumed that there was significant cooperation between the different levels of ministries (i.e., federal ministries and *Länder* ministries). To coordinate the water management policies, the *Länder* joined forces and created the "*Länder* Working Group on Water (LAWA)."

Synergies and barriers between the effluent tax and other sectoral policies

Several European policies that have been transposed into German legislation show apparent synergies with the German effluent tax (Table 3.1). Barriers between the effluent tax and sectoral policies could not be identified.

Table 3.1 Synergies between the effluent tax and sectoral policies

EPI Policy Objective: : Decrease the quantity and harmfulness of direct effluent discharges		
Other sectoral policies	Objectives of sectoral policies	Synergies and Barriers
Water Framework Directive (→WHG)	Ensure good ecological, chemical, and quantitative status of water bodies in Germany Water pricing policies which implement the "polluter-pays-principle" (Art 9)	++ The effluent charge follows the same overall objective as the WFD and introduces the polluter pays principle
IPPC (→WHG, AbwV)	Prevention and control of pollution from industrial activities Focus on cost-effectiveness	++ The IPPC guidelines have been transposed via the WHG and the AbwV into German legislation and thus form the basis of the effluent tax.
Urban Wastewater Directive (→AbwV)	Regulates the urban waste water discharges and discharges from certain industrial sectors	++ The Urban Wastewater Directive has been transposed via the AbwV into German legislation and thus forms the basis of the effluent tax.
Natura 2000	Protection of biodiversity - increased protection of aquatic areas which are of particular ecological interest	+ Natura 2000 provides an additional basis upon which the effluent tax can be justified
Renewable Energy Directive (→EEG)	Promotion of the sustainable development of renewable energy technologies Charges for renewable energy sources (e.g., hydropower) that do not treat their effluents according to the WFD standards	++ The charge for effluents which do not fulfil WFD standards are covered by the effluent tax.

Source: Author's compilation

Notes: + represents a positive synergy between the objectives of the EPI and the other policy; 2 levels:
+ (low positive interaction),++ (high positive interaction)
0 represents no discernible interaction
- represents a negative effect between the objectives of the EPI and the other policy; 2 levels:
- (low negative interaction),-- (high negative interaction)

→ means "transposed via ... German legislation". Please note that this analysis only covers the most relevant policies and is not extensive.

3.6 Transaction Costs

The policy mix of regulatory and economic policy instruments makes difficult the distinction of transactions costs related to investments, i.e., property and equipment costs and their operational costs. As stated in section 3.2, economy-wide investments for effluent treatment totalled EUR 16 billion in the year 2000. Of this, around 56% were used to cover operational expenditures while 44% covered capital expenditures.

Regarding the transaction costs related to administration, however, a clear distinction can be made. Table 3.2 illustrates a comparison of administrative costs incurred by the *Länder* as a percentage of revenue generated from the effluent tax.

Table 3.2 Annual Administrative Costs as Percentage of Revenue from Effluent Charges for the Länder, 1982 and 2006-2009

	1982	2006-2009
Baden-Württemberg	54%	8%-28%
Bavaria (Bayern)	122%	22%
Berlin	n/a	1.5%-3%
Brandenburg	n/a	n/a
Bremen	n/a	25%-40%
Hamburg	14%	1%-3%
Hesse (Hessen)	27%	n/a
Mecklenburg- Western Pommerania (Mecklenburg-Vorpommern)	n/a	13%
Lower Saxony (Niedersachsen)	49%	2.5%-11%
North.Rhine Westpahlia(NRW)	36%	7%-21%
Rhineland-Palatinate (Rheinland Pfalz)	47%-51%	12%
Saarland	n/a	7%-45%
Saxony (Sachsen)	n/a	15%
Saxony Anhalt (Sachsen Anhalt)	n/a	20%
Schleswig-Holstein	49%	38%-48%
Thüringen	n/a	7%-8%
Average	47%-48%	13%-21%

Source: Gawel and Fälsch (2011) and Kraemer (1995)

Note: Data for 1982 dos not include *Länder* from the former GDR. Values for the years 2006-2009 need to be treated with caution–for some *Länder* static values for a given year were provided; for others a percentage of revenues was provided. Years of the underlying data may differ.

It becomes clear that transaction costs were significantly reduced from 47-48% of revenues in 1982 to 13-21% of revenues in 2006-2009, showing that administrative procedures need time to adapt and be optimised. Bavaria achieved the highest reduction from 122% in 1982 to 22% in 2006-2009. It should be noted that the percentage of administrative costs of revenues varies with the amount of wastewater discharged and with the amount of dischargers offsetting tax obligations with investment expenditures. The high variance between the *Länder* can be further explained by the heterogeneity of the assessment methodologies of the *Länder*. No federal guidelines exist for the definition of administrative costs for effluent charges – as such, some *Länder* may include further cost factors. This becomes relevant when considering that the difference between the revenue from effluent charges and the administrative costs are earmarked for expenditures related to water quality improvements.

While the public sector faces annual transaction costs of approximately EUR 32.5 million, the private sector is burdened with a charge of around EUR 65 million annually to comply with the information requirements introduced by the effluent charge (Table 3.3). The forms required are not available online (Destatis, 2008). Interestingly, the most frequent and second most expensive transaction is the proof of eligibility for tax exemption or reduction. This illustrates that despite the high cost of this transaction, offsetting expenditures is still a rational economic decision. The most expensive transaction is similarly a specialised and thus the least occurring one.

Table 3.3 Annual transaction costs for the private sector for the fulfillment of information requirements of the effluent tax, 2008

Action required by AbwAG	Type of Action	Number of Occurances	Time required to fulfill requirement (minutes/ requirement)	Estimated Transcation Costs per Case (€/ case) (1)	Total (Germany-wide) Transaction Costs per Year (€)
Estimation of noxiousness of existing water before use (§4 Par 3, Sec 1)	Application for individual permit or exemption	332	110	102.41	34,000
Proof and explanation of effluent quality being higher or of quantity effluent being less than stated in the permit (§4 Par 5 Sec 1 and 3)	Application for individual permit or exemption	6,640	455	316.57	2,102,000
The proof of the underscoring of the permit has to be done by including results of the administrative monitoring program (§ 4 Par. 5 Sec 5)	Proof of eligibility for tax exemption or reduction	26,560	295	2,301.73	61,134,000
Information regarding effluent damage units and quantity to be emitted, if no permit has been received (§ 6 Par. 1 Sec 1)	Questionnaire	239	135	3,092.05	739,000
Proof of investment costs relevant to improvement of extension of waste water treatment plants, which result in a reduction of effluent quantity and damage units (§ 10 Par. 3 Sec 1,Par. 4 und 5)	Offsetting investments against tax	823	642.59	459.30	378,000

The submitting company is obligated to determine the amount of damage units emitted in the case of discharging polluted rainwater (§7) or of discharging domestic sewage (§8) (§ 11 Par. 2 Sec 1)	Calculation of damage units and submission of documents	7,950	47	34.59	275,000
In the case the submitting company is not the discharger, the discharger has to make the required data and documents available to the submitting party (§ 11 Par. 2 Sec 2)	Reporting and documentation obligation	11,470	47	30.69	352,000
TOTAL					65,014,000

Source: Destatis, 2008

Notes: (1) Authors' own calculation. The information requirements are received by the Ministry for the Environment, Nature Conservation and Nuclear Safety. .

3.7 Uncertainty

As the effluent tax was introduced to complement the regulatory instruments, the impact of the effluent tax cannot be singled out in this case study without uncertainty. Particularly the impact of the Waste Water Ordinance, which forms the basis of the damage units on which the effluent tax is based, is difficult to discern.

The occurrence of the announcement effect described in 3.1 may be interpreted in two ways, indicating the degree of uncertainty. One the one hand can be interpreted that the effluent tax had a direct effect on investment levels shortly before and after its introduction. However, it could also be argued that factors unrelated to the effluent tax might have driven the increased investment levels. Further research is needed to discern these factors.

The individual elements of the policy mix followed the same objective, which is the achievement of the water quality status "slightly burdened" (biologische Gewässergüteklasse II) for all water bodies by 1985 (SRU, 1974). The remaining objectives were not stated clearly (Ewringmann and Scholl, 19961-2).

As such it can be stated that the impact of the entire policy mix can be analysed with a high degree of certainty, while the partial impact of the effluent tax cannot.

Pedigree tables indicating the level of uncertainty of the data used can be found in Annex 3 (Table A3.2).

4 Conclusions

The need for an effluent tax arose from the threat to acceptable future water supply as a result of exceptionally high growth in highly polluting sectors (such as energy, chemicals, and construction) in the post-war period, which caused serious environmental problems. Direct regulation failed to incentivize the investments for effluent abatement, and, as a consequence, the construction of wastewater treatment facilities did not keep pace with the increasing effluent. This, in conjunction with a new federal government which identified the environment as a major new policy area, ignited the process of introducing an effluent tax in Germany.

While the policy mix makes it difficult to single out the impact of the effluent tax with certainty, it can be stated that the policy mix as a whole achieved most of its objectives:

- The quantity of overall discharges of pollutants into water ways was reduced by 4%, while discharges of private emitters were decreased by 18%. The harmfulness of effluents was decreased substantially. Mercury discharges were reduced by 99% from industrial dischargers and by 65% by municipal treatment plants in 2003-2005, when compared to the baseline of 1987. Nitrogen discharges from point sources were reduced by 76% in 2003-2005 when compared to the baseline of 1987
- The quality of water bodies increased substantially, with 65% of all surface water bodies achieving a water quality II status. The concrete objective, however, of improving all water bodies to water quality II status by 1985 failed.
- Waste water treatment plants were upgraded to the state of the art. In 2007, 92.6% of effluents in Germany underwent tertiary treatment–a percentage which, when compared to other Western European countries, makes Germany a frontrunner of advanced wastewater treatment standards
- Industries, such as the paper industry, developed production processes which required less wastewater development. Others, like the chemical industry, invested in effluent abatement measures and considerably reduced the discharge of pollutants
- The costs to mitigate, eliminate, and balance damage to water bodies were distributed among the polluters, which reflects a successful implementation of the polluter pays principle.

In addition, the effluent charge contributed significantly to capacity building in the water management administration.

However, it was found that the effluent tax rate has been set too low to fulfil its incentive function since its introduction in 1976. In addition, the steadily increased standards of the BAT in the Waste Water Ordinance have led to advances in waste water treatment techniques–the effluent tax rate did not keep up pace with these developments. Besides being set too low at its introduction, the tax rate was not adjusted for inflation, although the cost of abatement measures naturally did increase with inflation. Thus, the effluent tax did not maintain its innovation incentive to abate residual pollution, and thus the policy mix was deprived of the effluent tax's essential contribution to achieve its objectives.

The reasons for the failure to create the correct incentive structure can be found in the policy implementation process and the institutional settings. The participation of dominant players, i.e., the *Länder*, municipalities, and industries led to the rejection of the effluent tax design that would have had the optimal incentive structure. It can be said that political compromise and administrative realities, such as capacity and budget issues, shaped the effluent tax's current design in order to simplify implementation.

Several European policies that have been transposed into German legislation show apparent synergies with the German effluent tax. Barriers between the effluent tax and sectoral policies could not be identified.

Given that most point source pollution does not anymore pose a serious issue in Germany and that the incentive to abate residual pollution is weak, the effluent tax should be updated to reflect today's conditions.

Further research could focus on the behavioural changes of private and public enterprises as a reaction to the introduction of the water effluent tax. In addition, an analysis of the potential for a discharge permit trading system would enlighten discussions about Germany's future policy options. Finally, further research is needed to discern the separate impact of effluent taxes within the policy mix with certainty.

4.1 Lessons learned and Enabling/ Disabling Factors

This case study illustrated that a policy mix consisting of regulatory and economic instruments can be very powerful in implementing and enforcing policies to address direct effluent emissions. However, it has also shown the importance of setting the right incentive structure–a process which is often hampered by dominant interest groups. Furthermore, it became clear that the introduction of the effluent tax lead to significant capacity building in the water management administration–this can also be seen in the decreased public administration costs for the effluent tax over time. When designing an economic instrument, it is essential to assess the objective functions of the targeted economic agents. This case study shows that mostly profit-seeking agents (i.e., private industry) changed their behaviour as a reaction to the effluent charge, while municipalities prioritised the compliance with standards. Finally, external factors, such as the recession following the oil crisis in the mid 70s or algal blooms that changed the public's awareness to the environment, have a significant impact on the design and amendments of economic instruments.

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Annex 1

Pollutants and Pollutant Groups	One damage units equals the equivalent of each of the following measurements:	Thresholds of concentrations and annual discharge
Chemical oxygen demand (COD)	50kg oxygen	20 mg/ l and 250kg/ year
Phosphorous	3kg	0.1 mg/ l and 15 kg/ year
Nitrogen (sum of separate values of Nitrate nitrogen, nitrite nitrogen and ammonium nitrogen	25kg	5mg/l and 125 kg/ year
Organic halogens	2kg	100 microgram/ l and 10kg/ year
Mercury	20g	1 microgram/ l and 100g/ year
Cadmium	100g	5 microgram/ l and 500g/ year
Chromate	500g	50 microgram/l and 2.5 kg/ year
Nickel	500g	50 microgram/l and 2.5 kg/ year
Lead	500g	50 microgram/l and 2.5 kg/ year
Copper	1,000g	100 microgram/l and 5 kg/ year
Toxicity for fish eggs	the toxicity for fish needs to be assessed by dividing 6,000m³ of effluent by a dilution factor (G(deep)EI) which makes this effluent harmless to fish and fish eggs	G(deep)EI =2

Table 0.1 (Annex 1.1. Damage units for effluent charge (2005)

Source: Annex AbwAG, 2005

Annex 2

Table A2.1 Geographical characterisation[9]

	km2 (1966)	% of total area (1966)	km2 (1976)	% of total area (1976)	km2 (1992)	% of total area (1992)	km2 (2009)	% of total area (2009)
Forests:	71,835	29%	71,646	29%	104,535	29%	107,534	30%
Agriculture:	140, 295	57%	132,698	54%	195 111	55%	187,291	52%
Built-up areas: (1)	22,954	9%	27,236	11%	41,854	12%	48,718	14%
Water & wetlands:	4,238	2%	4,563	2%	7,837	2%	8,512	2%
Other uses (2)	8,125	3%	11,306	5%	7,629	2%	5,066	1%
Total:	247,447	100%	247,449	100%	356,970	100%	357,125	100%

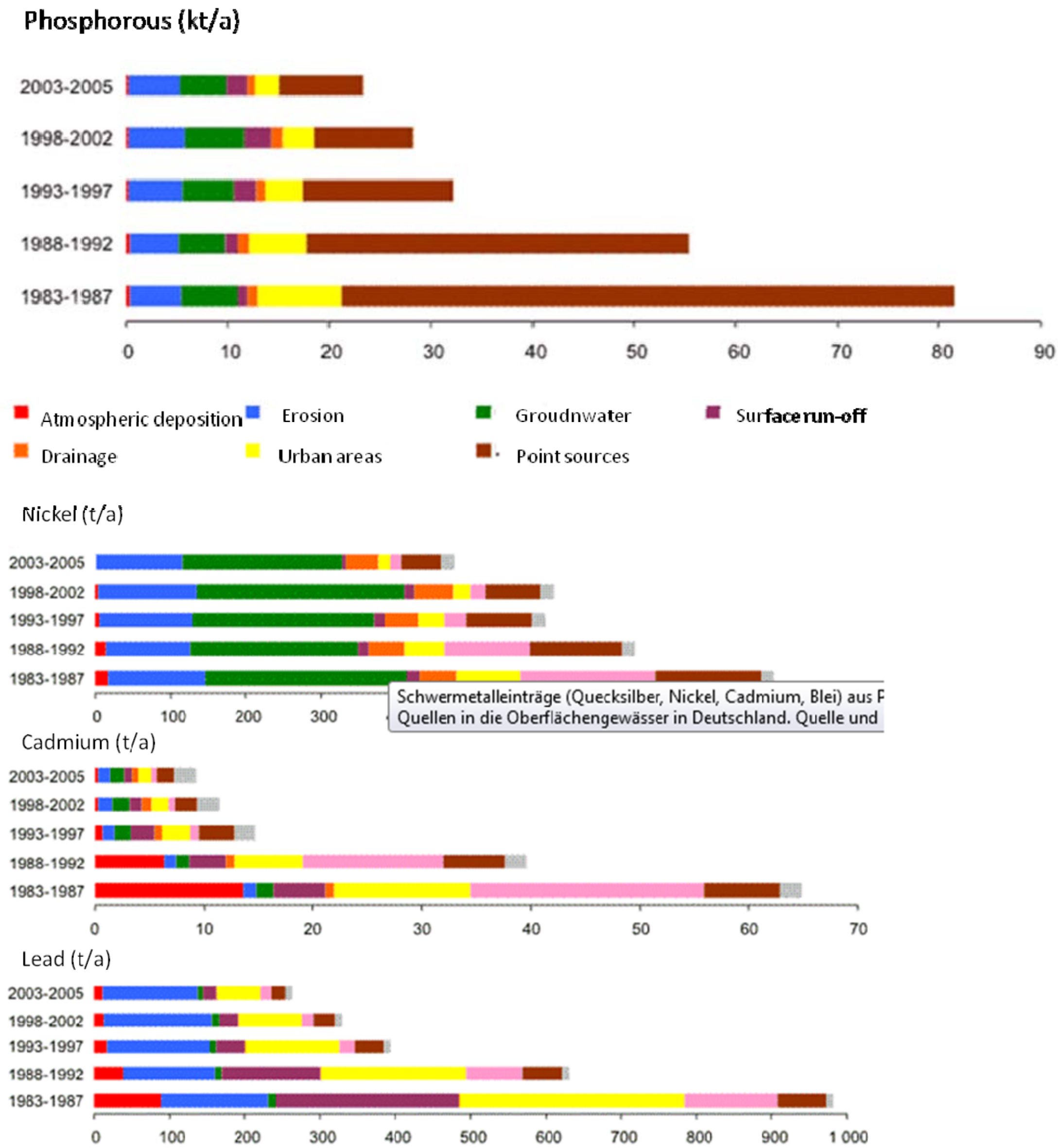
Sources: Destatis, 2011a; Destatis, 2011b
Notes: Pre 1990 data only includes the Federal Republic of Germany**. (1)** Buildings and open spaces, operating area, traffic area, recreation area, cemeteries (only 1966, 1976); (2) Cemeteries (only 1992, 2009), waste land (for 1966 and 1976, wasteland includes also unused, former agricultural land

Table A2.2 Wastewater discharges by public and private dischargers, 1975-2001

1,000m³	1975	1979	1983	1987	1991	1995	1998	2001
Total recorded effluent	23,666,825	32,717,248	33,644,116	38,835,647	36,973,040	37,307,866	35,619,671	34,951,991
Effluent (private sources)	17,660,825	25,482,248	25,534,116	29,953,647	28,461,040	27,461,866	25,980,671	24,478,991
Private Effluent (untreated cooling water)	17,161,234	24,504,348	23,777,565	28,465,975	28,396,836	27,410,812	25,862,716	24,363,557
Private Effluent (untreated, production-specific)	19,379	48,654	46,604	38,962	76,536	58,593	16,657	23,112
Effluent (public sources)	6,006,000	7,235,000	8,110,000	8,882,000	8,512,000	9,846,000	9,639,000	10,473,000

[9] Earliest available data: 1992

Figure A2.1 Discharges from point and diffuse sources into surface waters
Source: UBA, 2010



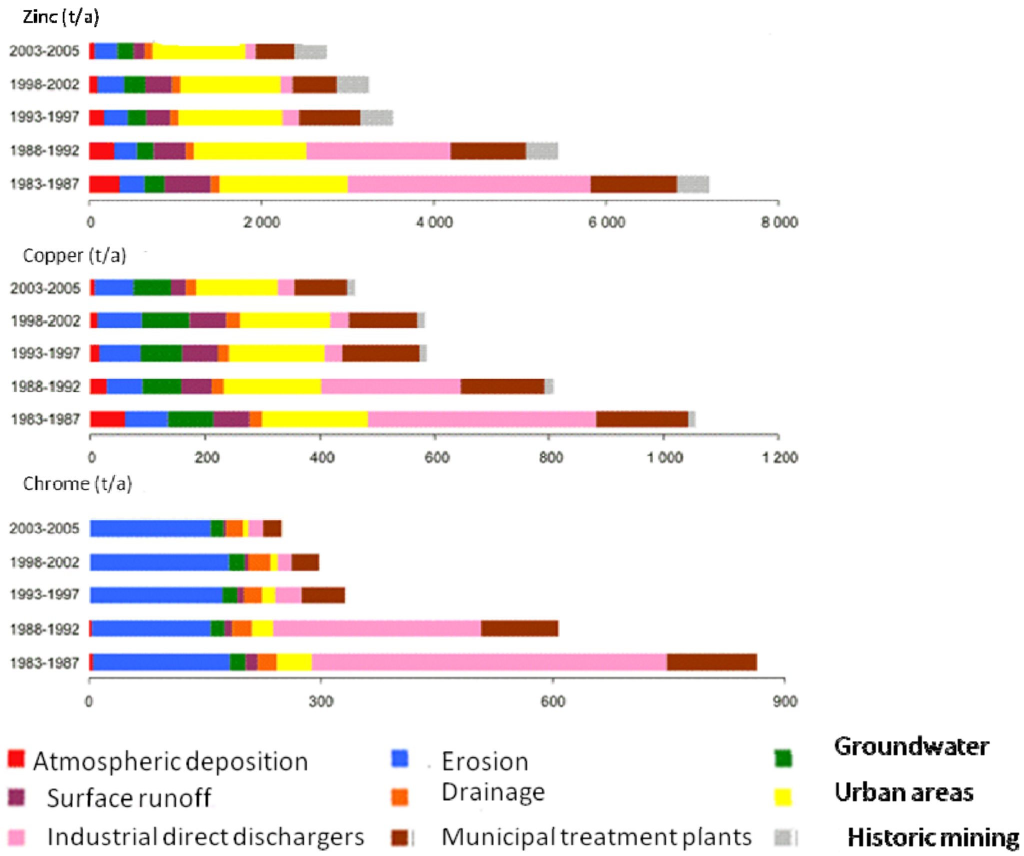


Table A.3 Classification of Water Quality Classes of German Surface Water Bodies

Class	Description
I - **un-loaded to slightly polluted**	River sections containing clear and sufficient supply of oxygen [BOD/COD] and nutrients; little bacterial content, moderately densely populated; contain mainly algae, mosses, flat worms and insects larvae; at times, spawning grounds for salmonids.
I-II - **slightly polluted**	River section with little anorganic nutrient intake and organic load and without significant decrease of oxygen demand [BOD/COD]; densely populated with high biological diversity; salmonid-populated water.
II - **moderately polluted**	River section containing moderate pollution and good oxygen supply, very rich biodiversity and population density of algae, snails, small crustaceans, insect larvae; aquatic plants can cover large surfaces; rich in fishing species.
II-III - **critically polluted**	River section containing oxygen-consuming organic matter creating critical conditions; possibly leading to fish deaths due to insufficient quantity of oxygen; decreased number of species by macro-organisms; certain species increase substantially, increased algae saturation over vast areas. Class III: very polluted.
III-IV – **highly polluted**	River section characterized by restrictive living conditions due to very strong contamination with organic oxygen-depleting substances, often exacerbated by toxic effects; at times total oxygen depletion; turbidity due suspended matters; extensive sludge deposits; densely populated by ciliates, red mosquitoes larvae or

	worms; decline in filamentous micro-organisms bacteria; the presence of fish populations is rare.
IV - **extremely polluted**	River section characterized by excessive pollution due to organic oxygen depletion; putrefaction predominates; continuous supply of oxygen present in very low concentrations or entirely absent; colonies exist mainly by bacteria, flagellates and wildlife ciliates; no fish; heavy toxic load leading to biological degradation.

Annex 3

Table A3.1 – Unit rates according to the Effluent Tax Act

Valid as of January	Proposal 1974	Original Act 1976	Third Amendment 1990	Fourth Amendment 1994	Actually in force
1975					
1976	25.00				
1980	40.00				
1981		12.00			12.00
1982		18.00			18.00
1983		24.00			24.00
1984		30.00			30.00
1985		36.00			36.00
1986		40.00			40.00
1991			50.00		50.00
1993			60.00		60.00
1995			70.00		60.00
1997			80.00	70.00	70.00
1999			90.00		70.00

Source: Kraemer (1995:23)

Table A3.2 Pedigree Tables

Effluent Tax	Value	Proxy	Empirical	Method
Reduction in pollution levels	Various – see section 3.1	4	4	4
Revenue from effluent tax	Various – see section 3.2	4	4	4
TC for public administration	Array – see section 3.6	3	2	3
TC for the private sector	EUR 65,014,000	4	4	4

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