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Wasted ink on waste water?

Of missed opportunities and untapped potential in the CWW BREF

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Executive summary

The CWW BREF primarily rules the treatment of waste water from chemical production. After a long procedure, the CWW BREF was adopted in 2016 and should have seen full implementation in all member states by June 2020.

The first step of this process, setting performance standards for the waste water treatment plants (section 2 of the CWW BREF and of this report), is supposed to be data-driven, but lacks technical stringency and consideration for the environment. The result is a document that offers some loopholes and the possibility for many to disregard continual improvement. Nevertheless, the CWW BREF also defines a level playing field that tightens existing regulation in several member states.

The second step of this process (section 4), transposition into national regulation and updating of individual operating permits, is slow and often environmentally unsatisfactory. Legislators and permit writers often tend to set the least stringent emission levels possible.

Real pollutant concentrations are often much lower than the levels defined in the CWW BREF, resulting in little incentive for operators to optimise, improve and invest. Based on E-PRTR and selected permit data, we showcase examples where room for improvement is particularly impressive (section 3 of this report).

These findings contrast with the IED's objective to prevent or […] reduce emissions *and the explicit aim of the BREF to* serve as a driver towards improved environmental performance across the Union.

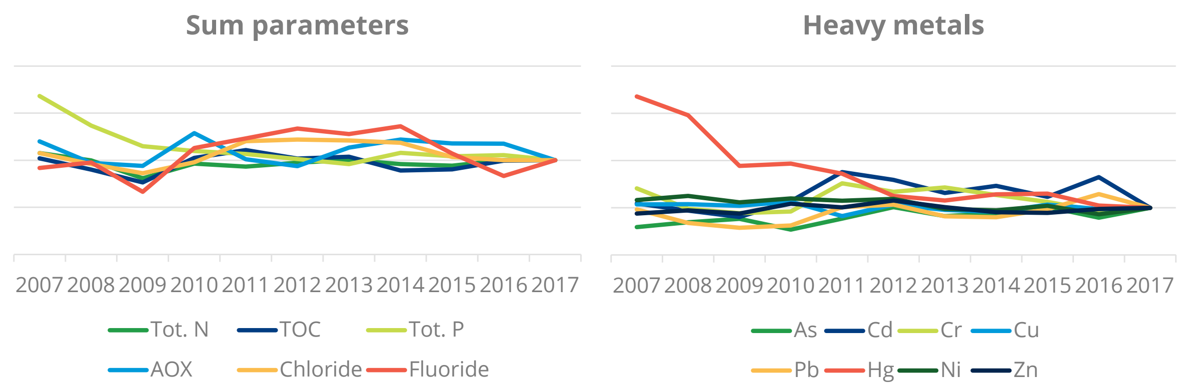
1. Contents

1. Introduction

According to the EEA[1], 46% of EU surface water bodies fail to achieve good chemical status.[2] Agriculture, urban and industrial wastewater treatment plants are the three top pressures to surface water bodies. Although industrial pressures have substantially eased from the situation fifty years ago, much remains to be done.

Data from the European Pollution Release and Transfer Register (E-PRTR, see section 3, facilities for activities in scope) shows that over the last decade, little progress has been made (Figure 1) in waste water emissions from the chemical industry.

Figure 1: Relative evolution of reported emissions for several relevant sum parameters (left) and heavy metals (right) (reference year: 2017, 2017 = index 100)[3]



The CWW BREF[4] is the EU's instrument under the Industrial Emissions Directive (IED) to drive prevention and reduction of pollution originating from the chemical industry. It aims to do so by periodically identifying Best Available Techniques (BAT), i.e. technical and management tools to avoid and abate pollution. These BATs are then used to set the emission levels by which all installations operating in the same sector must comply, the precise conditions being set in operating permits by member state permit writers. That's a high-level view of the theory. What does this look like in practice?

1.1. The CWW BREF

The first version of the CWW BREF, still under the IPPC Directive,[5] was published in February 2003 after almost four years of work. The Kick-off-Meeting for the CWW BREF's review (under the IED) was held in June 2008. Eight years later, the new, IED-based CWW was finally published. This makes the review of the second-generation CWW BREF the second longest BREF development in history.

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[1] All acronyms used are explained in the Glossary in section 6.3.

[2] EEA report No 7/2018: European waters assessment 2018.

[3] For each pollutant, the emitted quantity of 2017 was normalised to 100%, and all emitted amounts of other years were expressed as a relative percentage. To avoid mistaken conclusions due to threshold effects, only facilities reporting emissions for every year between 2007 and 2017 were taken into account.

[4] Officially called "Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector" BREF.

[5] The Integrated Pollution Prevention and Control Directive (96/61/EC) was the most important predecessor of the IED.

1.1.1. Activities in scope

The wording of the scope of the CWW BREF is reproduced in Figure 2. This scope definition is important and complex and deserves some explanation.

Figure 2: Scope of the CWW BREF as defined in the BAT-C, Annex I:

ANNEX

BEST AVAILABLE TECHNIQUES (BAT) CONCLUSIONS FOR COMMON WASTE WATER/WASTE GAS TREATMENT/MANAGEMENT SYSTEMS IN THE CHEMICAL SECTOR

SCOPE

These BAT conclusions concern the activities specified in Sections 4 and 6.11 of Annex I to Directive 2010/75/EU, namely:

— Section 4: Chemical industry;

— Section 6.11: Independently operated treatment of waste water not covered by Council Directive 91/271/EEC and discharged by an installation undertaking activities covered under Section 4 of Annex I to Directive 2010/75/EU.

These BAT conclusions also cover the combined treatment of waste water from different origins if the main pollutant load originates from the activities covered under Section 4 of Annex I to Directive 2010/75/EU.

The reference to section 4 of IED Annex I is straightforward (see section 4.1 for a rebel view on this): as the scope is "chemical industry", including the different sub-activities, effluents and waste gases of all chemical industry activities under the IED are in scope; the further text does not specify any exemptions, derogations or limitations.

The reference to section 6.11 is more complex:

- "Independently operated" refers to WWTPs that do not belong to the chemical factory itself, but they may be shared by several operators. This would typically be the case for large chemical complexes that host several companies, such as the complexes of Leverkusen (DE) or Geleen (NL).
- "Not covered by Council Directive 91/271/EEC" refers to the Directive on Urban Waste Water Treatment (UWWT)
- "And discharged by an installation […] under Section 4 […]" refers to chemical industry.

In other words, the CWW BREF applies to emissions from effluents from chemical factories when they are treated by non-urban WWTPs.

The last sentence of the scope description finally specifies that WWTPs treating both chemical effluents as well as non-chemical ones (other industrial ones or urban ones) are also included if the "main pollutant load originates" from the chemical industry activities. It goes without saying that it will in many cases be difficult to decide on whether a pollutant load is "main" or not.

1.1.2. Pollutants in scope

The CWW BREF bears the full title "Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector", the same title as the IPPC CWW BREF from 2003. The acronym and the full title may appear inconsistent, as the acronym contains no reference to waste gas. However, waste gases and waste water are not given nearly the same level of attention. If the IPPC CWW BREF was approximately balanced between emissions to water and to air, the same is not the case for the new IED CWW BREF, which does not set any BAT conclusions relating to air emissions. Therefore the full title does not reflect the purpose and content of the BREF, as opposed to the acronym.

Emissions to water and techniques to abate them are described in around 160 pages in the IED CWW BREF, and emissions to air are given ca. 200 pages, but only in the non-binding and descriptive part of the BREF. The picture looks very different on BAT-AELs (Table 1): not a single BAT-AEL is set for emissions to air. However, there is a clear improvement, with 11 water relevant pollutants regulated with binding BAT-AELs in the new BREF, against only 4 or 5 pollutants[6] with BAT-AELs in the old one.

Table 1: Number of pollutants with BAT-AELs in the old and the new CWW BREF.

	IPPC CWW BREF 2003	IED CWW BREF 2016
BAT-AELs on emissions to water	4 or 5	11
BAT-AELs on emissions to air	8	0

Table 2 shows the BAT-AELs defined for the specific pollutants in the old and the new BREF.[7] It contains a few striking features:

- The span of the BAT-AEL ranges are high for most pollutants. There is a factor 5 (total N, AOX, Cr), 10 (Cu, Ni) or even 15 (Zn) between the lower and the upper bounds. There is hardly any indication under which conditions an ELV closer to the upper BAT-AEL bound may be justified; the consequence of this is that many permits will effectively be aligned with the upper bound of the BAT-AEL range, short: uBAT-AEL. This is effectively the highest possible ELV that can be set in accordance with the IED (Art. 15 (3), unless the operator is allowed to emit even further due to a site-specific derogation in accordance to Art. 15 (4) of the IED).
- In some cases, the "technically and economically viable" (in the sense of IED Art. 3 (10) (b)) seems to have worsened over time, as in the cases of the uBAT-AEL for TSS and the lower level of the BAT-AEL range (lBAT-AEL) for inorganic N. One could theoretically imagine cases where techniques have become unavailable or where hugely increased cost has made a certain technique economically unviable. However, the 2016 CWW BREF document does not justify any such cases. More importantly, such relaxation of standards is obviously not aligned with the objective of the IED.
- The table contains several pollutants for which no BAT-AELs exist in either the old or the new BREF. These pollutants are nevertheless worth considering, as they are environmentally relevant, and as they are included in related regulatory documents such as the WT BREF or the German Waste Water Regulation.[8]

[6] These were TSS, COD, total inorganic N and total P. A fifth BAT-AEL was defined for free oil, i.e. akin to HOI (p. 281). No agreement was reached on BAT-AELs for 7 heavy metals, but ranges were proposed in a split view (p. 294). This means that 12 water pollutants were addressed already in 2003.
[7] It is important to note that the tables defining the BAT-AELs (Tables 1, 2 and 3 in the BAT-C) are accompanied by several footnotes that define or explain more closely the applicability or provide exemptions.
[8] Abwasserverordnung, AbwV.

- As so often, the devil is in the footnote. As an example, the already broad BAT-AEL range on Ni is reduced to meaninglessness by three footnotes:

The lower end of the range is typically achieved when few of the corresponding metal (compounds) [sic] are used or produced by the installation.

This BAT-AEL may not apply to inorganic effluents when the main pollutant load originates from the production of inorganic heavy metal compounds.

This BAT-AEL may not apply when the main pollutant load originates from the processing of large volumes of solid inorganic raw materials that are contaminated with metals (e.g. soda ash from the Solvay process, titanium dioxide).

Table 2: Comparison of BAT-AELs in the old and the new BREF

	CWW 2003				CWW 2016				
		BAT-AEL				BAT-AEL			
Parameter	Table	lower	upper	unit	Table	lower	upper	unit	threshold
TOC					1	10	33	mg/L	3.3 t/y
BOD5									
COD	4.8	30	250	mg/L	1	30	100	mg/L	10 t/y
TSS	4.8	10	20		1	5	35	mg/L	3.5 t/y
HOI									
total N					2	5	25	mg/L	2.5 t/y
inorg N	4.8	2	25		2	5	20	mg/L	2 t/y
total P	4.8	0.5	1.5		2	0.5	3	mg/L	300 kg/y
Phenol index									
CN^-									
AOX					3	0.2	1	mg/L	100 kg/y
As									
Cd									
Cr					3	5	25	µg/L	2.5 kg/y
Cr(VI)									
Cu					3	5	50	µg/L	5 kg/y
Pb									
Ni					3	5	50	µg/L	5 kg/y
Hg									
Sn									
Zn					3	20	300	µg/L	30 kg/y

It is striking that no BAT-AELs were derived for heavy metals such as Cd, Pb and Hg. The old 2003 BREF did not agree on any levels for those metals either, but includes a split view (p. 294) by one member state. Although the ranges mentioned in that split view are also exceedingly broad, this shows that discussions were conducted between 1999 and 2003. Fifteen years later, the authorities were still unable to reach any meaningful conclusions on these parameters.

1.1.3. Direct and indirect emissions

The BAT-C text stipulates (section 3.4. of the Annex) that the “[BAT-AELs] apply to direct emissions to a receiving water body”. This is a serious limitation of the scope, and the ensuing loophole can channel substantial loads of pollutants into the environment.

For any indirect emission of pollutants (see also section 2.5), i.e. a treated effluent from a chemical installation that is not discharged into a river, lake, canal or the sea, the receiving treatment plant may be either another CWW plant or a UWWTP:

- If the receiving plant is a CWW, the BAT-AELs of the CWW BREF will apply to the receiving CWW for its direct emissions. This will result in dilution of the pollutant with effluents from other (urban or industrial) sources, and abatement requirements will consequentially be lower.
- However, if the receiving plant is a UWWTP, the situation will be even worse. Emission requirements for UWWTPs are limited to certain pollutants (BOD5, COD, total N and total P) directly relevant for surface water eutrophication as well as TSS.[9] For this reason, emissions of AOX or heavy metals may not be monitored, nor effectively abated by the UWWTP and will end up in the environment without control or abatement.

1.1.4. Either mix or match

Simply diluting wastewater, treated or untreated, is a no-go.[10] There is, however, a subtler trick that makes life easier for large plants receiving wastewater from different activities.

Imagine two chemical plants A and B. Plant A produces chlorinated chemicals only and plant B produces only nitrogen-based fertilisers. Each emits 1000 m^3 of wastewater a day, but the untreated pollutant loads are very different: plant A likely has TOC and AOX to abate, and plant B will have total N.

If the plants have one WWTP each, they must abate each of their pollutants to below the ELV (which is often the uBAT-AEL). If the plants share a WWTP, this is still true, but the volume of wastewater is twice as high (2000 m^3). Indeed, plant A effectively dilutes its output by mixing it with plant B’s output, and vice-versa.

All other factors being equal, a CWW plant treating water from a large and diverse chemical park will find it easier to abate to low levels than an isolated CWW receiving water from a single, monolithic plant.

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[9] Directive 91/271/EEC, Annex I (D), Tables 1 and 2.

[10] Ironically, however, plant UK116 from the data collection (likely the now-defunct Dow facility in King’s Lynn), reports dilution as an “abatement” technique (CWW BREF, p. 602). This casts further doubt on the selection of model plants for the data collection.

					4) Air flotation 5) Sand filtration		
#116	UK	SIC	Direct, to an estuary	Physico-chemical treatment only	1) Neutralisation 2) Dilution	NI	2011
#117	UK	LVIS-S	Direct, to a river	- Physico-chemical treatment only - Filtration for final solids removal	1) Neutralisation 2) Sedimentation 3) Filtration	12	2011

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1.2. The CWW BREF in the regulatory landscape

1.2.1. Relation with the WGC BREF

Based on the title and scope definitions of the CWW and WGC[11] BREF, one may expect substantial overlap between the two documents. However, their focus and level of specificity is very different.

The CWW BREF only contains five BATs specific to air, and no BAT-AEL. Four of these CWW BATs deal with enclosing and treating emissions (BAT 15), flaring (BATs 17 and 18), and preventing and reducing diffuse emissions (BAT 19). The remaining CWW BAT on an integrated waste gas management and treatment strategy (BAT 16) is identical to BAT 4 of the WGC BREF draft 1.

On the contrary, the WGC BREF covers many other aspects of waste gas treatment in its currently proposed 36 BATs. These cover environmental management systems, monitoring techniques and frequencies, BAT-AELs on different abatement techniques, including many techniques and BAT-AELs specific to certain chemical processes and related pollutants.

1.2.2. Relation with the UWWTPs

According to the CWW BREF, the *main pollutant load* determines whether a WWTP operates under the CWW BREF or as a UWWTP. Notwithstanding the ambiguity of the term "main", there is a lack of regulatory consistency with the UWWTD: the UWWTD does not define at all under what conditions (or as of what percentage of industrial input) a WWTP ceases to be an urban plant and becomes an industrial one. Hence there would be no argument for the UWWTPD to "refuse" a WWTP receiving only a minute amount of urban wastewater to be permitted and monitored as an urban plant.

There is at least one example of an obviously – and formerly – industrial WWTP that changed status to become an UWWTP: the WWTP of the Dow Olefinverbund chemical complex in Schkopau (DE) operated as an industrial plant until 2018; as of 2019 the WWTP was sold to an external owner, who has been operating the facilities as an urban WWTP – on the grounds that it treats some urban waste water from the nearby village.[12]

As shown in Table 3, in case the WWTP is considered a UWWTP, concentration limits only apply for BOD5, COD and TSS, and, in addition, for total N and total P for eutrophication-sensitive areas[13]. The concentration limits are the standard metric, although abatement efficiencies ("reduction") may be applied instead in some cases.

Under the UWWTD regime, no monitoring obligations exist for the other pollutants.

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[11] Based on its 1st draft, published in November 2019.

[12] The large industrial WWTP at coordinates 51.4006; 11.9574 should be compared with the diminutive (pre-treatment only) UWWTP at 51.3937; 11.9916, which discharges the pre-treated water to the Dow Olefinverbund industrial plant. Reassuringly, monitoring requirements for "industrial" parameters have been maintained and the annual reports of 2018 and 2019 indicate compliance with BAT-AEL ranges for all relevant pollutants.

[13] As defined in UWWTD Annex II.

Table 3: Comparison of BAT-AELs in the CWW and ELVs for UWWTPs.

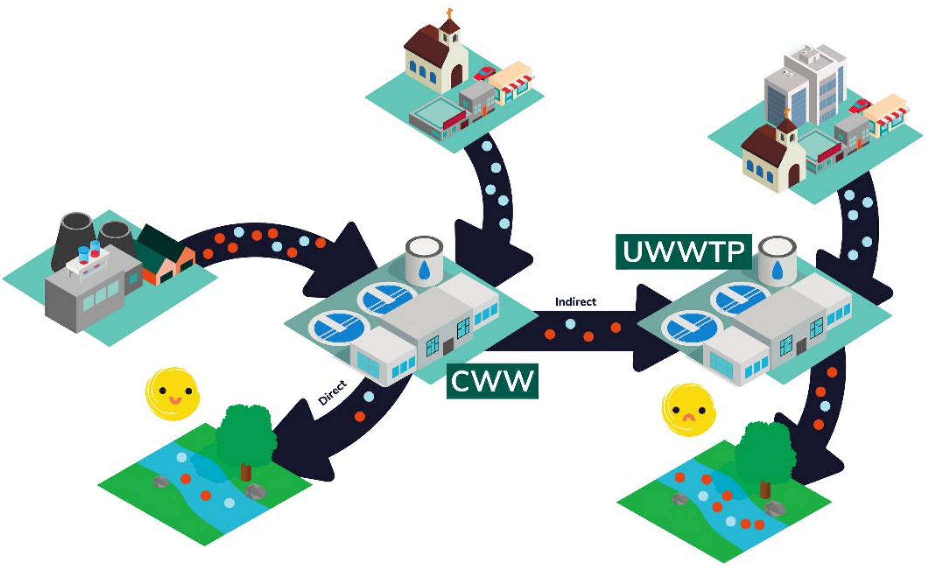
	CWW					UWWTP			
	Direct discharge								
		BAT-AEL					Limit		
Parameter	Table	lower	upper	unit	threshold	Table		unit	reduction[1]
TOC	1	10	33	mg/L	3.3 t/y				
BOD5							25	mg/L	70/90%
COD	1	30	100	mg/L	10 t/y		125	mg/L	75%
TSS	1	5	35	mg/L	3.5 t/y		35/60	mg/L	90/70%
HOI									
total N	2	5	25	mg/L	2.5 t/y		15/10	mg/L[2]	70/80%
inorg N	2	5	20	mg/L	2 t/y				
total P	2	0.5	3	mg/L	300 kg/y		2/1	mg/L[2]	80%
Phenol index									
CN^-									
AOX	3	0.2	1	mg/L	100 kg/y				
As									
Cd									
Cr	3	5	25	µg/L	2.5 kg/y				
Cr(VI)									
Cu	3	5	50	µg/L	5 kg/y				
Pb									
Ni	3	5	50	µg/L	5 kg/y				
Hg									
Sn									
Zn	3	20	300	µg/L	30 kg/y				

[1] Abatement efficiencies depend on the size of the UWWTP.
[2] Only relevant for emissions into eutrophication-sensitive areas.

1.2.3. Schematic view

Figure 3 summarises the difference between CWWs and UWWTPs with *main pollutant loads*, flows and abatement efficiencies, as well as obligations to abate certain pollutants.

Figure 3: Schematic view of different regimes for WWTPs. Blue dots: pollutants easily abated by biological treatment (such as bioeliminable COD); red dots: specific pollutants that are not abated by standard UWWTP techniques.



2. Evaluation of the CWW BREF text

2.1. The data collection process

The data used were collected in two phases. In the first phase in 2009, data were collected from more than 60 plants across Europe on a high number of parameters, including the set-up and techniques used in the plants, its capacity, use of consumables and energy, pollutant concentrations and abatement efficiencies.

In a second phase in 2012, more data were requested from some plants from the 1st phase, and another fifty plants were added to the second phase.

A comparison with the BREF Review Guidance[14] from 2012, especially its Chapter 5 on data collection, shows that most quality criteria defined in 2012 were adhered to in this first data collection.

2.2. Data transparency

Data transparency, however, is an exception to this rule, as plants codes cannot be linked to real plants. Plants in the survey are only identified by their country and a unique number, but the name and address of the CWW plant are not revealed – where companies indicated them, they were even removed by the Bureau. This is problematic, as typical pollutant concentrations for a given plant depend on the activities of the installations discharging into it. Obviously, the environmental quality of the receiving water body also depends on the relative sizes of the water treatment plant and of the receiving water body.

This anonymisation of the plants was explained with confidentiality reasons, however without any legally valid justification. As an example, an e-mail from the Bureau[15] links the anonymisation of some types of data with *concerns from several TWG members* who contended that costs and energy consumption should be considered CBI. The wording chosen gives a hint that those TWG members did not even attempt to provide a justification for the confidentiality of such data.

This decision on CBI status is at odds with the explanations of the BREF Review Guidance, which states in section 5.3 that *[confidentiality] is generally not an issue*, and that whenever data is deemed CBI, such as on the cited examples of *cost, production volume* [...] *the reason/justification for the confidentiality/sensitivity should be given*.[16] The only (to the best of our knowledge) existing legal provisions on CBI are those[17] prohibiting collusion: none of data relevant for the CWW BREF meet those criteria. Even if they did, they would be expressly exempted from sensitivity by TFEU Art. 101 (3) as such a data exchange would *[contribute] to improving the production [...] of goods or to promoting technical [...] progress, while allowing consumers a fair share of the resulting benefit*.

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[14] Commission Implementing Decision 2012/119/EU
[15] Dated 16th July 2013 and addressed to all TWG members.
[16] Although production volumes and cost data are generally irrelevant for BREF purposes, it is ironic that the BREF Review Guidance itself neither explains nor justifies how such data would legally be considered CBI.
[17] Types of data and activities in TFEU Art. 101 (1).

It is important to note, however, that there is hardly any legal handle to force companies to provide any data not expressly required by law.

As a conclusion, it should suffice to note that:

1) in this case, the lack of transparency is rather explained by leniency of the Bureau and unwillingness of some industrial actors to share data on plant identities, than by any legal prohibition,
2) such data would allow better analysis of plant performance and environmental impacts,
3) in the future, a legally sound and Aarhus-compliant justification for withholding any environmentally relevant data should be provided in all cases.

2.3. Technical implications

Effluents of chemical factories and other factories feeding into CWW plants are very different from one installation to the next: not only in volume flow, but also in the type of pollutants and their concentration. It is obvious that a refinery will have very different effluents to those of a fertiliser plant, yet no data on the pollutants reaching the CWW plant is available. Information on the design and the methods to run the plant are equally missing.

Figure 4: Types of factors influencing the effluent load of a water treatment plants.

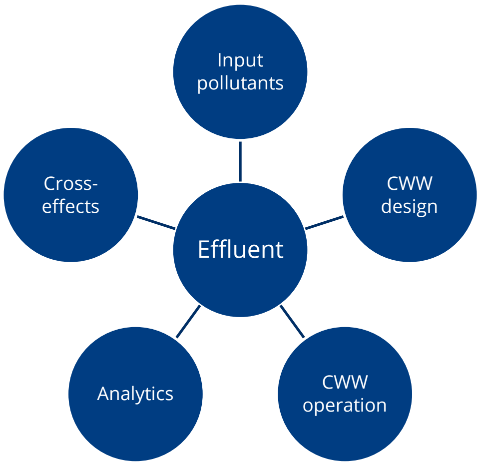


Figure 4 schematically displays some groups of factors influencing abatement efficiency and effluent concentration, in other words: the very factors influencing identification of BATs and setting of BAT-AELs. Regrettably, however, data used in the CWW BREF on most of these factors is scarce; data on the design and operation are superficial: tank sizes are given, but no detail e.g. on aeration; similarly, only rough indications are given on the chemicals used for the operation of the CWW, or how their dosage is determined. Non-identification of the plants also hampers any additional investigation of these factors – although they are all environmentally relevant information.

Finally, the selected plants are supposed to represent the frontrunner plants across Europe, on which BAT derivation[18] can reasonably be based. However, how can anyone be convinced that this selection was done properly, if neither its methodology nor its result is available?

The only available information helping to reconstruct the identity of plants are:

- the name of the receiving water body (not always revealed),
- the size (in population equivalents) of the installation,
- the years of starting operations and major modifications.

Information on the receiving water body is often not informative, as chemical industry installations tend to be grouped in clusters and along long and major rivers. In this sense, knowing that the CWW discharges into the Danube, the Schelde or the sea is not informative, nor does it help decide on environmental relevance of the discharge. For some plants, the questions in the questionnaires are not even answered properly, as e.g. questionnaires collected by Cefic and the member state competent authorities (MSCAs) of DE, NL and UK even lack information on the name of the river – although the wording in the questionnaire is "name of recipient water", not "type of recipient water".

Information on the size and the operating dates in some cases allow unambiguous identification of the plants, but only based on major investigations and google searches.

A request for access to documents by EEB to the European Commission[19] revealed that a list of the plant codes never existed, which means that even the members of the EIPPCB could not use technical data on the plants in their assessment for BAT and BAT-AEL derivation.

Using the information available, we have been able to identify several major installations, but stopped short of attempting to identify all of them as the effort would have been incommensurate with the information content involved.

2.4. Are the BAT-AELs correctly derived or even ambitious?

Ideally, a BAT would be derived by assessing techniques, including all their conceptual components (equipment design, management, analytics, residence time, maintenance, reagents etc.) that can have a substantial impact on the performance of the abatement. It goes without saying that this derivation process would have to be properly documented so the informed reader can follow the reasoning. Such an exercise including all parameters would rapidly become inextricable, so it is understandable that the BAT derivation process takes some shortcuts. In practice, in some BREF processes, these are very short indeed.

In the CWW BREF, almost all impactful and coercive information resides in the BAT-AELs on emitted pollutant concentrations. In comparison with other recent BREF drafts, the CWW BAT-AELs are derived in a moderately conscientious manner.

[18] Note ongoing concerns raised by the EEB (2017) on the absence of a proper and transparent BAT derivation methodology.
[19] Request and reply are available on our SharePpint site.

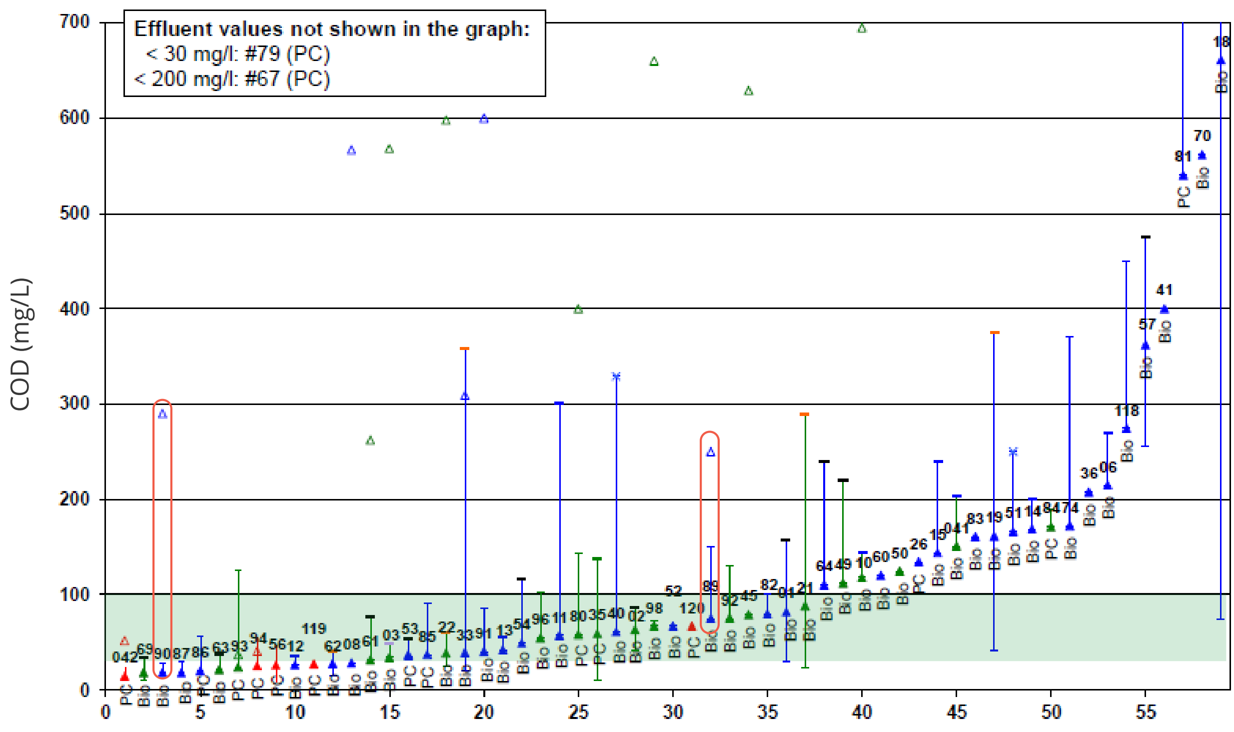
Emitted concentrations and some abatement efficiencies reported by the model plants are presented parameter by parameter in section 2.4 of the BREF, in the format shown in Figure 5.

2.4.1. Example 1: something fishy with COD?

A glance at Figure 5 raises some of the questions that often remain unanswered in BREF documents:

- Why were about a dozen plants with effluent concentrations below lBAT-AEL not considered?
- Why was the uBAT-AEL set to 100 mg/L rather than 90 or 110 mg/L?[20]
- Why do some plants with similar influent concentrations, such as plants IT89 and IT90 (circled) get to very different effluent concentrations? Why can both be considered BAT?

Figure 5: Reported COD concentration in effluent (full triangles) and inflow (hollow triangles) for model plants. Reworked from Figure 2.9, p. 49 of the CWW BREF. The BAT-AEL range is shown in light green; the numbers correspond to the plant codes.



Concentration of a pollutant in the effluent alone is neither directly relevant for environmental damage, nor directly indicative of plant performance. Plants cutting down water consumption will end up with higher concentration of pollutants – but so will plants that make little effort to *prevent*

[20] A popular explanation is the BREF Guidance's (Decision 2012/119, section 3.3) statement that *rounded values may be used to take into account limitations of the data collection or technical issues (e.g. use of different monitoring methods, uncertainty of measurements).* But then it is difficult to argue that 90 or 110 are not rounded values; explaining the decision on rounding would also be good practice in administrational transparency.

pollution. Although prevention beats abatement, a water treatment plant – the object of the CWW BREF – is primarily about abatement.

In this sense, instead of amalgamating data from all plants, a better BAT identification approach would be to identify plants that have most impressive abatement efficiencies, and to investigate why their abatement is so good. An impressive example is model plant BE52[21]: they abate COD from an influent concentration of 3 070 mg/L to a mere 67 mg/L in the effluent. DK74[22] abates COD from 7200 mg/L to 172 mg/L and thereby does not meet BAT: nevertheless, useful lessons can probably be derived from the very high abatement efficiency of the treatment plant.

It should be noted that abatement efficiencies *are* taken into account in the BAT-C (see section 2.6): however, they are not used to justify emissions in the upper part of the BAT-AEL range, but to derogate from the BAT-AEL range.

Similar observations hold for the following parameters: TOC, TSS, total N, inorganic N.

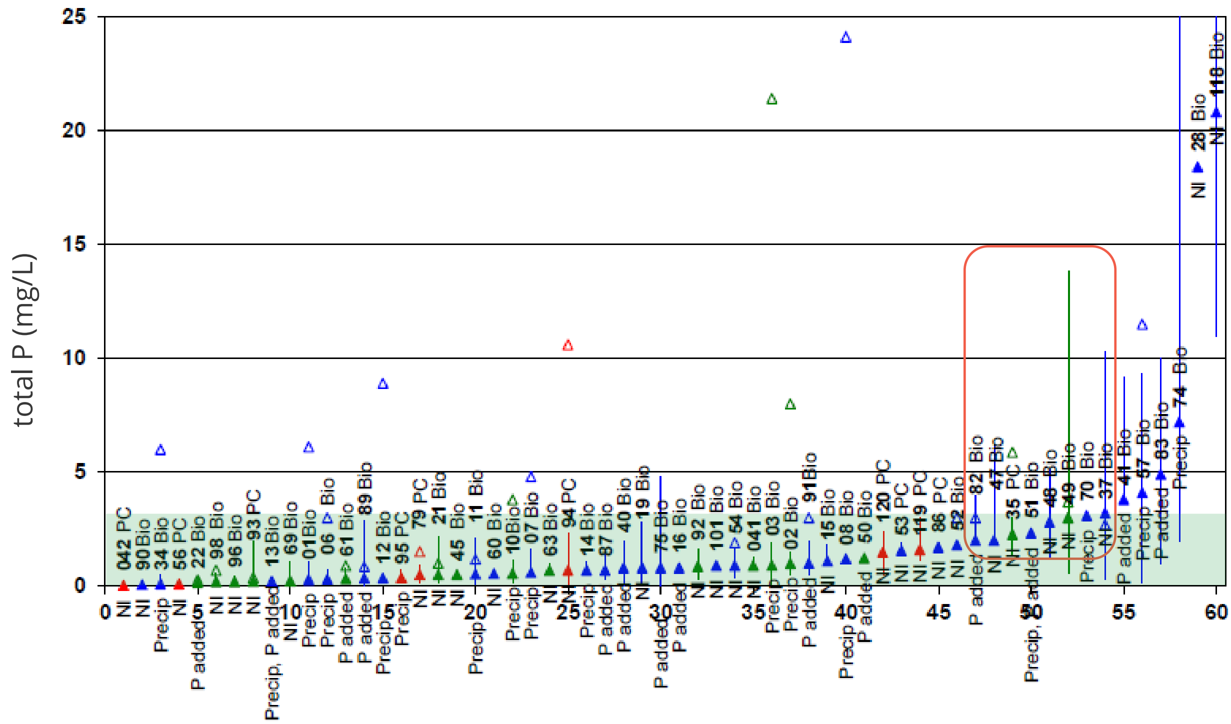
2.4.2. Example 2: total P: "best" becoming worse over time?

The picture is entirely different for total P, where the chosen BAT-AEL range of 0.5 – 3 mg/L cannot be explained by the data, for at least two reasons:

1) The old BREF gives a BAT-AEL range of 0.5 – 1.5 mg/L. It is unlikely that the best available techniques have deteriorated over time, and the opposite is generally assumed. Would industrial lobbying have played a role? Are promises easier to make when you do not have to live up to them (as several member states considered the 2003 IPPC BREFs as non-binding[23])?
2) The upper half of the current BAT-AEL range is occupied by only few plants (Figure 6, circled), some of which have remarkably high variability (as represented by the error bars), possibly indicating poor process control or stability.

[21] Unambiguously identified as Domo Polymers in Ghent (BE), a polyamide manufacturer.
[22] Likely Cheminova in Lemvig (DK), a manufacturer of organophosphate and other pesticides.
[23] This common interpretation is clearly at odds with the wording in Art. 9(5) of Directive 96/61/EC – which offers wide possibilities for derogations, but does not leave any doubt to the binding nature of the BREF: *[the ELVs] shall be based on the best available techniques, [...], but taking into account [possibilities for derogations].*

Figure 6: Reported total P concentration in effluent (full triangles) and inflow (hollow triangles) for model plants. Reworked from Figure 2.32, p. 82 of the CWW BREF. The BAT-AEL range is shown in light green; the numbers correspond to the plant codes.



The data on these eight plants (see data in Table 4), on top of high variability of emitted total P, reveals additional weaknesses in data and data treatment quality, for all eight plants:

- BE51, ES47 and ES48 do not report data on influent concentration; as no information on abatement performance can be drawn, such plants should not be regarded as employing BAT.
- ES47 reports[24] average total P concentrations of 1.2 and 0.8 mg/L for 2013 and 2014, respectively, i.e. a substantial improvement with respect to their performance reported into the BREF data collection for 2007/2008. By the time the BREF was published, data used to justify high BAT-AELs were already out of date.
- BE51 is, according to its operating permit, an indirect discharger (see also section 4.2.2), as opposed to what the data collection says. It adds around six times as much phosphorus for WWTP operation than it finally emits; whereas according to the BAT-C,[25] the lower BAT-AEL range should be achieved in such a case.
- AT70 reports a very strong abatement of total P in the total load. As AT70 is a pharmaceutical plant also treating wastewater brought by lorry from a sister plant,[26] it can safely be assumed that their relative water consumption is low and that pollutants are concentrated. Like BE52 and DK74 in section 2.4.1, such plants should be taken into

[24] Annual environmental report of Cepsa Química Palos for 2015, p. 54.
[25] Footnote 4 to Table 2.
[26] Sandoz's plant in Kundl receives some types of waste waters by road from Sandoz' Schaftenau plant ca. 15 km away.

account for abatement performance BAT setting, but should not be amalgamated with poorly performing installations.

- ES37 has a higher total P load and concentration in the effluent than in the influent, although no phosphorus is added in the treatment process.
- ES82 reports only rounded figures (no decimals) and claims running above its annual capacity in 2010. What's more, it only emits on average 1.0 mg/L in 2010, as opposed to 2.0 mg/L in 2011. One may wonder what the reasons for such performance fluctuations and oddly reported data are.
- BE49 hardly abates any phosphorus at all and therefore hardly qualifies for BAT.

Table 4: summary of data on total P for plants circled in Figure 6

Plant code	Company	Location	Capacity	Volume treated	Total P				Year	P added
					influent, average		effluent, average			
					conc.	load	conc.	load		
			[1000 m3/y]	[1000 m3/y]	[mg/L]	[t/y]	[mg/L]	[t/y]		
AT70	Sandoz GmbH	Kundl	3,103		no data	267.0	3.1	8.5	2011	no
BE49	BASF	Antwerp	13,100		3.7	45.4	3.0	36.8	2011	no
BE51	Axalta Coating Systems	Mechelen	700	270	no data	no data	2.3	0.6	2011	0.015 kg P/m^3
ES37	BASF	Tarragona	1,752		2.7	2.9	3.2	3.4	2011	no
ES47	Cepsa Química	Huelva	657		no data	no data	2.0	no data	2007/8	no data
ES48	*not identified*	*not identified*	2,300		no data	no data	2.8	no data	2008	no data
ES82	*not identified*	*not identified*	2,847	2,980	2.0	6.0	1.0	3.0	2010	0.021 kg P/m^3
FR35	Total/Arkema	St Avold	15,768		5.9	44.7	2.3	17.6	2008	no data

In short, not even one of the plants in the expansion of the BAT-AEL range with respect to the old CWW BREF provides a credible explanation for this relaxation, which is with little doubt at odds with the spirit of the IED.

2.4.3. Other BAT-AELs

As in the case of COD and total P, uBAT-AEL ranges are mostly by a factor 2 or 3 higher than what is routinely achieved by most plants.[27] We will only highlight here the most salient examples and refer the reader to the BAT text:

- For AOX[28], the uBAT-AEL is 1 mg/L, whereas most plants consistently achieve 0.4 mg/L. Plants in the range of 0.4-1 mg/L have high variability in their output, and mostly do not report on influent concentrations or abatement efficiencies (an exception being DE041, a medium-sized plant, which impressively abates AOX from 436 mg/L to 0.52 mg/L). As the AOX load is often due to either chlorochemistry (such as vinyl chloride manufacturing and the chlor-alkali process) or the use of bleach, substantial amounts of AOX are only generated in specific processes. For this reason, large CWWs diluting AOX (see also section 1.1.4) from such processes with waste water from other processes are favoured by the CWW BREF's reliance on effluent concentrations only. Three out of the plants in this range are among the 10 largest plants in the data collection.

[27] Already in 2013, EEB criticised the Bureau's largely statistical approach to BAT-AEL setting, trying to accommodate most operators instead of identifying best available techniques and performance levels. Data provided by Cefic confirmed that 80% of operators complied with AOX BAT-AELs, 82% for Cr, 76% for Cu, and 90% for Ni.
[28] CWW BREF, Figure 2.18, p. 59. See also section 4.4.1.

- For chromium (Cr)[29], the uBAT-AEL is 25 µg/L, but almost all plants are well below 15 µg/L. The three plants BE50, UK27[30] and FR119 do not provide much data on their performance, so it is once again difficult to understand why the BAT-AEL range includes them.
- For copper (Cu)[31], the situation is very similar to the one for Cr: the uBAT-AEL could have easily been lowered from 50 µg/L to 25 µg/L, as only three installations are in the upper half of the range.
- For zinc (Zn)[32], again the situation is analogous. Only eight installations, four of which with very high variability in effluent concentration and not reporting abatement efficiencies, make up the upper two thirds of the BAT-AEL range, whereas the lower third corresponds to more than 35 installations, mostly with low fluctuations.

In summary, current BAT derivation methods rest on lengthy data collection and superficial data analysis. Substantial improvement in either quality or efficiency could be achieved by either speeding up data collection (e.g. by relying on publicly available information (see also section 4.4.3) and information that is available by access to information requests) or by critical in-depth data analysis, eliminating inconsistent data such as the examples cited above, and by applying the suggested EEB BAT derivation methodology[33].

2.4.4. *Uncertain uncertainties*

The sub-chapters on the different pollutants in the BREF each contain a section on the limits of detection (LoD) and limit of quantification (LoQ), exemplified by the text on chromium:

> In Flanders (Belgium), Cu is considered not quantifiable below 25 µg/l. In France, the LOQ is 5 µg/l for copper and copper compounds. In Germany, the LOQ for Cu is 0.1 µg/l based on EN ISO 17294–1. Analytical methods to measure Cu include ICP-OES with an approximate LOQ of 2 µg/l (EN ISO 11885) and ICP-MS with a lower limit of application of approximately 1 µg/l (EN ISO 17294–1).

For other pollutants, the situation is analogous: LoQs differ by a factor 250 (!) between Belgium and Germany, a surprising statement without any explanation. The IED is supposed to promote best available techniques but does not seem to do so on measurement techniques; also the BREF is supposed to deliver a level playing field ("to limit imbalances in the Union as regards the level of emissions from industrial activities"[34]) but fails to set the methods to do so.

The BAT-AEL range for Cu is 5-50 µg/L; however, three BE plants (BE49, BE50, BE53) are used for BAT-AEL derivation and report values below 25 µg/L. Two of these are well below 10 µg/L, which would be below an LoD inferred from an LoQ of 25 µg/L.[35]

The data situation here is too confusing and of too low quality to hazard a guess about the origin of these contradictions, or even to correct the situation. Suffice it to say that a good understanding

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[29] CWW BREF, Figure 2.20, p. 64.
[30] Identified as Lanxess/Covestro in Antwerp (BE) and Inovyn in Runcorn (UK)
[31] CWW BREF, figure 2.21, p. 65.
[32] CWW BREF, figure 2.25, p. 71.
[33] See footnote 17
[34] IED recital 13.
[35] Depending on the convention used, LoQ is generally regarded as 2×LoD or 3.33×LoD.

of measurement science and control of measurement uncertainties is paramount, and that the TWG members should in the future give more attention to this aspect.

2.5. A loophole for indirect emissions

This is likely the worst conceptual weakness of the CWW BREF: it opens a loophole as big as a sewer pipe to indirect emissions from WWTPs. Indeed, although the CWW's scope includes both indirect and direct emissions, it does not set any BAT-AELs for indirect emissions.[36]

Consequently, one can easily construe scenarios where a CWW plant insufficiently abates some pollutants but discharges into another WWTP, i.e. indirectly. A UWWTP as the receiving plant (see scenario in Figure 3 and the pollutants shown in red) would neither abate these pollutants nor monitor its outflow, as those pollutants are not covered by the UWWTD.

One example of the – purposeful or inadvertent – use of this loophole can be found in the permit of the WWTP of Axalta Coating Systems in Mechelen (BE) (see also section 4.2.2), an installation linked to the paint and polymer industries and with indirect discharge, into a municipal sewer. Its permit was renewed in 2019[37] and several ELVs are above the uBAT-AELs of the CWW BAT-C (which indeed only apply for direct discharge): COD at 200 mg/L (uBAT-AEL 100 mg/L), TSS at 150 mg/L (35 mg/L), total N at 30 mg/L (25 mg/L). While these types of pollutants are likely sufficiently abated in the subsequent UWWTP, another parameter is not: total Cr is permitted up to 50 µg/L, whereas the BAT-AEL for direct discharges is 25 µg/L.

The permit does not justify this value, nor does it ascertain sufficient abatement in the downstream WWTP (according to IED Art. 15 (1), second sub-paragraph)). There are a few other inconsistencies, which we have not attempted to resolve:

- The permit sets the same BAT-AEL on the much more toxic Cr(VI) as on total Cr, indicating that all Cr is expected to come from Cr(VI), which is not surprising for a plant producing (corrosion protection) coatings.
- The plant has been identified as BE51 in the CWW BREF based on its receiving water body, WWTP design and production activities. BE51 reports emissions of both total Cr and Cr(VI) < 10 µg/L – its official limit of quantification in Flanders (see also section 2.4.4).
- The last Cr(VI) based paints were phased out latest in January 2019, the sunset date for the last Cr(VI) salts on the REACH Annex XIV list[38], whereas the permit was granted on 29th May 2019.

[36] This omission leads to a further inconsistency with the legal text: IED Art. 15 (1), second sub-paragraph stipulates that the downstream WWTP's effect may be taken into account, *provided that an equivalent level of protection of the environment as a whole is guaranteed and provided this does not lead to higher levels of pollution in the environment*.
The CWW BREF's second draft, issued in July 2011, contained a number of BAT proposals on pollutant abatement in upstream tributaries. The concept used did not equate to setting BAT-AELs for indirect emissions or to ensure consistency with IED Art. 15 (1); nevertheless, the concept had some environmental merit. Unfortunately, the BREF technical working group decided to scrap the concept instead of developing it.
[37] Document OMWV-2019-0003, p. 8. This document can be found on our SharePoint site or via the procedure in footnote 72.
[38] No application for authorisation had been introduced for uses in paint by that time.

2.6. Footnote loopholes

Once again, the devil's in the footnote. The tables containing the BAT-AELs[39] are decorated with no fewer than 20 footnotes. Of these, fully 12 specify derogations from the uBAT-AEL, and almost all of these are open-ended, i.e. they are formulated as "the upper end of the range may not apply…" without specifying, however, a ceiling for this new derogated value.

There are two types of such open-ended derogations:

- for installations equipped with certain technical features and achieving certain performance levels, such as the use of nitrification or certain levels of abatement efficiency;
- for certain sectors of the industry: the uBAT-AEL for TSS does not apply for soda ash production and the uBAT-AEL for chromium does not apply for producers of chromium compounds. To ascertain the ridicule of this derogation, it is even clarified that it holds for both inorganic as chromium-organic compounds, and that avoiding use or production of chromium compounds leads to lower effluent concentrations.[40] It basically means the more problematic pollutants or processes are used by an operator, that operator will get rewarded with a higher pollution allowance.

Such derogations could potentially be justified if good technical reasons were provided and if the absence of deleterious effects on the environment could be guaranteed. However, as information on the activities of the model plants is untransparent in the CWW data collection (see section 2.2) and is restricted at best to the BREFs applying to each model plant, one cannot trace any arguments potentially justifying the derogations.

3. Where are the emitters? A critical view on E-PRTR data

In assessing CWW BREF for its environmental releases and pressures, the level of ambition, reduction of pollution levels etc., access to reliable data is important. The European Pollution Release and Transfer Register (E-PRTR) is the only available tool for attempting this exercise; however, in practice data gathering and analyses are limited by inconsistencies and lack of comparability.

3.1. Comparison: definitions in CWW and E-PRTR

3.1.1. Definitions

The regulation setting up the E-PRTR[41] defines, like the IED, industrial activities subject to emission reporting in its Annex I. The activities relevant to the CWW BREF (see section 1.1.1), described as "Section 4: Chemical industry" and "Section 6.11: independently operated treatment of waste

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[39] BAT-C, Tables 1, 2 and 3.
[40] BAT-C, Table 3, footnotes 4, 6 and 3.
[41] Regulation 166/2006.

water [...]" have similar denominations in the E-PRTR and in the IED. A correspondence table of activity codes is provided in Table 5.

Table 5: Activity codes in IED and E-PRTR

E-PRTR	E-PRTR description	IED
4.a	Production of basic organic chemicals	4.1
4.b	Production of basic inorganic chemicals	4.2
4.c	Production of fertilisers	4.3
4.d	Production of basic plant health products and biocides	4.4
4.e	Production of basic pharmaceutical products	4.5
4.f	Production of explosives and pyrotechnic products	4.6
5.g	Independently operated industrial WWTPs	6.11

Independently operated industrial WWTPs can be subject to the UWWTD or the CWW BREF depending on their main pollutant load (see also sections 1.1.2 and 1.2.2). On this background, it is important to consider more closely the definition of E-PRTR activity code 5.g. The E-PRTR definition of code 5.g reads as follows:

> Independently operated industrial waste-water treatment plants which serve one or more activities in this annex; capacity threshold: with a capacity of 10 000 m^3 per day.[42]

In subsequent analysis of E-PRTR entries of code 5.g, a case-by-case analysis was used to retain only those entries likely subject to the CWW, i.e. those receiving their main pollutant load from the chemical industry.

3.1.2. Caveats

A complete list of CWW plants is not available, but the model plants used in the early phases of the development of the new BREF can provide some information. Data from 66 plants were collected, and 27 of them (41%) were likely[43] above the capacity threshold of 10 000 m^3. The plants with reporting obligations to the E-PRTR, however, correspond to around 93% of total treatment capacity of the model plants. This percentage drops to 80% when the by far largest of the model plants, a plant in Germany with a treatment capacity of 220 Mm^3, treating 122 Mm^3 in 2007 and discharging into the river Rhine,[44] is removed from the data set.

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[42] A footnote specifies: "The capacity threshold shall be reviewed by 2010 at the latest in the light of the results of the first reporting cycle." This footnote is still present in the current consolidated version of the E-PRTR regulation and remains unchanged.

[43] For a few plants, no capacity data were provided, but capacity information can be inferred from data on effectively treated volumes. This induction may have resulted in up to four false positives for "above the capacity threshold".

[44] Undoubtedly the central WWTP of BASF in Ludwigshafen.

As various thresholds (see Table 6) apply to the different pollutants, one may not deduce from this that a large majority of plants effectively report data to the E-PRTR, nor that a large majority of effective pollutant emissions are reported to the E-PRTR.

Another aspect worth checking is whether any specific pollutants display major discrepancies between BAT-AEL applicability thresholds in the CWW BREF and pollutant load reporting thresholds in E-PRTR. The CWW BREF gives for each pollutant annual load thresholds as of which the BAT-AELs apply. For this comparison, we have derived treatment capacity thresholds based on the upper and lower bound of the BAT-AEL. In other words, the derived capacity columns in blue in Table 6 are calculations of the minimum size of a WWTP to which the CWW BAT-AELs would apply, assuming it would operate at the lBAT-AEL and uBAT-AEL, respectively. Conversely, we have calculated as of what WWTP size (more saturated green columns) plants operating at upper or lower BAT-AEL bounds would have to report their emissions under E-PRTR.

The capacity ranges as of which the CWW BAT-AELs apply are consistently and substantially lower than those for the reporting duty under E-PRTR, in line with the observation based on the CWW BREF data collection model plants. Overlaps exist for Ni and Zn, due to the very broad BAT-AEL ranges for these pollutants.

Table 6: Alignment of CWW and E-PRTR thresholds

	CWW								E-PRTR				
	Direct discharge						Derived capacity [m^3/d]		for emissions to water			Derived capacity [m^3/d]	
		BAT-AEL			BAT applicabilit		at BAT-AEL		Reporting threshold			at BAT-AEL	
Parameter	Table	lower	upper	unit	threshold		lower	upper	Table		unit	lower	upper
TOC	1	10	33	mg/L	3.3	t/y	274	904	Annex II				
BOD5													
COD	1	30	100	mg/L	10	t/y	274	913					
TSS	1	5	35	mg/L	3.5	t/y	274	1,918					
HOI													
total N	2	5	25	mg/L	2.5	t/y	274	1,370		50000	kg/y	27,397	5,479
inorg N	2	5	20	mg/L	2	t/y	274	1,096					
total P	2	0.5	3	mg/L	300	kg/y	274	1,644		5000	kg/y	27,397	4,566
Phenol index										20	kg/y		
CN^-										50	kg/y		
AOX	3	0.2	1	mg/L	100	kg/y	274	1,370		1000	kg/y	13,699	2,740
As										5	kg/y		
Cd										5	kg/y		
Cr	3	5	25	µg/L	2.5	kg/y	274	1,370		50	kg/y	27,397	5,479
Cr(VI)													
Cu	3	5	50	µg/L	5	kg/y	274	2,740		50	kg/y	27,397	2,740
Pb													
Ni	3	5	50	µg/L	5	kg/y	274	2,740		20	kg/y	10,959	1,096
Hg										1	kg/y		
Sn													
Zn	3	20	300	µg/L	30	kg/y	274	4,110		100	kg/y	13,699	913

In the following, we shall examine and highlight discrepancies and unexplained inconsistencies between the E-PRTR and other information on plants.

3.2. Investigations into the large emitters

The data in E-PRTR shows emitted quantities or loads, not emitted concentrations, which would be relevant to check compliance with permitted ELVs. However, load information has the advantage of greater environmental relevance. A picture of the European CWWs would thus not be complete without an analysis of the main emitters (in loads) of pollutants.

The data structure (see also section 3.1) of E-PRTR allows to select installations under the CWW BREF with a good level of confidence, as activity definitions are analogous under E-PRTR and the IED. However, the pollutants reported under E-PRTR only have a partial overlap with the CWW-relevant ones (see also Table 6).

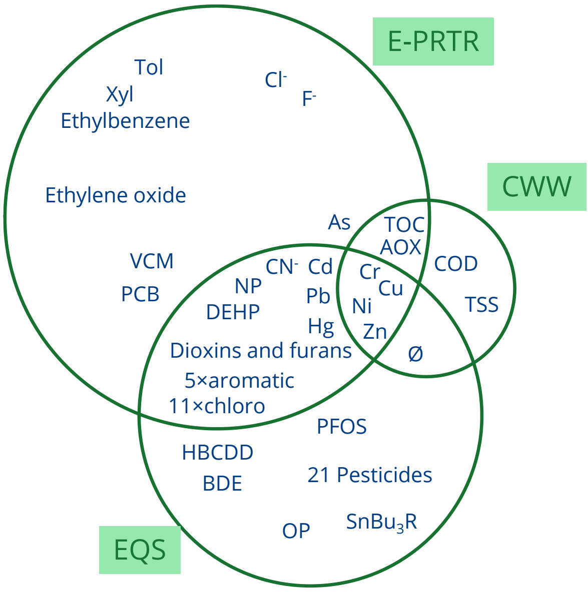
When comparing plants, two essential questions arise:

1. How to compare different pollutants? Is it worse to emit 1 tonne of nickel, or 10 tonnes of nitrogen?
2. Is a large plant with a better relative environmental performance a less bad polluter than a small plant with a poorer relative performance? In other terms, is it better that plant A produces 1000 tonnes of chemical X and emits 100 kg of pollutant Y, or that plant B produces 10 tonnes of the same chemical X and emits 10 kg of the same pollutant Y?

Regarding the 1st question, we have attempted to normalise (in the mathematical sense of the word) some pollutants using the Environmental Quality Standards (EQS) as set in the Water Framework Directive[45]. The EQS are standards used to define good chemical quality of water bodies; they consider the (eco)toxicological potency of the different pollutants as well as diffuse or background levels of these pollutants. As shown in Figure 7, the three sets of pollutants and parameters have only little overlap; however, all but two parameters with BAT-AELs in the CWW BREF are reported in E-PRTR – and COD is closely related to TOC. More importantly, many of the E-PRTR pollutants are industrially relevant substances. An analysis based on E-PRTR parameters thus promises to be both informative and practically relevant.

[45] Directive 2013/39, Annex I.

Figure 7: Venn diagram of pollutants in E-PRTR and EQS and pollutants with BAT-AELs in CWW



3.3. The top 30 list

Based on the 2017 E-PRTR data, we looked at the ten highest emissions reported for each of the 41 pollutants (see annex 6.1 for the values). In some cases, low absolute values of emissions were selected because of the very low EQS level, indicating that small amounts of potent pollutants are nevertheless environmentally relevant. The top 3 emissions selected are displayed in Table 7.

A very quick glance at that table reveals that some company names, and those of some facilities are present a few times: BASF, Inovyn, Prayon, Solvay (in different shades of orange depending on the facility).

Table 7: List of top 30 emissions in alphabetical order of the company name

Facility ID	Company	Location	Country	Amount (kg)	Pollutant	Activity
88777	Alpheus WWTP	Ayr	UK	184,000	Total P	5.(g)
109453	BASF	Ludwigshafen	DE	2,630	Ni	4.(b)
109453	BASF	Ludwigshafen	DE	4,320	Cu	4.(a)
73896	Dow	Stade	DE	22,800	AOX	4.(b)
85750	DSM Nutritional Products AG	Sisseln	CH	1,890	DCM	4.(e)
8910	Ercros S.A.	Sabiñanigo	ES	4,090,000	TOC	4.(b)
9685	Fortischem	Nováky	SK	250	Hg	4.(a)
124098	HIP Azotara	Pančevo-grad	RS	6,260,000	Total N	4.(b)
1294	Inovyn	Tavaux	FR	114	HCBD	4.(a)
1294	Inovyn	Tavaux	FR	29	$PhHCl_5$	4.(a)
1294	Inovyn	Tavaux	FR	41,500	AOX	4.(a)
1294	Inovyn	Tavaux	FR	460	PER	4.(a)
192196	Noralf AS	Odda	NO	879,000	F^-	4.(b)
15063	PRAYON sa	Engis	BE	912,000	F^-	4.(b)
15063	PRAYON sa	Engis	BE	172,000	Total P	4.(b)
167400	SC Oltchim SA	Râmnicu Vâlcea	RO	4,330,000	TOC	4.(b)
9340	Shell	Moerdijk	NL	3,250	$CHCl_3$	4.(a)
5150	Solvay	Rosignano	IT	6,680	Pb	4.(b)
5150	Solvay	Rosignano	IT	141	Cd	4.(a)
43934	Solvay	Rheinberg	DE	134	Cd	4.(a)
5150	Solvay	Rosignano	IT	2,230	Ni	4.(b)
3880	Solvay	Rosignano	IT	3,880	As	4.(b)
8727	Solvay	Torrelavega	ES	72	Hg	4.(b)
5150	Solvay	Rosignano	IT	22,900	Zn	4.(b)
3880	Solvay	Rosignano	IT	3,700	Cr	4.(b)
7372	Stabilimento di Priolo Gargallo	Priolo Gargallo	IT	37	Fluoranthene	4.(a)
32355	Synthomer Limited	Grimsby	UK	357	NP/NPEs	4.(a)
17853	Vencorex	Pont-de-Claix	FR	84	TCB	4.(a)
212082	Wilton Olefins 6 (Cracker)	Redcar	UK	1,110	Benzene	4.(a)
509	Zakłady Azotowe "Puławy" S.A.	Puławy	PL	2,500,000	Total N	4.(c)

No-one will be surprised that BASF's facility in Ludwigshafen, being the largest chemical site in Europe, and using a single WWTP, is present in the list, and even twice. However, it is more surprising to see the fourfold presence of Inovyn's facility in Tavaux (FR) or the sixfold presence of Solvay's Rosignano (IT) facility, complemented by another two Solvay sites (see also section 3.4 and subsections).

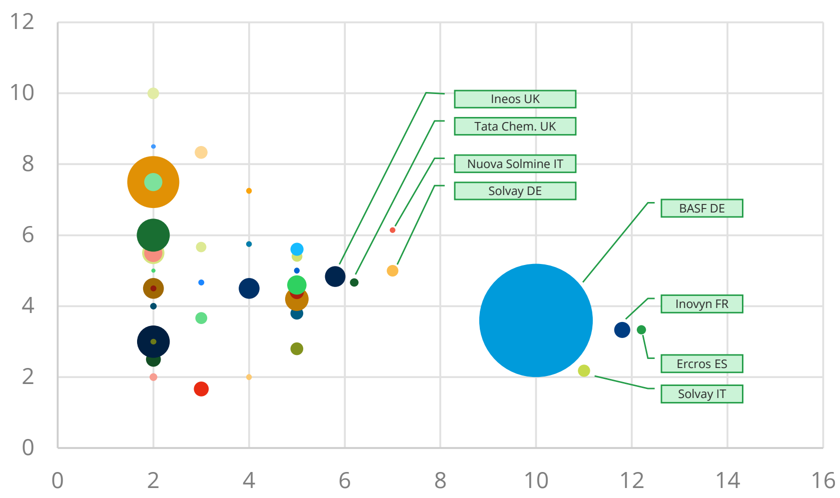
3.4. Small is not beautiful

It is difficult to find a good metric for the size of a plant: surface area and tonnage produced are not useful indicators, as the size of installations and the intensity of pollutant generation strongly depend on the chemicals made. Production volume is also generally less well reported: few companies give information on their website or in financial reports; the E-PRTR does not contain such data (as opposed to e.g. the Norwegian PRTR) and only few compliance reports contain production volume data. A more easily available (albeit far from perfect) metric is the number of staff, generally reported on companies' websites, although the figures are certainly polluted by the presence of contractors and administrative staff. Nevertheless, we have resorted to designing a metric that better illustrates how facilities score in leading the top of the polluters; the outcome is depicted in Figure 8.

Three variables are plotted in this graph; each data entry (i.e. circle) corresponds to one E-PRTR facility:

- The size of the circle corresponds to the number of employees on the site, according to company or newspaper information. For a few companies, no data were found.
- “Number of prizes”: The x-axis counts the number of pollutants (among the 41 parameters reported in E-PRTR) for which the facility is in the top 10 of the highest emissions, e.g. a facility being the number 4 on Pb and number 6 on DCM[46] (and not being in the top 10 for any other parameter) will have a score of 2 on this axis.[47]
- “Firstness”: The y-axis shows the average of the ranks for all parameters for which a facility is in the top 10, e.g. a facility being the number 4 on Pb and number 7 on TOC (and not being in the top 10 for any other parameter) will have a score of 5.5 on the y-axis.

Figure 8: Size of plants (size of the circle) for facilities scoring in the top 10 emissions for a number of parameters (x-axis) and winning on average the yth prize (y-axis). The circles are randomly coloured).



The large mid-blue circle at the bottom right is BASF’s facility in Ludwigshafen, being in the top 10 on 10 pollutants, and being on average the 3.6th largest emitter in those 10 parameters. As noted above, it is not surprising that large facilities “win many prizes”.

The pressure on the environment is caused by the amounts of pollutants emitted, not by the size of the plant itself. Nevertheless, when it comes to implementing BAT, the small “Jupiter moons” in the bottom right corner are more daunting, and the small dots in the centre of the graph are also worrying.

In the following sections, we will analyse some of these facilities one by one.

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[46] Dichloromethane, a chlorinated solvent.

[47] A few points have been horizontally shifted so they do not overlap. As values on the x-axis are integers, the reader can easily infer their exact position.

3.4.1. Ercros in Vila-seca (ES)

Ercros' facility (mid green circle) is located in the Tarragona province in North-Eastern Spain and is a chlorine chemistry plant: chlor-alkali process, hydrochloric acid and the production chain EDC-VCM-PVC[48]. It has a capacity of 525 kt/y of PVC and other chlorine derivatives,[49] which makes it a rather large PVC plant. It is by far the #1 emitter for C10-C13 chloroalkanes, #3 for EDC[50],#4 on DEHP[51], and is in the top 10 for several other pollutants.

Regarding pollutants of the CWW BREF, this Ercros plant is #7 on emissions of AOX.

3.4.2. Inovyn in Tavaux (FR)

Inovyn's plant (dark blue circle) in Eastern France is also a chlorine plant, producing up to 320 kt/y of PVC and more than 132 kt/y of caustic soda, as well as other chlorinated chemicals. The plant is:

- the #1 emitter of five polychlorinated pollutants, namely hexachlorobenzene, hexachlorobutadiene, pentachlorobenzene, tetrachloroethylene (PER), and tetrachloromethane; in three cases by a large margin, and in one case it is the sole reporter;
- the #2 emitter of trichloroethylene; and
- the number #3 of AOX.

Inovyn's facilities are part of a larger industrial complex that formerly belonged to Solvay (see also section 3.4.3). Inovyn collects all waste waters from the industrial platform and operates a WWTP for process waters discharging via a dedicated open duct into a pond,[52] which drains via a brook into the Saône river.

In 2019, the authorities issued a new permit[53] with stricter load and concentration limits on many pollutants, mostly to counter damage to the sensitive Saône system. The new limits are all in line with the BAT-AEL ranges of the CWW BREF and in several cases lower than the uBAT-AEL. They should lead to strongly decreased emissions for some pollutants (see Figure 9).

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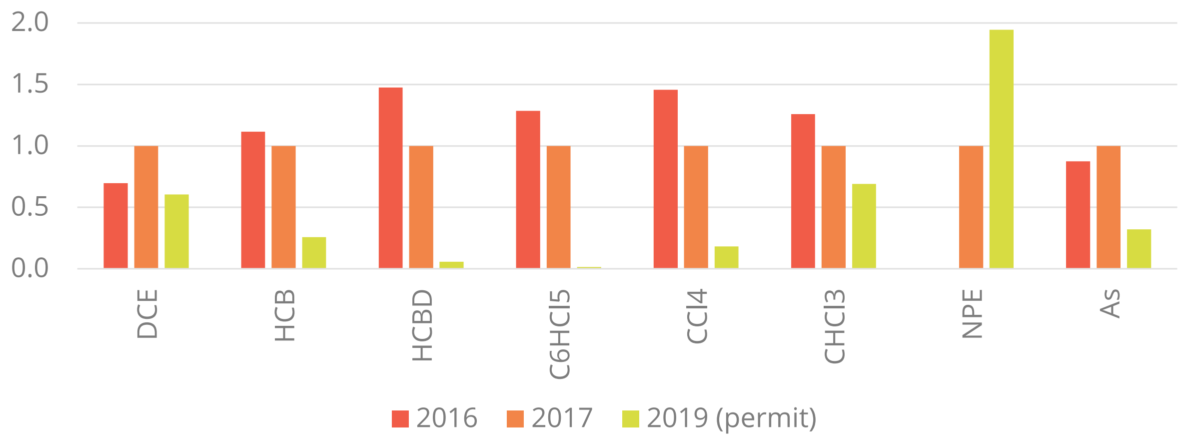
[48] Ethylene dichloride (EDC) is transformed into vinyl chloride monomer (VCM), which is then polymerised into polyvinyl chloride (PVC).
[49] According to Ercros' website.
[50] Ethylene dichloride, EDC, is referred to as the synonymous 1,2-dichloroethane (DCE) in E-PRTR), see also footnote 48.
[51] It is also the #1 emitter of ethylene oxide, but also the only one reporting to E-PRTR. The emissions of DEHP (di(2-ethylhexyl)orthophthalate, the most famous phthalate used esp. to plasticise PVC) are at the level of kilograms.
[52] Geographical coordinates 47.058515, 5.404306 (WWTP) and 47.083507, 5.332309 (pond).
[53] Arrêté préfectoral (Jura) No. 39-2019-04-16-001, available here. The stricter limit only enter into force as of 2020 or 2021. Emission monitoring data up to the end of 2019 do not show a decrease in total organochlorine compounds.

Figure 9: Emitted loads (2016 and 2017) and permitted loads for selected pollutants[54] (normalised to the 2017 load).



These data deserve a few comments:

- The ELVs are daily averages. Considering inherent fluctuations, the total permitted annual loads (in Figure 9) are overestimations of the effective annual loads providing the installation complies. Quarterly compliance reports from 2019 indicate that the installation has no major problem complying with the new permit conditions.[55]
- The 2019 permit allows daily emissions of 300 kg/d of fluoride, whereas the plant only emitted 13 500 kg in all of 2017.[56] It is unclear from the permit how this ELV was derived and why the permissible and actual emissions would suddenly increase.[57]
  The same holds for NPEs,[58] of which 6.1 kg were emitted in 2017, but the 2019 permit allows annual loads of up to 11.86 kg.
- Emissions can in practice be brought down substantially by good permit conditions.
- Regarding receiving body water quality, this change in permit conditions is doubtlessly – in spite of the doubts on fluoride and NPEs – good news, as emissions of all priority substances under the Water Framework Directive are bound to strongly decrease.

3.4.3. Solvay in Rosignano (IT) and Rheinberg (DE)

Solvay's Rosignano plant (light green) on Italy's western shores scores highest in its footprint on Mendeleev's periodic table: it is the #1 polluter in arsenic, cadmium, lead and zinc, and #2 in

[54] The permit ELV is on COD rather than on TOC. The permitted COD values were converted to TOC using a COD/TOC ratio of 3.0, based on the CWW BREF, section 2.4.2.1.2, p. 48.
[55] The permit documents and quarterly reports are available on our SharePoint site.
[56] The fluoride reporting is altogether inconsistent. E-PRTR emissions for fluoride are 13500 kg in 2017, whereas the monitored amounts sum up to more than 21000 kg in 2017, and increase to 24600 kg in 2019. The comfortable daily emission limit is generally respected.
[57] This is a grey area in the IED. Art. 24 (2.e) obliges permit writers to publish the rationale for the *permit conditions referred to in Article 14*. This includes those pollutants for which there is no BAT-AEL in the BREF, whereas the subsequent wording *in relation to the [BATs and BAT-AELs]* would logically limit the obligation to publish the rationale to those pollutants for which there are BATs and BAT-AELs. Most permit writers circumvent this ambiguity by disregarding their obligation altogether.
[58] Nonylphenol ethoxylates have been heavily restricted (restrictions 46 and 46a) for years and were added to Reach Annex XIV in 2019. NPEs are never accidentally produced, but their emission is always caused by substances, mixtures and articles used. NPEs are not registered under REACH as they meet the polymer definitions in REACH Art. 3 (5) and Art. 6 (3), despite being small molecules and behaving like small molecules.

copper and #3 in mercury, nickel, chlorides and total phosphorus[59]. Rosignano's sister plant in Rheinberg (DE) (amber dot) also emits lavishly on heavy metals: #2 on Cd, #3 on As, #4 on Cu, #5 on Cr, #7 on Ni and #8 on Pb. Another similar installation with high emissions of heavy metals is Tata Chemicals' plant in Lostock (UK) (dark green).

Both installations produce a range of innocuous soda derivatives via an unspectacular production process (the Solvay process), which does not involve heavy metals. The heavy metals stem from the limestone used as a raw material, and which are "purified out" during the process.[60] The wastewater treatment process for this type of installations is primitive, resting largely on decantation. The CWW BREF takes this into account and contains a generous exemption for heavy metals in wastewater from soda ash production.[61] If Rosignano's emissions are substantially higher than those of Rheinberg, it should be noted that Rosignano's capacity is almost twice as high.[62]

In Rosignano, Solvay discharges large amounts of white solids into the sea, rendering the beaches bright white in an area that would have greyish-yellow sand. Solvay's website is an exemplar of corporate – well – white-washing.[63]

Is the Rosignano plant compliant? The devil is in the detail. Surprisingly, most pollutant parameters (except boron) comply with the limit values in the national GBRs (Table 8, see also section 4.5 for the GBRs). All parameters comply with the often laxist GBR ELVs. However, even considering uBAT-AELs from the CWW BREFs, only the parameter Cr is outside what is considered BAT.

The discrepancy between the two first data columns originates in different definitions: in E-PRTR and in the CWW BREF, all chemical forms of metals "dissolved or bound to particles"[64] must be taken into account, whereas the measurements according to national law (for compliance and monitoring) only take into account dissolved forms.[65]

Rosignano's overall score is particularly catastrophic, as it rests on pollutants for which a high number of facilities report emissions. It is bad enough to be the largest emitter if there are only three of them, but it is much worse when there are thirty of them.

[59] The environmental pressure of chlorides and total phosphorus is likely negligible as the WWTP discharges directly into the sea.
[60] See Table 2.10, p. 183 of the CLM BREF.
[61] Table 3, footnote 5 of the CWW BREF.
[62] In 2002, 1020 kt/y for Rosignano and 600 kt/y for Rheinberg, see Table 2.3, p. 37 of the LVIC-S BREF.
[63] Solvay's website.
[64] Definitions section of the CWW BREF.
[65] According to the website of the regional environment agency ARPAT (in IT only).

Table 8: Pollutant concentrations for Solvay's plant in Rosignano, selected pollutants[66]

		from E-PRTR 2017	Annual report 2017	uBAT-AEL CWW BREF	Dec. leg. 152/2006
As	µg/L	45	0.5	na	0
Cd	µg/L	1.6	2.0	na	20
Cr	µg/L	43	30	25	2000
Cu	µg/L	21	10	50	100
Pb	µg/L	78	65	na	200
Hg	µg/L	0.7	0.2	na	5.0
Ni	µg/L	25	13	50	2000
total N	mg/L	5	7	25	
total P	mg/L	1.0	0.3	0.5	10.0
Zn	µg/L	266	163	300	500

It should be noted that the Rosignano WWTP receives wastewater from different installations on the site, operated by Solvay (the historical operator, manufacturing soda ash), Ineos (high-density polyethylene) and Inovyn (chlorinated solvents); yet the impressive emissions originate mostly in the Solvay process.

3.4.4. Nuova Solmine in Scarlino (IT)

This smallish plant (red dot) produces sulphuric acid and related substances from sulphur. It is the number one discharger of chloride ions; however, this does not result in any environmental pressure as the plant discharges via a pipeline into the sea. More importantly, Nuova Solmine in Scarlino is also the #2 emitter of cyanide and among the top ten for As, Cd, Hg and Ni, as well as fluoride.

Measured values for the five parameters in question in the annual report are well below the ELVs and the pollutants were not even detected. Recalculating pollutants from the treated volumes of waste water yields values that clash with the measured concentrations. However, the high volumes of the stated pollutants have been reported consistently to E-PRTR for several years now; they thus cannot be due to inadvertent misreporting.

3.4.5. Ineos in Grangemouth (UK)

This plant is a major refinery with few non-refining activities. It scores high on emissions of:

- toluene and xylene: emissions of aromatics are typical of refineries and petrochemical plants. Alongside Total in Gonfreville (FR), Sabic in Redcar (UK) and Eni in Porto Marghera (IT) it is one of the largest emitters of aromatics;
- dichloromethane: as no chlorochemical activities are obvious on this site, the origins of DCM emissions are unclear.

[66] The data in the 1st column are calculated from loads reported to E-PRTR and based on a total discharge volume of 86 000 000 m^3 in 2017 (source: annual report). The data for the 2nd column can be found on our SharePoint site.

4. Member state specific case studies

In the following, the national regulatory practice is assessed for five member states that are major producers of chemicals (in alphabetical order). This is rather meant as a set of non-representative case studies to illustrate diversity in approaches. Of course, this way relevant good or bad regulatory systems in other member states may be overlooked.

Most differences are seen along two parameters:

- Centralised (FR, IT) vs. regionalised legislation (BE, DE) and permitting authorities
- GBRs (General Binding Rules) or not.

GBRs (see IED Art. 6 and 17) are a means to transpose the binding provisions of the BAT-C into national law; in this case, permits generally refer by default to the GBR. In most cases, the uBAT-AELs are used as the binding ceiling value. In some cases, GBR conditions are more stringent than the uBAT-AEL. In reality, GBR conditions are sometimes less stringent than in the BAT-C – while this goes against the provisions of the IED, it may happen either intentionally or by not updating existing legislation. Updating the GBRs is mandated to happen latest 4 years after publication of the BAT-C (IED Art. 17 (3) and Art. 21 (3.a)).

4.1. Austria

Although the federal ministry in charge acknowledges the existence[67] of the CWW BREF, the Austrian approach to implementation is particularly creative, and disappointing. In an official letter from 2016[68], the ministry reassures industry that publication of the CWW BREF does not trigger any permit reviews! They argue that the CWW BREF does not relate to the principal activity of the companies and hence, according to IED Art. 21 (3), no permit updates are mandated. This argument defies common sense, logic and law.

As detailed in section 1.1.1, activities in scope of the CWW BREF include those mentioned in section 4 of Annex I of the IED, i.e. "chemical industry" and the different sub-activities. A chemical factory can hardly be regarded not to have "chemical industry" as the main activity. National legislation cited in the said letter (§ 81b GewO[69]) even goes beyond the IED, stipulating that within one year of the publication of BAT-C on the principal activity, the operator must request a permit change.

Current practise confirms Austria's particularly laxist approach. In a dossier for a new installation currently under consideration, Jungbunzlauer's lawyers request[70] adventurous ELVs, three to ten times above the uBAT-AEL for COD, TSS, nitrogen, Cu and Zn!

Given their track record, one may unfortunately expect that the authorities will regard the CWW BREF, the IED and GewO as mostly decorative regulation.

[67] On its online compilation of relevant BREFs, available here.
[68] Available on our SharePoint site.
[69] Austrian Commercial Code, available here.
[70] Dossier WST1-UG-4-2018 of the authorities of Lower Austria, available here, p. 3.

4.2. Belgium

4.2.1. Belgium's federal structure

Belgium is probably the EU member state most known for its fractured structure: some responsibilities are legislated and managed at a national level, but many responsibilities are devolved to the three regions of Brussels (which holds very few IED installations), Flanders and Wallonia. The regions regulate and permit IED installations based on regional environmental legislation.

4.2.2. Flanders

The Flemish region uses the GBR approach via its Vlarem legislation[71], which transposes the CWW BAT-C in section 3.9. The maximum ELVs for CWW installations are given in section 3.9.3.8 and correspond in general to the uBAT-AEL from the BAT-C. Many installation permits simply refer to "Vlarem III" or the specific section.

Vlarem III was updated in 2018 to reflect the BAT-AELs of the CWW BAT-C. Although it only aligns with the higher concentration and lower ambition limit of the BAT-C, the legislation at least follows the BAT-C and does so within the imparted time frame.

While this approach sounds reassuring, the reality looks different. Let us examine the case of the CWW plant of Lanxess[72] in Antwerp. A major revision of their permit took place in 2015, i.e. before publication of the BAT-C on CWW. Derogating and complementing sectoral standards in force at that time, it specifies ELVs for 16 parameters, of which 125 mg/L for COD, 60 mg/L for TSS and 50 mg/L for TOC.[73] In addition, the authority expressed a favourable opinion on an ELV of 0.06 mg/L for both Cr and Cu.

In 2016, the BAT-C imposed uBAT-AEL below all these values, and they were properly transposed into Vlarem III in 2018. However, the permitted ELVs a have not been aligned with Vlarem III or the BAT-C until the current date, four years after publication of the BAT-C on 9th June 2016. Worse still, an active re-examination of the permit in 2018[74] confirmed the ELVs for COD, TSS and TOC, in blatant disregard of the authorities' legal obligations to implement BAT.

4.2.3. Wallonia

Wallonia does not use the GBR approach, but specifies all ELVs in the relative permits. A potential advantage of this approach is that authorities have more leeway to decrease the ELVs below the

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[71] Especially the Vlarem III legislation (available here, only in NL). Vlarem III covers IED installations, whereas the older Vlarem II (still in force) regulates broader environmental standards and processes.

[72] See also section 2.4.3. This WWTP operated by Lanxess also collects wastewater from the adjacent Covestro, Cepsa and FRX Polymers plants. Permit documents on plants in the Flanders region can be found conveniently via the geopunt.be website (in NL only). On the right hand side, select *Kaarten en plaatsen* > *Natuur en milieu* > *GPBV-installaties industrie* (IPPC installations) > *Zelfstandig geëxploiteerde behandeling van afvalwater* (type 6.11) or *chemische industrie* (type 4) en navigate the map. On each dot, one can find an unstructured collection of permit documents via the *meer info over de installatie [...]* link.

[73] Document MLAV1-2015-0258, p. 129-130, available as explained in footnote 72.

[74] Document OMWV-2018-0001, p. 13-14.

uBAT-AEL depending on the plant's capabilities and the environment's need. Unfortunately, this does not necessarily happen, and some older ELVs have not been aligned with the CWW BAT-C.

One such case is the one of Prayon in Engis, a plant under the LVIC-AAF BREF producing, among others, phosphoric acid. This plant discharges via eight different points into the river Meuse; neither an aerial view of the plant nor a plan[75] attached to the permit reveal the existence of a WWTP. The current permit dates to 2012 and is valid until 2023, but was modified in 2014 after a complaint by the operator.[76] The crucial and most problematic parameter is total P, as the activity of the plant hints. Table 9 shows the volumes discharged via the different discharge points, the origins of the pollutants (P being most probably the most impactful one), the permitted ELVs, and the annual average concentrations for all (mathematically) combined outlets, based on annual compliance reports. No further comment is made. The readers are invited to indulge in these numbers.

Table 9: ELVs in Prayon's current permit, actual emissions and uBAT-AEL

Discharge	Flow	**total P**	**Cu**	**Zn**	**Origin**
#	m^3/d	mg/L	µg/L	µg/L	
1	250	22	500	2,000	CDFR
2	25,000	22	500	1,000	ACDP
3	24,000	64	500	500	ACDP
4	10,000	64	500	500	ACDP
5	32,000	5	500	2,000	ACDP
5bis	120	10	no ELV	no ELV	C
6	12,000	5	no ELV	no ELV	ACD
7	43,000	64	500	500	ADP
emissions, annual average (2016-19)		5-9	3-9	220-590	
uBAT-AEL	N/A	3	50	300	

4.3. France

In France, applicable legislation is national, but the permitting authorities are generally at the departmental level: the *préfectures* are the organisms writing and enforcing permits, although many permits are also delivered by the DREALs, regional environment agencies.

The France's transposition system is a hybrid: it uses GBRs for some BREFs, but not so for the CWW BREF. French environmental legislation obliges permit holders to introduce a re-evaluation request within a year after publication of the BAT-C[77]. Installations having the CWW as their

[75] Permit LGRGPE32938 (plan: sub-file 2670), available from our SharePoint site. Permit documents from the Wallonia region can also be downloaded here (in FR only). Click on "Établissements IED" and select the installation from the list. After clicking "exécuter la requête", one can scroll through useful short permit descriptions, which one can select to download the permit documents as .zip files.
[76] Document LGRGPE17671, modified by application ACRGPE3934-2340, p. 38-46. The complaint is based on arguments like "the new ELVs are incompatible with continuing operation [...], p. 8.
[77] Art. R515-71 paragraph I of the French *Code de l'environnement*.

principal BREF thus had to introduce such a request by June 2017; however, the authorities have up to four years after the publication of the BAT-C to review the permit.[78]

4.4. Germany

Legislation on waste water in Germany is national; permitting happens either at a regional (Land) level or at the lower district level (Regierungsbezirke), especially in the larger and more industrial regions.

4.4.1. Formal transposition into German law

Current German GBRs are set in Annex 22 of the *Abwasserverordnung* (ordinance on wastewater, short: AbwV, at the national level). AbwV is the legislation covering all types of waste water management and specifying the more procedural laws on protection from pollution[79] (*Bundesimmissionsschutzgesetz*, short: BImSchG) and on water management (*Wasserhaushaltsgesetz*, short: WHG).

Annex 22 of the AbwV was created in 2004 and has been updated (June 2020) to reflect the CWW BREF just within the four-year deadline. Annex 22 relies on three concepts that go beyond those of the CWW BREF:

- limit values generally refer to bihourly concentrations[80],
- limit concentrations apply to tributaries before being combined with other streams, and overall limit values are calculated based on the characteristics of the tributaries,
- thanks to this mixing rule, indirect discharges (in the BREF sense) are also in scope.

These concepts were maintained in the updated Annex 22; they were complemented by the CWW uBAT-AELs (annual means). Where the CWW uBAT-AELs are higher than the existing values, no negative impact on the environment is expected when the provisions of annex 22 are respected.

4.4.2. Access to documents request

To assess permit and emissions compliance with the CWW BREF, with earlier national legislation and the quantitative performance of industrial WWTPs in Germany, the author requested documents to many regional and district authorities.[81]

The right to know stipulated by European directive 2003/4/EC, based on the Aarhus Convention, is transposed into national law in the *Umweltinformationsgesetz* (law on environmental information, short: UIG, applying to federal agencies) as well as regional legislation applying to the regional and district authorities. Operators of industrial WWTPs are deemed to submit annual reports on monitoring to the permitting authorities on the basis of the *Industriekläranlagen-*

[78] Art. R515-70 paragraph I of the French *Code de l'environnement*.
[79] Applicability to pollution of or by water is somewhat inconsistent: the title of the law mentions air, noise, vibrations and "similar effects", but not water, and neither do most provisions. However, the law (§ 1 Abs. 2) explicitly aims for an integrated approach to avoiding and reducing emissions to air, water and soil.
[80] Part D of the new Annex 22. Part C paragraphs 4 and 5, corresponding to the CWW BAT-AELs were added as annual averages not to be exceeded.
[81] Documents from France, Italy and Belgium as well were researched and requested, but the most adventurous procedures and complications are doubtlessly those from Germany.

Zulassungs- und Überwachungsverordnung (ordinance on permitting and monitoring of industrial WWTPs, short: IZÜV).

Therefore, German reporting and transparency legislation is somewhat fragmented but generally in line with the European directive. However, the practical handling of requests is very different from one region and district to another, ranging from quick, simple and reliable access to information to cases of grotesque attempts to hide environmental data. The findings of this major endeavour will shortly be published in a dedicated report.

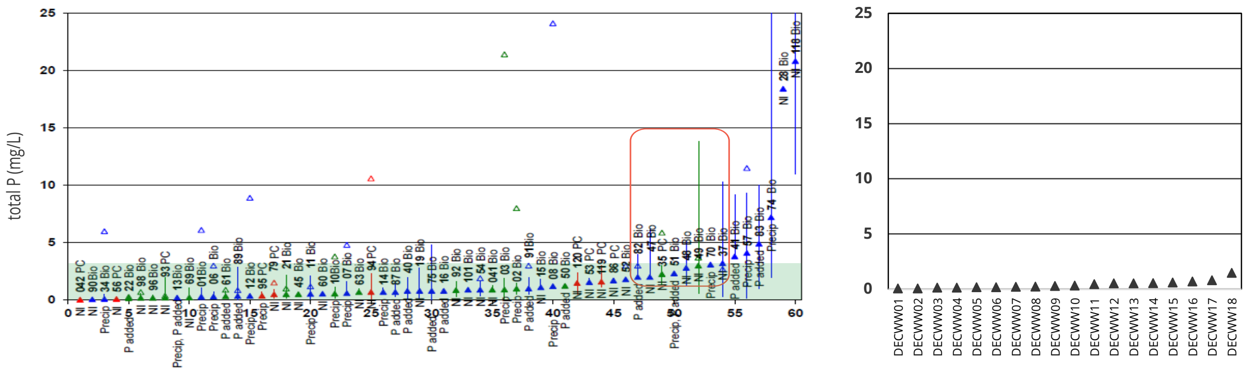
4.4.3. Data analysis

As explained in section 2.4, current BAT derivation methods only look at emission concentration data at the surface level, without taking into account particularities of the different installations under scrutiny, some of which may disqualify several plants.

Here we argue, based on data from German plants, that similarly superficial BAT-AEL derivations are possible with existing data, obviating the need for detailed data collection that is not taken advantage of. If the quality of the BAT-AEL would not improve by such a step, at least its derivation procedure could be substantially sped up[82] and no discussions about purported (but hardly ever argued) data confidentiality would arise.[83]

Taking the example of total P (see section 2.4.2), using emission monitoring data from randomly selected plants. This randomness, if not actively designed, can be reasonably assumed by virtue of selecting federal states of Germany or some of their districts independently of the CWWs they host. Emission data (mostly from 2017, but in a few cases from 2016, 2018 or 2019) were arranged in a similar way to the one used in the BREF document (see also Figure 6).

Figure 10: Data plots for superficial BAT-AEL derivation based on data collected by questionnaire (CWW BREF, left) and by access to document request (right)



[82] This statement should not distract from the fact that it cost substantial time and effort to get hold of these data, which should, legally speaking, be publicly available in the first place. However, one should expect that local authorities would be substantially less secretive when such a request comes from another national or European authority.
[83] EEB has repeatedly proposed improvements to the BAT derivation procedure, among others here.

The two curves are strikingly similar.[84] If BAT-AEL derivation is (and it should not be) mainly based on superficial analysis of average values irrespective of individual plants applying true BAT-AEL, then these simple data allow very similar conclusions as the questionnaire data.

4.5. Italy

Italy has a dual system, somewhere between a centralised and a localised system: in Italy, the largest installations are permitted centrally by the Ministry of the Environment, while smaller plants can be permitted by regional authorities.

Italy is one of the best pupils in the European class when it comes to data transparency; the amount and variety for nationally permitted installations make Italy almost comply with the requirements of IED Art. 24.[85]

Italy has used the GBR system to set permit conditions. The original Italian legal act (*Decreto legislativo* 152-2006) dates from 2006 and has not been updated to reflect the CWW BREF. Some of the limits set by the GBR in table 3 of annex 5 are outrageously laxist, making non-compliance almost impossible (Table 10).

Table 10: Comparison of CWW BAT-AELs and limits set by the Italian GBR legislation

	CWW Direct discharge			**Decr. Leg. 2006-152** Annex 5 table 3	
	BAT-AEL			**Limit**	
Parameter	lower	upper	unit		unit
TOC	10	33	mg/L		
BOD5				40	mg/L
COD	30	100	mg/L	160	mg/L
TSS	5	35	mg/L	80	mg/L
HOI					
total N	5	25	mg/L		mg/L
inorg N	5	20	mg/L		
total P	0.5	3	mg/L	10	mg/L
Phenol index				0.5	
CN^-				0.5	
AOX	0.2	1	mg/L		
As				500	µg/L
Cd				20	µg/L
Cr	5	25	µg/L	2000	µg/L
Cr(VI)				200	µg/L
Cu	5	50	µg/L	100	µg/L
Pb				200	µg/L
Ni	5	50	µg/L	2000	µg/L
Hg				5	µg/L
Sn				10000	µg/L
Zn	20	300	µg/L	500	µg/L

[84] Some people are not easily convinced by graphical similarities such as in Figure 10: statistical tests do not dicsern significantly different variances (P=0.29) nor means (2-sample t-test assuming equal variances, P=0.26). Only values up to 3 mg/L were included, as the aim is BAT determination. These tests are obviously designed to discern differences in mean and variance of two normally distributed variables, not to confirm equal distributions, and non-difference of mean and average is a necessary, but not a sufficient condition for non-difference of distributions.

[85] Remaining shortcomings are (a) information on IED Art. 24 (2.e), i.e. how ELVs are determined with respect to BAT-AELs and (b) the user-friendliness of the website. Instructions for finding e.g. the inspection reports can be found in Annex 6.2. Further information on transparency in Italy and in other member states can be found in EEB's *Burning – the Evidence* report (2017) and in the *IPDV background Briefing* (2020).

5. Recommendations and Conclusion

5.1. For the BREF process

- Keep in mind that the IED's objective is to *prevent or [...] reduce emissions* by identifying *Best Available Techniques*, not to allow most or all operators to rest on their claimed laurels.
- Do not simply analyse (past) emission data superficially, but carry out a thorough technical analysis of data and techniques used, determining for each relevant model plant whether it applies BAT.
- Do not waste time collecting data using questionnaires if they are available in compliance reports.
- Whenever a BAT-AEL range is broad (e.g. a ratio of 2 or more between the upper and lower limits of the range), specify when the lower or higher ranges should be followed.
- Do not allow uBAT-AEL to fall behind national GBR in force: plants abiding by these rules are operating in the real world, and BAT-AEL ranges cannot logically go higher than these without a logical explanation.
- Tackle pollution at the source by setting pre-treatment BATs in case of high input effluent loads (due to production processes), instead of giving footnote derogations .
- Include environmental aspects in the BAT determination, setting load-based BAT-AELs.

5.2. For the IED revision

- Realise that the time needed in the past to revise a BREF is an order of magnitude too long for the speed at which the industrial transformation in Europe must happen.
- The European legislator should provide the tools to drive and accompany this endeavour.

5.3. For permitting authorities

- Take into account the environmental pressures and status of the receiving water body.
- Take into account operators' commitments to continual improvement (e.g. ISO 14001 certification) and hold them accountable on delivering.
- Consider that good industrial management (possibly triggered by permit conditions) can substantially decrease pollution levels, and likely at little to no cost to the operator.
- Respect your legal obligation to justify publicly any ELV set (IED Art. 24 (2.e)) with respect to BAT(-AEL).

6. Annexes

6.1.Top 10 reported emissions in E-PRTR, per pollutant

Numbers have been rounded uniformly per column to enhance legibility. Values for some columns are to be multiplied by the factor on top of the column to obtain values in kg (as for all other columns). Values on a pink background have been selected for the "top 30" of emissions.

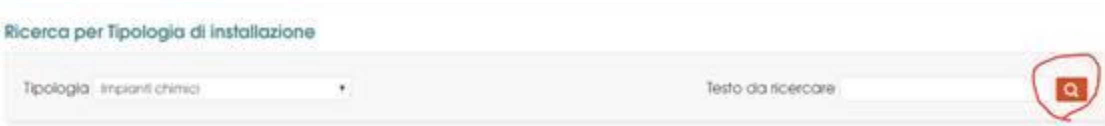
The top two emissions of AOX were not selected as they related to independently operated WWTPs (activity 5.(g) in E-PRTR), but relating to activities of the pulp and paper industry, not the chemical industry.

Rank	1,2-dichloroethane (DCE)	Arsenic and compounds (as As)	Benzene	Cadmium and compounds (as Cd)	Chlorides (as total Cl)	Chloro-alkanes, C10-C13	Chromium and compounds (as Cr)	Copper and compounds (as Cu)	Cyanides (as total CN)	Di-(2-ethyl hexyl) phthalate (DEHP)	Dichloromethane (DCM)	Ethyl benzene	Ethylene oxide	Fluoranthene	Fluorides (as total F)	Halogenated organic compounds (as AOX)	Hexachlorobenzene (HCB)	Hexachlorobutadiene (HCBD)	Lead and compounds (as Pb)
	DCE	As	Benzer	Cd	Cl-	Chloro-	Cr	Cu	CN-	DEHP	DCM	PhEt	EO	Fluorar	F-	AOX	HCB	HCBD	Pb
					$\times 10^8$										$\times 10^4$	$\times 10^4$			
1	263	3880	1110	141	15.8	50	3700	4320	3850	12.0	1890	2.03	20.9	36.7	91.2	7.0	2.6	114	6680
2	259	1250	873	134	14.4	10	2500	1820	3250	6.9	718				87.9	4.6		1	753
3	233	330	290	117	8.9	6	1650	912	2920	3.5	354				58.2	4.2			633
4	215	268	241	112	7.4	1	1490	650	2740	2.5	307				23.8	2.3			472
5	172	221	92	56	5.1		1480	544	1110	1.9	264				11.0	2.2			281
6	172	209		53	4.8		1480	478	394	1.5	62				8.4	2.0			279
7	52	170		45	4.8		1230	473	394		59				7.3	1.3			241
8	47	165		36	4.6		1060	447	350		44				6.3	0.9			240
9	30	136		33	4.4		563	332	342		42				5.8	0.5			201
10	25	133		27	3.9		489	311	222		41				5.6	0.5			181

Rank	Mercury and compounds (as Hg)	Naphthalene	Nickel and compounds (as Ni)	Nonylphenol and Nonylphenol ethoxylates (NP/NPEs)	PCDD + PCDF (dioxins + furans) (as Teq)	Pentachlorobenzene	Pentachlorophenol (PCP)	Phenols (as total C)	Polychlorinated biphenyls (PCBs)	Polycyclic aromatic hydrocarbons (PAHs)	Tetrachloroethylene (PER)	Tetrachloromethane (TCM)	Toluene	Total nitrogen	Total organic carbon (TOC) (as total C or COD/3)	Total phosphorus	Trichlorobenzenes (TCBs) (all isomers)	Trichloroethylene	Trichloromethane	
	Hg	Naph	Ni	NPE	Diox	$PhHCl_5$	PCP	Phenol	PCB	PAH	PER	CCl_4	Tol	Total N	TOC	Total P	TCB	TRI	$CHCl_3$	V
					$\times 10^{-4}$									$\times 10^6$	$\times 10^6$	$\times 10^4$				
1	250	38	2630	357	1.5	28.8	6.3	4140	2.0	65	460	79	612	6.3	4.3	18.4	84	161	3250	
2	72		2260	22	1.3	1.1	4.4	4020	0.6		65	20	423	2.5	4.1	17.2	18	155	623	
3	59		2130	18	1.1		1.9	1740	0.5		62	20	370	1.54	3.1	8.4	15	50	508	
4	59		1310	10				1330	0.2		47	17	348	1.0	3.0	6.9	3	31	245	
5	56		1100	6				1100			18	11	47	0.9	2.8	6.2	3	17	226	
6	33		775	5				1050			18	9		0.9	2.6	5.2	2	13	146	
7	29		770	4				957			17	8		0.7	2.2	4.8			125	
8	22		767	4				950			14	8		0.6	1.6	4.6			124	
9	20		634	4				820				7		0.6	1.6	3.4			119	
10	11		541	2				643				5		0.5	1.3	3.1			111	

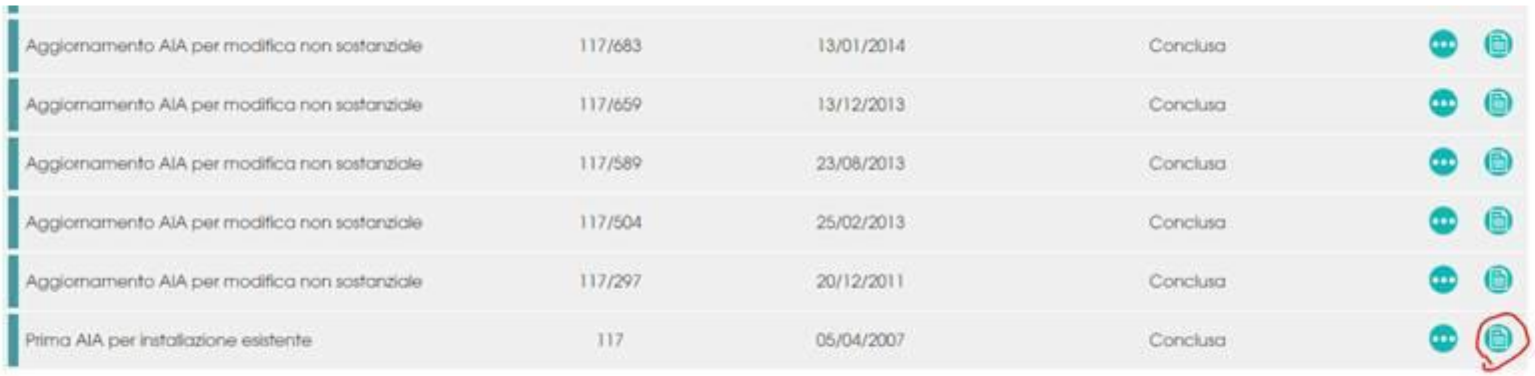
6.2.Instructions to navigate the Italian IED website

1. Go to https://va.minambiente.it/it-IT/Ricerca/AIA.
2. Select e.g. "chemical plants" and click on the magnifying glass



3. Choose an installation by clicking on the "*i*":

4. Go to the oldest AIA permit at the very bottom and click on the document icon



5. Open the hierarchy and select the operator report

6. Sometimes the reports are zipped, sometimes not. In some cases, the annexes are separated from the main document. The numbering of the annexes is highly standardised, so you will find similar data in e.g. "Allegato 7" for all plants.

6.3. Glossary

All country codes are used in accordance with the Alpha-2 standard in ISO 3166 and are not listed here.

Symbols of chemical elements are used in accordance with IUPAC guidance and are not listed here.

AOX	Adsorbable organically bound halogens
BAT	Best Available Technique
BAT-AEL	BAT associated emission level
BAT-C	BAT Conclusions
BREF	BAT reference document
BOD5	Biochemical oxygen demand (oxidation in 5 days)
CBI	Confidential business information
COD	Chemical oxygen demand
CWW (BREF)	Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector BREF, also used to refer to a WWTP regulated by the CWW BREF
DREAL	Direction Régionale de l'Environnement, de l'Aménagement et du Logement (regional environmental agencies in France, also in charge of other policy areas))
EEA	European Environment Agency
EIPPCB	European IPPC Bureau, also referred to as "the Bureau"
ELV	Emission limit value
E-PRTR	European Pollution Release and Transfer Register
EQS	Environmental Quality Standard (defined by the Water Framework Directive 2000/60)
GBR	General Binding Rules
IPPC	Integrated Pollution Prevention and Control
IED	Industrial Emissions Directive (2010/75/EC)
IUPAC	International Union of Pure and Applied Chemistry
KoM	Kick-off-Meeting
lBAT-AEL	lower bound of the BAT-AEL range
LoD/LoQ	Limit of detection/quantification
MSCA	Member state competent authority
NFM (BREF)	Non-Ferrous Metals Industries BREF
REACH	Regulation on chemicals (1907/2006)
WWTP	Waste water treatment plant
TFEU	Treaty on the functioning of the European Union ("Lisbon Treaty")
TOC	Total organic carbon
TSS	Total suspended solids
uBAT-AEL	Upper bound of the BAT-AEL range
UWWTD	Urban waste water treatment directive (91/271/EEC)
UWWT(P)	Urban waste water treatment (Plant)
WGC	Common Waste Gas Treatment in the Chemical Sector (BREF)
WT	Waste Treatment (BREF)

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