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Summary on IED contribution to water policy

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Contact:

Ben Grebot
Ricardo Energy & Environment
Gemini Building, Harwell, Didcot, OX11 0QR, United Kingdom

t: +44 (0) 1235 753 055
e: ben.grebot@ricardo.com

Ricardo-AEA Ltd is certificated to ISO9001 and ISO14001

Author:

Ben Grebot
Alfredo Lopez
James Sykes

Approved By:

Ben Grebot

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Abstract

The aim of this study was to provide an understanding of the contribution of the Industrial Emissions Directive (IED) to meeting EU water policy objectives; best practices in the use of water in IED sectors; and the potential for further water savings in these sectors. It also aimed to gather and analyse data concerning emissions to water, water use and reuse from activities covered by the IED.

A list of data and information requirements, both quantitative and qualitative, was generated to facilitate assessment of data sources. The sources were identified and reviewed against the data requirements. A detailed review of the Best Available Technique (BAT) Reference documents (BREFs) themselves and associated BAT Conclusions was carried out to capture qualitative and quantitate information on techniques to reduce emissions to water and to reduce water usage as well as data on current performance.

Despite the data gaps and methodological uncertainties encountered during the study, it is clear that the IED and BREFs have had, and are likely to continue to have, positive impacts for both reducing emissions to water and, perhaps to a lesser extent, reducing water usage (including via increasing water reuse).

Le but de cette étude fut de fournir une meilleure compréhension de la contribution de la Directive relative aux émissions industrielles (IED) afin d'atteindre les objectifs définis par le programme de l'UE sur l'eau, les meilleures pratiques de son utilisation et potentielles réductions supplémentaires dans les secteurs de l'IED. Un autre objectif fut de réunir et d'analyser les données relatives à l'eau, son utilisation et recyclage dans les activités couvertes par l'IED.

Une liste de données et exigences d'information, qualitatives et quantitatives, furent générées pour faciliter l'évaluation des sources de données, puis identifiées et révisées face aux exigences. Un examen détaillé des documents de référence (BREFs) des meilleures techniques disponibles (MTD) et des conclusions sur les MTD a été réalisé pour saisir les informations qualitatives et quantitatives sur les techniques de réduction d'émissions dans le secteur de l'eau et de réduction de son usage, mais également des données sur les performances actuelles.

Malgré des données incomplètes et des incertitudes méthodologiques, il est évident que la directive et BREFs ont eu, et probablement continueront d'avoir des impacts positifs sur les réductions d'émissions dans le secteur de l'eau et, dans une moindre mesure, son utilisation (via une augmentation du recyclage).

Ziel dieser Studie war es, einen Überblick über den Beitrag der IE-Richtlinie zur Erfüllung der wasserpolitischen Ziele der EU zu geben; bewährte Methoden zur Nutzung von Wasser in Sektoren die von der IE-Richtlinie erfasst werden; und das Potenzial für weitere Wassereinsparungen in diesen Sektoren. Außerdem sollten Daten zu Emissionen, Wassernutzung und Wiederverwendung aus den von der IE-Richtlinie erfassten Tätigkeiten gesammelt und analysiert werden.

Es wurde eine Liste quantitativer und qualitativer Daten und Informationsanforderungen erstellt, um die Bewertung der Datenquellen zu erleichtern. Diese wurden identifiziert und anhand der Datenanforderungen überprüft. Eine detaillierte Überprüfung der BVT-Referenzdokumente (BVT) und der zugehörigen BVT-Schlussfolgerungen wurde durchgeführt, um qualitative und quantifizierende Informationen über Techniken zur Verringerung der Emissionen in Gewässer und zur Verringerung des Wasserverbrauchs, sowie Daten zur aktuellen Leistung zu erfassen.

Trotz der Datenlücken und methodischen Unsicherheiten, die während der Studie auftraten, wurde deutlich, dass die IE-Richtlinie und die BVT-Merkblätter positive Auswirkungen sowohl auf die Verringerung der Wasseremissionen als auch in geringerem Maße auf die Verringerung des Wasserverbrauchs hatten und wahrscheinlich auch weiterhin haben werden (einschließlich durch zunehmende Wiederverwendung von Wasser).

Executive Summary

Introduction

The aim of this study was to provide an understanding of the contribution of the IED to meeting EU water policy objectives; best practices in the use of water in IED sectors; and the potential for further water savings in these sectors. It also aimed to gather and analyse data concerning emissions to water, water use and reuse from activities covered by the Industrial Emissions Directive (IED).

A list of data and information requirements, both quantitative and qualitative, was generated to facilitate assessment of data sources. The sources were identified and reviewed against the data requirements. A detailed review of the BREFs themselves and associated BAT Conclusions was carried out to capture qualitative and quantitate information on techniques to reduce emissions to water and to reduce water usage as well as data on current performance. A key input for the study was data developed as part of a related study titled “Industrial emissions policy country profiles” (also being undertaken by Ricardo for the European Commission.

Analysis relating to emissions to water

First, emissions to water were analysed using data from E-PRTR. E-PRTR captures data on direct industrial discharges from large industrial installations; smaller industrial discharges are often indirect dischargers and thus included in the urban waste water treatment sector. Pollutants emitted by non-IED sectors such as urban waste water treatment plants and aquaculture were not considered in the analysis.

Pollutants emitted to water by IED installations in the highest quantities in the EU include chloride, total organic carbon (TOC), nitrogen (as TN), fluoride, phosphorus (as TP) and halogenated organic compounds (as AOX). According to E-PRTR data for 2014, the most significant emitter of chloride is the production of inorganic chemicals sector (IED activity 4.2). The chemicals sector overall is the highest IED emitter of fluoride to water, and one of the top IED emitters of nitrogen. Among the IED activities, TOC emissions are dominated by the pulp, paper and board industry (IED sector 6.1), emitting more than three times the quantity of the second largest polluter, organic chemical production (IED sector 4). The pulp, paper and board sector (6.1) similarly dominates IED emissions of halogenated organic compounds (AOX). The waste management sector (5) is also a prominent contributor to the pollutants of high quantities, with disposal and recovery of non-hazardous waste (5.3) being an important source of phosphorus and nitrogen. Activity 6.4 related to food, drink and milk manufacturing is also a key IED activity for several pollutants, notably phosphorus and nitrogen.

The BREFs reviewed under the IED were then analysed to **characterise techniques** that reduce emissions to water. A large number of the BAT conclusions aim at minimising emissions to water from industrial activities. Although this share varies from one document to another, most BREFs include a set of techniques to minimise relevant emissions to water. Water emission related conclusions represent 17% of the total conclusions in the IED BREFs (145 conclusions out of a total of 850 were set with this aim). This overall percentage varies between sectors; CAK with 47 % and CWW with 39% of conclusions on emissions to water, while CLM has none, and GLS only 3%.

Some of these techniques apply to the whole sector (generic BAT conclusions), but some also address emissions to water from specific processes. Generic BAT conclusions on water topics represent 39% of the water related conclusions inside the IED BREFs. The remaining BAT conclusions, 61%, apply only to specific processes.

The majority of techniques included in the BREFs for water emission reductions are abatement techniques or managerial ones. Fewer techniques are aiming to change or select a given primary manufacturing process that leads to lower emissions to water. Techniques on water emission reductions cover a wide range of issues. In each BREF, the techniques address the most relevant issues. For example, in the LVOC BREF, the BAT conclusions contain numerous techniques to minimise COD or hydrocarbons emissions; in the NFM BREF the majority of techniques aim to minimise emissions of metals to water.

The main issue controlled is the effluent load, followed by the COD, TOC or organic load. Inorganic compounds and metals are also frequently addressed by these BAT conclusions. The majority of techniques inside the BAT conclusions (legally binding) do not contain BAT-Associated Emissions Levels (BAT-AELs). In the BREFs reviewed under IED so far, 80% of the BAT conclusions related to water emission topics do not contain BAT-AELs. These water emission techniques, with no associated emission level, do not allow for a simple estimation of potential emission reductions as impacts are extremely uncertain.

Some BAT conclusions on emissions to water can have a significant impact on the given industrial sector (e.g. BAT conclusion on CAK phasing out mercury cells does not have a BAT-AEL but will eliminate 100% mercury emissions to water in this sector). Other BAT conclusions have an uncertain impact on emission reductions and it is challenging to estimate what this may be. For example, those BAT conclusions forcing higher monitoring frequencies will normally lead to better water effluent management and thus lower emissions to water but the absolute impact is highly uncertain.

BAT-AELs in the IED BREFs have been reviewed in this study. These BAT-AELs are normally established for the sector's key environmental issues, at generic or process-specific levels. The emission reduction estimations have been calculated assuming that each emission data set has a normal distribution. Two different emission reductions were obtained when the BAT-AEL was expressed with a range: low and high emission reductions. In other data sets the baseline emission level was only available as an average and this led to an oversimplified estimation of potential emission reductions. The potential emission reductions of key pollutants due to BAT-AELs have a large variability: some BAT-AELs are set so that dramatic emission reductions are expected, while other BAT-AELs reflect the current plant performances. This variability is present even within sectors so that some processes are expected to reduce emissions by 80%, with negligible reductions in others.

In sectors identified as being of key importance for water pollution, **estimates of impacts on emissions vary**. In the production of pulp, paper and board, reductions in high quantity pollutants such as COD and Total Nitrogen are generally high for meeting lower BAT-AELs, and in some cases the upper BAT-AELs as well, although there is more variation between processes. In the Chlor-alkali plants 80 kg per year of mercury emissions to water will be eliminated with one BAT conclusion in this BREF. In the case of LCPs, there are small estimated reductions for many pollutants for meeting either upper or lower BAT-AELs. However, there are some exceptions where high reductions are anticipated, such as for mercury. In the FDM sector, there are estimated to be high % reductions for meeting both upper and lower BAT-AELs in TSS for the most intensive sub-sectors of fruit and vegetables, sugar manufacturing and dairies (84-98%). There are also high % reductions estimated for the most significant sub-sectors for phosphorus and COD.

Analysis relating to water use

Data was gathered to compare **industrial sector water usage**. Eurostat data was used to review the trends over time. In addition to water use data from Eurostat, estimates of sector water use significance were made through analysis of the BREFs. From this analysis, the refining of mineral oil and gas sector was identified as a sector with particularly high water use, with the iron and steel and pulp, paper and board sectors also being particularly significant. Of these high usage activities, pulp, paper and board is the most water intensive, with an intensity of 20 m^3 per tonne of products ('per 90% air dry pulp'). In the case of refining of mineral oil and gas the intensity is just 4 m^3 per tonne of crude oil processed, however the tonnage production of the industry is high at 600,000 kilotonnes per year, resulting in a high overall consumption.

The **focus on water usage in BAT conclusions** was also reviewed for both IED and IPPC BREFs. Out of the 12 reviewed BREFs published since 2011 (i.e. under the IED), only the TAN BREF has set BAT-AEPLs for water usage based on the intake of water. Other BREFs, such as CAK, have developed BAT conclusions on water effluent reduction that will indirectly reduce water intake. The PP BREF also contains BAT-AEPLs for water usage based on water effluent generation. FDM, POL, SIC, STM and TXT are the BREFs developed under the IPPC Directive that contain performance levels in their BAT conclusions. These levels are set at subsector or process levels and cover normally only a few processes of a given sector.

In the BREFs reviewed under the IED, there are 20 conclusions on water usage within the BAT conclusions. There are therefore far less conclusions on water usage than there are on emissions to water. Of these water usage conclusions, 95% of the techniques related to water usage do not contain an associated BAT-AEPL. Most BREFs reviewed under IED contain only generic techniques to reduce water usage (55% of total conclusions) although the Iron & Steel BREF and the Non-Ferrous Metal BREF contain subsector-specific techniques.

IED contribution to water policy objectives

Reducing pressures on water bodies from pollution

The impact of BREFs on emissions of priority substances under the Water Framework Directive was also assessed. The results of this analysis indicate that BREFs are expected to result in at least some positive impact (i.e. reductions) on emissions of all priority substances through BAT for emissions to water monitoring and/or abatement techniques. Some BREFs are likely to lead to reductions in emissions of the majority of priority substances. These include Iron and Steel production, Tanning of hides and skins, Pulp, Paper and Board and Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector. A number of BREFs fell short of being likely to result in emission reductions, however still had specific BAT-AELs targeting priority substances or chemical groups into which priority substances fall. Overall twelve BREFs were placed into this category.

As such, several BREFs are identified which are not only relevant for priority substances but are also still yet to be reviewed under the IED, with potential for addressing emissions in the BREF review. In particular, many BREFs with BAT-AELs for priority substances or associated chemical families are IPPC BREFs, such as Textiles, Polymers, Speciality Inorganic Chemicals, and Surface Treatment of Metals and Plastics. In these BREFs priority substances are relevant and there is scope for reducing their emissions in the BREF review to be undertaken.

Reducing stress on availability of water resources

The data reviewed shows that industrial activities are large water consumers. When analysis is done with a local focus some industrial installations may consume a large amount of water within a given region.

The industrial water usage map varies within countries and regions and depends on the prevalence of a given type of industrial activity. The analysis done based on numerous sources (such as BREFs and industrial federation reports) identified a number of industrial activities, covered by IED, that consume larger amounts of water. These larger consumers were the following sectors:

- Intensive rearing of poultry and pigs: driven by the large amount of installations
- Refining of mineral oil and gas
- Iron and steel production
- Petrochemical (such as large volume organic chemicals)
- Pulp, paper and board

Water consumption has generally not been a key environmental issue, or BREF priority, for the corresponding Technical Working Groups that make these decisions in the BREF developments. Only one BREF (TAN) developed under the IED so far contains BAT-AEPL for water usage while BREFs developed under the IPPC had included these water usage levels in their conclusion document (these five will be reviewed under IED). In addition, the PP BREF contains BAT-AEPL for effluent generation which will impact on water consumption. These values are normally set for only a few of the specific subsectors inside each BREF. None of the other larger industrial water consuming sectors, such as refineries, have BAT-AEPLs in their BAT conclusions.

Regarding the coverage of techniques taken on water usage, almost half of the conclusions are generic. A large amount of BAT conclusions on water usage (40%) were related to core process features and the rest were holistic approaches or managerial techniques or tools. No degree of technique adoption (prior to BAT conclusion publication) is reported in BREFs which hinders a quantitative estimation of their impact (without significant additional data gathering).

Only 20 BAT conclusions out of 850 in total included water usage reductions or increasing water reuse. This ratio has variability between BREFs, with CLM, IRPP or PP having no BAT on water consumption (although the PP BREF does include BAT for waste water generation) and IS or CWW having around 8% or more of their conclusions on these issues.

Water usage in IED industrial sectors is expected to decrease in the coming years in the European Union. Those sectors with BREFs which incorporate a BAT-AEPL on water usage will ensure certain water usage reductions as a result of the IED. The TAN, POL and SIC BREFs are examples of reference documents incorporating BAT-AEPLs on water usage which could lead to some installations, beyond IED threshold size, to have a water usage equal to or below the best performers (note the POL and SIC

BREFs have not yet been reviewed under the IED). Some BREFs, such as FDM or CAK set BAT-AEPLs on specific water effluent in order to minimise (indirectly) water usage.

Conclusions and recommendations

Future presentation of water data in the BREFs

Building on the overall findings of the study and, in particular, the in-depth review of the BREFs, the Commission were keen to understand how the presentation of water issues in the BREFs could be improved in the future. A series of data visualisation proposals were designed based on the experience gained during the execution of this work. These are presented in Section 6.1.

Data availability

This study has relied primarily on the BREFs and data from EPRTR for gathering data on emissions, consumption and implications of the BAT Conclusions. It is important to note that these two sources were designed for different purposes and their resources and capabilities are not always aligned with analytical exercises such as those undertaken in this study. There are significant challenges in aligning data from the BREFs and EPRTR and, in particular, at the process level at which many BAT Conclusions apply. This is discussed further in Section 6.2 and key data and methodological limitations are described in Sections 3.5 and 4.5.

Future work

This report was carried out with a limited set of resources and has thus delivered only an initial overview of the contribution that the IED and associated BREFs may have on water consumption and emissions. A more detailed assessment would need to be carried out in order to capture a detailed, quantitative assessment of the impact of IED on water. Some proposals for future work are described in Section 6.3.

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Appendices

1 Introduction

1.1 This report

This report is the final report for project "**Summary on IED contribution to water policy**", specific contract number 070201/2016/742793/SFRA/ENV.C.4, which is Service Request 5 under framework ENV.C.4/FRA/2015/0042.

1.2 Policy context

The Industrial Emissions Directive 2010/75/EU (IED) is the main instrument operating in the EU to regulate the potential negative effects of large (agro)industrial installations on the environment, including but not exclusively on water. Under the IED, all installations conducting activities listed in Annex I to the IED (and where applicable exceeding the capacity thresholds set out in that Annex) are required to operate according to a permit – issued by the relevant Member State authorities, and reflecting the principles and provisions stipulated by the IED. The permit extends to all environmental aspects of an installation's operating activities, including water usage and emissions. All permit conditions must be based on Best Available Techniques (BAT) Conclusions (within 4 years of adoption), which are adopted by the European Commission following an exchange of information culminating in BAT Reference Documents (BREFs).

BREFs consider the performance of installations, which is gauged according to a number of performance aspects, including water consumption and generation of wastewater. The BREFs reviewed and published under the IED take a systematic approach to gathering and collating underlying data. In the process of the BREF review, each Technical Working Group (TWG) selects key environmental issues for their sectors and dedicates greater resources to those specific areas. To date, priority areas for the majority of the sectors concerned were emissions to air and water and generation of waste, and less to raw materials or water usage. However, information on water consumption and re-use across industrial activities regulated under the IED is already, to some extent, captured by some vertical BREFs (addressing one or more sectors) and horizontal BREFs (addressing one topic across various sectors). The main impact of IED on minimising emissions to water and water consumption in industrial activities is achieved through the implementation of the techniques set in the BAT Conclusions (BATC) adopted for the sectors, for example through BAT-AELs for emissions to water. These BAT-AELs are most commonly expressed as emission concentrations (mg/l) for the key pollutants and key parameters such as COD or TSS. Very few associated environmental performance levels concerning water consumption and waste water generation have been included in BATC to date.

In addition to the IED, the protection of water from potentially harmful industrial activities is regulated by the Water Framework Directive (WFD) (Directive 2000/60/EC)[1]. The WFD forms the basis of water management policy in EU Member States. Under the WFD, Member States are required to achieve minimum levels of water quality according to the water body type. While the WFD does not include direct provisions pertaining to industrial activities, Member States are required to take the necessary measures to meet the objectives. This may include introducing further controls to limit industrial emissions to water. Decision 2455/2001/EC established a list of priority substances to become Annex X of the WFD, selected due to their presenting of a significant risk to or via the aquatic environment (European Commission, 2016). This list was replaced by Annex II of the Directive on Environmental Quality Standards in 2008, also known as the Priority Substances Directive, which set environmental quality standards (EQS) for substances in surface waters, and confirming their status as priority or priority hazardous substances. According to Annex V of the WFD, good chemical status is reached for a water body when it complies with the EQS for all priority substances in Annex I of the Environmental Quality Standards Directive.

In 2013, and in keeping with the requirements established by the WFD, the Commission published a Communication outlining implementation progress of the WFD to date, a review of Europe's water resources, and measures, plans, proposals, etc. adopted by Member States to meet the objectives of

[1] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02000L0060-20141120

the WFD (COM(2012)673)[2]. The Blueprint drew attention to the potential of innovation to facilitate greater uptake of water reuse for irrigation in agriculture and industrial activities.

Specific actions to facilitate greater uptake of reused water have since been incorporated in the Commission's action plan for a circular economy (COM(2015)614)[3]. The action plan refers to, among others, water reuse as an example of a secondary raw material (i.e. materials that are recycled and then returned to the economy as new). The action plan notes that the current use of secondary raw materials is limited and that the main reasons for this are concerns over the quality of the materials and a lack of EU standards. Thus, the action plan sets out a series of actions intended to facilitate greater uptake of reused water, including the following:

- 2016-2017: Promotion of safe and cost-effective water reuse, including guidance on the integration of water reuse in water planning and management, inclusion of BAT in relevant BREFs, and support to innovation (through the European Innovation Partnership and Horizon 2020) and investments. A consultancy report to support the Commission's impact assessment was published in March 2015 (European Commission, 2015). Guidance has been developed by the JRC and discussions are ongoing in this regard (JRC, 2014).
- 2017: Proposed legislation setting minimum requirements for reused water for irrigation and groundwater recharge. Final report to support the Commission's impact assessment was published October 2016 (Amec Foster Wheeler, 2016).

The drive to achieve a circular economy derives from the Commission's recognition that there is a need to ensure that any economic growth achieved by EU industrial activities is decoupled from environmental pressures[4]. In this context there is a need to strengthen an overall understanding of the environmental impacts associated with activities regulated under the IED, and their contribution to the economy so as to gauge the potential for ongoing decoupling in these sectors in the context of the circular economy. The 2020 strategy for a resource-efficient Europe highlights this need with examples where the industrial sector in the EU could shift towards decoupling, such as reducing water consumption.

In addition to decoupling, there is a drive to improve the delivery of existing legal instruments through "better implementation" – not least with regards to industry and the IED. To address this issue, the European Commission has launched an Environmental Implementation Review (EIR) which will fill in implementation gaps and identify and share best practices for implementation. This study aims to provide a summary of the implementation of the IED and its contribution to water policy, expanding the knowledge base in this regard, and serving as additional information to inform the European Commission's biannual EIR. Although there is a wealth of information concerning Member State implementation of the IED and the WFD (Amec Foster Wheeler, 2016), water use from industrial sectors, industrial emissions to water and wastewater data (E-PRTR, waste statistics, Waterbase) – there are significant gaps, particularly in the way the information is presented.

1.3 Aims and objectives of the study

The aim of this study was to gather and analyse data concerning emissions to water, water use and reuse from agro-industrial activities covered by the IED. It also aimed to provide an understanding of:

- the contribution of IED to meeting EU water policy objectives;
- data on emissions to water and water consumption split by relevant IED sector in the EU, including evolution over time where possible;
- best practices in the use of water in IED sectors; and
- the potential for further water savings in these sectors.

1.4 Structure of this report

The results of the study are presented in the following sections:

[2] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A Blueprint to Safeguard Europe's Water Resources. COM(2012)673. Brussels, 14.11.2012. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0673&from=en

[3] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions (2015) Closing the loop – An EU action plan for the Circular Economy. COM(2015)614. Brussels, 2.12.2015. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0614

[4] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions for a resource efficient Europe – Flagship initiative under the Europe 2020 Strategy. COM(2011)21. Brussels, 26 January 2011.

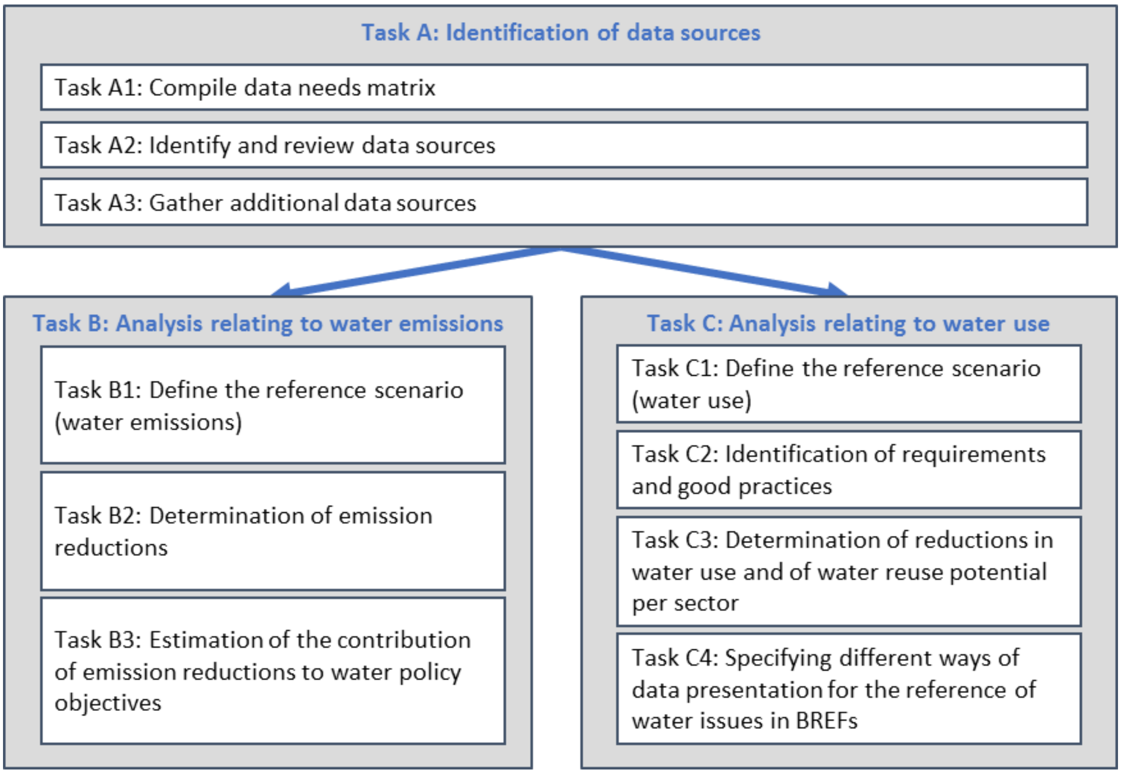
- Section 2 describes the approach taken for this study.
- Section 3 covers water pollution emissions, providing information on current levels of emissions and estimates of the reductions resulting from implementation of the IED.
- Section 4 covers water consumption, providing information on current levels of consumption and estimates of the reductions resulting from implementation of the IED.
- Section 5 summarises key findings and presents new data on the potential impact of the IED on WFD priority substances.
- Section 6 presents recommendations on management of water issues through the IED.

2 Approach taken in this study

2.1 Overview

The schematic overview of the approach taken for this study is presented in Figure 1.

Figure 1 Overview of project tasks



2.2 Identification of data sources

The following steps were taken for the achievement of Task A:

- A precise list of data and information requirements, both quantitative and qualitative, was generated to facilitate assessment of data sources.
- The sources were identified and reviewed against the data requirements. A detailed review of BREF contents was carried out to capture qualitative and quantitative information on water emission and consumption techniques. Baseline data was also gathered from BREFs.
- Additional data sources were reviewed to cover the information gaps from previous steps.
- For information on current levels of emissions to water and water consumption, data inputs were used from work conducted on the "Industrial emissions policy country profiles" study.

2.3 Analysis relating to emissions to water

2.3.1 Scope

Task B was focused on the review of techniques included in the BREFs aimed at reduction of emissions to water, identification of the BAT Conclusions in which Associated Emission Levels (BAT-AELs) for emissions to water have been established, followed by the estimation of emission reductions. This review has focused on the BREFs and BATC adopted under the IED (since 2010). Thirteen BATC have been adopted to date: iron and steel production (28/02/2012), manufacture of glass (28/02/2012), tanning of hides and skins (11/02/2013), production of cement lime and magnesium oxide (26/03/2013), production of chlor-alkali (9/12/2013), production of pulp, paper and board (26/09/2014), refining of mineral oil & gas (09/10/2014), wood based panels production (24/11/2015), common waste water and waste gas treatment/management systems in the chemical sector (09/06/2016), non-ferrous metals industries (30/06/16), intensive rearing of poultry and pigs (15/02/2017), large combustion plants (31/07/2017) and large volume organic chemicals (21/11/2017). The LVOC BATC were not adopted in time for review in this study. However, the draft revised BREF that was available was reviewed along with the draft revised BREF for the Food, Drink and Milk (FDM) sector.

Other sectors with large impacts to water are textiles and slaughterhouses and animal by-products. These sectors are being investigated in the "Preliminary determination of Key Environmental Issues for industrial sectors in BREF reviews under the IED" study delivered by Ricardo for DG ENV in parallel to this study. In the absence of any other data, the IPPC BREFs were used, however it is recognised that this may be outdated and does not always provide a good coverage of current emissions and consumption levels for water. For these two sectors it was also not possible to determine emission reductions in task B.2 (see below), given the BREF review process under the IED has not yet started.

Water-related BAT-AELs are established depending on whether a facility discharges into an urban waste water treatment plant or after treatment directly to receiving body. They are commonly expressed in concentrations, and in a few instances as specific loads (e.g. for the production of pulp, paper and board and speciality inorganic chemicals).

The methodology for this study built on the recommendations provided to DG Environment as part of the recently completed study on identification of methodologies to estimate impacts of BAT Conclusions on emission reductions and costs. The study identified and reviewed the feasibility of different methodologies against the resources available. The assessment used a streamlined, high-level assessment methodology to calculate emission reductions (methods ER1/ER2 from the study described above assuming direct use of BAT-AELs), given the limited resources available for the assessment. Furthermore, in the case of aggregated water emission data at the sector level, more detailed modelling using specific abatement techniques (identified as method ER3 in the above study) would not provide added value in terms of improved accuracy due to the poor quality of the underlying data.

2.3.2 Approach

Task B.1 Define the reference scenario (emissions to water)

Data from E-PRTR was used as a basis for the development of a reference scenario for this task based on our understanding of the available data sources in terms of coverage, relevance and availability. This was conducted as part of the study on development of Member State industry profiles. This is presented in section 3.2.

The latest available data at the start of the study was for 2014 and that was used in the analysis. 2014 data may already reflect some early impacts of BATC for iron and steel and glass production sectors which were adopted in 2012; however, it is considered unlikely given BATC would only be expected to be translated into permit conditions and complied with in 2016.

The data in the E-PRTR has gaps and the significance of these gaps vary from one sector to another due to the emission intensity of the processes used, relevance of emissions to water for the sector and the pollutant reporting thresholds in the E-PRTR. Once the emissions data was processed, a review was undertaken of where the largest gaps are, whether data sources identified in Task A could support any gap filling, focusing on those sectors for which water pollution is a priority area, and for which techniques and BAT-AELs were established in BREFs.

Task B.2 Determination of emission reductions

In order to calculate potential emission reductions, the following data was used:

- Information on techniques in BREFs for reducing pollutant emissions to water.
- Value of BAT-AELs established in BAT Conclusions.
- Baseline (current) performance levels on emissions to water included in 'current emission and consumption' chapters of BREFs. In some data sets the baseline describes best performing plants. In others the source of information for the status quo (current performance) was captured in the technique description section.

The assessment then used a qualitative and quantitative approach to analyse potential emission reductions related with reference documents and IED.

The outcome of the qualitative analysis of BAT to reduce emissions to water is presented in Section 3.3.5 of this report. In the **qualitative** approach, BAT described in BREFs were characterised and analysed from various angles (nature, issues, etc.). The prevalence of each category is also reported.

The techniques for each sector were not grouped in accordance with the impact on each pollutant (for example, high – emission reduction efficiency between 70-100%; medium – emission reduction efficiency between 40-70% and low – emission reduction efficiency of less than 40%). Whilst this was initially planned, information was not always provided in BREFs and they do not contain information on the uptake of techniques prior to the BREF review. Without information on the uptake of different techniques, it is not possible to determine a potential emission reduction when implementing a BAT (e.g. a BAT described in BAT conclusions might already be applied across the sector).

The results of the quantitative analyses are shown in section 3.4.11. For the **quantitative** approach, it was not feasible to assess emissions reductions by modelling specific techniques for each sector and applying the reduction efficiency to the emissions in the reference scenario. This was because there are significant uncertainties on the uptake of techniques in individual sectors particularly in the baseline. Instead, quantitative assessment was only undertaken for the sectors and pollutants for which BAT-AELs were established, using the BAT-AEL values directly. In order to determine the scale of reductions achieved, emission reduction for each pollutant were calculated by comparing IED BAT-AELs with baseline emission levels (based on information on current emission levels from the BREF):

$$Emission\ reduction\ = \frac{Emission\ baseline - (IED\ BAT - AEL)}{Emission\ baseline}$$

Baseline concentration levels were based on the data in the 'Current emissions and consumption' chapters of the BREFs, and any additional data identified for specific sectors.

An elaborated calculation has been carried out for those cases where the BREF provided a robust baseline data set (including a range). It was assumed that these sets follow a normal distribution. The calculation used minimum values as 5^{th} percentile and maximum values as 95^{th} percentiles. The aim of this calculation was to capture the fact that, in each subsector, the best performers will need no emission reduction but average or worst performers will need larger emission reductions. Modelling each emission data set population with a normal distribution allowed to determine what proportion of the installations had to decrease emissions in order to meet the new emission levels imposed by the BAT-AELs. This approach is more precise than modelling the population with a simple average emission value (that was used in limited occasions when the baseline data was only available as an average value). The exercise included several steps and the first was to determine the share of plants (%) that have to make reductions and those that would not.

Furthermore, industrial operators will typically not run their units exactly at BAT-AEL levels but at lower levels to allow certain room for variability. Therefore, an additional emission reduction of 8% below the BAT-AEL was assumed to accommodate this. When the baseline data was expressed as a yearly average and BAT-AELs were set at short term average (weekly or less) a further reduction of 8% was applied to the data to make it more comparable. These reductions were based on expert judgement building on experiences from related studies for the Commission.

Given the quantitative assessment was undertaken at a high level, it was important to reflect on the uncertainty of the results by using lower and upper values for the BAT-AELs. Therefore, results of emission reductions calculations are presented for each pollutant as a range of values. The highest emission reduction value will correspond to comparing the baseline with the lower emission value from the BAT-AEL range. The lowest emission reduction value will correspond to comparing the baseline with the upper end of the BAT-AEL range. This exercise was not carried out when the BAT-AEL is derived in the BAT conclusion as a single number (it was done only when BAT-AEL ranges were available).

Task B.3 Estimation of the contribution of emission reductions to water policy objectives

In this sub-task conclusions have been drawn on the contribution of emission reductions achieved by the IED to the water policy objectives. Reduction of emissions to water from industrial facilities supports the water policy objective to reduce pressures on water bodies from pollution. The review of the first round of the River Basin Management Plans indicated that industrial emissions contributed significantly to chemical pollution in all 28 Member States, and in 87% (129) of River Basin Districts (RBD)[5].

As a first step the list of priority hazardous substances was compared to the list of pollutants for which BAT-AELs to water were set, and for which the review of techniques in the previous sub-task suggested an impact. The current list of priority hazardous substances is available from the European Commission's website[6]. Emissions of priority substances were extracted from E-PRTR, to give an indication of the extent to which these emissions are reported in E-PRTR. E-PRTR activities were converted into BREF categories according to the table presented in Appendix 3 along with the results of this analysis.

The impact of BREFs on priority substances was assessed through analysis of the documents looking for specific mention of pollutants in BAT-AELs and generic abatement techniques which may also contribute to reductions. In many cases, priority substances fall into chemical groups which are targeted specifically in the BREFs. For example, BREFs often set BAT-AELs for total organic carbon (TOC), or halogenated organic compounds (AOX). Where BREFs referred to target groups that priority substances fall under, this was seen to be a relevant impact.

2.3.3 Outputs

The main outputs for this task were:

- A characterisation of techniques to reduce water pollution included in the IED BREFs per sector.
- A quantified impact of BAT-AELs on the emissions of pollutants to water in the relevant sectors.
- An estimated impact matrix of BREFs on priority substances.

The underlying data and calculations are presented in the Excel file in Appendix 1.

2.4 Analysis relating to water use

2.4.1 Scope

Following on from Task B, this task focused on water consumption and how it has changed over time. Due to limited data, there are a number of data gaps, limitations and uncertainties. However, this risk is mitigated by the data collection undertaken as part of the industrial country profiles study. Part of this task was to consider how these gaps could be filled both as part of this study (within the context of the limited resources available to deliver the work) as well as in the future (e.g. possibly linking into the BREF process).

Furthermore, this task identified requirements and good practices on water use, reuse and recycling in the BREFs. Building on the review of techniques in the BREFs, this work also includes estimations of the impact that they could have for the reduction of water consumption/usage in the IED sectors. The outcome on this topic is limited due to lack of available data in BREFs (few BAT-AEPLs on water consumption/usage).

2.4.2 Approach

Task C.1. Define the reference scenario (water use)

This first sub-task developed estimates of water consumption for the different industrial sectors covered by Annex I of the IED as well as how these data have changed over time. Initially data on water consumption from each BREF was collated, supplemented with data extracted from Eurostat as part of the Member State industry profiles study. This combined data set provided a reference scenario for further analysis of the potential to reduce water consumption and increase water re-use in sectors regulated by the IED. Data was compiled as disaggregated as possible in line with the activities included in Annex I of the IED, and per process. The outcome of this work is presented in Section 4.2

The study has also considered how consumption has changed over time. Data on water consumption in EU industry was gathered from the Eurostat database, using the dataset "Water use in the

[5] http://ec.europa.eu/environment/water/water-framework/pdf/4th_report/CSWD%20Report%20on%20WFD%20PoMs.pdf
[6] http://ec.europa.eu/environment/water/water-framework/priority_substances.htm .

manufacturing industry by activity and supply category" [env_water_ind] (Eurostat, 2016). Extrapolation was used to fill data gaps where gaps for 2014 and 2015 were preceded by at least 3 years of data.

Estimates of sector water use significance were also made through analysis of the BREFs, through combining estimated water usage intensities with estimated industrial activity. When BREF data was not robust, had large variability and/or gaps, alternative sources (such as industrial federation reports) were used to derive overall sector water usage estimations. The values obtained for LVOC and IRPP BREF have lower accuracy than the rest of the overall sector performance estimations. The reason for this larger uncertainty is that the value obtained is the sum of only some of the main subsectors, but not all of them (see Section 4.2).

Task C.2. Identification of requirements and good practices in BREFs and BATC

This sub-task involved the review of each of the BREFs finalised under the IED and BATC adopted as well as the BREFs under the IPPCD for those BREFs not yet finalised under IED. The CWW BREF and its BAT conclusions contain best practices on water and can generate impacts on subsectors of the chemical industry (such as polymers production) that have not yet been reviewed under the IED.

The BREFs and BATC were reviewed in order to identify:

1. Any BAT-associated environmental performance levels (BAT-AEPL) related to water consumption and water re-use. These are reported for IED and IPPC BREFs in Section 4.3.1 of this document.
2. Techniques that would lead to lower water usage (including those that would increase water recycling and reuse). These are described, characterised and analysed in Section 4.3.2.

Information on techniques has been analysed by generating different categories and providing the prevalence of those categories.

The key hurdle to provide a qualitative estimation of water usage reduction based on techniques was the absence of data on uptake of techniques in BREFs. Without these values on technique uptake (prior to BREF), no impact projection could be carried out. Additional limitations on this analysis are presented in section 3.5 of this document.

Most of the techniques described in the BREFs and selected as BAT for water usage matters do not provide an effectiveness or performance capability value.

Task C.3. Determination of reductions in water use and of water reuse potential

Building on the data on water consumption and information on requirements and good practices on water use, the aim of this sub-task was to provide some estimates of the potential impacts these techniques could have. Resources were prioritised on those sectors with the greatest levels of water consumption and with quantified performance levels. REF and PP sectors were selected on this basis. The exercise was undertaken as follows:

1. The key techniques were analysed to capture their efficiency or performance values. Information on the key techniques was summarised focussed on potential impacts on water consumption. Recognising uncertainty around the impact that techniques may have, anticipated reduction in water consumption was estimated in two discrete ranges.
2. Information on existing uptake and/or application of key techniques within different sectors was summarised to avoid overestimating the impacts of potential techniques. This sort of information may be very difficult to obtain, particularly without extensive data gathering and consultation. Multiple scenarios were established reflecting both existing uptake of techniques as well as potential future uptake.
3. The information on techniques was applied to the consumption data from BREFs to estimate the potential range of impacts that could be expected under IED.

The results of this exercise are shown in Section 4.3.6.

Task C.4. Specifying different ways of data presentation for the reference of water issues in BREFs

The final element of Task C was to elaborate and specify different ways in which water data could be presented in BREFs in the future. This built on the review of the BREFs themselves and the subsequent analysis undertaken in both Tasks B and C.

2.4.3 Outputs

The overall outputs from this task included the following:

- Data analysis on sector water consumption, as well as total water consumption for all sectors. This is included in section 4.2.
- A review of the BAT included in the horizontal and vertical BREFs is included in section 3.3.
- An estimation of the potential impacts of BAT for reduction of water usage in the IED sectors is included in section 4.4.
- Summary of key data gaps, limitations, inconsistencies and uncertainties and options for addressing them. Where data issues have been addressed within this study the overall approach and assumptions made have been documented. See section 4.5.
- Potential options for improving the way in which water data could be presented in BREFs in the future are included in section 6.1.

3 Reducing water pollution from industrial installations

3.1 Overview

This section focuses on industrial emissions to water (Task B of the study). Current emissions to water are described in Section 3.2. Section 3.3 includes the identification of techniques in BREFs for reducing pollutant emissions to water and BAT Conclusions in which BAT-Associated Emission Levels (BAT-AELs) are established for emissions to water. Finally, Section 3.4 includes some estimations of the potential reduction in pollutant emissions to water from the implementation of the IED and BAT Conclusions (disaggregated by sector).

3.2 Current emissions to water from industrial installations

Data on pollutant emissions to water was extracted from E-PRTR as part of the Member State industry profiles study and analysed by IED sector, with E-PRTR activities mapped to equivalent IED activities. Pollutants emitted by non-IED sectors such as urban waste water treatment plants and aquaculture were not considered in the analysis. Based on this data, pollutants emitted to water by IED installations in the highest quantities in the EU include chloride, total organic carbon (TOC), nitrogen (as TN), fluoride, phosphorus (as TP) and halogenated organic compounds (AOX) (see Table 1).

The most significant emitter of chloride is the production of inorganic chemicals sector (IED activity 4.2). The chemicals sector as a whole is also the highest emitter of fluoride to water, and one of the top emitters of nitrogen. TOC emissions are dominated by the pulp, paper and board industry (6.1), emitting more than three times the quantity of the next largest polluter, organic chemical production (see Section 3.4.1). The pulp, paper and board sector similarly dominates on emissions of halogenated organic compounds (AOX) (see Section 3.4.1.5). The waste management sector is also a prominent contributor to the highest volume pollutants, with disposal and recovery of non-hazardous waste (5.3) being an important source of phosphorus and nitrogen. Activity 6.4 which corresponds with the food, drink and milk manufacturing sector is also a key activity for several pollutants, notably phosphorus and nitrogen. Heavy metals emissions have also been summarised, aggregated in Section 3.4.9 for all activities with large combustion plants, the metal sector and the pulp, paper and board industry being the most significant emitters. As such, from the pollutants with the highest quantities, the most critical sectors appear to be the large combustion plants, chemical production, waste management, food and drink manufacturing, and pulp, paper and board production.

Table 1: Top ten pollutants emitted to water from IED industrial sectors by mass in 2014 from E-PRTR

Pollutant	Emissions to Water (Tonnes)
Chlorides (as total Cl)	11,935,420
Total organic carbon (TOC) (as total C or COD/3)	215,745
Total nitrogen	47,941
Fluorides (as total F)	5,070
Total phosphorus	4,068
Halogenated organic compounds (as AOX)	2,232
Phenols (as total C)	637
Zinc and compounds (as Zn)	565
Chromium and compounds (as Cr)	370
Nickel and compounds (as Ni)	155

Table 2 sets out the IED activities and corresponding activity number to aid interpretation of the figures that follow.

Table 2: IED Activities

IED Activities
1.1 Combustion of fuels in installations with a total rated thermal input of 50 MW or more

IED Activities
1.2 Refining of mineral oil and gas
1.3 Production of Coke
1.4 Gasification or liquefaction
2.1 Metal Ore (including sulphide ore) roasting or sintering
2.2 Production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2.5 tonnes per hour
2.3 Processing of Ferrous Metals
2.4 Operation of ferrous metal foundries with a production capacity exceeding 20 tonnes per day
2.5 Processing of Non-Ferrous Metals
2.6 Surface treatment of metals or plastic materials using an electrolytic or chemical process where the volume of the treatment vats exceeds 30 m^3
3.1 Production of cement, lime and magnesium oxide
3.2 Production of asbestos or the manufacture of asbestos-based products
3.3 Manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day
3.4 Melting mineral substances including the production of mineral fibres with a melting capacity exceeding 20 tonnes per day
3.5 Manufacture of ceramic products
4.1 Production of organic chemicals
4.2 Production of Inorganic Chemicals
4.3 Production of phosphorous-, nitrogen- or potassium-based fertilisers (simple or compound fertilisers)
4.4 Production of plant protection products or of biocides
4.5 Production of pharmaceutical products including intermediates
4.6 Production of explosives
5.1 Disposal or recovery of hazardous waste with a capacity exceeding 10 tonnes per day
5.2 Disposal or recovery of waste in waste incineration plants or in waste co-incineration plants
5.3 Disposal or recovery of non-hazardous waste
5.4 Landfills receiving more than 10 tonnes of waste per day or with a total capacity exceeding 25,000 tonnes, excluding landfills of inert waste
5.5 Temporary storage of hazardous waste
5.6 Underground storage of hazardous waste with a total capacity exceeding 50 tonnes
6.1 Production of pulp, paper and board, and wood-based panels
6.2 Pre-treatment (operations such as washing, bleaching, mercerisation) or dyeing of textile fibres or textiles where the treatment capacity exceeds 10 tonnes per day
6.3 Tanning of hides and skins where the treatment capacity exceeds 12 tonnes of finished products per day
6.4 Treatment and processing of animal or vegetable raw materials
6.5 Disposal or recycling of animal carcases or animal waste with a treatment capacity exceeding 10 tonnes per day
6.6 Intensive Rearing of Poultry or Pigs
6.7 Surface treatment using organic solvents with an organic solvent consumption capacity of more than 150 kg per hour or more than 200 tonnes per year
6.8 Production of carbon (hard-burnt coal) or electrographite by means of incineration or graphitisation
6.9 Capture of CO2
6.10 Preservation of wood and wood products with chemicals with a production capacity exceeding 75 m^3 per day
6.11 Independently operated treatment of waste water not covered by Directive 91/271/EEC and discharged by an installation covered by Chapter II

Figure 2: Chloride emissions to water by IED activity (top ten) (ktonnes)

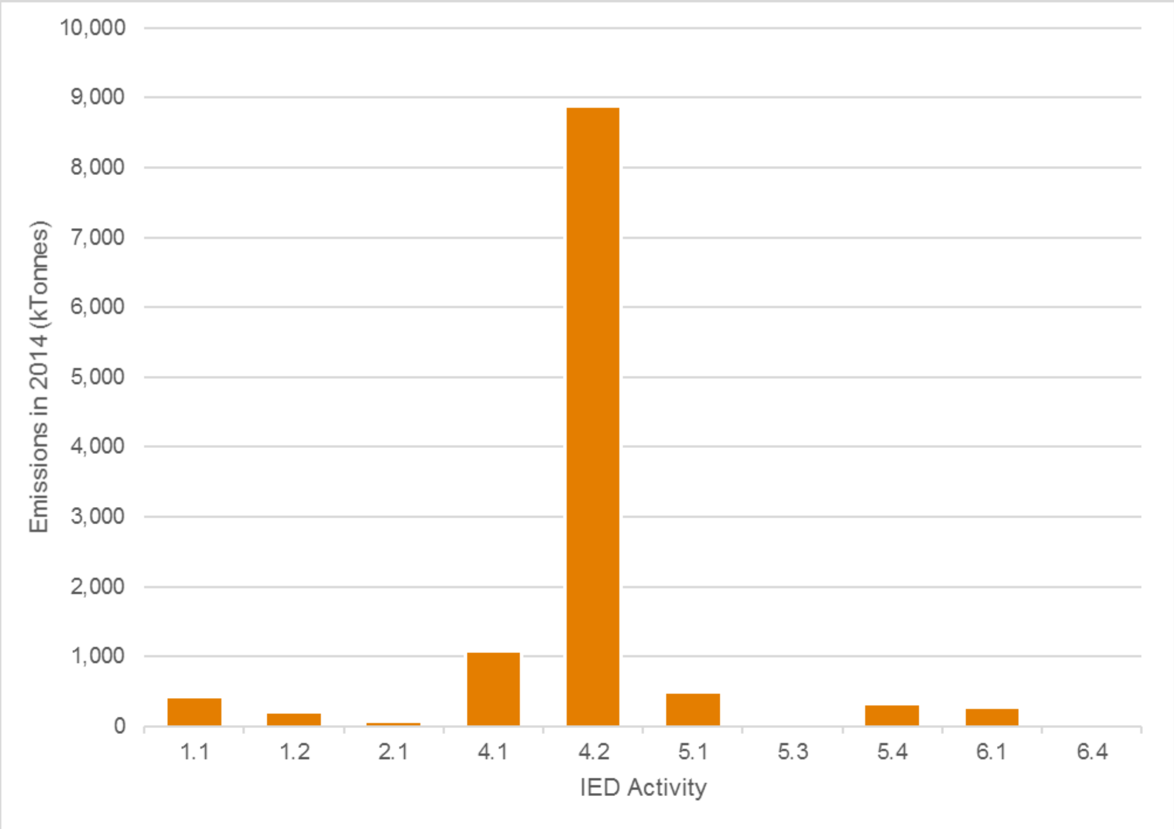


Figure 3: Total Organic Carbon (TOC) emissions to water by IED activity (top ten) (ktonnes)

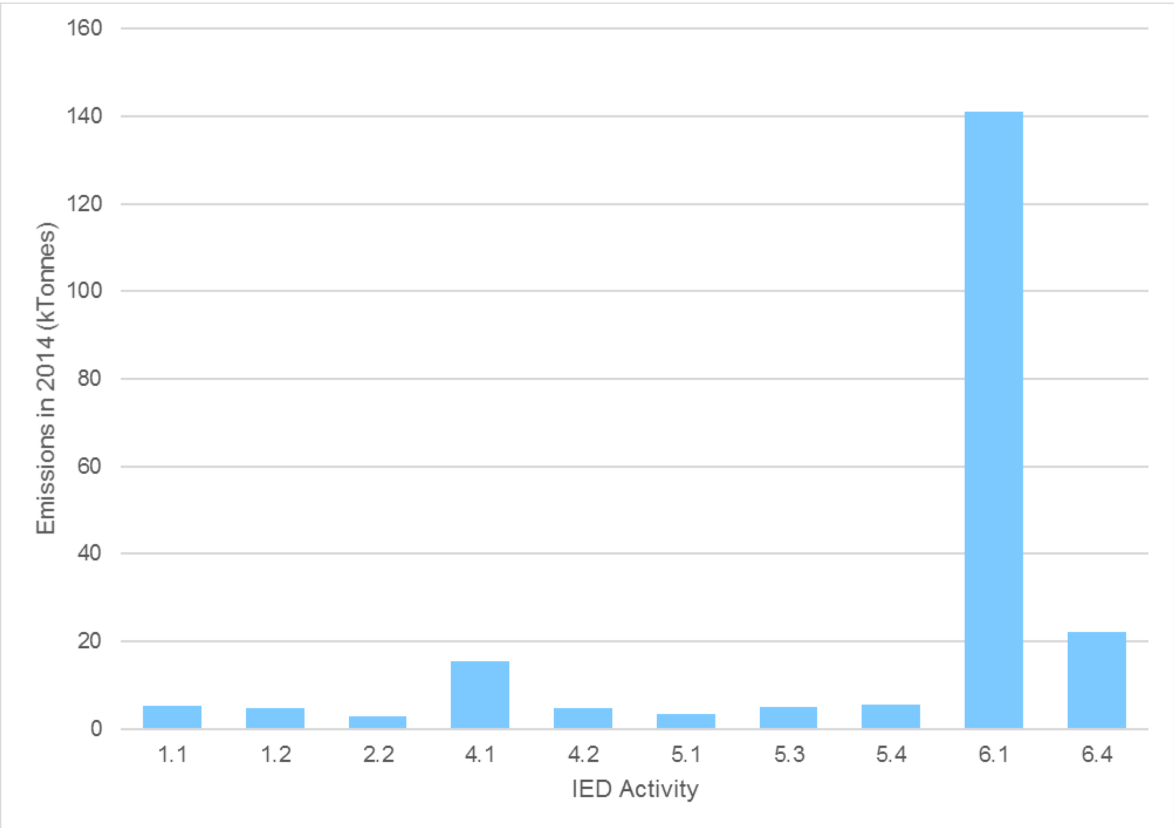


Figure 4: Total Nitrogen (TN) emissions to water by IED activity (top ten) (tonnes)

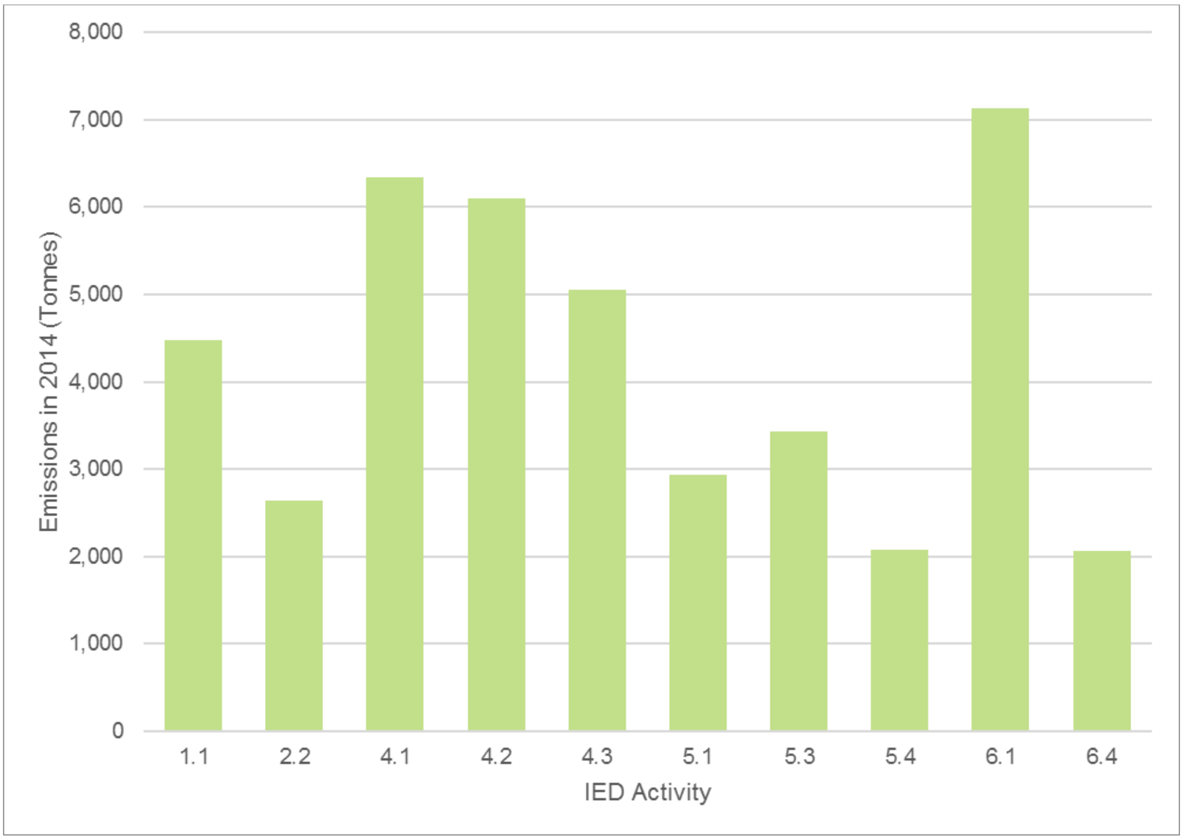


Figure 5:Fluoride emissions to water by IED activity (top ten) (tonnes)

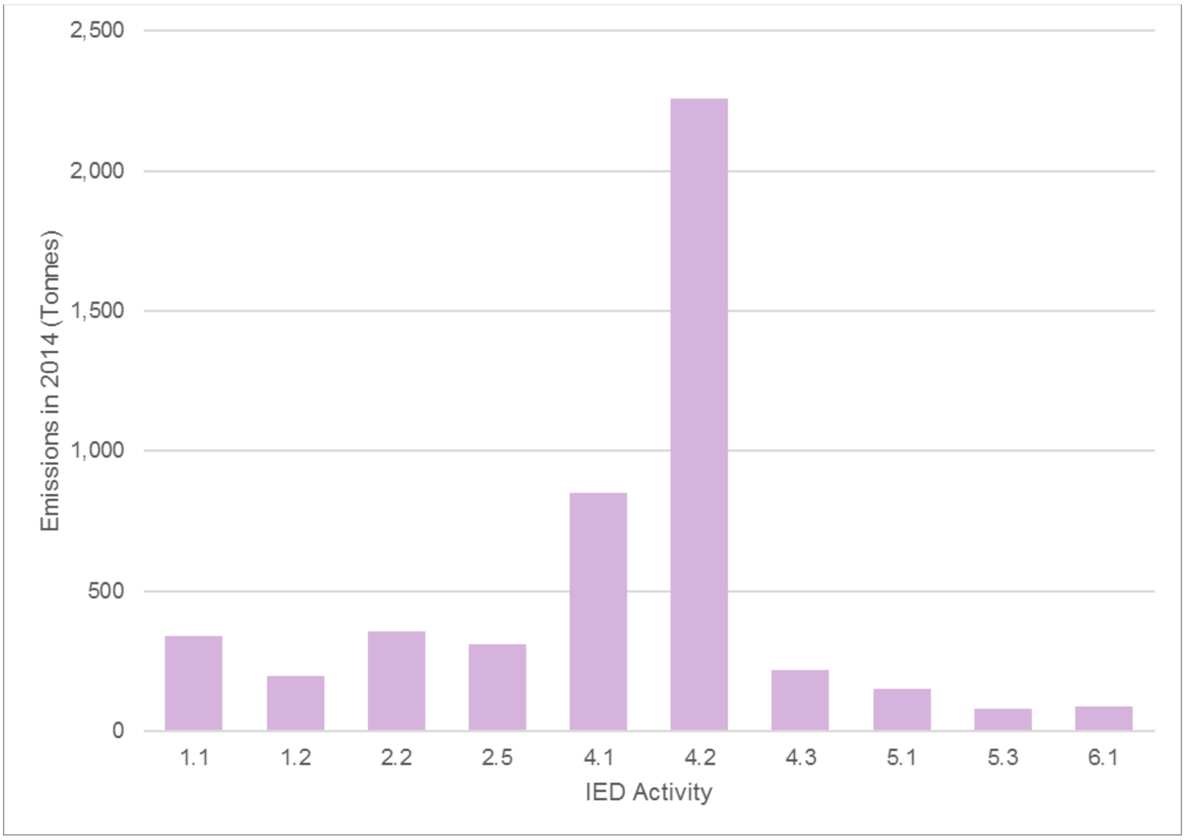


Figure 6: Total Phosphorus emissions to water by IED activity (top ten) (tonnes)

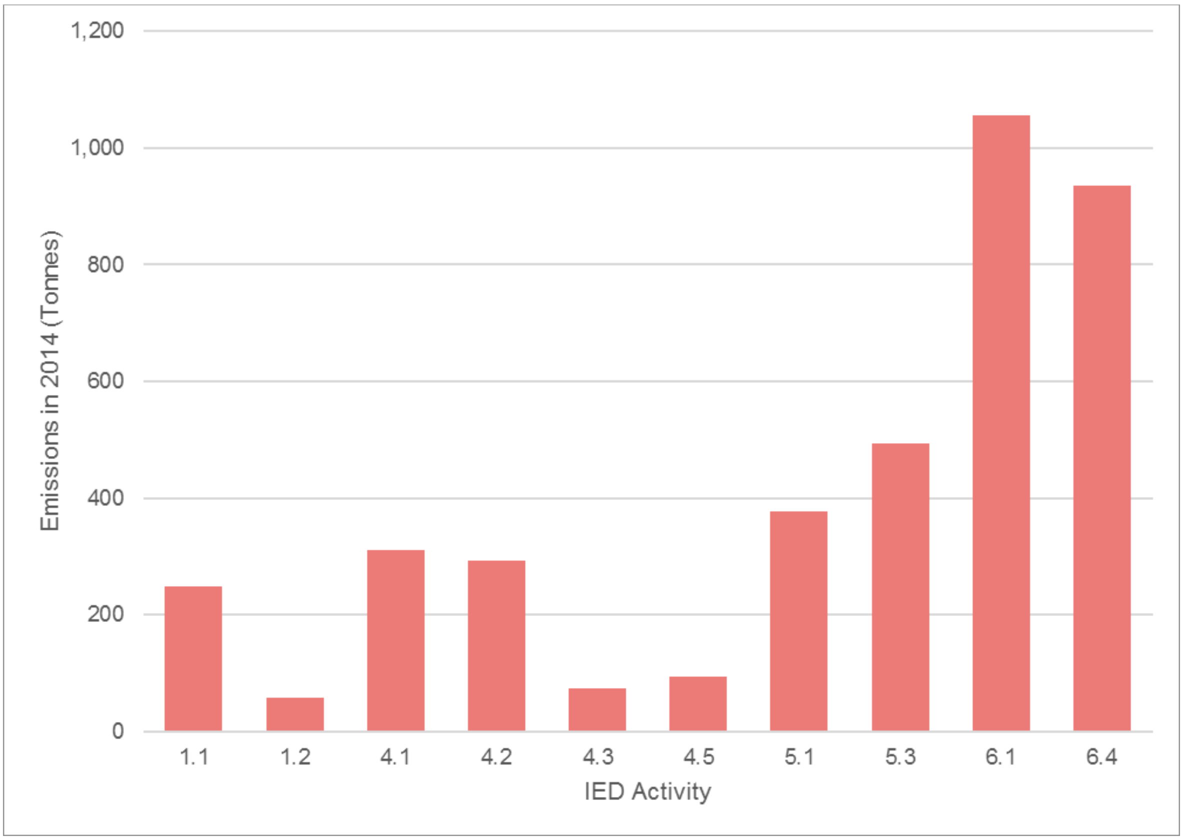


Figure 7: Halogenated Organic Compounds (AOX) emissions to water by IED activity (top ten) (tonnes)

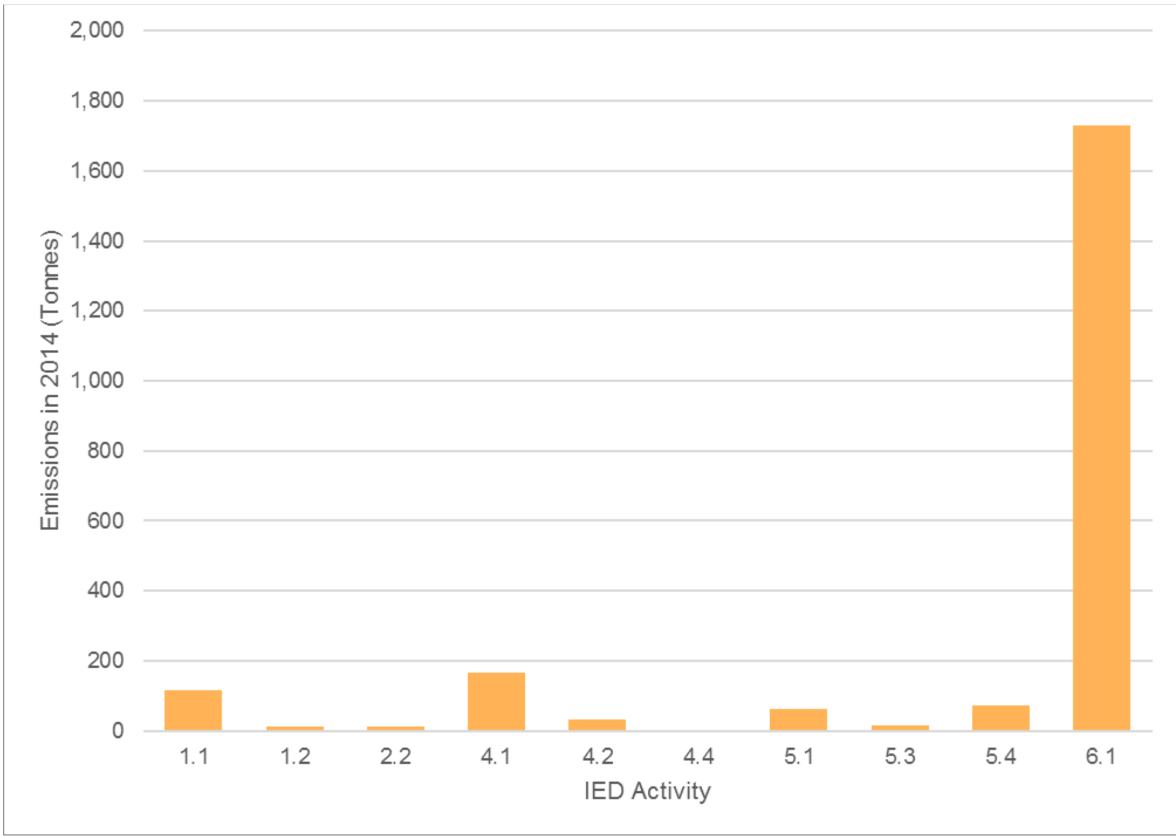
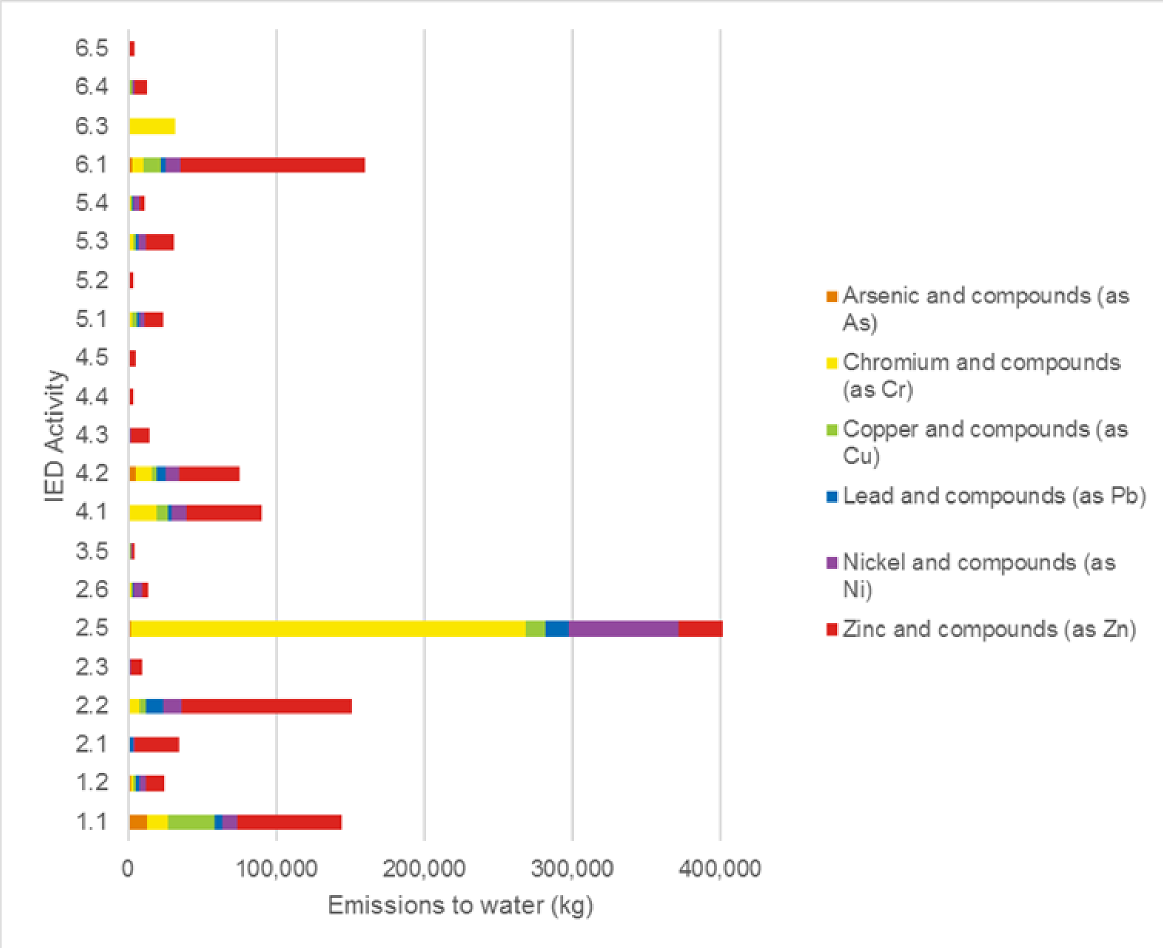
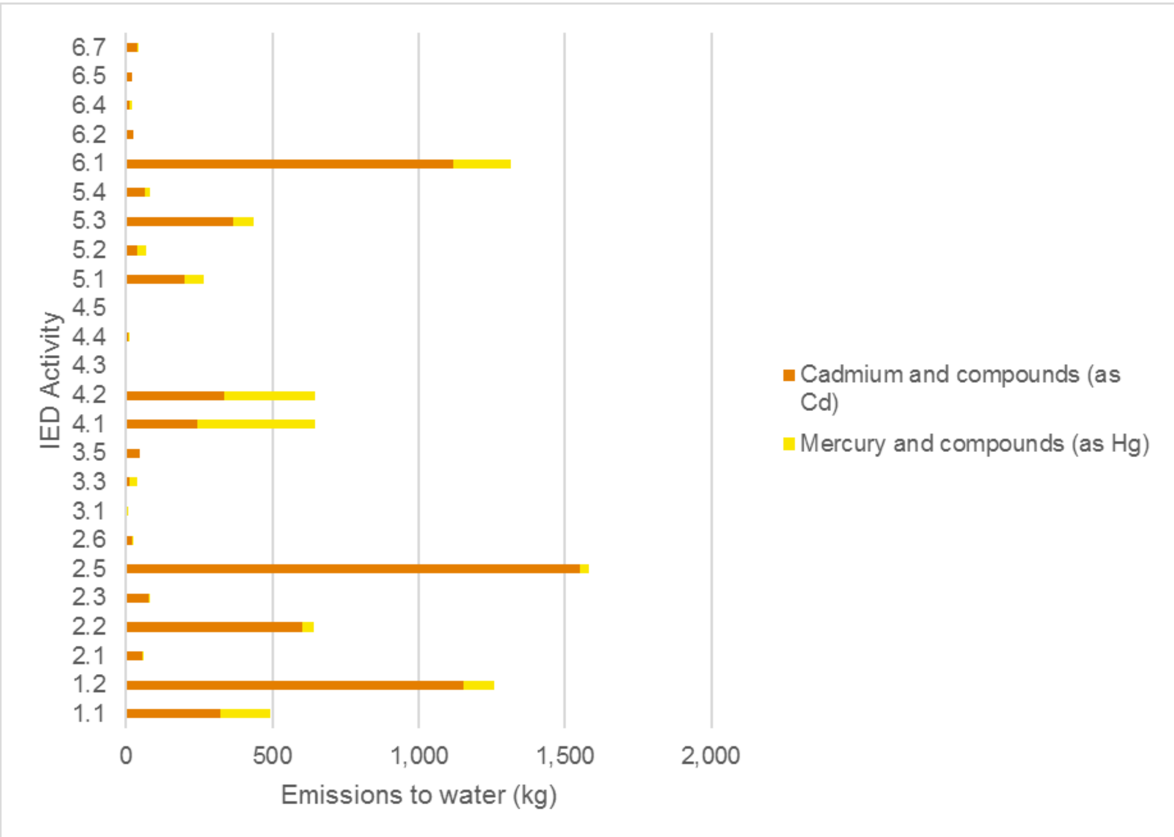


Figure 8: Metal emissions to water in 2014 by IED activity





Note: Cadmium and mercury included in separate chart to show detail due to lower quantities of emissions.

Metal emissions to water are also of high importance (see Figure 8). Most commonly, zinc is the metal released in the highest quantity, with the highest emissions from the production of pulp, paper and board (6.1) and production of pig iron or steel (2.2). Chromium and nickel are emitted in particularly large quantities by the processing of non-ferrous metals (2.5). Other metals such as cadmium, mercury and copper are emitted in smaller quantities by a large number of activities.

3.3 Techniques to reduce water pollution

This section covers techniques described in BREFs to reduce or control pollution to water primarily focussed on those listed inside the BAT conclusions. The majority of techniques inside the legally binding, and standalone, BAT conclusions document of IED BREFs do not contain BAT-AELs. In the BREFs reviewed under the IED so far, 80% of BAT conclusions related to water emission topics do not contain a BAT-AEL. These water emission techniques, with no BAT-AEL, do not allow an estimation of emission reductions (see section 3.5 on limitations).

This section also includes qualitative analysis of the techniques in the BREFs that aim to reduce emission to water. An assessment of potential quantitative emission reductions related with the associated emission limits ('BAT-AELs') is presented in section 3.4.

3.3.1 Classification of BAT conclusions on emission to water

Water emission related conclusions represent 17% of the total conclusions in the IED BREFs: 145 conclusions out of a total of 850 were set with this aim. This includes both management techniques and process related ones. This overall percentage has large variability between sectors; Chloral-alkali production (CAK) with 47 % and common waste water and waste gas treatment in the chemical sector (CWW) with 39% of water emission related conclusions have the largest proportion and cement, lime and magnesium oxide (CLM) (with none) and manufacture of glass (GLS) with 3% have the fewest.

BREFs contain a large number of techniques to reduce the impacts of industrial activities on the water environment. More than 140 BAT conclusions on water topics are present in thirteen BREFs reviewed under the Industrial Emission Directive (since 2011). Each one of these conclusions contains an average of 3 to 4 BAT which can be analysed in different ways, with respect to:

- Whether techniques apply to the **whole sector** (**general) or are process-specific**. See section 3.3.2 in this document.
- **The nature** of the techniques that are proposed. In some occasions one BAT conclusion may contain BATs of different nature e.g. abatement system at end-of-pipe or process design feature. See section 3.3.3 in this document.
- **Environmental issue or pollutant** that a technique aims to control e.g. mercury, organic halogens. See section 3.3.4 in this document.

Some BAT conclusions address multiple issues. In this characterisation exercise a BAT conclusion was registered (counted) when containing a technique targeting water emissions regardless of other topic areas being also covered. If a BAT conclusion covered several features (e.g. contained both managerial techniques and abatement ones), then this conclusion was accounted only once. The category with the majority of techniques was registered only. The intention of this exercise was to underpin a qualitative discussion included at the end of this section.

As an example, the following BAT explains how this categorisation has been undertaken: "*BAT 36. In order to reduce waste water generation from ethylbenzene dehydrogenation and to maximise the recovery of organic compounds, BAT is to use an appropriate combination of the techniques given below.*" This BAT addresses two environmental issues: emissions to water and resource efficiency (raw materials). This BAT was counted only once in this exercise. Four techniques were listed after the BAT statement. The majority of these four techniques were of an abatement nature and thus this BAT conclusion was labelled as abatement technique.

3.3.2 Generic or process-specific BAT conclusions

The IED BREF series has been reviewed to determine if techniques included in the BAT conclusions sections are process-specific or generally applicable to a whole sector. Every BREF includes a section, called 'General BAT conclusions', with those techniques that apply to most industrial processes in the given sector. Techniques included in that section vary in nature. This subsection is used in some BREFs to avoid repetition of BAT conclusions in process specific chapters.

Generic techniques are useful because they cover every process in a sector and as such can have a very wide impact. Generic techniques are, nevertheless, less precise since they have to ensure general applicability. In most cases these techniques fall into the category of abatement techniques. This is because process design techniques vary across sectors and cannot be generalised so easily. The risk of generic techniques is that they set a common performance target across all sectors whereas some subsectors could have delivered beyond this if required.

Some examples of generic techniques are in Table 3.

Table 3: Examples of generic BAT conclusions

BREF	BAT conclusion example	BAT # (page)	Water
REF	*In order to reduce water consumption and the volume of contaminated water, BAT is to use all of the techniques given below: (i) Water stream integration (ii) Water and drainage system for segregation of contaminated water streams…*	11 (595)	Emission & Consumption
WBP	*In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features*	1(215)	Emission & Consumption
NFM	*For water sampling, BAT is to use ISO 5667.*	14 (1004)	Emission

Recently reviewed BREFs have certain similarities in their generic conclusions. The most common generic conclusions on water topics included in the BREFs since 2011 (IED) are:

- **Environmental management systems**: this BAT conclusion is now included in almost every BREF. It is very wide but covers also specific features to reduce impact of installations on water e.g. '*XII. Establishment of inventories of waste water and waste gas streams*'.
- **Monitoring of emissions to water**: most BREFs reviewed under IED include a measure to ensure that emission monitoring is done with the same EN standards and using minimum monitoring frequencies. In some cases, parameters without a BAT-AEL are required to be monitored because they are useful for optimum control of waste water treatment units e.g. pH, BOD. In other occasions monitoring BAT are established to allow a better understanding, build knowledge and facilitate reduction and control of a pollutant.
- **Waste water strategy**: There are numerous BAT conclusions to establish best practices on a holistic approach for water management. Segregation of contaminated water from rainwater is commonly present.

Specific conclusions on water matters are more common in BREFs than generic ones. The BATs, inside these specific conclusions are tailored to minimise pollution often at the process selection or process design stages. Table 4 presents some of these options.

Table 4: Examples of process-specific conclusions

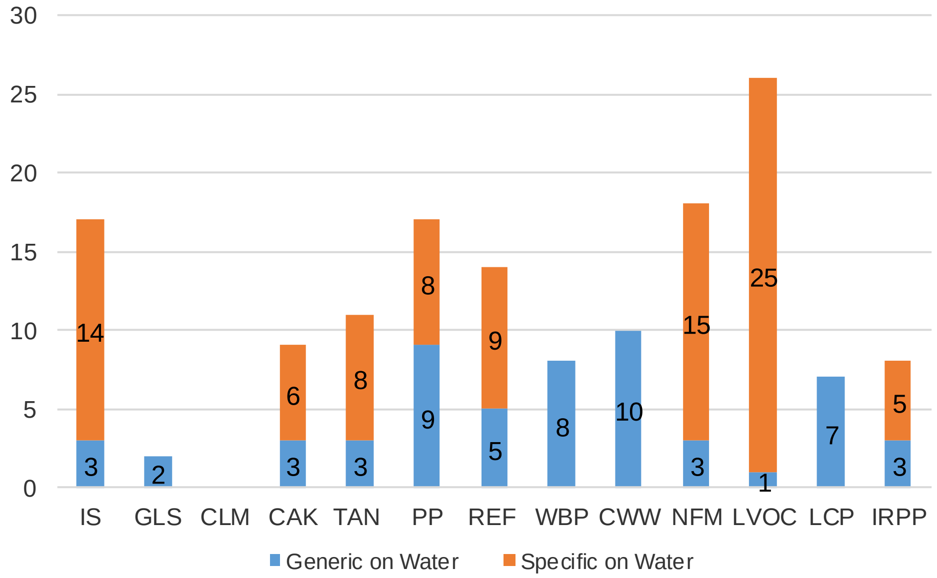
BREF	BAT conclusion example	BAT # (page)	Water
LVOC	In order to prevent or reduce the amount of organic compounds and waste water discharged to waste water treatment, BAT is to maximise the recovery of hydrocarbons from the quench water of the primary fractionation stage and reuse the quench water in the dilution steam generation system	21 (593)	Emission
REF	*In order to reduce water consumption and emissions to water from the desalting process, BAT is to… Multistage desalter*	33 (62)	Emission

BREF	BAT conclusion example	BAT # (page)	Water
IS	*BAT is to treat the effluent water from sinter plants where rinsing water is used or where a wet waste gas treatment system is applied, with the exception of cooling water prior to discharge by using a combination of the following techniques: I. heavy metal precipitation*	28 (81)	Emission

Selection of generic versus specific techniques varies from one sector to another. BREFs will include more generic techniques when the manufacturing processes have similar features with regard to water usage or water effluent generation.

Figure 9 shows the amount and type of BAT conclusions in the BREFs that have recently been reviewed under the IED.

Figure 9: Number of BATC on water issues in IED BREFs



The following observations can be made:

- The CWW BREF is a BREF on abatement techniques that does not deal with process specific features: it has no process-specific conclusions.
- The CAK BREF primarily includes specific BAT Conclusions on water issues although some are generic in that they apply to all subsectors and processes within the BREF such as BAT 11 which specifies a broad range of techniques to be applied covering process-integrated techniques, waste water treatment at source, waste water pretreatment and final waste water treatment. The BAT Conclusions in the CAK BREF could all be considered specific when taking into account the fact that the CWW BREF covers the entire chemical sector. However, for the purposes of this study we have tried to keep a consistent interpretation of generic and specific techniques when assessing each BREF independently.
- Linked to the above points, the LVOC BREF is a chemical sector BREF that focuses on process-specific features. However, the LVOC BREF also contains one conclusion that applies to the whole LVOC sector whereas the rest are all process-specific (e.g. there are BAT conclusions that apply only to phenol plants).
- In the LCP BREF the water topics were addressed in the general section of the BAT Conclusions. However, in some instances they could be considered as specific. For example, techniques to reduce emissions to water and the BAT-AELs only refer to waste water from flue-gas cleaning which in turn is only relevant for some LCP subsectors, mostly the combustion of coal/lignite.
- The WBP BREF includes BAT conclusions on emission to water that apply to the whole sector. There are no specific conclusions in this BREF applicable to only one process.

Generic BAT conclusions on water topics represent 35% of the water techniques inside the IED BREFs. Most BREFs reviewed under the IED so far show a balanced mix between specific and generic conclusions.

3.3.3 Nature of BAT conclusions in the BREFs

The large list of BREFs currently 13 reviewed under the IED, include a variety of conclusions to reduce the impact of European industrial installations on water. In order to facilitate characterisation of these BAT conclusions, a set of categories were created for this purpose: managerial, process design and abatement conclusions. Terminology used in this review is not formally defined in BREF 'guidelines' but the majority of technical working group members are familiarised with these terms.

Managerial BAT conclusions: this category includes best practices that are not directly related to technical features and not based on an installation's design. Managerial BAT conclusions are neither primary, process design, nor secondary (abatement techniques). This group of conclusions can refer to monitoring analysis best practices or specific features that the environmental management systems should include. Table 5 provides illustrative examples of these techniques.

Table 5: Examples of managerial BAT conclusions

BREF	BAT conclusion example	BAT # (page)	Water
WBP	*In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features*	1(215)	Emission & Consumption
NFM	*For water sampling, BAT is to use ISO 5667.*	14 (1004)	Emission
REF	*In order to reduce water consumption and the volume of contaminated water, BAT is to use all of the techniques given below: (i) Water stream integration (ii) Water and drainage system for segregation of contaminated water streams…*	11 (595)	Emission & Consumption

Process design BAT conclusions: relate to industrial engineering design features or process option selection. The BATs in these conclusions lead to lower generation of emissions at source. These conclusions focus on avoiding pollution rather than treatment of generated emissions. Table 6 provides examples of some of these conclusions in BREFs.

Table 6: Examples of process design conclusions

BREF	BAT conclusion example	BAT # (page)	Water
LVOC	*In order to ensure the efficient use of water and so minimise the quantity of waste water requiring treatment and disposal, BAT is to apply one or a combination of the techniques given below: (iii) Water-free vacuum generation*	26 (678-9)	Emission & Consumption
PP	*In order to reduce nutrient (nitrogen and phosphorus) emissions into receiving waters, BAT is to substitute chemical additives with high nitrogen and phosphorus contents by additives containing low nitrogen and phosphorus contents*	13(789)	Emissions
PP	*In order to reduce emissions of pollutants into receiving waters from the whole mill, BAT is to use TCF or modern ECF bleaching (process) ..*	19(792)	Emission

Abatement BAT conclusions: are applied downstream of emission generation sources in order to treat, capture or reduce the pollutant contents. This group of conclusions is normally applied at the so called 'end-of-pipe'. They can be applied in individual sources or in common streams where various emission streams can be treated together. Depending on the technique approach, some will be applied close to generation of pollutants, 'treatment at source', or else further downstream. Some examples of these types of techniques are included in the table below.

Table 7: Examples of abatement BAT conclusions

BREF	BAT conclusion example	BAT # (page)	Water
TAN	*In order to reduce emissions to receiving waters, BAT is to apply waste water treatment comprising an appropriate on-site and/or off-site combination of the following techniques: i) mechanical treatment; ii) physico-chemical treatment; iii) biological treatment; iv) biological nitrogen elimination*	10(226)	Emission
REF	*In order to reduce emissions to water from the hydrofluoric acid alkylation process, bat is to use a combination of the techniques given below: (i) precipitation/neutralisation step (ii) The insoluble compounds produced at the first step (e.g. CaF2 or AlF3) are separated in e.g. a settlement bas*	20(599)	Emission
LVOC	*BAT 96. In order to prevent or reduce emissions to water of methyl hydroperoxide from oxidation, BAT is to apply the thermal treatment technique described below to the aqueous stream that arises in the decanter of the charcoal recovery system.*	96(714)	Emission

The BREFs reviewed under the IED generally contain managerial and abatement conclusions. This is shown in Figure 10. The other types of BAT conclusions are less frequent, but not negligible.

Figure 10: Nature of BAT conclusions on water emissions in IED BREF series

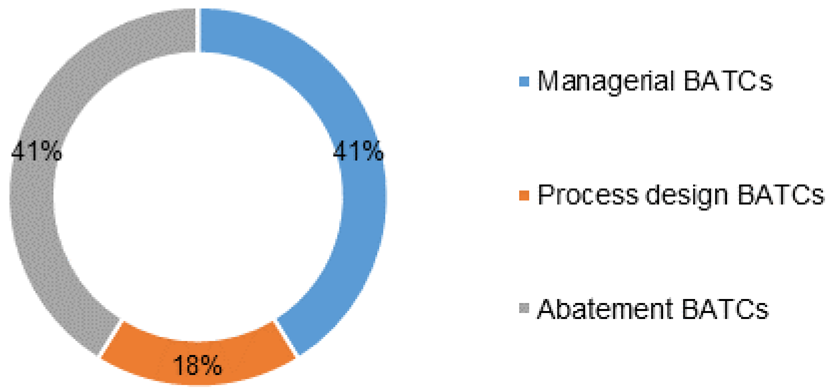
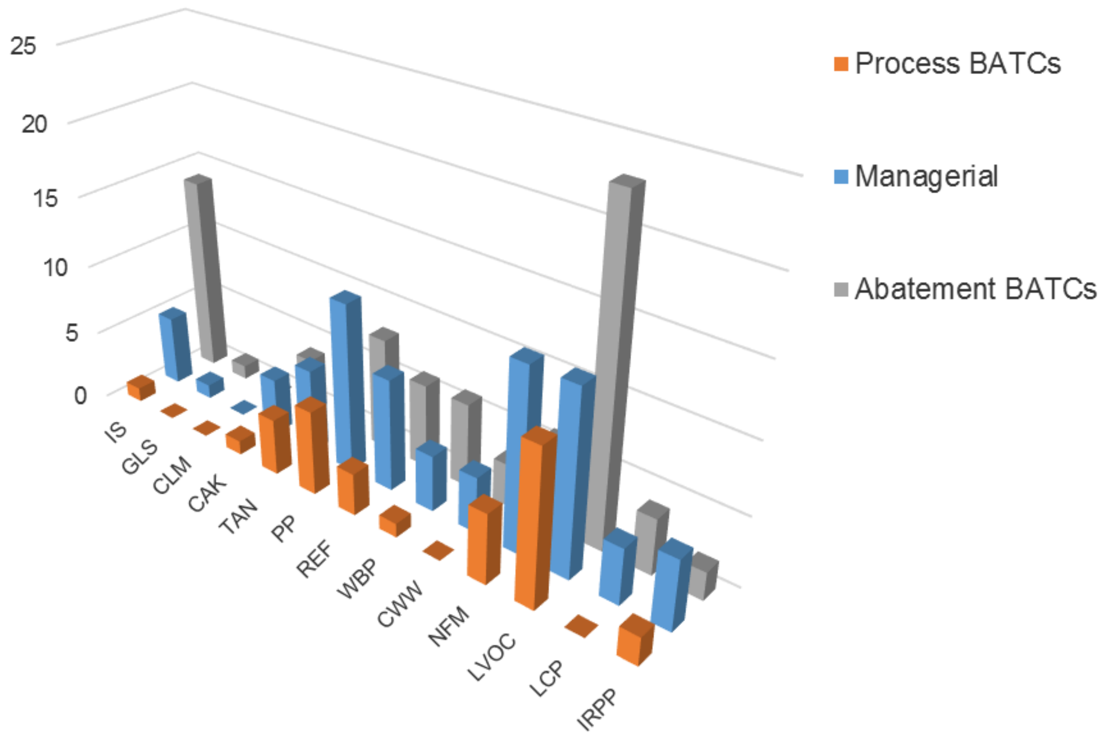


Figure 11 presents the same information but disaggregated by BREF. The proportions are similar in most cases.

Figure 11: Nature of BAT conclusions per BREF



All BREFs have some managerial conclusions such as environmental management systems and/or monitoring of emissions to water.

3.3.4 Issues or pollutants controlled with the BAT conclusions in BREFs

The BAT conclusions adopted under the IED are, in most cases, unambiguous; each one states the issue (or pollutant) that is going to be controlled. The analysis included in this section provides insight on which environmental issues the BAT conclusions address.

Each BAT with an explicit pollutant name (category) in the BAT conclusions was registered. Conclusions addressing many environmental issues (e.g. for monitoring or setting BAT-AELs) were also counted. In these cases, each pollutant was counted. If the BAT conclusion and other sections of the conclusions (e.g. a table) addressed the same pollutant, double counting was avoided. The exercise reviewed all conclusions including specific BAT conclusions for each subsector as well as generic ones.

The number of chemical species, compound groups and other issues in water is numerous. The following set of categories is used in this study to facilitate the characterisation of environmental issues in water related BAT conclusions:

- **Effluent flow/load**: this is one of the most common conclusions. This category gathers techniques that aim to minimise effluent flowrates, effluent loads or specific mass flows of waste water streams.
- **Metals**: this category contains BAT conclusions derived to minimise release of metals to water. In some cases, these metals are used in the manufacturing processes (as raw material, products or residues). In other occasions, emissions to water may contain metals due to piping or equipment corrosion. Some conclusions use the term 'metals' as the total of a long list of metals but most of the conclusions explicitly mention only specific metals.
- **COD, TOC, organic load or hydrocarbons** are the most common parameters to set goals on organic compounds.
- **TSS:** total suspended solids.
- **Nutrients:** total phosphorous (TP) and total nitrogen (TN) are the parameters most frequently used. There are specific compounds explicitly mentioned in BAT conclusions to eutrophication.

- **Rest:** other issues different from the above mentioned categories.

Table 8 provides examples of techniques in the categories used in this document to characterise the water environmental issues.

Table 8: Example of water issues inside BAT conclusions

Issue	Example	BREF	# (page)
Effluent flow/load	*In order to reduce the generation and the pollution load of waste water from wood storage and preparation, BAT is to use a combination of the techniques given below.*	PP	4 (784)
Metals	*In order to reduce emissions to water, BAT is to treat the waste water from non-ferrous metals production, including the washing stage in the Waelz kiln process, to remove metals and sulphates by using a combination of the techniques given below.*	NFM	15 (1004)
COD, TOC, organic load or hydrocarbons	*In order to prevent or reduce the amount of organic compounds and waste water discharged to waste water treatment, BAT is to maximise the recovery of hydrocarbons from the quench water of the primary fractionation stage and reuse the quench water in the dilution steam generation system.*	LVOC	21 (593)
Nutrients	*In order to reduce nutrient (nitrogen and phosphorus) emissions into receiving waters, BAT is to substitute chemical additives with high nitrogen and phosphorus contents by additives containing low nitrogen and phosphorus contents.*	PP	13 (789)

Issues addressed by BAT conclusions varies from one BREF to another. Conclusions to reduce effluent flow (or load) and emissions of organic pollutants are the most frequently occurring BAT Conclusions. Metals and inorganic compounds related conclusions are also common.

Figure 12: Water issues in BREFs

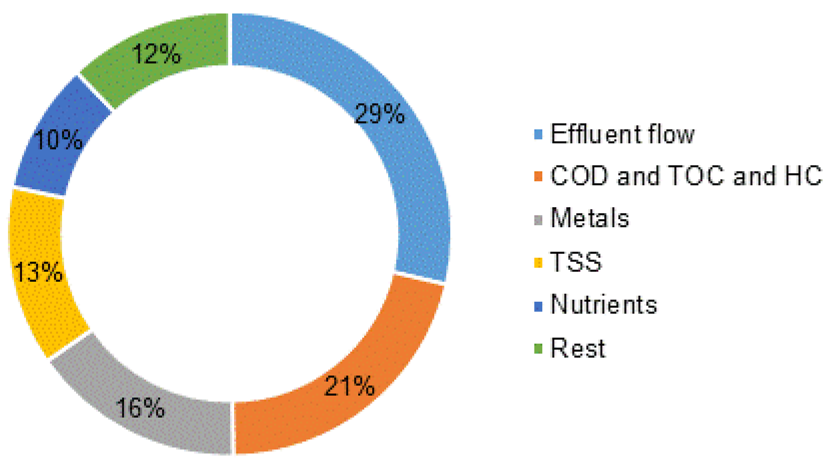
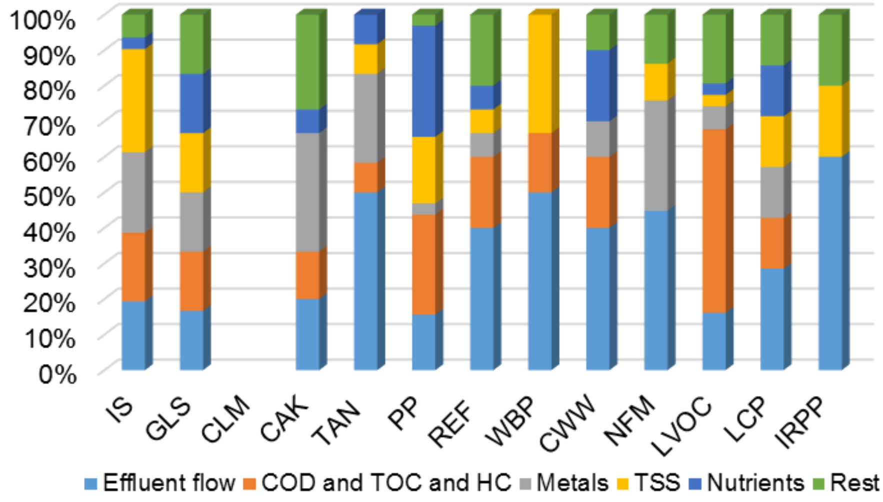


Figure 13 shows the variability of these issue categories across the BREF series. It indicates that the BREFs are tailored to cover each industrial activity's key environmental issue: there is not a common pattern. Only a few cover emissions to ground water. Most of the reference documents have at least one BAT conclusion on: Organic, Inorganic, Flow and Metals categories.

Figure 13 Water issues in the IED BREF reviews



3.3.5 Summary

This characterisation of the BAT conclusions provides insights for a qualitative discussion.

A large number of the BAT conclusions are aimed at minimising emissions to water from industrial activities covered by IED. Although this share varies from one document to another, most BREFs include a set of techniques to minimise relevant emissions to water.

Some of these techniques apply to the whole sector (generic conclusions), but some also address emissions to water from specific processes. An accurate estimation of the impact of these sets of techniques is not possible mainly due to the fact that the BREF do not provide percentage technique uptake prior to BREF publications.

The majority of techniques included in the BREF for water emission reductions are abatement techniques or managerial ones. Fewer techniques are aiming to change or select a given primary manufacturing process that leads to lower emissions to water.

Techniques on water emission reductions cover a wide range of issues. In each BREF the techniques address the most relevant issues. For example, in the LVOC BREF, the BAT conclusions contain numerous techniques to minimise COD or hydrocarbons emissions; in the NFM BREF the majority of techniques aim to minimise emissions of metals to water.

Some BAT conclusions on emission to water can have a significant impact on the given industrial sector (e.g. BAT conclusion on CAK phasing out mercury cells does not have a BAT-AEL but will eliminate 100% mercury emissions to water in this sector). Other BAT conclusions have an uncertain impact on emission reductions and it is challenging to estimate what this may be. For example, those BAT conclusions forcing higher monitoring frequencies will normally lead to better water effluent management and thus lower emissions to water but the absolute impact is highly uncertain.

3.4 Anticipated reduction in emissions to water from industrial installations

This section provides estimates of potential emission reductions based on the techniques set out in the BREFs. As discussed in section 2 the reduction estimates are based on BREF baselines ('current emission and consumption' chapters) and requirements for future permits based on BAT conclusions). The tables presented here correspond to BREFs with available data for both items: baselines and BAT-AELs.

In each BREF the BAT-AELs are set for the sector's key environmental issues which are decided by the TWG members. In most cases where a BAT-AEL was set, the BREF contained a set of baseline data to perform emission reduction estimations. The BREFs also contain in some cases an indication of emission significance per subsector or process: Current emission intensities were extracted from these BREFs at process level for all pollutants, where available. These current emission intensities were used in order to indicate significance of a process for a given pollutant, and these emissions intensities were then compared with lower and upper BAT-AELs to produce estimates of percentage reductions in emissions. In some cases, BAT-AELs within a BREF are set as a single figure, but not as a range. It is also sometimes the case that current emissions are already expected to be below the BAT-AELs, resulting in no anticipated reductions, shown as 0% in the tables. It should be noted that these baseline data and emission intensities represent a snapshot of activity at a particular time when the BREF was being revised and often the data is several years older. The performance of individual plants will vary considerably with some potentially achieving much greater reductions, whereas others will already be operating in line with the BAT Conclusions and no further reductions would be expected.

Twelve BATC had been adopted at the time of the analysis being undertaken: iron and steel production (28/02/2012), manufacture of glass (28/02/2012), tanning of hides and skins (11/02/2013), production of cement lime and magnesium oxide (26/03/2013), production of chlor-alkali (9/12/2013), production of pulp, paper and board (26/09/2014), refining of mineral oil & gas (09/10/2014), wood-based panels production (24/11/2015), common waste water and waste gas treatment/management systems in the chemical sector (09/06/2016), non-ferrous metals industries (30/06/16), intensive rearing of poultry and pigs (15/02/2017) and large combustion plants (15/07/2017). The large volume organic chemicals BATC were adopted too late for the study to consider (21/11/2017). However, draft reviewed BREFs for large volume organic chemicals as well as food, drink and milk manufacturing were included in the analysis.

The emission reductions forecasted for the LVOC sector are not included here because most of these BAT-AELs are based on a small sample or first LVOC BREF review (under IPPC). The uncertainty of this LVOC analysis is higher than the rest of the BREFs. The subsection that forecasts emission reductions for the CAK BREF is based on industrial federation data rather than BREF emission data.

According to the analysis presented in Section 3.2, sectors of key importance for emissions to water are pulp, paper and board production, chemical production, and large combustion plants. As such, these sectors are considered first, followed by other IED BREFs.

3.4.1 Production of Pulp, paper and board (PP)

3.4.1.1 COD

The most significant processes for COD in the pulp paper and board sector are bleached kraft pulp mills (39 kg/t), magnefite paper grade pulp (35 kg/t), bleached sulphite paper grade pulp (26 kg/t), and CTMP/CMP pulp mills (17 kg/t). The largest estimated reductions from meeting BAT-AELs are seen in the recycled fibres pulp mills, with a potential 78% reduction in emissions for meeting the upper BAT-AELs, and a potential 98% reduction for meeting lower BAT-AELs. Percentage reductions are estimated to be low in the case of papermaking mills for meeting the upper BAT-AELs (11-12% potential reduction) but increase significantly for meeting the lower BAT-AELs (93-98% potential reduction).

Table 9: COD significance by process (emissions intensity in kg/t of product), and % emissions reduction from meeting lower and upper BAT-AELs

Sub-Sector	Process	Sig. (kg/t)	Lower BAT-AEL %	Upper BAT-AEL %
Kraft pulping process	Bleached Kraft pulp mill	39	88%	57%
Sulphite pulping process	Magnefite paper grade pulp	35	41%	11%
Sulphite pulping process	Bleached Sulphite paper grade pulp	26	68%	13%
Mechanical pulping and Chemi-Mechanical pulping	CTMP or CMP pulp mill	17	35%	8%
Kraft pulping process	Unbleached Kraft pulp mill	9	78%	27%
Sulphite pulping process	Sulphite pulp mill manufacturing NSSC pulp	8	60%	8%
Processing paper for recycling	Recycled fibres pulp, produced without deinking	5	98%	78%

Sub-Sector	Process	Sig. (kg/t)	Lower BAT-AEL %	Upper BAT-AEL %
Mechanical pulping and Chemi-Mechanical pulping	Mechanical pulp	4	84%	17%
Processing paper for recycling	Recycled fibres pulp, produced with deinking	4	82%	36%
Papermaking and related processes	Non-integrated speciality paper mill	4	98%	12%
Papermaking and related processes	Non-integrated paper and board mill (excluding speciality paper)	1	93%	11%

3.4.1.2 Total Suspended Solids (TSS)

The most significant processes for TSS in the pulp, paper and board sector are magnefite paper grade pulp, bleached sulphite paper grade pulp, bleached kraft pulp mill and unbleached kraft pulp mill. For all of these activities, meeting lower BAT-AELs is estimated to result in large potential % reductions in emissions ranging from 85-96%. Meeting upper BAT-AELs results in estimated emissions reductions of 8-52% for these most polluting activities.

Table 10: TSS significance by process (Emissions intensity in kg/ t of product), and % emissions reduction from meeting lower and upper BAT-AELs

Sub-Sector	Process	Significance (Kg/t)	Lower BAT-AEL %	Upper BAT-AEL %
Sulphite pulping process	Magnefite paper grade pulp	2.5	85%	33%
Sulphite pulping process	Bleached Sulphite paper grade pulp	2.15	88%	8%
Kraft pulping process	Bleached Kraft pulp mill	2.13	92%	42%
Kraft pulping process	Unbleached Kraft pulp mill	1.75	89%	52%
Papermaking and related processes	Non-integrated speciality paper mill	1.05	96%	26%
Mechanical pulping and Chemi-Mechanical pulping	CTMP or CMP pulp mill	0.92	52%	18%
Sulphite pulping process	Sulphite pulp mill manufacturing NSSC pulp	0.75	41%	8%
Processing paper for recycling	Recycled fibres pulp, produced with deinking	0.68	50%	30%
Processing paper for recycling	Recycled fibres pulp, produced without deinking	0.55	100%	71%
Mechanical pulping and Chemi-Mechanical pulping	Mechanical pulp	0.47	93%	25%
Papermaking and related processes	Non-integrated paper and board mill (excluding speciality paper)	0.36	100%	25%

3.4.1.3 Total Nitrogen (TN)

The most significant activities for TN in the pulp, paper and board sector are sulphite pulp mill manufacturing NSSC pulp and mechanical pulp. For both of these sectors, there are estimated to be large % reductions for meeting both upper and lower BAT-AELs, with potential 94-98% savings in the case of lower BAT-AELs and 82-83% for upper BAT-AELs for both sectors. In the case of non-integrated specialty paper mills, which are of medium significance, there is estimated to be a 100% emissions reduction for meeting lower BAT-AEL and 11% reduction for meeting upper BAT-AEL. The recycled fibres activity is of relatively low significance at only 0.01 kg/t.

Table 11: TN significance by process (Emissions intensity in kg/ t of product), and % emissions reduction from meeting lower and upper BAT-AELs

Sub-Sector	Process	Significance (kg/t)	Lower BAT-AEL %	Upper BAT-AEL %
Sulphite pulping process	Sulphite pulp mill manufacturing NSSC pulp	0.85	94%	83%
Mechanical pulping and Chemi-Mechanical pulping	Mechanical pulp	0.42	98%	82%
Kraft pulping process	Unbleached Kraft pulp mill	0.3	73%	44%
Papermaking and related processes	Non-integrated speciality paper mill	0.28	100%	11%
Kraft pulping process	Bleached Kraft pulp mill	0.27	88%	27%
Sulphite pulping process	Magnefite paper grade pulp	0.21	51%	8%
Sulphite pulping process	Bleached Sulphite paper grade pulp	0.19	22%	8%
Mechanical pulping and Chemi-Mechanical pulping	CTMP or CMP pulp mill	0.17	18%	8%
Papermaking and related processes	Non-integrated paper and board mill (excluding speciality paper)	0.1	95%	25%
Processing paper for recycling	Recycled fibres pulp, produced without deinking	0.08	96%	18%
Processing paper for recycling	Recycled fibres pulp, produced with deinking	0.01	38%	8%

3.4.1.4 Total Phosphorus (TP)

The most significant processes for TP in the pulp, paper and board sector are magnefite paper grade pulp, bleached sulphite paper grade pulp, and bleached kraft pulp mills. The emissions reductions from meeting lower BAT-AELs are estimated to be high for these processes, from 86-95%. Percentage reductions for these processes from meeting upper BAT-AELs are estimated to be significantly lower, at 31-52%. In the case of non-integrated specialty paper mills, which is of medium significance at 0.03 kg/t, percentage reductions for meeting lower BAT-AEL is estimated to be 99%, while emissions appear to already be below the upper BAT-AEL resulting in 9% reduction.

Table 12: TP significance by process (Emissions intensity in kg/ t of product), and % emissions reduction from meeting lower and upper BAT-AELs

Sub-Sector	Process	Significance (kg/t)	Lower BAT-AEL %	Upper BAT-AEL%
Sulphite pulping process	Magnefite paper grade pulp	0.09	95%	35%
Sulphite pulping process	Bleached Sulphite paper grade pulp	0.06	89%	31%
Kraft pulping process	Bleached Kraft pulp mill	0.06	86%	52%
Kraft pulping process	Unbleached Kraft pulp mill	0.03	73%	44%
Papermaking and related processes	Non-integrated speciality paper mill	0.03	99%	9%
Processing paper for recycling	Recycled fibres pulp, produced with deinking	0.02	94%	16%
Sulphite pulping process	Magnefite paper grade pulp	0.02	41%	8%

Sub-Sector	Process	Significance (kg/t)	Lower BAT-AEL %	Upper BAT-AEL%
Processing paper for recycling	Recycled fibres pulp, produced without deinking	0.01	96%	61%
Mechanical pulping and Chemi-Mechanical pulping	Mechanical pulp	0.01	94%	48%
Mechanical pulping and Chemi-Mechanical pulping	CTMP or CMP pulp mill	0.01	89%	8%
Papermaking and related processes	Non-integrated paper and board mill (excluding speciality paper)	0.01	55%	8%

3.4.1.5 Halogenated Organic Compounds (AOX)

No lower BAT-AELs are set for AOX in the pulp, paper and board sector. The most significant process for AOX in this sector is recycled fibres pulp, produced without deinking (wet strength paper). For this process, there is estimated to be high percentage emission reductions for meeting the upper BAT-AEL (91%). For all other processes, there is anticipated to be little or no reduction for meeting upper BAT-AEL. This is due to the fact that current emissions levels are either close to or already below the upper BAT-AELs for these processes.

Table 13: AOX significance by process (Emissions intensity in kg/ t of product), and % emissions reduction from meeting upper BAT-AEL

Sub-Sector	Process	Significance (kg/t)	Lower BAT-AEL %	Upper BAT-AEL%
Processing paper for recycling	Recycled fibres pulp, produced without deinking (wet strength paper)	0.73	-	91%
Kraft pulping process	Bleached Kraft pulp mill	0.17	-	6%
Papermaking and related processes	Non-integrated speciality paper mill	0.01	-	0%
Papermaking and related processes	Non-integrated paper and board mill (excluding speciality paper)	0.01	-	0%

3.4.2 Chlor-alkali (CAK)

3.4.2.1 Mercury emission

In the CAK BREF mercury emissions to water will be eliminated with a BAT conclusion that has no BAT-AEL. A conclusion that rejects the use of mercury cells (phase out) will lead to a reduction of around 80 kg of mercury per year in the European Union. The data in the table below was not taken from the CAK BREF but from industrial federation (EuroChlor, 2015) reports.

Table 14: Emission to water of mercury from CAK plants in 2016 based on Eurochlor data

Site	Production rate (t/y)	Specific Mercury emission (g/t of product)	Mercury load emission (kg Hg/y)
Belgium INOVYN	86,028	0.011	0.95
Belgium VYNOVA	205,000	0.009	1.85
Czech Republic Spolana	135,167	0.192	25.95
Czech Republic Spolchemie	61,276	0.123	7.54

Site	Production rate (t/y)	Specific Mercury emission (g/t of product)	Mercury emission load (kg Hg/y)
Finland AkzoNobel Oulu	40,219	0.042	1.69
France PC Loos	18,040	0.069	1.24
France S P C H Harbonnières	22,550	0.002	0.05
France KEM ONE Lavera	152,167	0.079	12.02
Germany Evonik Lülsdorf	137,400	0.015	2.06
Germany Akzo Nobel Ibbenbüren	125,276	0.001	0.13
Germany BASF SE Ludwigshafen	174,711	0.01	1.75
Hungary BORSODCHEM Zrt. Kazinckarcika	130,853	0.047	6.15
ITALIA Hydrochem Italia Pieve Vergonte	41,995	0.00	0.00
Spain Ercros Flix	78,434	0.021	1.65
SPAIN INOVYN Martorell	217,653	0.009	1.96
SPAIN Electroquímica Onubense, S.L. Palos	47,496	0.017	0.81
Spain ELNOSA Pontevedra/ Lourizan	33,552	0.009	0.30
SPAIN ERCROS, S.A. Vilaseca	135,004	0.048	6.48
SPAIN Solvay Torrelavega	62,747	0.089	5.58
Sweden INOVYN Stenungsund	120,000	0.003	0.36
Total EU	2,025,568	-	78.50

3.4.3 Large Combustion Plants (LCP)

3.4.3.1 All Pollutants

There are many pollutants in the LCP sector where current emissions levels are already close to upper and lower BAT-AELs, and as such there are estimated to be relatively limited reductions. Mercury is the pollutant for which meeting BAT-AELs is estimated to produce the largest reductions in emissions; 16% for meeting the upper BAT-AEL and 95% for meeting the lower BAT-AEL. The baseline values used to estimate these emission reductions come from well performing plants so reductions are likely to be greater for most plants.

Table 15: Pollutant significance by process (Emissions/tonne of product), and % emissions reduction from meeting lower and upper BAT-AELs

Pollutant/ Parameter	Sub-Sector	Process	Sig.	Units	Lower BAT-AEL %	Upper BAT-AEL%
COD	Generic	Flue gas treatment systems	95.04	kg/d	18%	16%
TOC	Generic	Flue gas treatment systems	35.64	kg/d	23%	16%
TSS	Generic	Flue gas treatment systems	23.76	kg/d	30%	16%
Fluoride	Generic	Flue gas treatment systems	23.76	kg/d	23%	16%

Pollutant/ Parameter	Sub-Sector	Process	Sig.	Units	Lower BAT-AEL %	Upper BAT-AEL%
Sulphate	Generic	Flue gas treatment systems	2.8	kg/d	20%	16%
Sulphite	Generic	Flue gas treatment systems	2.4	kg/d	49%	16%
Sulphide	Generic	Flue gas treatment systems	0.12	kg/d	16%	16%
Zn	Generic	Flue gas treatment systems	47.52	g/d	77%	16%
As	Generic	Flue gas treatment systems	11.88	g/d	50%	17%
Cr	Generic	Flue gas treatment systems	11.88	g/d	35%	16%
Cu	Generic	Flue gas treatment systems	11.88	g/d	29%	16%
Ni	Generic	Flue gas treatment systems	11.88	g/d	37%	16%
Pb	Generic	Flue gas treatment systems	11.88	g/d	20%	16%
Cd	Generic	Flue gas treatment systems	4.75	g/d	37%	16%
Hg	Generic	Flue gas treatment systems	4.75	g/d	95%	16%

3.4.4 Food, Drink and Milk Industries (FDM)

Information presented for the FDM BREF is from a Draft 1 document, and as such a final version has not been published nor have the BAT Conclusions been adopted. In the FDM sector, significance of pollutants is measured in different units across sub-sectors and as such relative significance is not easily ascertained. The technical working group members of the FDM BREF review have determined that a different format of expression was required for each different sub sector.

3.4.4.1 Total Suspended Solids (TSS)

Reductions for meeting BAT-AELs for TSS are estimated to be 84% to 96% for meeting upper and lower BAT-AELs respectively in the fruit and vegetables sub-sector. In the case of generic food, drink and milk plants, reductions are likely to be low for meeting upper BAT-AELs at only 45%, and high for meeting lower BAT-AELs (95%).

Table 16: TSS Significance by process (Emissions intensity per unit of product), and % emissions reduction from meeting lower and upper BAT-AELs

Sub-Sector	Process	Sig.	Units	Lower BAT-AEL %	Upper BAT-AEL%
Fruit and vegetables	All Processes	453	g/tonne of products	96%	84%
Sugar manufacturing	All Processes	271	g/tonne of beet processed	98%	97%
Dairies	All Processes	150	g/tonne of raw materials	98%	86%
Generic	All Processes	83.1	mg/l	95%	45%
Oilseed processing	All Processes	31.5	g/tonne of products	-	78%

3.4.4.2 Total Phosphorus (TP)

For phosphorus emissions, the % reduction for meeting BAT-AELs is estimated to be 89% for upper BAT-AEL and 97% for lower BAT-AEL in the fruit and vegetables sector. In the case of generic food, drink and milk manufacturing plants, there is a large difference in meeting upper vs. lower BAT-AELs, 63% and 98% respectively. In the case of breweries, meeting the upper BAT-AEL is only likely to result in limited reductions (20%) as current levels are already close to the BAT-AEL.

Table 17: TP significance by process (Emissions intensity per unit of product), and % emissions reduction from meeting lower and upper BAT-AELs

Sub-Sector	Process	Sig.	Units	Lower BAT-AEL %	Upper BAT-AEL%
Fruit and vegetables	All Processes	46.7	g/tonne of products	97%	89%
Generic	All Processes	11.1	mg/l	98%	63%
Dairies	All Processes	6.53	g/tonne of raw materials	97%	55%
Oilseed processing	All Processes	4.01	g/tonne of products	98%	72%
Sugar manufacturing	All Processes	1.32	g/tonne of beet processed	94%	41%
Brewing	All Processes	0.55	g/hl	72%	20%

3.4.4.3 Total Organic Carbon (TOC)

In generic food, drink and milk manufacturing plants, the average significance is 12.9 mg/l for TOC. There are likely to be limited reductions in emissions for meeting the upper BAT-AEL as current levels are already close to this. There is a 44% reduction estimated for meeting the lower BAT-AEL.

Table 18: TOC significance by process (Emissions intensity in mg/l), and % emissions reduction from meeting lower and upper BAT-AELs

Sub-Sector	Process	Significance (mg/l)	Lower BAT-AEL %	Upper BAT-AEL%
Generic	All Processes	12.9	44%	16%

3.4.4.4 Total Nitrogen (TN)

For nitrogen emissions, in the case of the fruit and vegetable sub-sector, reductions are estimated to be high for meeting both upper BAT-AEL (84% in g/tonne of product) and lower BAT-AEL (97% in g/tonne of product). In the case of sugar manufacturing, brewing and generic food, drink and milk manufacturing plants, there are likely to be limited reductions for meeting the upper BAT-AEL as current levels are already close to this.

Table 19: TN Significance by process (Emissions intensity per unit of product), and % emissions reduction from meeting lower and upper BAT-AELs

Sub-Sector	Process	Sig.	Units	Lower BAT-AEL %	Upper BAT-AEL%
Fruit and vegetables	All Processes	311	g/tonne of products	97%	84%
Dairies	All Processes	20.6	g/tonne of raw materials	83%	39%
Sugar manufacturing	All Processes	13.7	g/tonne of beet processed	95%	22%
Generic	All Processes	11.7	mg/l	97%	16%
Oilseed processing	All Processes	8.8	g/tonne of products	99%	56%
Brewing	All Processes	1.55	g/hl	87%	10%

3.4.4.5 Chemical Oxygen Demand (COD)

Chemical oxygen demand (COD) is a key parameter in the FDM sector, where organic loads are frequently large. For meeting lower BAT-AEL, percentage reductions are estimated to be 86-99%. In some instances, such as for breweries, meeting the upper BAT-AEL provides lower reductions in pollutants (49%).

Table 20: COD significance by process (Emissions intensity per unit of product), and % emissions reduction from meeting lower and upper BAT-AELs

Sub-Sector	Process	Sig.	Units	Lower BAT-AEL %	Upper BAT-AEL%
Fruit and vegetables	All Processes	1256	g/tonne of products	97%	87%
Sugar manufacturing	All Processes	1044	g/tonne of beet processed	99%	98%
Generic	All Processes	397	mg/l	92%	88%
Dairies	All Processes	324.9	g/tonne of raw materials	97%	71%
Oilseed processing	All Processes	110.51	g/tonne of products	98%	70%
Brewing	All Processes	22.2	g/hl	86%	49%

3.4.5 Manufacture of Glass (GLS)

3.4.5.1 All Pollutants

Acid polishing is the only process in the glass manufacturing BREF for which there are both BAT-AELs and current emission levels. In the case of all pollutants, there is only an upper BAT-AEL, and meeting this is not expected to result in large emissions reductions, ranging from 16 to 25%.

Table 21: Pollutant significance by process (Emissions intensity in kg/ t of product), and % emissions reduction from meeting upper BAT-AELs

Pollutant/ Parameter	Sub-Sector	Process	Sig. (kg/t)	BAT-AEL%
SO4	Domestic glass	Acid polishing	500	16%
TSS	Domestic glass	Acid polishing	25	25%
F	Domestic glass	Acid polishing	3	16%
Sb	Domestic glass	Acid polishing	0.05	16%
Pb	Domestic glass	Acid polishing	0.025	16%

3.4.6 Wood-based Panels Production (WBP)

3.4.6.1 All Pollutants

For meeting BAT-AELs in the wood based panels sector, there is an estimated 74% reduction in t/y for meeting upper BAT-AEL and 97% reduction for meeting lower BAT-AEL. In the case of TSS, reductions are estimated to be 53-64% for meeting the upper BAT-AEL and 92-99% for meeting the lower one.

Table 22: Pollutant significance by process (Emissions in average T/y), and % emissions reduction from meeting lower and upper BAT- AELs

Pollutant/ Parameter	Sub-Sector	Process	Significance (T/y)	Lower BAT-AEL %	Upper BAT-AEL%
COD	Generic	Process water	610	97%	74%
TSS	Generic	Process water	80	99%	64%
TSS	Generic	Surface run-off water	70	92%	53%

3.4.7 Refining of Mineral Oil and Gas (REF)

3.4.7.1 All Pollutants

In the refineries sector, the most significant parameter is COD (related with organic load) at 66 mg/l of product. Emissions reductions for this process are estimated to be small for meeting the upper BAT-AEL as current levels are already close to it, and reductions for meeting the lower BAT-AEL are estimated to be 64%. For HOI, reductions are estimated to be high for meeting both the upper BAT-AEL (86%) and the lower BAT-AEL (98%). For all other pollutants, there are likely to be small reductions from meeting the upper BAT-AELs as emissions intensities are already close to them with greater variations for meeting the lower BAT-AEL.

Table 23: Pollutant significance by process (Emissions intensity), and % emissions reduction from meeting lower and upper BAT-AELs

Pollutant/ Parameter	Sub-Sector	Process	Sig. (mg/l)	Lower BAT-AEL %	Upper BAT-AEL%
COD	Generic	Waste water treatment	66	64%	8%
(HOI) Hydrocarbon Oil Index	Generic	Waste water treatment	15	98%	86%
TSS	Generic	Waste water treatment	15	76%	10%
Total nitrogen	Generic	Waste water treatment	8	93%	8%
Ni	Generic	Waste water treatment	0.01	61%	8%
Benzene	Generic	Waste water treatment	0.005	63%	9%
Pb	Generic	Waste water treatment	0.001	10%	8%
Cd	Generic	Waste water treatment	0.001	51%	29%
Hg	Generic	Waste water treatment	0.0002	60%	15%

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3.4.8 Iron and Steel Production (IS)

3.4.8.1 All Pollutants

In the Iron and Steel production sector, only upper BAT-AELs are set. Reductions for meeting these vary, with limited anticipated reductions expected in the case of COD, TN, and TSS in pelletisation, TSS in sinter, and BOD (no expected reductions) and phenols in coke ovens. This is due to the fact that current emission levels are already close to the BAT-AELs for these pollutants (or below in the case of BOD in coke ovens). There are high reductions expected for meeting BAT-AELs in some processes, with an estimated 85% reduction in SCN in coke ovens and an estimated 94-96% reduction in metals in sintering and pelletisation.

Table 24: Pollutant significance by process (Emission intensity), and % emissions reduction from meeting the upper BAT-AELs

Pollutant	Process	Sig.	Units	BAT-AEL%
COD	Coke oven	422.5	mg/l	65%
COD	Sinter	300	mg/l	72%
TN	Coke oven	70	mg/l	48%
COD	Pelletisation	68.5	mg/l	16%
TSS	Sinter	30	mg/l	16%
Total N	Pelletisation	29.25	mg/l	16%
SCN-	Coke oven	17.5	mg/l	85%
BOD	Coke oven	10	mg/l	0%
TSS	Pelletisation	6.6	mg/l	16%
Sum of metals	Sinter	0.55	mg/l	94%
Phenols	Coke oven	0.15	mg/l	16%
Metals	Pelletisation	3.1	µg/l	96%

In the case of blast furnaces and steelmaking and casting, there are expected to be high reductions for meeting the upper BAT-AELs, particularly for zinc emissions in the most significant processes in basic oxygen steelmaking and blast furnaces, with anticipated reductions of 98% and 93% respectively. Conversely, there are relatively limited or no anticipated reductions for meeting the BAT-AELs in some cases, such as for TSS and iron in the case of all processes.

Table 25: Pollutant significance by process (mg/l emission intensity), and % emissions reduction from meeting the upper BAT-AELs

Pollutant	Subsector	Process	Significance (mg/l)	BAT-AEL %
Zn	Basic Oxygen steelmaking and casting	Dedusting	105.2	98%
Zn	Blast Furnaces	-	29	93%
TSS	Blast Furnaces	-	27.1	47%
Zn	Basic Oxygen steelmaking and casting	Continuous casting	18	89%
TSS	Electric arc furnace steelmaking and casting	-	17.8	24%
TSS	Basic Oxygen steelmaking and casting	Dedusting	10	16%
Pb	Blast Furnaces	-	4.2	88%
Fe	Basic Oxygen steelmaking and casting	Continuous casting	4	23%
Ni	Basic Oxygen steelmaking and casting	Continuous casting	2.4	92%

Pollutant	Subsector	Process	Significance (mg/l)	BAT-AEL %
Fe	Blast Furnaces	-	1.315	16%
Cr	Basic Oxygen steelmaking and casting	Continuous casting	0.75	52%
T HC	Basic Oxygen steelmaking and casting	Continuous casting	0.25	16%
T HC	Electric arc furnace steelmaking and casting	-	0.1	0%
Fe	Electric arc furnace steelmaking and casting	-	0.053	0%
Zn	Electric arc furnace steelmaking and casting	-	0.05	0%
Ni	Electric arc furnace steelmaking and casting	-	0.02	0%

3.4.9 Non-Ferrous Metals Industries (NFM)

In the Non-Ferrous metals BREF, there are only upper BAT-AELs presented for emissions to water. In the case of the most significant pollutants emitted to water, reductions are estimated to be high for meeting these. Copper emissions from the ferro alloys and nickel & cobalt subsectors have emissions intensities of 22 and 15 mg/l respectively, with estimated reductions of 98% and 97%. There are many metal/metalloid pollutants emitted in very limited quantities, such as Hg and As, for which there are little estimated reductions from meeting the BAT-AELs. This is due to the fact that current emission levels are already close to or below the BAT-AELs.

Table 26: Pollutant significance by process (mg/l emission intensity), and % emissions reduction from meeting the upper BAT-AELs

Pollutant	Subsector	Significance (mg/l)	Upper BAT-AEL % Reduction
Cu	Ferro alloys	22	98%
Cu	Nickel & Cobalt	15	97%
Ni	Nickel & Cobalt	10	96%
Zn	Ferro alloys	8.5	88%
Cd	Nickel & Cobalt	5	98%
Ag	Precious Metals	5	88%
Ni	Precious Metals	5	90%
Zn	Nickel & Cobalt	2.5	60%
Ni	Lead & Tin	2.4	95%
Zn	Lead & Tin	2	66%
Cu	Precious Metals	2	85%
Zn	Zinc & Cadmium	1.9	63%
Co	Nickel & Cobalt	1.5	56%
Ni	Ferro alloys	1.46	0%
Pb	Lead & Tin	1.45	82%
Cu	Lead & Tin	1	96%
Pb	Ferro alloys	1	96%

Pollutant	Subsector	Significance (mg/l)	Upper BAT-AEL % Reduction
Pb	Zinc & Cadmium	0.8	91%
Pb	Nickel & Cobalt	0.6	33%
Cd	Lead & Tin	0.55	79%
Zn	Copper	0.5	16%
Ni	Zinc & Cadmium	0.5	96%
Pb	Precious Metals	0.5	16%
Cu	Copper	0.4	16%
Ni	Copper	0.4	16% (best 89%)
As	Nickel & Cobalt	0.4	41%
Zn	Precious Metals	0.3	0%
Pb	Copper	0.2	16%
Cr T	Ferro alloys	0.2	16%
Cd	Zinc & Cadmium	0.15	49%
As	Copper	0.1	16%
Cd	Copper	0.1	16% (best 75%)
As	Lead & Tin	0.1	16%
As	Zinc & Cadmium	0.1	16%
As	Precious Metals	0.1	16%
As	Ferro alloys	0.08	0%
Cu	Zinc & Cadmium	0.05	0%
Cd	Precious Metals	0.05	16%
Hg	Precious Metals	0.05	16%
Cr vi	Ferro alloys	0.04	16%
Cd	Ferro alloys	0.025	0%
Hg	Copper	0.024	17% (best 78%)
Hg	Lead & Tin	0.024	0%
Hg	Nickel & Cobalt	0.006	0%
Hg	Ferro alloys	0.005	0%
Hg	Zinc & Cadmium	0.002	0%

3.4.10 Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector (CWW)

In the CWW BREF, BAT-AELs are set for major pollutants such as COD, TOC, TSS and Total N and P as well as metals. For the most high-volume intensity pollutants, there are savings from meeting the upper BAT-AELs of 33% to 56% reductions in emissions. Meeting the lower BAT-AELs by comparison results in reductions of around 61-74% reductions for the highest intensity pollutants (COD, TOC, TSS, Total N).

Table 27: Pollutant Significance by Process (mg/l emission intensity), and % emissions reduction from meeting lower and upper BAT-AELs

Pollutant	Subsector	Sig.	Unit	Lower BAT-AEL reduction%	Upper BAT-AEL reduction%
COD	All Processes	100	mg/l	66%	49%
TOC	All Processes	50	mg/l	72%	56%
TSS	All Processes	40	mg/l	61%	56%
Total N	All Processes	20	mg/l	74%	33%

Pollutant	Subsector	Sig.	Unit	Lower BAT-AEL reduction%	Upper BAT-AEL reduction%
Total P	All Processes	1	mg/l	59%	33%
AOX	All Processes	0.2	mg/l	57%	47%
Zn	All Processes	700.5	µg/l	97%	57%
Cu	All Processes	278	µg/l	98%	87%
Ni	All Processes	150.5	µg/l	97%	73%
Cr	All Processes	113	µg/l	96%	83%

3.4.11 Summary

In sectors identified as being of key importance for water pollution in section 3.2, estimates of impacts on emissions reduction vary. In the production of pulp, paper and board, reductions in high quantity pollutants such as COD and Total Nitrogen are generally high for meeting lower BAT-AELs, and in some cases the upper BAT-AELs as well although there is more variation between processes. In the Chlor-alkali plants 80 kg per year of mercury emissions to water will be eliminated with one BAT conclusion in this BREF. In the case of LCPs, there are small estimated reductions for many pollutants for meeting either upper or lower BAT-AELs. However, there are some exceptions where high reductions are anticipated, such as for mercury. In the FDM sector, there are estimated to be high % reductions for meeting both upper and lower BAT-AELs in TSS for the most intensive sub-sectors of fruit and vegetables, sugar manufacturing and dairies (84-98%). There are also high % reductions estimated for the most significant sub-sectors for phosphorus and COD.

3.5 Limitations

Both qualitative and quantitative analysis of potential emissions reductions to water were subject to a number of limitations. These limitations are presented in Table 28 with a brief description of the implications on the results.

Table 28: Limitations on water emission reduction analysis

Applies	Limitation	Implications
Quantitative analysis	Baseline emission values (population/spectra) are represented in certain data sets only by average values	There is a negative emission reduction outcome for the (lowest) emission reduction based on upper BAT-AEL values. This was overcome with two different assumptions that avoid negative emission reductions.
	Some BAT-AEL ranges are very wide	This generates much greater uncertainty on the emission reduction estimation than a narrow BAT- AEL range would deliver
	BREFs do not provide numbers (on baseline or potential emission reductions) for each manufacturing process of an industrial sector	Data was not available for all manufacturing processes per BREF
	Number of installations is missing for certain subsectors.	This blocks an overall sector estimation impact (even if robust data available on specific water emissions).
	Some BREFs do not provide contextual information (e.g. emission stream flowrates) to convert BAT-AEL and baseline data from concentration to load	

4 Reducing water use in industrial installations

4.1 Overview

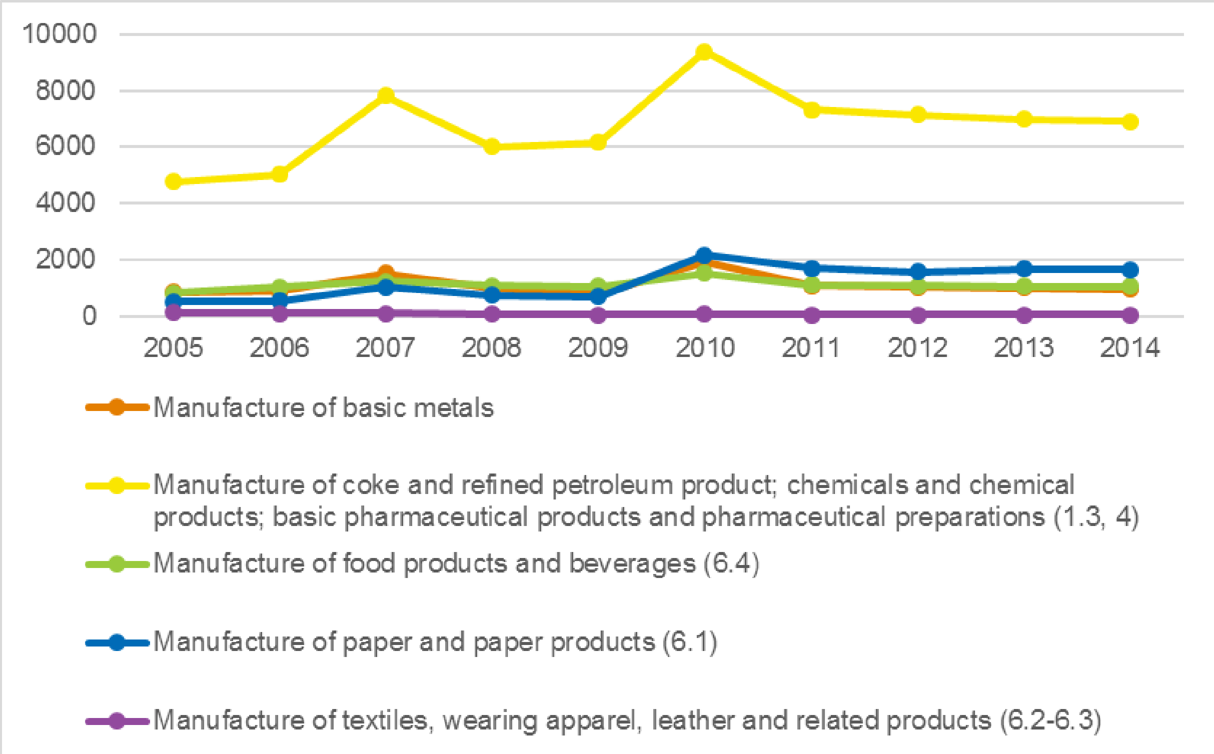
This section is focused on industrial usage of water (Task C of the study). It first provides a reference scenario based on Eurostat data (Section 4.2). Water consumption per sector, limitations and data gaps are summarised along with requirements and good practices described in BREFs.

The core content of section 4 is to describe the outcome of the qualitative (section 4.3.3) and quantitative (section 4.4) analysis of water usage reductions potentially generated by the techniques referred to in BREFs.

4.2 Water consumption in industrial installations

Data on water consumption in EU industry was gathered as part of the Member State industry profiles study, first from the Eurostat database, and then estimates were made based on available information in the BREFs. On Eurostat, in the dataset "Water use in the manufacturing industry by activity and supply category" [env_water_ind] (Eurostat, 2016), the number of industries with data is low, with the broad category encompassing coke production and the chemical sector having the highest water use. Extrapolation was used to fill data gaps where gaps for 2014 and 2015 were preceded by at least 3 years of data.

Figure 14: Water Consumption in EU Industries (Millions of Cubic Metres) (Eurostat)



In addition to water use data from Eurostat, estimates of sector water use significance were made through analysis of the BREFs (see Table 29). The data is expressed in loads as a result of multiplying process intensity by sector annual production. The IRPP sector is a high water usage sector mainly due to the significant number of installations. For the IRPP sector the data from the BREF was not robust and inconsistent with alternative data sources reviewed. From this analysis, the refineries sector was identified as a particularly high water use sector, with iron and steel and pulp, paper and board also particularly significant. Of these high usage activities, the latter is the most water intensive, with an intensity of 20 m^3 per tonne of production. In the case of refineries, intensity is just 4 m^3 per tonne of production, however the tonnage production of the industry is high at 600,000 kilo tonnes per year.

When data was not available in the BREF other sources were used: (Concawe, 2015), (Cembureau, 2017), (Lafarge, 2011), (EPF, 2016), (Cotance, 2012), (Cefic, 2017).

Table 29: Water Usage estimates from analysis of BREFs [Source: Ricardo Energy & Environment elaboration based mainly on BREFs]

Sector (BREF)	Production	Production Unit	Water usage	Water use Unit	Usage (k m^3/y)
IRPP (1)	33,000	k t/y	3909	m^3/t	(2)*Not available*
REF	600,000	k t/y	4	m^3/t	2,400,000
IS	200,000	k t/y	5.5	m^3/t	1,100,000
LVOC (1)	300,000	k t/y	3	m^3/t	900,000
PP	41,600	k t/y	20	m^3/t	832,000
GLS	37,000	k t/y	8.7	m^3/t	321,900
LCP	1,000,000	k MWh/y	0.1-7(3)	m^3/MWh	200,000
NFM	20,000	k t/y	7.4	m^3/t	148,000
CLM	167,000	k t/y	0.32	m^3/t	53,440
CAK	10,000	k t/y	3.3	m^3/t	33,000
TAN	200,000	k m^2/y	0.13	m^3/m^2	26,000
WBP	46,000	k m^3/y	0.46	m^3/m^3	21,160

(1) Lower accuracy for IRPP and LVOC due to lack of data availability for some subsectors

(2) Data from BREF was not robust and inconsistent with alternative data sources reviewed

(3) Data for LCP varies significantly with cooling system approach in place and with air emission abatement techniques selected

4.3 Requirements and good practices in BREFs and BATC

This section analyses the potential impact of BREFs on European industrial water consumption. The first subsection, 4.3.1, describes the performance levels on water usage that are included within BAT Conclusions as a BAT-associated environmental performance level (so called BAT-AEPL). A second subsection, 4.3.2, presents an analysis of the techniques described and selected in the BREFs.

4.3.1 Associated environmental performance levels related to water consumption

There is a number of BREFs that provide robust and useful reference values on manufacturing process water usage. However, very few BREFs have established BAT-AEPLs on water usage in the BAT conclusion sections. For a large water usage sector such as refineries (REF) BAT-AEPLs on water usage have not been set.

Some BREFs (such as PP or FDM draft1) include BAT conclusions on water use but have included a BAT-AEPL on a different parameter e.g. water effluent flow. In some processes there is a justified correlation between water usage and water effluent flow.

There are a few exceptions to this generic absence of water usage BAT-AEPL, which are listed and described in Table 30.

Table 30: BAT-AEPLs on water usage in BREFs

BREF	Subsector	BAT-AEPL	units	Comments
TAN	salted bovine hides (Raw to wet blue/white)	13-18	m^3/t of product	The previous reference document, developed under the IPPC Directive had only one BAT-AEPL on water consumption
	salted bovine hides (Post-tanning processes and finishing)	6-10	m^3/t	

BREF	Subsector	BAT-AEPL	units	Comments
	salted bovine hides (total)	19-28	m^3/t	
	unsalted bovine hides (Raw to wet blue/white)	10-15	m^3/t	
	unsalted bovine hides (Post-tanning processes and finishing)	6-10	m^3/t	
	unsalted bovine hides (total)	16-25	m^3/t	
	Sheep skin (Raw to pickle)	65-80	l/skin	
	Sheep skin (Pickle to wet blue)	30-55	l/skin	
	Sheep skin (Post-tanning processes and finishing)	15-45	l/skin	
	sheep skins (total)	110-180	l/skin	
FDM	fish& selfish (mackerel)	<2	m^3 / tonne of product	IED draft: BAT conclusions chapter devoted to water usage with BAT-APELs. The specific feature of this BREF is that the conclusion that aims to limit water usage (and selects BATs for that purpose) has set BAT-AEPL on water effluent instead of water uptake.
	fish& selfish (white fish)	1.8-2.2	m^3 / tonne of product	
	fish& selfish (market milk)	0.6-1.8	l/l of product	
	milk & dairy (milk powder)	0.8-1.7	l/l of product	
	milk & dairy (ice-cream)	4-5	l/kg of product	
POL	Unsaturated Polyester (UP)	1-5	m^3/t of product	BREF under the IPPC Directive. Only generic BAT (no specific BATs)
	Viscose staple fibres (process water)	35-70	m^3/t of product	
	Viscose staple fibres (cooling water)	189-260	m^3/t of product	
SIC	explosive production	<50	m^3/t of product	BREF under the IPPC Directive. BAT: recycle waste water into production process when justified using an evaporator/concentrator
STM	installations using an electrolytic or chemical process where the volume of the treatment vats exceeds 30 m^3	3 - 20	l/m^2/rinse stage	BREF under the IPPC Directive. It has not been yet reviewed under the IED
TXT	wool scouring with water (medium and large mills)	2-4	l / kg greasy wool	BREF review started in summer 2017

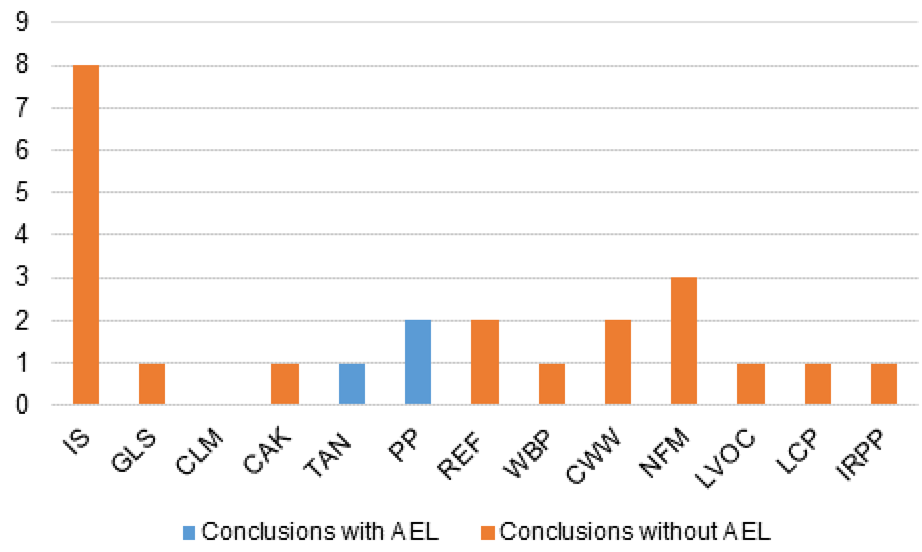
BREF	Subsector	BAT-AEPL	units	Comments
	wool scouring with water (small mills)	<6	l / kg greasy wool	

Difficulties arise when establishing BAT-AEPLs for water consumption or water re-use. Technical Working Group members face several challenges when addressing water usage topics in the BREF reviews:

- Some techniques show **cross-media effects**: e.g. a scrubber may reduce the emissions to air of a manufacturing process unit but will increase the water usage and emissions to water. In these cases, a holistic approach is required to prioritise one environmental aspect against another.
- BREFs struggle to deal with every different process in a given sector (or subsector). BREFs focus data collection efforts on reference plants for the main polluting processes solely. The data collected to underpin the BAT-AELs cannot be then generalised because the water usage drivers or features are normally different for different processes in the same subsector. This fact **limits the generalisation of a water BAT-AEPL for a wider set of processes.** For example, in one process the water usage may be driven by air abatement device and in another process may be driven by raw material usage of one product in the portfolio.
- Industrial operators and other IED stakeholders perceive that the **IED priority is to limit emissions** (to water, air or reduce waste generation).
- Energy consumption has become more relevant on industrial policy agenda but raw materials are still seen, by many industrial operators, as part of their own decision making.
- **Raw material consumption, such as water, is perceived as commercially sensitive information by operators.**

An analysis has been carried out in the reference documents to identify BAT conclusions that address water intake. This exercise did not take into account indirect water usage savings that may occur when reducing water effluent loads. The majority of BAT conclusions do not contain a BAT- AEPL. Figure 15 shows that, in the BREFs reviewed under IED so far, there are only 20 conclusions on water usage. BAT conclusions reducing effluent flow has been included here since they have certain impact in water intake. There are therefore far less conclusions on water usage than there are on emissions to water. Of these water usage conclusions, 95% of techniques related to water consumption do not contain a BAT-AEPL. This prevents estimation of water consumption reductions.

Figure 15: Water usage conclusions in IED BREFs



4.3.2 Techniques targeting lower water usage and promoting water reuse

This section covers techniques set out in BREFs to reduce consumption of water with a particular focus on the techniques selected, in BAT conclusions, as BAT.

4.3.3 Classification of BAT conclusions on water usage

The BAT conclusions on industrial water usage in BREFs can be analysed with respect to:

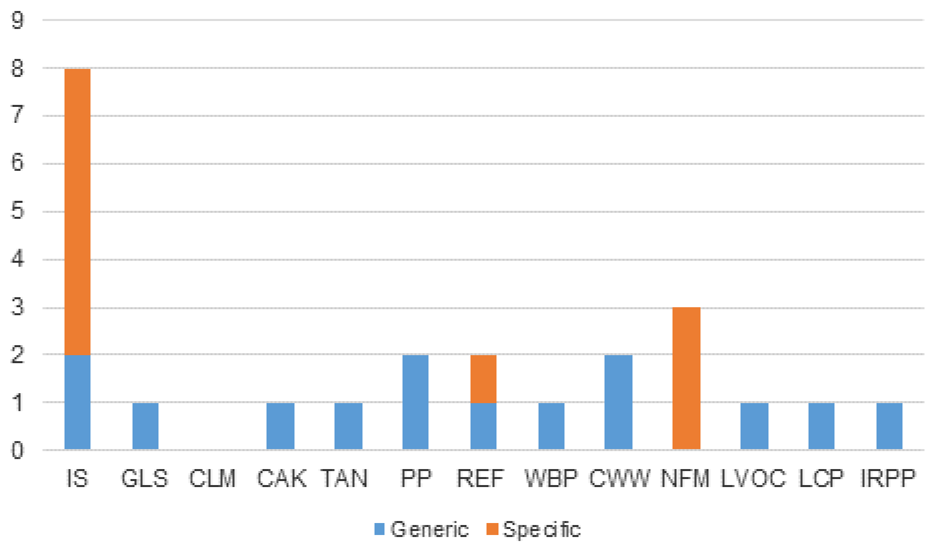
- Whether a conclusion applies to whole sector **(general)** or is **process-specific**. See section 4.3.4 in this document.
- **The nature** of the conclusion that is proposed. In some occasions one BAT conclusion may contain various types of BATs. See section 4.3.5 in this document.

4.3.4 Generic or specific conclusions on water usage

In BREFs generic or specific techniques are included to reduce water usage. These two concepts are described in detail in section 3.3.2 of this document.

Most BREFs reviewed under IED contain only generic techniques to reduce water usage (55% of total conclusions) although the Iron and Steel the Non Ferrous Metal BREFs subsector specific approaches are different in this respect. Figure 16 presents an overview of the proportion of generic water usage conclusions in the IED BREF series (including also conclusions on water effluent reduction, not only intake).

Figure 16: BAT conclusions on water usage in BREFs



The figure shows that:

- Three BREFs do not contain any conclusions with water consumption reduction targets: Pulp, paper and board, Cement, lime and magnesium oxide and Chlor-alkali. Although some of these BREFs and BATC (e.g. PP and CAK) do include requirements for water effluent which are likely to have knock on impacts for water reuse and recycling and therefore overall consumption.
- The structure of the Iron and Steel BREF (using specific BAT conclusions more than generic ones) leads to a large number of similar techniques on water usage.

Generic techniques on water usage are included in Table 31.

Table 31: Examples of generic BAT conclusions on water usage

BREF	BAT conclusion	BAT # (page)	Water
IRPP	*In order to use water efficiently, BAT is to use a combination of the techniques given below. (a) Keep a record of water use…*	5 (731)	Consumption
LCP	*In order to reduce water usage and the volume of contaminated waste water discharged, BAT is to use one or both of the techniques given below. (a).Water recycling….*	13 (23)	Consumption

Process specific techniques on water usage are shown in Table 32.

Table 32: Examples of specific BAT conclusions on water usage

BREF	BAT conclusion	BAT # (page)	Water
REF	*In order to reduce water consumption and emissions to water from the desalting process, BAT is to use one or a combination of the techniques given below. (i). Recycling water and optimisation of the desalting process…*	33 (609)	Consumption
IS	*BAT is to minimise water consumption in sinter plants by recycling cooling water as much as possible unless once-through cooling systems are used*	27 (497)	Consumption

4.3.5 Nature of BAT conclusions for water consumption reduction in BREFs

The BREFs include a number of techniques to reduce the impact of European industrial installations on water usage. In order to facilitate characterisation of these techniques, a set of categories were created (discussed further below). In this section the analysis is done on the BATs set out in each BREF.

Holistic BATs: this category includes best practices that are related to water management approaches. Table 33 provides illustrative examples of these BATs.

Table 33: Examples on holistic BAT conclusions for water usage techniques

BREF	BAT conclusions	BAT # (page)	Water
GLS	*BAT is to reduce water consumption by using one or a combination of the following techniques: (i) Minimisation of spillages and leaks, …*	12 (335)	Consumption
IS	*BAT for waste water management is to prevent, collect and separate waste water types, …. This includes techniques utilising, e.g. oil interceptors, filtration or sedimentation*	12(490)	Emission & Consumption

Recycle and/or reuse: a large number of BATs impose the reuse or recycle of water streams. Some of these BATs are more precise whilst others are more vague. These BATs can be specified in both generic or specific BAT Conclusions.

Table 34: Examples on water usage conclusion related with reuse or recycle

BREF	BAT conclusions	BAT # (page)	Water
REF	*In order to reduce water consumption and emissions to water from the desalting process, BAT is to use one or a combination of the techniques given below. (i). **Recycling water** and optimisation of the desalting process…*	33 (609)	Consumption

BREF	BAT conclusions	BAT # (page)	Water
IS	*BAT is to minimise water consumption in sinter plants by* ***recycling*** *cooling water as much as possible unless once-through cooling systems are used*	27 (497)	Consumption

Process design related: these BATs are related with primary (core process design) or secondary (abatement) techniques. Some examples of this type of BAT are included in Table 35.

Table 35: Examples on BAT conclusion for water usage based on process design

BREF	BAT conclusions	BAT # (page)	Water
IS	*BAT for pelletisation plants is to minimise the water consumption and* ***discharge of scrubbing, wet rinsing*** *and cooling water and reuse it as much as possible*	38 (501)	Emission and consumption
IS	*BAT is to minimise and* ***reuse quenching water*** *as much as possible*	53 (507)	Emission and consumption

There are also other BATs that do not fit with the categories mentioned above such as generating inventories of water streams. Figure 17 shows an overview of the nature of water consumption BATs across the IED BREFs.

Figure 17: Nature of BAT conclusions on water usage

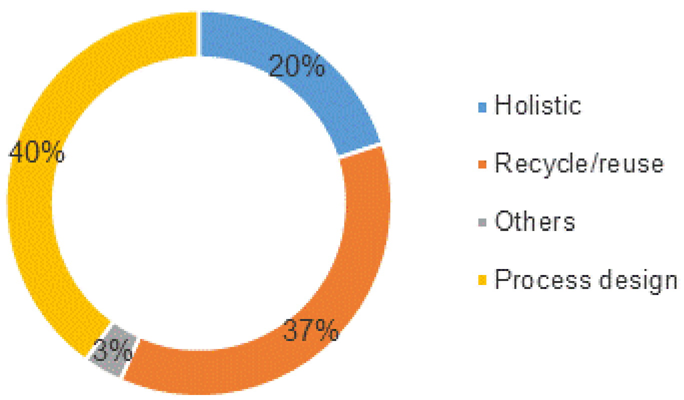
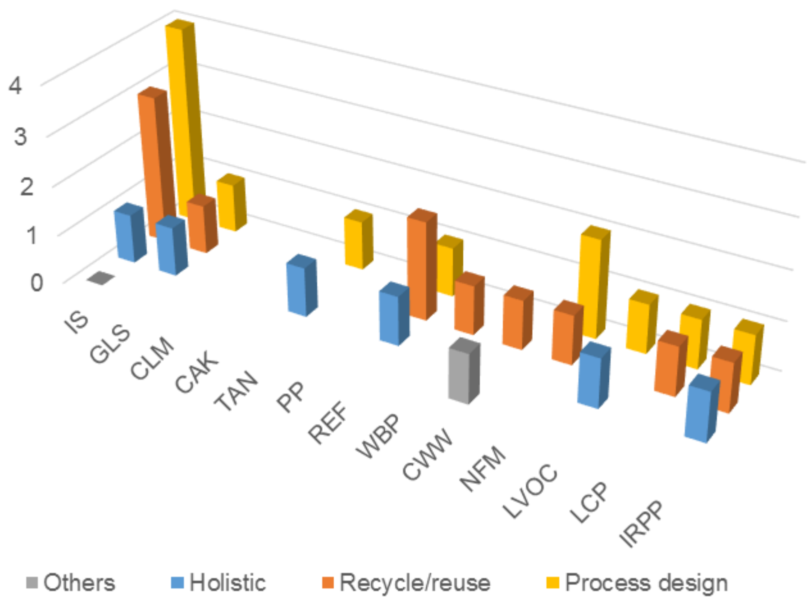


Figure 18 presents the same data disaggregated by BREF.

Figure 18: Nature of BAT conclusions on water usage per BREF



4.3.6 Determination of reductions in water use and of water reuse potential

A relatively high-level assessment was undertaken to provide some estimates of the potential impacts these techniques could have on water usage. This has been done on two large industrial water consuming sectors: refineries and pulp, paper and board.

Step 1: The key techniques on water use were analysed to capture their efficiency or performance values. Information on BAT conclusions was reviewed, focusing on potential impacts on water consumption. This information is shown in Table 36. This table shows that the information on the technique description is usually either not present, imprecise or very broad. Only one technique out of the 11 analysed contained a representative numeric value. Others contained reference or sample values. A number of the techniques selected in the water use BAT conclusions are not formally (10 headings template) described in the BREF.

Step 2: Information on existing uptake and/or application of key techniques within different sectors was summarised to avoid overestimating the impacts of potential techniques. Again, the information within BREFs for current uptake of each technique is either qualitative, imprecise or not present. No numeric value was available for the techniques reviewed.

Table 36: Summary of water usage techniques in PP and REF BREFs

BREF	BATC	Technique	Source usage	Efficiency	Current uptake (Taken from BREFs)
REF	BAT #11 (i)	Water stream segregation	4 m^3/t	*> 50% (example: 0.5 m3/t saving)*	*Most refineries*
REF	BAT #11 (ii)	Water and drainage system for segregation of contaminated water streams		*Varies from refinery to refinery*	*Not many*
REF	BAT #11 (iii)	Segregation of non-contaminated water streams (e.g. once-through cooling, rain water)		No information provided	*In a number of refineries*
REF	BAT #11 (iv)	Prevention of spillages and leaks			*Common practice*

BREF	BATC	Technique	Source usage	Efficiency	Current uptake (Taken from BREFs)
PP	BAT #5 (a)	Monitoring and optimising water usage		*"Reduced water consumption" / "one study..12 to 22%"*	*Most European paper mills have implemented*
PP	BAT #5 (b)	Evaluation of water recirculation options		No information provided	*Used in a number of European pulp and paper mills*
PP	BAT #5 (c)	Balancing the degree of closure of water circuits and potential drawbacks; adding additional equipment if necessary		No formal description in BREF	
PP	BAT #5 (d)	Separation of less contaminated sealing water from pumps for vacuum generation and reuse	20 m^3/t	Up to 1 m^3/t reduction	Common practice in many European mills
PP	BAT #5 (e)	Separation of clean cooling water from contaminated process water and reuse			
PP	BAT #5 (f)	Reusing process water to substitute for fresh water (water recirculation and closing of water loops)		No formal description in BREF	
PP	BAT #5 (g)	In-line treatment of (parts of) process water to improve water quality to allow for recirculation or reuse			

Step 3: An estimation of the water saving potential of these techniques was carried out to understand the order of magnitude of BREF impacts. Multiple scenarios were established reflecting both **existing uptake of techniques as well as potential future uptake**. Two estimation efforts are shown in Table 37.

- Qualitative or broad techniques efficiency were converted into discrete values e.g. converting '*one study revealed...12-22%*' into a 17% average efficiency.
- Qualitative technique uptake description was converted into numbers. For example, converting '*not many*' into a 10% uptake or '*is current practice*' into a 90% uptake.

Once these estimations were done the final outcome on water usage was calculated by multiplying the current water use by the usage reduction and technique uptakes increase (e.g. moving from 50% uptake to 100% uptake). In many techniques there was not sufficient information to attempt this sort of quantitative assessment.

Table 37: Estimation of BAT conclusions impact on PP and REF water usage

BREF	BATC	BAT Efficiency	Current BAT uptake	Future BAT uptake		Usage with BAT (m^3/t)	
		Estimated		Best Case	Worst case	Best Case	Worst case
REF	BAT #11 (i)	50%	90%	100%	90%	3.8	4
	BAT #11 (ii)	Not available (N.A.)	10%	100%	10%	No estimation possible	
	BAT #11 (iii)		25%	100%	25%		
	BAT #11 (iv)		90%	100%	90%		
PP	BAT #5 (a)	17%	90%	100%	90%	18.34	20
	BAT #5 (b)	Not available (N.A.)	50%	100%	50%	No estimation possible	
	BAT #5 (c)		Not Available (N.A)	100%	-		
	BAT #5 (d)	5%	90%	100%	90%	18.1	20
	BAT #5 (e)			100%			
	BAT #5 (f)	Not available (N.A.)		100%	-	No estimation possible	
	BAT #5 (g)			100%	-		

In this case study the water usage values and the BAT conclusions refer to generic sources (whole installations). Table 37 shows the high degree of uncertainty that any similar calculation based on BREF data would provide.

4.4 Anticipated reduction in water consumption and potential for further water reuse

Analysis on the potential impacts of the BREFs on water consumption was conducted where quantitative data was available. Tanning of Hides and Skins is currently the only BREF for which there is a BAT-AEPL on water usage. There are other BREFs that have BAT conclusions on water effluent flowrates (such as PP and CAK) but they are not analysed here since there are no direct correlations between effluent flowrates and water intakes. IPPC BREFs were also reviewed for BAT-AEPLs (see section 4.3.1). Percentage water consumption savings were calculated using BAT-AEPLs and current consumption levels from the BREFs' descriptive chapters (such as current consumption and emissions'). Sections 4.4.1, 4.4.2, 4.4.3 and 4.4.4 show IED BREFs for which quantitative estimates were possible due to the setting of BAT-AEPLs, and subsequent tables show analysis made on IPPC BREFs.

Analysis has also been made of significance of water consumption by process for BREFs which are estimated from section 4.2 to have high water usage.

4.4.1 Tanning of Hides and Skins (TAN)

The Tanning of Hides and Skins BREF sets BAT-AEPLs for water consumption in m^3 per tonne of hide in the case of bovine hides, and litre per skin piece for sheepskins. In all processes except for total water use in sheepskin tanning, meeting the Upper BAT-AELs is not estimated to result in any water savings as current levels appear to be below the Upper BAT-AEPL. Meeting the lower BAT-AEPLs is estimated to result in savings of 35-46%, except for in post tanning water use in bovine hide tanning where no reductions are foreseen.

Table 38: Water consumption significance by process and % consumption savings from meeting lower and upper BAT-AEPLs in Tanning of Hides and Skins BREF

Process	Sig.	Units	Upper BAT-AEPL %	Lower BAT-AEPL%
Salted bovine hides (or goatskins) Total Water	24.5	m^3/t hide	0%	35%
Salted bovine hides (or goatskins) Post tanning	6	m^3/t hide	0%	0%
Sheepskins (wet-salted) Total Water	202.5	l/skin piece	11%	46%
Sheepskins (wet-salted) Post Tanning	25	l/skin piece	0%	40%

4.4.2 Production of Polymers (POL)

The Production of Polymers BREF set BAT-AEPLs for tonnes of water consumption per tonne of product. The most intensive processes for water consumption is cooling of the GPPS and HIPS process in polystyrene production, with 75 tonnes of water per tonne of product. Estimated savings for meeting the BAT-AEPL for these processes is 33%. There are large estimated savings in cooling of the EPS process too, at 61%. Process water usage is generally small, with estimated savings equally low, with the exception of EPS process water for which there is an estimated 48% saving.

Table 39: Water consumption significance by process (tonnes of water per tonne of product), and % consumption savings from meeting lower and upper BAT-AEPLs in POL BREF

Product / sub-sector	Process	Sig. (t/ tonne of product	BAT-AEPL % Saving
Polystyrene	GPPS (Cooling)	75	33%
Polystyrene	GPPS (Process Water)	0.6	0.33%
Polystyrene	HIPS (Cooling)	75	33%
Polystyrene	HIPS (Process Water)	0.56	7%
Polystyrene	EPS (Cooling)	43.5	61%
Polystyrene	EPS (Process Water)	4.05	48%

4.4.3 STM

The STM BREF sets a BAT-AEPL range for water consumption for the sector as a whole, with an estimated 63% saving from meeting this when considering estimated current consumption levels. No savings are expected from the upper BAT-AEL.

Table 40: Water Consumption Significance by Process (litres per m2 per rinse stage), and % consumption savings from meeting lower and upper BAT-AEPLs in STM BREF

Product / sub-sector	Sig. (l/ m^2/rinse stage)	Lower BAT-AEL % Saving	Upper BAT-AEL % Saving
All	8	63%	0%

4.4.4 Intensive Rearing of Poultry and Pigs (IRPP)

The IRPP BREF sets % reduction reference values for water consumption reductions, although there is no information on current levels of water consumption or significance (these values are not legally binding). The most noteworthy of these is a generic BAT-AEPL with a reduction of 50% for all sub-sectors and installations.

Table 41 Water consumption BAT-AEPLs in IRPP BREF

Sub-Sector	Process	BAT-AEPL %
Poultry	Multiphase feeding	8%
Pigs	Multiphase feeding	6-9%
Generic	Whole installation	50%

.

4.5 Limitations

The main limitations are similar to the ones for emission reduction that are described in section 3.5 of this document. The following additional difficulties are specific to water usage:

Table 42 Limitation on water usage analysis

Limitation	Implications
BAT-AEPLs are not legally binding: the IED states that only BAT-AELs must be incorporated into the environmental permits by the competent authorities	BAT-AEPLs on water usage have a lower chance of being incorporated into installations' environmental permits (than BAT-AELs). Assuming that all sites will meet these levels may generate a greater water usage reduction estimate than in practice
BREFs generalise water BAT-AEPL (when possible) in order to have greater impact. When carrying out these extrapolation (generalisation) efforts the BAT-AEPL may become less ambitious than the original specific data that underpinned it.	Less ambitious BAT-AEPL are derived when generalising raw sample data (from one or few processes) to cover many (others) manufacturing processes

5 Conclusions on the IED contribution to water policy objectives

5.1 Reducing pressures on water bodies from pollution

In Section 3, estimates were made of the potential emissions reductions of pollutants based on BAT-AELs set in the BREFs. Analysis was conducted to see where these emissions reductions were relevant to priority substances under the Water Framework Directive, or chemical families into which these substances fall. Emissions of priority substances were first extracted from E-PRTR, to give an indication of the extent to which these emissions are reported in E-PRTR. E-PRTR activities were converted into BREF categories according to the table presented in Appendix 3. The results of this analysis is presented in Appendix 2. It was found that a selection of priority substances was absent from E-PRTR, such as alachlor, chlorfenvinphos, hexachlorocyclohexane, and priority substances 34-45. It was also found that several sectors were seen to report emissions for a large number of priority substances, such as pulp, paper and board, refining of mineral oil and gas, non-ferrous metals production, large volume organic chemicals, large combustion plants, waste incineration and waste treatment.

The impact of IED BREFs on priority substances was assessed through analysis of the BAT reference documents looking for specific mention of pollutants in BAT-AELs and generic abatement techniques, which also contribute to reductions. In many cases, priority substances fall into chemical groups which are targeted specifically in the BREFs. For example, BREFs often set BAT-AELs for total organic carbon (TOC), or halogenated organic compounds (AOX). Where BREFs were seen to target groups that priority substances fall under, this was seen to be a relevant impact. A matrix was created presenting the estimated impact of IED BREFs and IPPC BREFs on emissions of priority and priority hazardous substances using criteria presented in Table 43. The results of analysis of the BREFs against this matrix for each priority substance are presented in Table 44 and Table 45 for IED and IPPC BREFs respectively.

Table 43: Matrix of estimated impact of BREFs on emissions of WFD Priority Substances

1	No anticipated impact of BREF on emissions
2	BREF contains BATC only for EMS, generic water emissions monitoring and/or generic abatement techniques
3	BREF contains a specific BATC for the substance (or family of substances) but no BAT-AELs have been set
4	BAT-AEL have been set for this substance (or family of substances)
5	Evaluation of the BREFs and BATCs shows that they are likely to bring about reductions in emissions

Table 44: Estimated impact of IED BREFs on priority substances. "X" indicates hazardous substances

WFD Priority substance	IS	GLS	CLM	CAK	TAN	PP	REF	WBP	NFM	LVOC	LCP	IRPP	FDM	WI	WT	CWW
(1) Alachlor	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(2) Anthracene X	5	4	2	2	5	5	4	4	2	3	4	2	5	4	2	5
(3) Atrazine	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(4) Benzene	5	4	2	2	5	5	5	4	2	3	4	2	5	4	2	5
(5) Brominated diphenylethers X (4)	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(7) Chloroalkanes, C10-13 X	5	4	2	3	2	5	4	4	2	3	4	2	5	4	2	5
(8) Chlorfenvinphos	5	4	2	3	3	5	4	4	2	3	4	2	5	4	2	5
(9) Chlorpyrifos (C	5	4	2	3	3	5	4	4	2	3	4	2	5	4	2	5
(10) 1,2-dichloroethane	5	4	2	3	5	5	4	4	2	5	4	2	5	4	2	5
(11) Dichloromethane	5	4	2	3	5	5	4	4	2	5	4	2	5	4	2	5
(12) Di(2-ethylhexyl)phthalate (DEHP) X	5	4	2	2	5	5	4	4	2	3	4	2	5	4	2	5
(13) Diuron	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(14) Endosulfan X	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(15) Fluoranthene	5	4	2	2	5	5	4	4	2	3	4	2	5	4	2	5
(16) Hexachlorobenzene X	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(17) Hexachlorobutadiene X	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(18) Hexachlorocyclohexane X	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(19) Isoproturon	5	4	2	2	5	5	4	4	2	3	4	2	5	4	2	5
(6) Cadmium and its compounds X	4	4	2	2	2	2	5	3	5	2	5	2	2	4	4	2
(20) Lead and its compounds	4	5	2	2	2	2	4	3	5	2	5	2	2	4	4	2

WFD Priority substance	IS	GLS	CLM	CAK	TAN	PP	REF	WBP	NFM	LVOC	LCP	IRPP	FDM	WI	WT	CWW
(21) Mercury and its compounds X	4	2	2	5	2	2	5	3	5	2	5	2	2	4	4	2
(23) Nickel and its compounds	5	4	2	2	2	2	4	3	5	2	4	2	2	4	4	5
(22) Naphthalene	5	4	2	2	5	5	4	4	2	3	4	2	5	4	2	5
(24) Nonylphenols X (5)	5	4	2	2	5	5	4	4	2	3	4	2	5	4	2	5
(25) Octylphenols (6)	5	4	2	2	5	5	4	4	2	3	4	2	5	4	2	5
(26) Pentachlorobenzene X	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(27) Pentachlorophenol	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(28) Polyaromatic hydrocarbons (PAH) (7) X	4	4	2	2	5	5	4	4	2	3	4	2	5	4	2	5
(29) Simazine	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(30) Tributyltin compounds X (8)	5	4	2	2	5	5	4	4	2	3	4	2	5	4	2	5
(31) Trichlorobenzenes	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(32) Trichloromethane (chloroform)	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(33) Trifluralin X	5	4	2	2	5	5	4	4	2	3	4	2	5	4	2	5
(34) Dicofol X	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(35) Perfluorooctane sulfonic acid and its	5	4	2	2	5	5	4	4	2	3	4	2	5	4	2	5
(36) Quinoxyfen X	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(37) Dioxins and dioxin-like compounds X (9)	5	4	2	3	5	5	4	4	2	5	4	2	5	4	2	5
(38) Aclonifen	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(39) Bifenox	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(40) Cybutryne	5	4	2	2	5	5	4	4	2	3	4	2	5	4	2	5
(41) Cypermethrin (10)	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(42) Dichlorvos	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(43) Hexabromocyclododecanes (HBCDD) X (11)	5	4	2	2	5	5	4	4	2	3	4	2	5	4	2	5
(44) Heptachlor and heptachlor epoxide X	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5
(45) Terbutryn	5	4	2	3	5	5	4	4	2	3	4	2	5	4	2	5

Table 45: Estimated impact of IPPC BREFs on priority substances. "X" indicates hazardous substances

WFD Priority substance	STS	FMP	TXT	SA	LVIC-AAF	LVIC-S	CER	OFC	POL	SIC	SF	STM	EFS	ENE	ICS
(1) Alachlor	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(2) Anthracene X	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(3) Atrazine	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(4) Benzene	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(5) Brominated diphenylethers X (4)	2	2	4	4	2	2	4	4	4	4	2	4	2	2	2
(7) Chloroalkanes, C10-13 X	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(8) Chlorfenvinphos	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(9) Chlorpyrifos (C	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(10) 1,2-dichloroethane	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(11) Dichloromethane	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(12) Di(2-ethylhexyl)phthalate (DEHP) X	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(13) Diuron	2	2	4	4	2	2	4	4	4	4	2	4	2	2	2
(14) Endosulfan X	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(15) Fluoranthene	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(16) Hexachlorobenzene X	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(17) Hexachlorobutadiene X	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(18) Hexachlorocyclohexane X	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(19) Isoproturon	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(6) Cadmium and its compounds X	2	2	2	2	2	2	4	2	2	4	2	4	2	2	2
(20) Lead and its compounds	2	4	2	2	2	2	4	2	2	4	2	4	2	2	2

WFD Priority substance	STS	FMP	TXT	SA	LVIC-AAF	LVIC-S	CER	OFC	POL	SIC	SF	STM	EFS	ENE	ICS
(21) Mercury and its compounds X	2	2	2	2	2	4	2	2	2	2	2	2	2	2	2
(23) Nickel and its compounds	2	4	2	2	2	2	2	4	2	2	2	4	2	2	2
(22) Naphthalene	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(24) Nonylphenols X (5)	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(25) Octylphenols (6)	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(26) Pentachlorobenzene X	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(27) Pentachlorophenol	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(28) Polyaromatic hydrocarbons (PAH) (7) X	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(29) Simazine	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(30) Tributyltin compounds X (8)	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(31) Trichlorobenzenes	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(32) Trichloromethane (chloroform)	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(33) Trifluralin X	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(34) Dicofol X	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(35) Perfluorooctane sulfonic acid and its	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(36) Quinoxyfen X	2	2	4	4	2	4	2	4	4	4	2	4	2	2	2
(37) Dioxins and dioxin-like compounds X (9)	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(38) Aclonifen	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(39) Bifenox	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(40) Cybutryne	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(41) Cypermethrin (10)	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(42) Dichlorvos	2	2	4	4	2	2	4	4	4	4	2	4	2	2	2
(43) Hexabromocyclododecanes (HBCDD) X (11)	2	2	4	4	2	2	2	4	4	4	2	4	2	2	2
(44) Heptachlor and heptachlor epoxide X	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2
(45) Terbutryn	2	2	4	4	2	4	4	4	4	4	2	4	2	2	2

The results of this analysis indicate that BREFs are expected to result in at least some positive impact on emissions of all priority substances through requirements for generic emissions to water monitoring and/or abatement techniques. Some BREFs are likely to lead to reductions in emissions of the majority of priority substances. These BREFs include Iron and Steel production, Tanning of Hides and Skins, Pulp, Paper and Board, and Common waste Water and waste Gas Treatment /Management Systems in the Chemical Sector. A number of BREFs fell short of this category of being likely to result in emission reductions, however still had specific BAT-AELs targeting priority substances or chemical groups into which priority substances fall. Overall twelve BREFs were placed into this category (Category 4 according to Table 43).

As such, several BREFs are identified which are not only relevant for priority substances but are also still yet to be reviewed under the IED, with potential for addressing emissions in the BREF review. In particular, many BREFs which are categorised as Category 4 due to BAT- AELs in priority substances or associated chemical families are IPPC BREFs, such as Textiles, Polymers, Speciality Inorganic Chemicals, and Surface Treatment of Metals and Plastics. In these BREFs priority substances are relevant and there is scope for reducing their emissions in the BREF review.

5.2 Reducing stress on availability of water resources

The data reviewed shows that industrial activities are large water consumers. When analysis is done with a local focus some industrial installations may represent a large amount of water usage within a given region. Only six BREFs, out of 31, include explicit water consumption performance levels in the conclusions. Only one BREF reviewed under IED (out of 12) provides specific BAT-AEPLs for water consumption. These values are normally set for only a few of the specific subsectors inside each BREF. Few of the larger industrial water consuming sectors, such as refineries, have BAT-AEPLs in their BAT conclusions.

Regarding the coverage of techniques taken on water usage, almost half of the conclusions are generic. A large number of BAT conclusions on water usage (40%) were related to core process features and the rest were holistic approaches or managerial decisions or tools. No degree of technique adoption (prior to BAT conclusion publication) is reported in BREFs which blocks a quantitative estimation of the impact of these techniques (without significant additional data gathering).

The industrial water usage map varies within countries and regions and depends on the prevalence of a given type of industrial activity. The analysis done based on numerous sources (such as BREFs and industrial federation reports) identified a number of industrial activities, covered by IED, that consume larger amounts of water. These larger consumers were the following sectors:

- Intensive rearing of poultry and pigs: driven by the large number of installations
- Refining of mineral oil and gas
- Iron and steel production
- Petrochemical (such as large volume organic chemicals):
- Pulp, paper and board

The data to support LVOC and IRPP was less robust than that underpinning the estimation for the other sectors.

Water consumption has not been a key environmental issue, or BREF priority, for the corresponding Technical Working Groups that make these decisions in the BREF developments e.g. under the IED thirteen BREFs have been reviewed and 145 conclusions were developed for emissions to water with only 20 on water usage matters. One BREF developed under the IED so far contains BAT-AEPL for water uptake while five BREFs developed under the IPPC had included these water usage levels inside their conclusion document (these five will be reviewed under IED before 2020).

20 BAT conclusions out of 850 in total were addressing water usage reductions or water reuse. This ratio has great variability inside the BREF series, with CLM, IRPP or PP having no explicit requirement on water consumption (although it does have requirements linked to effluent) and IS or CWW having 8% or more of their conclusions on these issues.

Those sectors with BREFs which incorporate a BAT-AEPL on water usage will have greater and more certain water usage reductions than other sectors. TAN, POL and SIC are examples of reference documents incorporating BAT-AEPLs on water usage which may lead to some installations beyond IED threshold size, to have a water usage equal to or below the best performers.

There are limitations to estimate the water usage reductions as, for example, BREFs do not provide the percentage of plants having already adopted BAT.

6 Recommendations

6.1 Presentation of water issues in BREFs

6.1.1 Overview

Building on the overall findings of the study and, in particular, the in-depth review of the BREFs, the Commission were keen to understand how the presentation of water issues in the BREFs could be improved in the future.

BREFs have proven to be a very useful tool for permit writers providing a more homogeneous approach across the EU. There are obviously limited resources to develop BREFs and these reference documents need to focus their scope on a limited amount of processes per sector and limited amount of environmental issues per sector. When a BREF has little or no conclusions on water usage, it is because the sector experts (TWG) have selected other environmental issues as priority based on evidence. Member States and competent authority permit writers can go beyond BAT conclusions on water usage and other environmental topics.

6.1.2 Options for data visualisation

The data presented here to facilitate visualisation is hypothetical and has been generated as examples.

Generally speaking, the type of water information presented in BREFs is very similar for emissions and water consumption. The only key difference is that water usage data relies on one environmental issue (water consumption) and emission data needs to report on many environmental issues such as COD, BOD, TSS, etc. This section deploys a set of suggestions for reporting in BREFs that are thus **applicable for both water usage and emissions**. The tables shown in the examples could obviously generate different options for figures that have not been included here to split formatting/design features from the added value debate.

Several options can be considered for any data analysis on a given parameter (environmental issue) such as water usage, COD, etc. These options are described in Table 46.

Table 46: Options for visualisation figures on water topics

Water Issue	Option	Added value	Comments: pros or cons
Usage or Emission	Evolution of values per sub sector (process) in time	Best tool to visualise impact of IED (and operator's efforts) with time	Maximum of two data points per sector in the X axis (same as BREF reviews).
Usage or Emission	Share of each sub sector (or process) contribution to sector total	This will be useful to allocate resources accordingly e.g. can be used to select KEI and pursue BAT-AEPLs	Data available only for some of the processes. May require larger BREF resources to cover data availability gaps (or TWG consultation)
Usage or Emission	Dividing the sub sector (or process) results by number of sites: generating an average site value or trend	This provides a useful understanding of how an average plant performs (for permit writer's decision making)	In some BREFs (such as LVOC or textiles) the number of plants per process may be available only for main ones
Usage or Emission	Identification of inconsistencies, discrepancies or outdated data that remain unsolved after gap filling or consultation.	This is current practice in BREF documents. TWG and shadow groups are used to capture gaps	Footnotes are frequently used in BREFs for these purposes

Water Issue	Option	Added value	Comments: pros or cons
Usage or Emission	Showing any decoupling of water use and/or emissions with activity and economic performance.	Identifies if performance changes are due to changes in production rates or specific emission or water usage	In certain BREFs may be difficult to gather precise data for production rates per subsector over time

This analysis leads to the development of a number of visualisation options. Some of these options aim to visualise quantitative data and other will help to visualise qualitative data.

Option #1: this type of table will help to visualise the achievements expected with the implementation of the BAT conclusions. It can show the degree of ambition of the BAT-AEPL. The table will compare the baseline performance prior to BAT implementation (described in 'current emissions and consumptions' section) with the range of performance after the adoption of BAT conclusions.

Table 47 Example on option#1 for emission to water

		Current emission			BAT-AEPL		Reduction	
KEI	unit	Min	Avg.	Max	lower	upper	High	Low
TSS	mg/l	5	15	25	4	15	73%	0%
COD	mg/l	30	60	125	35	70	42%	-17%

This type of analysis deployed with option #1 could be included in concluding remarks only for the key environmental issues (KEI) where a BAT- AEPL was established.

Option #2: This type of visualisation table provides overall analysis on one parameter. The example has been elaborated with hypothetical data on water usage for a sector X that comprises 4 different subsectors or processes. The example shown here would represent a best case regarding data availability. In many occasions, the 4 blocks deployed in the example would need to be reduced into two or one blocks due to lack of data.

Option #2 would contain two major sections in the table: The leftmost section showing results from the first IPPC BREF review and a second section on the right containing data from the IED BREF review. The specific water usage data is deployed on top and the net results on the bottom part of the table. Production values per sector are required in order to convert values from specific water usage to net water usage or vice versa. Each section will have a different use:

- Specific water usage will be used to compare and analyse process intensity
- Net water usage is useful indicating the net outcome of how large consumers (or polluters) are implementing IED provisions.

Table 48 Example on option#2 for water usage

	IPPC BREF review				IED BREF review				
	Specific water usage								
	Baseline (m^3/t)	AEPL (m^3/t)	Reduction (m^3/t)		Baseline (m^3/t)	AEPL (m^3/t)	Reduction (m^3/t)		Production (kt)
Process 1	2	2	0		1.8	1.8	0		1000
Process 2	1	1	0		0.8	0.7	0.1		2500
Process 3	4	3	1		2.5	2.4	0.1		3500
Process 4	2	1	1		0.5	0.4	0.1		900
Sector X	2.6				1.6				7900
	Net water usage								
	Baseline (k m^3)	Share (%)	Reduction (k m3)	(%)	Baseline (k m^3)	Share (%)	Reduction (k m3)	(%)	
Process 1	2000	10%	0	0%	1800	14%	0	0%	
Process 2	2500	12%	0	0%	2000	15%	250	36%	
Process 3	14000	69%	3500	80%	8750	67%	350	51%	
Process 4	1800	9%	900	20%	450	3%	90	13%	
Sector X	20300	100%	4400	100%	13000	100%	690	100%	

Table 48 simplified to use only IPPC data can be used for the KEI selection when reviewing a BREF. A similar simplified table (or associated chart) can be included in the current emissions and consumptions section of each BREF.

Another proposal was generated also on qualitative data analysis (Option #3 below). This qualitative information is mainly related with the techniques, the BAT conclusions and their degrees of implementation.

Option #3: This type of figure will help to visualise the impact of the selected or available techniques on water topics. The figure shows a qualitative (discrete) assessment of the techniques available on water topics to facilitate a projection of impacts. Two discrete or qualitative parameters will help to assess the overall set of techniques:

(1) % implementation before BREF: this will provide information on how many plants are already (at BREF review date) using each technique

(2) % efficiency: this parameter will provide only an indication on the average impact of the technique in the issue related with this technique e.g. water consumption (reduction).

For example, when most of the plants are using a given technique, then little or no improvement is expected by selecting it as BAT.

Table 49: Example on Option #3 for water usage techniques

Item	Technique	% adoption before BREF	% efficiency
a	Use ejectors for vacuum generation	Most installations (>75%)	Low (<10%)
b	Use filters (instead of scrubber) for air abatement in unit X	Few installations (<25%)	Significant (>10%)
c	Reuse cooling water system purge in unit Z	Some installations (25-75%)	Significant (>10%)

These type of tables (Table 49) could be used at the end of the ‘techniques to consider’ subsections e.g. they could be inserted at the end of techniques to consider on water usage.

6.2 Data availability

This study has relied primarily on the BREFs and data from E-PRTR for gathering data on emissions, consumption and implications of the BAT Conclusions. It is important to note that these two sources were designed for different purposes and their resources and capabilities are not always aligned with analytical exercises such as those undertaken in this study. There are significant challenges in aligning data from the BREFs and E-PRTR and in particular at the process level at which many BAT Conclusions apply.

BREFs are meant to select best available techniques for an industrial sector. They use robust fit for purpose data to compare environmental performance but only for key polluting processes and key environmental issues. BREFs are not developed to record or track emission reductions per sector. This means that BREF data does not need/aim to:

- cover all processes in a sector.
- cover every pollutant in a sector.
- map precisely the degree of uptake of techniques.
- provide average capability of every technique in every issue (such as water usage).
- use load as format of expression in every occasion. Concentrations are the most frequent format of expressions because the available data at industrial plants is captured in that way.
- set emission limit values only on individual compounds (such as priority substances) but more frequently on families or group of compounds such as TOC, AOX, Total Nitrogen, etc.

A number of actions could be taken in BREF development in order to facilitate emission and consumption reduction estimations on European industrial sectors. However, these actions could lead to longer BREF development periods and higher resources (man-hours) required for each BREF development. The current trend, agreed with BREF stakeholders, is to move BREF development in the opposite direction i.e. reduce length and intensity of BREF reviews by focusing solely on key environmental issues in order to address the biggest impact to the environment.

There are two sections (see section 3.5 and 4.5) that describe the current challenges on using BREFs as the primary source for this sort of analysis.

6.3 Future research

This report was carried out with a limited set of resources and has thus delivered only an initial overview of the contribution that the IED and associated BREFs may have on water consumption and emissions. A more detailed assessment would need to be carried out in order to capture a detailed, quantitative assessment of the impact of IED on water. Some proposals for future work are described below:

- On water usage baseline several assumptions were taken in order to rank the industrial activities performance. With the support of industrial federations and Competent Authorities (Member States) a deeper data gathering exercise would provide light on the subsectors or manufacturing processes that are driving sector performance e.g. how many LCPs are using once through water cooling systems (per type of fuel) or what is the water usage in each of the ten key sub sectors reviewed in the LVOC BREF. Both of these types of information have impacts on ranking water usage and were not available for the study.
- For large water usage sectors/processes there are no BAT-AEPLs in their BAT conclusions. A more in-depth study could differentiate, for each one of these key consumers, the proportion allocated to cooling systems, abatement techniques or process water. A water usage potential savings could be defined by selecting best practices on these large manufacturing processes: refining of mineral oil and gas, iron and steel production, intensive rearing of poultry and pigs and large volume organic chemical.
- Analysing a sample of recently reviewed environmental permits would allow to better forecast IED impact on water emission and usages. This sample can help to visualise if water usage requirements are set when no BAT-AEPLs are included in BREFs (using reference values from descriptive chapters). This set will show how permit writers are selecting Emission Limit Values from the BAT-AEL ranges: closer to upper or lower BAT-AELs.
- Regarding priority substances, a further study could provide information on how environmental permits are dealing with them: how many permits (from a sample covering various sectors) are setting emission limit values for individual priority substances and how many are setting limit values only for family of compounds (such as chloride, PHA, etc.).
- There are industrial technology and service providers specialised on water topics: Ecolab, Xylem, GE water, Kemira, Danaher, Kurita, Solenis, Veolia, Agbar, etc. These companies and

their experts are not participating in BREF development initiatives. Their presence in BREF reviews could increase the quality of data regarding emissions to water and water usage techniques. Any initiative, such a workshop, with active participation from these key stakeholders will provide lights on both best available techniques performance and emerging techniques ready to be used at commercial stage. Involving them in the ongoing Industrial Observatory for Emerging Techniques for BREF study will improve the data available to BREFs on BAT and Emerging Techniques candidates on emissions to water and water usage.

7 References

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Appendix 1

Appendix 1: Repository of data on water emissions, consumption and measures included in the BREFs (Excel file)

Appendix 2: Priority Substances

Table 50 shows the checklist of emissions of priority substances. Cell categories are as follows:

- Y= Emissions in EPRTR for this BREF.
- N= No Emissions in EPRTR for this BREF.
- Grey = Substance not present in EPRTR database and not associated with this BREF in Pollutant Factsheet.
- CAT1/ CAT3 = Substance not present in EPRTR database and mentioned in Pollutant Factsheet in relation to this BREF as Category 1 or Category 3. Category 1: Source/pathway may result in or contribute to potential failure of WFD objectives. Category 3: No potential release, or does not contribute to potential failure of WFD objectives

Table 50. Checklist of Emissions of Priority Substances.

Chemical Name	IS	GLS	CLM	CAK	TAN	PP	REF	WBP	NFM	LVOC	LCP	IRPP	FDM	WI	WT	STS
Alachlor									CAT 1	CAT 1	CAT 1					
Anthracene	Y	N	N	N	N	Y	Y	N	Y	Y	Y	N	N	Y	Y	N
Atrazine	N	N	N	N	N	N	N	N	N	Y	Y	N	N	N	Y	N
Benzene	N	N	N	N	N	N	Y	N	Y	Y	Y	N	N	Y	Y	N
Brominated diphenylethers (PBDE)	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N
(7) Chloroalkanes, C10-13 X	Y	N	N	N	N	Y	Y	N	Y	Y	Y	N	N	Y	Y	N
(8) Chlorfenvinphos																
(9) Chlorpyrifos (C	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	Y	N
(10) 1,2-dichloroethane	Y	N	Y	N	N	Y	Y	N	Y	Y	Y	N	N	Y	Y	N
(11) Dichloromethane	Y	N	N	N	N	Y	Y	N	Y	Y	Y	N	N	Y	Y	Y
(12) Di(2-ethylhexyl)phthalate (DEHP) X	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N
(13) Diuron	N	N	N	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y	N
(14) Endosulfan X	N	N	N	N	N	N	N	N	N	Y	Y	N	N	N	Y	N
(15) Fluoranthene	Y	N	Y	N	N	N	Y	N	Y	Y	Y	N	N	Y	Y	Y
(16) Hexachlorobenzene X	N	N	N	N	N	N	Y	N	Y	Y	Y	N	N	Y	Y	N
(17) Hexachlorobutadiene X	Y	N	N	N	N	N	Y	N	Y	Y	Y	N	N	Y	Y	N
(18) Hexachlorocyclohexane X							CAT 3			CAT 1						
(19) Isoproturon	N	N	N	N	N	Y	N	N	N	Y	N	N	N	Y	Y	N
(6) Cadmium and its compounds X	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y
(20) Lead and its compounds	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y
(21) Mercury and its compounds X	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y
(23) Nickel and its compounds	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y
(22) Naphthalene	Y	N	N	N	N	N	Y	N	Y	Y	Y	N	N	Y	Y	Y
(24) Nonylphenols X (5)	Y	N	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y
(25) Octylphenols (6)	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y
(26) Pentachlorobenzene X	Y	N	N	N	N	N	Y	N	Y	Y	Y	N	N	Y	Y	N
(27) Pentachlorophenol	Y	N	N	N	N	Y	Y	N	Y	Y	Y	N	N	Y	Y	N
(28) Polyaromatic hydrocarbons (PAH) (7) X	Y	N	Y	N	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y
(29) Simazine	N	N	N	N	N	Y	N	N	N	N	Y	N	N	Y	Y	N
(30) Tributyltin compounds X (8)	Y	N	N	N	N	N	Y	N	Y	Y	Y	N	N	N	Y	N
(31) Trichlorobenzenes	Y	N	N	N	N	N	Y	N	Y	Y	Y	N	N	Y	Y	Y
(32) Trichloromethane (chloroform)	Y	N	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y
(33) Trifluralin X	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N
(34) Dicofol X																
(35) Perfluorooctane sulfonic acid and its																
(36) Quinoxyfen X																
(37) Dioxins and dioxin-like compounds X (9)	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3
(38) Aclonifen																
(39) Bifenox																
(40) Cybutryne																
(41) Cypermethrin (10)																
(42) Dichlorvos																
(43) Hexabromocyclododecanes (HBCDD) X (11)																
(44) Heptachlor and heptachlor epoxide X	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N
(45) Terbutryn																

Chemical Name	FMP	TXT	WGC	SA	LVIC-AAF	LVIC-S	CER	OFC	POL	SIC	SF	STM	CWW	EFS	ENE	ICS
Alachlor																
Anthracene	Y	N	N	N	N	Y	N	N	N	N	N	Y	Y	N	N	N
Atrazine	N	N	N	N	N	Y	N	Y	N	N	N	N	Y	N	N	N
Benzene	N	N	N	N	Y	Y	N	Y	Y	N	Y	N	Y	N	N	N
Brominated diphenylethers (PBDE)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
(7) Chloroalkanes, C10-13 X	Y	N	N	N	Y	Y	N	Y	N	N	Y	Y	Y	N	N	N
(8) Chlorfenvinphos																
(9) Chlorpyrifos (C	N	Y	N	N	Y	Y	N	Y	N	N	N	N	Y	N	N	N
(10) 1,2-dichloroethane	Y	N	N	N	Y	Y	N	Y	Y	N	Y	N	Y	N	N	N
(11) Dichloromethane	Y	N	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	N	N
(12) Di(2-ethylhexyl)phthalate (DEHP) X	Y	Y	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	N	N
(13) Diuron	N	N	N	N	N	Y	N	Y	N	N	N	N	Y	N	N	N
(14) Endosulfan X	N	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N
(15) Fluoranthene	Y	Y	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	N	N
(16) Hexachlorobenzene X	N	N	N	N	Y	Y	N	Y	Y	N	Y	N	Y	N	N	N
(17) Hexachlorobutadiene X	Y	N	N	N	Y	Y	N	Y	Y	N	N	Y	Y	N	N	N
(18) Hexachlorocyclohexane X					CAT 1			CAT 1								
(19) Isoproturon	N	N	N	N	Y	N	N	Y	N	N	N	N	Y	N	N	N
(6) Cadmium and its compounds X	Y	Y	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N
(20) Lead and its compounds	Y	Y	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N
(21) Mercury and its compounds X	Y	Y	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	N	N
(23) Nickel and its compounds	Y	Y	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N
(22) Naphthalene	Y	Y	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	N	N
(24) Nonylphenols X (5)	Y	Y	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	N	N
(25) Octylphenols (6)	Y	Y	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	N	N
(26) Pentachlorobenzene X	Y	N	N	N	N	N	N	N	Y	N	N	Y	Y	N	N	N
(27) Pentachlorophenol	Y	N	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	N	N
(28) Polyaromatic hydrocarbons (PAH) (7) X	Y	Y	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	N	N
(29) Simazine	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
(30) Tributyltin compounds X (8)	Y	N	N	N	N	Y	N	N	N	N	N	Y	Y	N	N	N
(31) Trichlorobenzenes	Y	N	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	N	N
(32) Trichloromethane (chloroform)	Y	N	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	N	N
(33) Trifluralin X	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
(34) Dicofol X								CAT 1								
(35) Perfluorooctane sulfonic acid and its																
(36) Quinoxyfen X								CAT 1								
(37) Dioxins and dioxin-like compounds X (9)	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3	CAT 3
(38) Aclonifen								CAT 1								
(39) Bifenox								CAT 1								
(40) Cybutryne								CAT 1								
(41) Cypermethrin (10)								CAT 1								
(42) Dichlorvos								CAT 1								
(43) Hexabromocyclododecanes (HBCDD) X (11)																
(44) Heptachlor and heptachlor epoxide X	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
(45) Terbutryn								CAT 1								

Appendix 3: IED Activity to BREF Matching

IED Activity	BREF
1.1. Combustion of fuels in installations with a total rated thermal input of 50 MW or more	LCP
1.2. Refining of mineral oil and gas	REF
2. Production and processing of metals	NFM
2.1. Metal ore (including sulphide ore) roasting or sintering	NFM
2.2. Production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour	IS
2.3. Processing of ferrous metals	FMP
2.4. Operation of ferrous metal foundries with a production capacity exceeding 20 tonnes per day	SF
2.5. Processing of non-ferrous metals	NFM
2.6. Surface treatment of metals or plastic materials using an electrolytic or chemical process where the volume of the treatment vats exceeds 30 m3	STM
3.1. Production of cement, lime and magnesium oxide	CLM
3.3. Manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day	GLS
3.4. Melting mineral substances including the production of mineral fibres with a melting capacity exceeding 20 tonnes per day	GLS
3.5. Manufacture of ceramic products by firing	CER
4.1. Production of organic chemicals	LVOC
4.2. Production of inorganic chemicals	LVIC-S
4.3. Production of phosphorous-, nitrogen- or potassium-based fertilisers (simple or compound fertilisers)	LVIC-AAF
4.4. Production of plant protection products or of biocides	OFC
4.5. Production of pharmaceutical products including intermediates	OFC
4.6. Production of explosives	OFC
5.1. Disposal or recovery of hazardous waste with a capacity exceeding 10 tonnes per day involving one or more of the following activities	WT
5.2. Disposal or recovery of waste in waste incineration plants or in waste co-incineration plants	WI
5.3. (A) Disposal of non-hazardous waste; (B) Recovery, or mix of recovery and disposal, of non-hazardous waste	WI
6.1. Production in industrial installations of: (a) pulp from timber or other fibrous materials; (b) paper or card board with a production capacity exceeding 20 t/day; (c) wood-based panels with a production capacity exceeding 600 m3/day	PP
6.10. Preservation of wood and wood products with chemicals with a production capacity exceeding 75 m3 per day other than exclusively treating against sap stain	STS
6.2. Pre-treatment (operations such as washing, bleaching, mercerisation) or dyeing of textile fibres or textiles where the treatment capacity exceeds 10 tonnes per day	TXT
6.4. (a) Operating slaughterhouses with a carcass production capacity greater than 50 tonnes/ day; (b) Treatment and processing, other than exclusively packaging of animal and vegetable raw materials over a certain production capacity	FDM

6.7. Surface treatment of substances, objects or products using organic solvents	STM
6.8. Production of carbon (hard-burnt coal) or electrographite by means of incineration or graphitisation	NFM

Ricardo
Energy & Environment

The Gemini Building
Fermi Avenue
Harwell
Didcot
Oxfordshire
OX11 0QR
United Kingdom

t: +44 (0)1235 753000
e: enquiry@ricardo.com

ee.ricardo.com