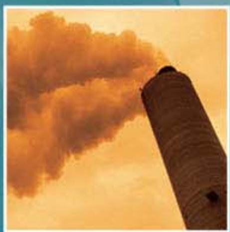
European Commission
DG Environment

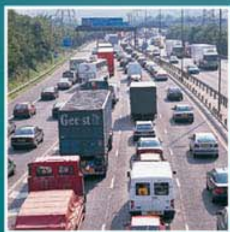
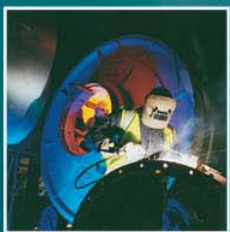
Assessment of the implementation of the IPPC directive

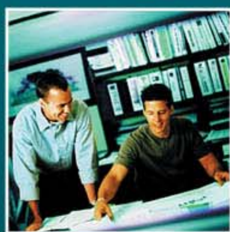
Summary report - contract number
070307/2007/486594/FRA/C4

February 2010





THE REGIONAL ENVIRONMENTAL CENTER
for Central and Eastern Europe

ARCADIS BELGIUM

Entec

Copyright and Non-Disclosure Notice

Third-Party Disclaimer

Document Revisions

No.	Details	Date
1	Summary report based on final report submitted on 22/01/2010	25/01/2010
2	Summary report revised taking client comments into account	04/02/2010

Entec

Creating the environment for business

European Commission DG Environment

Assessment of the implementation of the IPPC directive

Summary report - contract number 070307/2007/486594/FRA/C4

February 2010

Entec UK Limited

Report for

European Commission, DG Environment
Unit ENV.C.4
BU-5
B-1049 Brussels
Belgium

Main Contributors

Caspar Corden (Entec)
Kris Devoldere (Arcadis)
Irene Estrada-Subirats (Entec)
Lynda Fellows (Entec)
Sandra Glynn (Entec)
Keith Lawton (Entec)
Karen Polfliet (Arcadis)
Massimo Scirea (Entec)

Issued by

....
Caspar Corden

Approved by

....
Martin Houldin

Entec UK Limited

17 Angel Gate
City Road
London EC1V 2SH
England
Tel: +44 (0) 207 843 1400
Fax: +44 (0) 207 843 1410

Doc Reg No. 21937CA005i2

h:\projects\em-260\21000 projects\21937 ippc implementation\c - client\reports\final i5\summary report\21937ca005i1 ippc implementation summary 20100122 v5.doc

Certificate No. FS 13881 Certificate No. EMS 69090

In accordance with an environmentally responsible approach, this document is printed on recycled paper produced from 100% post-consumer waste, or on ECF (elemental chlorine free) paper

Contents

1. Introduction

1.1 Project background

This is a summary of a report produced for DG Environment on assessment of the implementation of the IPPC Directive. For full details of the analysis and conclusions, the reader is referred to the main report.

The original Integrated Pollution Prevention and Control (IPPC) Directive[1] was adopted in September 1996 with all Member States being required to bring it into effect by 30th October 1999. The Directive was recently codified as Directive 2008/1/EC[2].

The Directive applies an integrated environmental approach to the regulation of certain industrial activities, which means that emissions to air, water and land plus a range of other environmental effects must be considered in the issuance of a permit in compliance with the Directive. It also requires that competent authorities in Member States must develop and set permit conditions for operation of installations falling within the regime so as to achieve a high level of protection of the environment as a whole. Permit conditions must be based on the use of Best Available Techniques (BAT), which are defined in the Directive as the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole.

The ability for Member States to take into account the installation's geographical location, site-specific technical characteristics and local environmental conditions as well as the requirement to engage, consult with and enable contributions from members of the public in the setting or permit conditions, are also important characteristics of the Directive.

The Directive is not only concerned with the prevention of pollution during the operational lifetime of an installation but also requires that provisions are made to protect the environment upon cessation of the industrial activity concerned and for the restoration of the site of the installation to a satisfactory state.

The deadline for full implementation of the requirements of the IPPC Directive in Member States was 30th October 2007, at which point Member States should have ensured that all existing installations were operating in accordance with integrated permits that meet the requirements of the IPPC Directive. For some of the newer Member States, transition periods were incorporated into the relevant Accession Treaties for a number of individual installations, allowing for longer timescales in implementing certain aspects of the Directive.

---

[1] Council Directive 96/61/EC concerning integrated pollution prevention and control, OJ L257, 10.10.1996, pp. 26-40.

[2] OJ L24, 29.1.2008, pp. 8-29.

1.2 This study

DG Environment contracted[3] Entec UK Limited, in association with Arcadis Belgium and the Regional Environmental Center for Central and Eastern Europe (REC), to undertake an assessment of the implementation of the IPPC Directive. The requirement for this project arose as a result of:

- Previous studies examining how industrial emissions legislation was being implemented (including an assessment of the implementation of the IPPC Directive[4]) and areas for potential improvement;
- The passing of the deadline for implementation of the Directive at the end of October 2007. Since relevant installations should have had a permit in place, there was a need to focus on the quality of the permits in place and the implementation of the legislation;
- The Commission issued an Action Plan on implementation of legislation on industrial emissions as part of its Communication 'Towards an improved policy on industrial emissions'[5]. The Plan recognised the need to ensure that Member States apply the current legislation to the fullest extent possible, by strengthening its monitoring and supporting mechanisms. Actions of particular relevance to the current study include:
    - Supporting Member States in their implementation of the legislation, including aspects of enhanced information exchange, guidance development, visits to authorities and training.
    - Enhanced monitoring and compliance checks on the application of the legislation, including investigating the system of monitoring and inspection at IPPC installations, covering specific industrial installations and sectors, the use of general binding rules and the analysis of complaints.

On 21 December 2007 the Commission adopted a proposal for a Directive on industrial emissions (IPPC) that recasts the IPPC Directive and associated legislation on industrial emissions. However, **the focus of this study was on implementation of the current legislation**.

The overall aim of the study was to assess the implementation of the IPPC Directive by Member States through the use of installation-specific case studies focusing on how the requirements of the Directive had been implemented. With this in mind the project considered three main tasks:

1. Assisting the Commission to assess the implementation of the IPPC Directive for certain individual installations subject to complaints, petitions or questions from Members of the European Parliament;

---

[3] Under framework contract number ENV.C.4/FRA/2007/0011.

[4] http://circa.europa.eu/Public/irc/env/ippc_rev/library?l=/implementation_entec&vm=detailed&sb=Title.

[5] COM(2007) 843 final.

2. Assessing 20 case study installations across five different industry sectors to gain understanding of the practical implementation of the Directive in the Member States and the issues faced for different IPPC activities and

3. Assessing the state of the implementation of the IPPC Directive in more detail for one particular sector and across a larger number of Member States. The sector chosen in this particular case was the mineral oil and gas refinery sector. This task included the assessment of 12 case study installations.

The over-arching objective of the study was to build on previous work completed by the Commission and others in the assessment of the effectiveness of Member States implementation of the IPPC Directive and to present the Commission with a series of case studies examining implementation issues.

The study identifies where problems exist in implementation and where horizontal issues may need to be addressed. Conclusions have been drawn from the installation-level data. The remit of the project does not necessarily allow for wider conclusions to be drawn and so further investigations may be required to determine whether the problems apply more widely. Given the remit of the work, it is acknowledged that the conclusions drawn might be indicative rather than representative.

1.3 Purpose of this report

This report sets out *a summary of* the main results and outputs of the work undertaken. Based on the specification for the work and subsequent discussions with the Commission, the report provides:

- Assessment of 20 individual case study installations across five different industry sectors selected on the basis of a methodology developed by the contractor and the Commission (Task 2).

- Assessment of the state of implementation of the IPPC Directive in the mineral oil and gas refinery sector, including a general sector evaluation and assessment of 11 case study installations (Task 3).

The results of task 1 of this project are not included in this report.

The purpose of this report is to provide support to the Commission in its policy decision-making. The results of the study are not intended to be used by any other party in making financial or policy decisions.

The case study installations are intended to be illustrative and the assessments are not intended to be a check on “compliance” with the IPPC Directive.

2. Methodology

For each of the tasks, the work involved: installation-specific assessments to address the content of the permit; the procedures followed to establish that permit; and the actual operation of the installation in relation to the permit conditions and BAT (from the relevant BAT Reference Documents, BREFs).

The aim was to provide answers to a number of questions. The questions to be addressed were the same for all tasks. The conclusions of this report set out the findings in relation to each of the individual questions but broadly the assessments involved determining the following:

- Have existing and new permits been issued or updated in accordance with the IPPC Directive?
- Are the installations selected currently operating in accordance with their permits and with BAT?

Assessment of individual installations involved providing technical support to the Commission in assessing specific installations (20 installations for task 2 and 11 for task 3). These installations were selected on the basis of a methodology developed and agreed in conjunction with the Commission. Details of the methodology used are provided in the main report.

The following documentation was reviewed for each of the case study installations, where such information was available:

- A copy of the IPPC permit and subsequent variations (where applicable);
- A copy of the supporting technical report in support of the IPPC permit application, including additional information provided by the operator (where applicable);
- A copy of the completed permit reporting forms that detail current emissions;
- A copy of historical emissions data from release points within the installation (if available); and
- A copy of the IPPC permit supporting decision documentation (if available)[6].

Site visits and interviews were then undertaken with operators and competent authority representatives in order to confirm understanding of the implementation of the Directive for the installations concerned and to seek feedback on the process of implementation in order to identify opportunities for improvement of the IPPC Directive and

---

6 Such documents, where available, provide a regulatory explanation as to the reasons behind the selection of the particular permit conditions. This type of document can be valuable as they present an audit trail of the process of decision making, which would be referred to, for example, if the competent authority was exposed to legal scrutiny. Such documentation is not available for all installations (and as such the level of detail possible in the assessments has varied amongst the case studies.)

areas where the Commission may help with implementation of the Directive (e.g. through enhanced information exchange or provision of guidance). It was stressed to the competent authorities and operators that this study was not a legal check on compliance and also that details of the installations concerned were to be kept confidential[7].

For each case study, a single report was produced and a draft sent to the competent authority and operator in order to clarify any areas of uncertainty and to provide a check on the accuracy of the information presented and validity of conclusions drawn regarding implementation.

An overview of the selection of installations within specific sectors and Member States is provided in the table below.

Table 2.1 Numbers of installations in each sector and Member State for tasks 2 and 3

	Belgium	Czech Republic	France	Germany	Greece	Italy	Nether-lands	Poland	Slovakia	Spain	UK	Total
Surface treatment of metals and plastic (Printed Circuit Board manufacture)						1					1	**2**
Combustion installations (coal-fired power plants)					1	1	1	1	1	1	1	**7**
Iron and steel production (sinter plants & associated blast furnaces)						1	1		1	1		**4**
Production of basic inorganic chemicals (nitric acid manufacture)						1	1			1		**3**
Fertiliser manufacture (NPK/CN)						1	1		1	1		**4**
Mineral oil and gas refineries	1	1	1	1	2	*	1	1	1	1	1	**11**
Total	**1**	**1**	**1**	**1**	**3**	**5**	**5**	**2**	**4**	**5**	**3**	**31**

* Note that this installation was originally included but was not assessed because the permit was not issued within the timescales of this project.

In addition to the assessment of individual installations within each of these sectors, a general evaluation was undertaken for the mineral oil and gas refineries sector. The combination of the results of the assessment of individual installations, previous studies and the results of a general sector evaluation allow conclusions to be drawn on the overall level of implementation of the IPPC Directive in the mineral oil and gas refineries sector in Europe.

---

7 Mainly details that would allow individual installations or the employees of such installations to be identified or other information considered commercially confidential on a case-by-case basis.

3. Task two findings – Installations selected on the basis of a methodology developed by the consultants and Commission

3.1 Overview

This section provides details of the assessments undertaken for selected case study installations assessed under Task 2 of the study.

For each sector, **a summary of** the results of the analysis is provided in the following sections. The assessments of the individual installations are provided in the main report, along with more detail on the relevant environmental issues and emission levels associated with the implementation of the best available techniques (BAT-AELs). The following sectors are covered in this section of the report:

- Surface treatment of metals and plastic (printed circuit board manufacture);
- Combustion installations (coal and lignite-fired power plants);
- Iron and steel manufacture (blast furnaces and associated sinter plants);
- Production of basic inorganic chemicals (nitric acid manufacture); and
- Manufacture of NPK/CN fertilisers.

3.2 Surface treatment of metals and plastic (printed circuit board manufacture)

3.2.1 Background to the sector

Printed circuit boards (PCBs) are a manufacturing sub-sector of the surface treatment industry, where intricate electronic circuits are manufactured using metals on the surface of plastics. PCBs have particularly complex production sequences that may comprise over 60 operations. All activities are carried out using jig equipment (racks), barrel or coil operations.

The 2006 BREF on large volume inorganic provides the following information on the sector:

- The world market for PCBs in 2002 was $31.6 billion US (€33.4 billion in 2002 prices) and the European share of the world market in 2002 was 18.0 %.

- In 2002, total PCB production in Europe was €3.4 billion and the sector employed 29,000 people at 434 plants (note that not all of the plants are covered by the IPPC Directive).
- In 1999 there were 612 European PCB manufacturers. This number had reduced to 434 by 2002, with more than 80% of these being small and medium sized enterprises (SMEs).
- In Europe, there has been a trend towards a greater share of high-tech PCB production (higher specification products).

PCBs are electronic circuits with thin layers of tracking printed onto thin, nonconductive layers. Components such as resistors, capacitors, semi-conductors, mounts for processing chips and memory chips, are added in subsequent operations

The main environmental impacts of PCB manufacture relate to:

- Energy and water consumption.
- Consumption of raw materials and emissions to water.
- The BREF on surface treatment of metals and plastics (2006) does not indicate air emissions to be a primary environmental impact; however point source and fugitive emissions of volatile organic compounds (VOCs), entrained metal compounds and ammonia may have a localised environmental impact[8].
- Wastes, notably hazardous wastes containing chemicals and/or metal compounds, are generated in the process of PCB manufacture. The particular wastes that can result in environmental impacts are metal-containing sludges and spent process solutions.

BAT that may be applied includes maximising recovery of metals such as copper through process optimisation, the recycling of etchant solution to reduce volumes of alkali waste, stripping of the dry resist and etch and final treatment to recover metals in the residues. Liquid wastes should receive oil/grease separation, centrifuge for solids reduction, nitrite, chromate and precipitation treatments to remove metals, nitrogen and sulphides. Final liquid effluent discharges should receive treatment using one or more of the following techniques: sedimentation, simple filtration, flotation and/or zero discharge techniques such as ultra filtration, membrane filtration and thermal or infra-red evaporation.

3.2.2 Summary of main conclusions

Based on the two case study installations reviewed (Italy and the UK), the following overall conclusions can be drawn:

---

8 As such, the BREF on surface treatment using solvents is also of relevance for this sector.

- Only one of the permits includes ELVs for emissions to air, despite the BREF indicating that emissions to air, in particular VOCs, may be significant. The ELVs for the installation whose permit contains such limits are based on benchmark values in national guidance documents; these in turn are based on the BAT-AELs in the draft BREF document on surface treatment of metals and plastics. All of the relevant ELVs are within the BAT-AEL ranges. For the other installation, ELVs for air emissions are due to be set following the submission of monitoring data by the operator.

- In terms of installation performance for air emissions, the monitoring data provided suggest that, for the one installation with air ELVs set, emissions are all below the permit ELV values and, with the exception of one emission source, all within the range of the BREF BAT-AELs.

- In relation to emissions to water, only one of the two installations has permit conditions setting ELVs (the other has no direct discharges to water). For this installation, the data provided suggest that emissions are below the ELVs set in the permit and also below the upper range of the BAT-AELs set in the BREF.

- Because the BREFs for this sector[9] include emission levels intended to cover a wide range of different activities (other than PCB manufacture), the pollutants for which BAT-AELs are set in the BREF are not all applicable to this activity. This may explain why corresponding ELVs are not included in the permits for these two installations.

- The monitoring undertaken appeared to comply with permit conditions for one installation, with the picture mixed for the other installation, as described above.

- Both of the installations had been inspected by the competent authority at least once within the 12 months prior to the assessment.

The table below provides an indicative summary of the standards and emissions to air of key pollutants from this sector. In particular, it includes information on the relevant BREF BAT-AELs; ELVs set in permit conditions; and actual installation performance. This information is only intended to be indicative of the broad ranges of these values and the reader is referred to the assessments for each installation in the main report for further information on the emissions from specific sources and the applicable permit ELVs and BAT-AELs.

[9] On surface treatment of metals and plastic and on surface treatment using solvents.

Table 3.10 Indicative information on emissions of certain air pollutants from STM installations (BAT-AELs, permit ELVs and actual installation performance)

Member State	Pollutant	BAT-AEL (Note 1)	Permit ELVs (Note 1)	Actual emissions (Note 1)
Italy	All	Various	No permit ELVs	No data
UK	VOC	20-100 mg/m^3	50-75 mg/m^3	4-9 mg/m^3
UK	Particulates	5-30 mg/m^3	50 mg/m^3	Not monitored (Note 3)
UK	NO_x	< 5-500 mg/m^3 (Note 2)	100 mg/m^3	9.4 mg/m^3
UK	Ammonia	N/A	30 mg/m^3	10 mg/m^3
UK	HCl	< 0.3-30 mg/m^3 (Note 2)	10 mg/m^3	0.4 mg/m^3

Notes:

1) Where there are several points at which emissions are measured and ELVs set, the applicable range is quoted. The STM BREF does not include averaging periods for emissions to air. For emissions to water, the emissions monitoring applied the same averaging period (daily) as that specified in the BREF. BAT-AEL for VOCs is based on the BREF on surface treatments using solvents.

2) These values are referred to as indicative emission ranges to air achieved by some installations in the BREF, rather than being explicitly specified as BAT-AELs.

3) Permit ELV is included but emissions not relevant for this installation.

3.3 Combustion installations (coal and lignite fired power plants)

3.3.1 Background to the sector

The IPPC Directive covers combustion installations with a rated thermal input exceeding 50 MW. The assessment in this report is specifically focused on combustion installations fired with coal and lignite.

According to Eurelectric, approximately one third of the EU's electricity production comes from combustion of solid fuels. Steam cycle coal and lignite plants are in use extensively across Europe and involve conversion of coal and lignite into electricity by burning the fuel and running a steam turbine to drive an electricity generator[10].

Furthermore, Directive 2001/80/EC[11], referred to as the large combustion plants directive (LCP Directive), applies to combustion plants with a rated thermal input of 50MW or more. The LCP Directive places requirements upon Member States to reduce emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x) and particulate matter (PM or dust) from combustion plants within power plants, petroleum refineries, iron and steelworks and other industrial processes.

[10] http://www2.eurelectric.org/content/default.asp?PageID=821, accessed 18 February 2009.

[11] OJ L 309, 27.11.2001, p. 1.

The LCP Directive sets minimum requirements. However, the IPPC Directive also applies to LCPs, requiring emission limit values based on BAT to be set (or equivalent parameters or technical measures to be used) in the environmental permit.

The main environmental impacts result from the combustion process, which leads to the generation of emissions to air and, in some cases, also to water and soil. The most important polluting substances emitted to air from the combustion of fossil fuels are SO_2, NO_x CO, particulate matter (PM_{10}) and greenhouse gases, such as CO_2 and N_2O. Other substances such as heavy metals, halide compounds and dioxins are emitted in smaller quantities although it is worth noting that given the acute toxicity of some of these compounds, smaller absolute quantities can have potentially significant environmental effects. Most of the heavy metals considered (As, Cd, Cr, Cu, Hg, Ni, Pb, Se, V, Zn) are normally released as compounds (e.g. oxides, chlorides) in association with particulates.

In addition to environmental impacts from emissions and the residues collected from pollution abatement equipment and the combustion process itself, there are a number of other potential environmental impacts. These include those associated with transportation, storage, handling and use of large quantities of coal and lignite from mines (typically outside the control of the integrated permit) to the site, which may give rise to impacts such as noise, dust and water contamination. To some degree, these effects can be mitigated through the application of techniques such as enclosed conveyors, water sprays, covered storage and filtration. Appropriate re-use of secondary materials such as boiler ash and synthetic limestone from flue gas desulphurisation (FGD) is also a key environmental concern to minimise the waste produced and its subsequent disposal.

3.3.2 Summary of main conclusions

The assessment for this sector covered seven installations in seven Member States (Greece, Italy, Netherlands, Poland, Slovakia, Spain and the UK).

The setting of ELVs for this sector is complicated by the fact installations fall within the remit of both the IPPC and the LCP Directives. The LCP Directive has two implementation options for existing plants: the use of emission limit values or a National Emission Reduction Plan (NERP), as well as certain flexibilities and derogation possibilities. Furthermore, the installations covered include examples from the newer (EU-12) Member States, some of which have been granted temporary derogations for specific plants from either certain parts of the IPPC Directive or the LCP Directive.

The table below provides an indicative summary of the standards, BAT levels and emissions to air of three key pollutants from this sector (dust, NO_x and SO_2). In particular, it includes information on the relevant BREF BAT-AELs; the ELVs set in permit conditions; the ELVs set out in the LCP Directive; and actual installation performance. This information is only intended to be indicative of the broad ranges of these values and the reader is referred to the assessments for each installation in the main report for further information on the emissions from specific sources and the applicable permit ELVs, BAT-AELs and LCP Directive limit values[12].

Table 3.10 Indicative information on LCPs for emissions of certain air pollutants (BAT-AELs, permit ELVs, LCP Directive limits and actual installation performance)

Member State (1 installation each)	Pollutant	BAT-AEL (Note 1)	Permit ELVs (Note 1)	LCPD ELVs (Note 5)	Actual emissions (Note 1)
Greece	NOx	50-200 mg/m3 (daily)	500 mg/m3 (48h average and monthly average)	500 mg/m3	199 - 461 mg/m3 (6-8h interval samples over 3d; 30 min average for some points)
Italy	NOx	90-150 mg/m3 (daily)	100 mg/m3 (hourly)	200 mg/m3	N/A
Netherlands	NOx	90-200 mg/m3 (daily) (Note 2)	65-75 mg/m3 (yearly); 100 mg/m3 (daily); 200 mg/m3 (hourly)	200-500 mg/m3	75-158 mg/m3 (yearly average)
Poland	NOx	50-200 mg/m3 (daily)	500 mg/m3 (Note 7)	500 mg/m3	378-426 mg/m3 (6-month average) (Note 3)
Slovakia	NOx	50-300 mg/m3 (daily)	400-500 mg/m3 (daily)	600 mg/m3	119-726 mg/m3 (annual average)
Spain	NOx	90-200 mg/m3 (daily)	1,200-1,750 mg/m3 (Note 7)	500 mg/m3	905 mg/m3 (daily)
UK (Note 6)	NOx	90-200 mg/m3 (daily)	1.8 t/GWh 60,000t total mass	500 mg/m3	1.42 t/GWh 22,201t total mass
Greece	Particulates	5-20 mg/m3 (daily)	100 mg/m3 (48h average and monthly average)	50 mg/m3 (100 for certain types of solid fuels)	4.5 - 158 mg/m3 (6-8h interval samples over 3d; 30 min average for some points)
Italy	Particulates	5-10 mg/m3 (daily)	15 mg/m3 (hourly)	30 mg/m3	N/A
Netherlands	Particulates	5-20 mg/m3 (daily) (Note 2)	3-5 mg/m3 (yearly); 8 mg/m3 (daily); 10 mg/m3 (hourly)	50 mg/m3 (100 for certain types of solid fuels)	4-5 mg/m3 (yearly average)
Poland	Particulates	5-20 mg/m3 (daily)	100 mg/m3 (Note 7)	50 mg/m3 (100 for certain types of solid fuels)	93-133 mg/m3 (6-month average) (Note 3)
Slovakia	Particulates	5-20 mg/m3 (daily)	50-100 mg/m3 (daily)	50-100 mg/m3	24-280 mg/m3 (annual average)

[12] Note that the BAT-AELs and LCP Directive limit values vary according to the age of the plant (new, existing), the size of the combustion plant, type of fuel used and other factors (specific details for each are provided in the detailed assessments.

Member State (1 installation each)	Pollutant	BAT-AEL (Note 1)	Permit ELVs (Note 1)	LCPD ELVs (Note 5)	Actual emissions (Note 1)
Spain	Particulates	5-20 mg/m3 (daily)	50-280 mg/m3 (Note 7)	50 mg/m3 (100 for certain types of solid fuels)	90 mg/m3 (daily)
UK	Particulates	5-20 mg/m3 (daily)	25 mg/m3 (monthly)	50-100 mg/m3	3-8 mg/m3 (monthly)
Greece	SO_2	20-200 mg/m3 (daily)	400 mg/m3 (48h average and monthly average)	400 mg/m3	172 - 910 mg/m3 (6-8h interval samples over 3d; 30 min average for some points)
Italy	SO_2	20-150 mg/m3 (daily)	100 mg/m3 (hourly)	200 mg/m3	N/A
Netherlands	SO_2	20-200 mg/m3 (daily) (Note 2)	40-127 mg/m3 (yearly); 60 mg/m3 (daily); 189 mg/m3 (hourly)	200-400 mg/m3	89-166 mg/m3 (yearly average)
Poland	SO_2	20-200 mg/m3 (daily)	996 mg/m3 (Note 7)	400 mg/m3	538-802 mg/m3 (6-month average) (Note 3)
Slovakia	SO_2	20-400 mg/m3 (daily)	400 mg/m3 (daily)	400-1032 mg/m3	210-8,663 mg/m3 (annual average) (Note 4)
Spain	SO_2	20-200 mg/m3 (daily)	400-3000 mg/m3 (Note 4,7)	400 mg/m3	2424 mg/m3 (daily)
UK (Note 6)	SO_2	20-200 mg/m3 (daily)	1.8 t/GWh 47,000t total mass	400 mg/m3	0.72 t/GWh 11,565t total mass

Notes:

1) Where there are several points at which emissions are measured and ELVs set, the range is quoted.

2) The BAT-AEL for one emission source is 5-10 mg/m3 for dust, 20-150 mg/m3 for SO_2 and 90-150 mg/m3 for NOx (new installation).

3) Range of values for different emission points. Most recent data have been taken.

4) Note that the highest emissions relate to emissions points that are considered as opted out of the requirements of the LCP Directive.

5) LCPD ELVs presented in this table do not include the specific ELVs related to plant operating under e.g. limited hours provisions. This should be taken into account in the comparison.

6) ELVs are not directly comparable with BAT-AELs because they are set on a different basis (concentration-based for the former and both total mass and mass per unit of electricity generation for the latter).

7) No averaging period given.

In interpreting the above table, it should be noted that the LCPs in Greece, Spain and the UK form part of the corresponding NERP under the LCP Directive, with the Spanish installation having reduced operating hours for one unit in order to comply with the mass emission limits under the NERP. The Polish LCP has a transition period for complying with the LCP Directive under the Accession Treaty. The Slovakian LCP has one unit opted out (due to limited operating hours) under the LCP Directive and has a temporary derogation from certain parts of the IPPC Directive under the Accession Treaty.

In one case in the table above (the UK), the ELVs set are based on mass emissions or emissions per unit of electricity generation and are therefore not directly comparable with the concentration-based BAT-AELs in the BREFs[13].

In relation to ELVs set in permits for emissions to air, there is significant variability amongst the installations with regard to the levels at which the ELVs are set and the basis for setting the ELVs. It is evident that the LCP Directive has been the main driver in defining NO_x, SO_2 and dust emission limit values for the majority of the installations assessed (with at least some ELVs set at the LCP Directive limit values for five of the seven installations). For each of the Member States, the approaches adopted were as follows:

- Greece: The installation is covered under the NERP under the LCP Directive. The permit includes ELVs for the main polluting substances, including concentration-based ELVs, effective from September 2007, for particulates, NO_x and SO_2 which have been based upon and are equal to the limit values in the LCP Directive[14]. The permit also includes mass emission limit values for SO_2 and NO_x, with revised mass emission values applicable following implementation of the NERP in August 2008 (though it was not clear during the assessment when these will be implemented in the permit and the relationship between these mass limits and the concentration-based limits was not clear).

- Italy: The ELVs for air emissions are more stringent than the LCP Directive ELVs and are generally consistent with the BAT-AELs, having been based on the LCP BREF. This is a new installation and was not operational at the time of the assessment.

- Netherlands: The ELVs appear to be consistent with the BAT-AELs for all relevant pollutants referred to in the LCP BREF and are hence lower than the ELVs in the LCP Directive.

- Poland: The installation has a transition period under the Accession Treaty for certain requirements of the LCP Directive. Consequently, certain permit ELVs are higher than the ELVs set in the LCP Directive (with all ELVs for LCP Directive pollutants above the BREF BAT-AELs).

- Slovakia: Some units of the combustion plant are “opted-out” under article 4(4) of the LCP Directive as they will not operate for more than 20,000 hours between 2008 and 2015. For those units that are opted out, permit ELVs have not been set, whilst for others permit ELVs appear to be in line with the ELVs in the LCP Directive (e.g. for NO_x and SO_2). For this installation, Slovakia has a temporary derogation from the requirement under the IPPC Directive to set ELVs based on BAT during a transition period set out in the Accession Treaty.

- Spain: The installation is covered under the Spanish NERP under the LCPD. Annual mass emission limits or bubble limits have been set which apply from 2008 to 2015, covering four production units (including the two main installations assessed). Concentration-based ELVs are also set in the permit for the two main installations. It is understood that BAT is not being applied in Group 1 (one of the

---

13 The ELVs set are in line with the UK’s guidance on BAT. The value of 1.8 tSO_2/GWh generated corresponds to 400 mg/m^3 and the value of 1.8 tNO_x/GWh generated corresponds to 500 mg/m^3, equivalent to the LCPD ELVs.

14 The permit ELVs are based directly on the limits in the LCP Directive (as incorporated into national legislation).

two main production units) as a result of the decision to reduce the operating hours of the plant, allowing the overall annual mass emission limits set under the LCPD NERP to be met. For that unit, higher concentration-based ELVs have been set. For the second unit, ELVs less stringent than those in the LCP Directive have been set, with stricter ELVs (in line with the LCP Directive) applying following required improvements.

- United Kingdom: The installation is covered under the LCPD NERP and emission limit values are set as annual mass emissions. These include an 'A' limit (included in the table above) which cannot be exceeded and is intended to ensure compliance with ambient air quality standards, as well as a transferable (tradable) 'B' limit, also expressed in mass terms. BAT for this sector is determined at a sector level in the UK[15] and the permit also includes concentration-based ELVs for particulate emissions and limits on mass emissions per unit of electricity generation for NO_x and SO_2 (which are calculated by the competent authority to be equivalent to the LCP Directive ELVs).

Where installations are covered by a national emission reduction plan under the LCP Directive, this does not exempt those installations from needing to apply ELVs set out in accordance with the IPPC Directive. However, it is clear that in practice, it has affected the levels at which those ELVs are set by some competent authorities. Likewise, although some combustion plant can "opt-out" under article 4(4) of the LCP Directive as they will not operate for more than 20,000 hours between 2008 and 2015, this provision applies without prejudice to the IPPC Directive (i.e. emission limit values or equivalent parameters should still be set according to the requirements of the IPPC Directive).

For emissions to water, there is generally much greater consistency between permit ELVs and BAT-AELs set out in the BREF. In the case of Italy, permit ELVs are based on general binding rules applicable to all IPPC installations (some of which include values higher than the BAT-AELs).

In relation to actual operation of the installations when compared to permit conditions (in particular ELVs) and to the BREF BAT-AELs, the following conclusions can be drawn:

- There is significant variability amongst the installations with regard to the averaging periods set in permits and used in practice (and in some cases such averaging periods could not be identified). In some cases, information on the averaging periods applying to permit ELVs and monitoring results was not provided. This makes a comparison between installations problematic.

- Monitoring undertaken by the operators appeared to comply with the conditions of the permit for five of the installations. The situation was mixed for one installation (due to malfunctioning of the continuous monitoring system) and the remaining installation (Italy) was not yet operational at the time of the assessment.

- Monitoring data for some of the installations (e.g. Greece, Spain) suggest that emissions have exceeded the permit ELVs in some cases.

---

15 In this case, the permit conditions are based on the national competent authority's decision on the techniques and associated emission levels that are considered by them to represent BAT.

- Based on the information made available, only one of the seven installations reported emissions that were all within the relevant BAT-AEL ranges.
- Inspections were conducted by the competent authority for the six installations that were operational at the time of the assessments. These were generally at a frequency of 1 to 3 inspections per year with less than one per year for one installation and around 4 per year for the remaining one.

3.4 Iron and steel production (sinter plants and associated blast furnaces)

3.4.1 Background to the sector

According to the 2001 BREF on iron and steel production, the production of crude steel in the European Union stood at 155.3 million tonnes in 1999, equivalent to about 20% of world production. In the EU about two thirds of crude steel was produced at this time via the blast furnace route at 40 sites and one third in 246 electric arc furnaces.

In 2008, crude steel production in the EU-27 was around 198 million tonnes (with levels having varied between around 192 and 210 million tonnes over the period 2003-07)[16]. In 2005, blast furnace (oxygen) steelmaking accounted for 61% of crude steel production, with the remainder accounted for by the electric arc process.

It was agreed with the Commission that the assessment should focus on the blast furnace and sinter plant (given the complexity of some of the installations involved in this sector). As such, the assessment does not include pelletisation plants, coke oven plants or basic oxygen steelmaking and casting. Sintering involves the physical and metallurgical preparation of the burden prior to the blast furnace.

The most important environmental issues of iron and steelmaking relate to emissions to air and solid wastes/by-products, with emissions from sinter plants dominating the overall emissions for most of the pollutants. Wastewater emissions from blast furnaces are one of the most relevant emissions to water in this sector.

For sinter production, the most relevant environmental issues are the off-gas emissions from the sinter strand, which contain a wide range of pollutants such as dust, heavy metals, SO_2, HCl, HF, PAHs and organochlorine compounds (such as PCB and PCDD/F).

The blast furnace consumes most of the overall energy input of an integrated steelworks.

---

[16] http://www.eurofer.org/index.php/eng/Facts-Figures/Figures/EU-Crude-steel-production.

3.4.2 Summary of main conclusions

Based on the four installations reviewed for this sector (in Italy, the Netherlands, Slovakia and Spain), the following overall conclusions can be drawn:

- All four installations have permits that include ELVs for emissions to air and water. In three of these cases, the ELVs for the main air pollutants are set using General Binding Rules rather than on a site-specific basis. In three of the four cases, ELVs for key air pollutants are set above BAT-AELs. It was clear that ELVs set for the case study in the Netherlands were stricter overall than the other three case studies although there is a significant disparity between case study permits with regard to the ELVs set for specific pollutants.

- All case study respondents within the competent authority noted that, during determination, local factors were taken into consideration in setting of permit conditions and ELVs. Despite this, GBRs remain the prime mechanism by which permit ELVs have been set by competent authorities and therefore it was not clear in all cases how competent authorities are taking into account such factors according to Article 9(4) of the Directive.

- Dust is a primary concern within the iron and steel industry, a fact supported by this study, which demonstrates – in two of the four case studies – reported data for dust emissions from the sinter and/or blast furnace plants in exceedance of the ELVs as set in the permit.

- For the three of the four installations, there is evidence to suggest that not all emissions are within the BAT-AEL ranges (for the fourth installation, emissions were within the BAT-AEL ranges but available data was limited). In several instances, reported emissions are above the BAT-AELs.

- There was, in general, a lack of information on the averaging periods applicable to the permit ELVs and those that had been applied in the monitoring data provided, making a robust comparison problematic.

- All four case studies demonstrated clear evidence that members of the public were given the opportunity to comment upon and engage in dialogue regarding the determination and issue of the IPPC permits. Two of the case studies concerned installations where considerable local support against the plant was evident.

- For all four installations, monitoring data was collected and reported to the competent authority. For three of the installations, the monitoring undertaken complied with the permit conditions with the picture mixed for the remaining one.

- Inspections of the installations were reported to be undertaken at three of the four installations, with four or more annual visits reported for one installation (Netherlands) but fewer than one visit for two installations (the Slovakian and Italian installations). No information was available on inspections for the Italian installation.

The table below provides an indicative summary of the standards and emissions to air of key pollutants from this sector. In particular, it includes information on the relevant BREF BAT-AELs; ELVs set in permit conditions; and actual installation performance. This information is only intended to be indicative of the broad ranges of these values and the reader is referred to the assessments for each installation in the main report for further information on the emissions from specific sources and the applicable permit ELVs and BAT-AELs.

Table 3.10 Indicative information on emissions of certain air pollutants from iron and steel installations (BAT-AELs, permit ELVs and actual installation performance)

Member State	Pollutant	BAT-AEL (Note 1)	Permit ELVs (Note 1)	Actual emissions (Note 1)
Sinter plant				
Italy	Dust	<50 mg/m^3 (10-20 mg/m^3 with fabric filter)	50 mg/m^3	1-18 mg/m^3
Netherlands	Dust	<50 mg/m^3 (10-20 mg/m^3 with fabric filter)	40-250 mg/m^3	289 mg/m^3
Slovakia	Dust	<50 mg/m^3 (10-20 mg/m^3 with fabric filter)	100 mg/m^3	54-68 mg/m^3
Spain	Dust	<50 mg/m^3 (10-20 mg/m^3 with fabric filter)	50 mg/m^3	31-83 mg/m^3
Italy	SO_2	<500 mg/m3 (<100 mg/m^3 with wet FGD)	None	No data
Netherlands	SO_2	<500 mg/m3 (<100 mg/m^3 with wet FGD)	40 mg/m^3 250-300 mg/m^3 (off gas)	No data
Slovakia	SO_2	<500 mg/m3 (<100 mg/m^3 with wet FGD)	400 mg/m^3	179-196 mg/m^3
Spain	SO_2	<500 mg/m3 (<100 mg/m^3 with wet FGD)	1000 mg/m^3	391-619 mg/m^3
Italy	PCDD/PCDF	0.1-0.5 ngTEQ/m^3	0.4 ngTEQ/m^3	No data
Netherlands	PCDD/PCDF	0.1-0.5 ngTEQ/m^3	0.4 ngTEQ/m^3	0.4 ngTEQ/m^3
Slovakia	PCDD/PCDF	0.1-0.5 ngTEQ/m^3	None	No data
Spain	PCDD/PCDF	0.1-0.5 ngTEQ/m^3	0.5 ngTEQ/m^3	No data
Blast furnace				
Italy	Dust	<10 mg/m^3	10 mg/m^3	1.5-2.3 mg/m^3
Netherlands	Dust	<10 mg/m^3	5-15 mg/m^3	<1-10 mg/m^3
Slovakia	Dust	<10 mg/m^3	100 mg/m^3	0.4-36 mg/m^3
Spain	Dust	<10 mg/m^3	40-120 mg/m^3	1-7 mg/m^3
Italy	NO_x	<350 mg/m^3	350 mg/m^3	5-16 mg/m^3
Netherlands	NO_x	<350 mg/m^3	40 mg/m^3	No data

Member State	Pollutant	BAT-AEL (Note 1)	Permit ELVs (Note 1)	Actual emissions (Note 1)
Slovakia	NO_x	<350 mg/m^3	500 mg/m^3	11-50 mg/m^3
Spain	NO_x	<350 mg/m^3	300ppm (564 mg/m^3)	<5ppm (<9 mg/m^3)

Notes:

1) Where there are several points at which emissions are measured and ELVs set, the range is quoted. It was concluded in the BREF that it was not possible to draw a conclusion on what averaging periods should be used, though there was a recommendation that the BAT-AELs should be considered as daily averages unless otherwise stated. BAT-AELs for dust emissions with fabric filters in place and SO_2 emissions with wet FGD are also quoted above. It is understood that fabric filters will be in place at the Italian installation.

3.5 Production of basic inorganic chemicals (nitric acid manufacture)

3.5.1 Background to the sector

According to the BREF on large volume inorganic chemicals, nitric acid is one of the top 10 industrial chemicals, with production of 16.6 million tonnes in Europe in 2003 and around 100 nitric acid manufacturers in the EU25 plus Norway and Switzerland in 2006.

Most nitric acid is manufactured through oxidation of ammonia with air to form nitrogen oxides that are absorbed in water to form nitric acid.

The majority of nitric acid use is in production of inorganic fertilisers, ammonium nitrate explosives and in chemicals. Weak nitric acid (50-65%) constitutes the greater part of nitric acid manufacture and is suitable for production of fertilisers; stronger acid (up to 99%) is used for many organic reactions.

In terms of the key environmental issues, considerable amounts of the greenhouse gas N_2O are generated during nitric acid production; oxidation of ammonia generates NO, with N_2O as a by-product. Increases in combustion pressure from 1 to 5 bar in recent decades have slightly increased the N_2O emission level. The average European plant emits 6 kg of N_2O per tonne of HNO_3 corresponding to about 2 tonnes CO_2-eq. per tonne of 100% HNO_3.

The other main pollutant emitted to air is NO_x. Ammonia emissions also have the potential to be significant.

3.5.2 Summary of main conclusions

Based on the three case studies (installations in Italy, Netherlands and Spain), the following main conclusions can be drawn:

- Despite the importance of nitrous oxide emissions highlighted in the relevant BREF, ELVs are not included in the permits for nitrous oxide for two of the three installations; Spain and Italy. The reason provided for such an exclusion in Spain was indicated to be a result of national legislation that does not contain ELVs for this pollutant (according to the operator). In the Italian case, the reason provided by the competent authority was that emissions from the nitric acid process were understood to be relatively low (however, there is a pilot plant in place for catalytic destruction of N_2O from the associated adipic acid process, which generates a significantly higher quantity of N_2O emissions).

- For the third installation (Netherlands), the permit ELV for nitrous oxide (300 ppmv) is at the upper end of the BAT-AEL range (20-300 ppmv). Reported emissions from this installation were below the permit ELV.
- In relation to NO_x emissions, all three of the permits contain ELVs; these range from around 40 ppmv (Netherlands) to around 220 ppmv (Italy) (the value for the Spanish installation is 50 ppmv). Emissions of NO_x from the nitric acid processes range from 28 ppmv (Netherlands) to 147 ppmv (Italy). The BREF BAT-AEL is 5-90 ppmv.
- The monitoring undertaken for the installations was generally reported as being compliant with the permit conditions, although data availability for one installation did not allow this aspect to be confirmed.
- All of the installations were inspected by the competent authority, with inspection frequencies ranging from less than one per year to more than four per year.

The table below provides an indicative summary of the standards and emissions to air of key pollutants from this sector. In particular, it includes information on the relevant BREF BAT-AELs; ELVs set in permit conditions; and actual installation performance. This information is only intended to be indicative of the broad ranges of these values and the reader is referred to the assessments for each installation in the main report for further information on the emissions from specific sources and the applicable permit ELVs and BAT-AELs.

Table 3.10 Indicative information on emissions of certain air pollutants from nitric acid manufacture installations (BAT-AELs, permit ELVs and actual installation performance)

Member State	Pollutant	BAT-AEL (Note 1)	Permit ELVs (Note 1)	Actual emissions (Note 1)
Italy	N_2O	20-300 ppm	None	No data
Netherlands	N_2O	20-300 ppm	1000 ppm maximum 300 ppm average over lifetime of catalyst	216 ppm (30 min averages)
Spain	N_2O	20-300 ppm	None	No data
Italy	NO_x	5-90 ppm	195-219 ppm (30 min averages)	57-147 ppm (30 min averages)
Netherlands	NO_x	5-90 ppm	40 ppm	28 ppm (30 min averages)
Spain	NO_x	5-90 ppm	50 ppm (annual average)	67 mg/m^3 (32 ppm) (annual average)
Italy	NH_3 slip from SCR	<5 ppm	22 ppm (30 min averages)	0.2 ppm (30 min averages)

Member State	Pollutant	BAT-AEL (Note 1)	Permit ELVs (Note 1)	Actual emissions (Note 1)
Netherlands	NH_3 slip from SCR	<5 ppm	<5 ppm	No data
Spain	NH_3 slip from SCR	<5 ppm	None	No data

Notes:

1) Where there are several points at which emissions are measured and ELVs set, the range is quoted. Note that the LVIC-AAF BREF does not specify the averaging periods to be used.

3.6 Fertiliser manufacture (NPK/CN)

3.6.1 Background to the sector

The production of compound fertilisers using the key components of nitrogen, potassium and phosphorous (NPK) involves a number of complex manufacturing process stages and may be achieved using a mixed acid process (with or without phosphate rock digestion), nitrophosphate process or mechanical grinding and blending of single or multi-nutrient compounds.

The plant size varies from several hundred to up to more than 3,000 tonnes per day. A plant of typical size produces about 50 tonnes per hour (1,200 tonnes per day or 350,000 tonnes per year). As of February 2006, there were 38 NPK fertiliser producers in the EU-25 that had a capacity of more than 150,000 tonnes per year.

The most important emissions to air from fertiliser manufacture are NH_3, NO_x, HF, HCl and dust. The main source of NO_x is the dissolution of phosphate rock in nitric acid. The main source of NH_3 is from the neutralisation process (pipe reactor, pre-neutralisation tank, granulation drum ammoniation or ammoniation tanks). Fluorine compounds originate from the phosphate rock. The main sources of fertiliser dust are the drying and granulation drums, spherodiser and/or prilling towers, with dust also coming from the cooling drum, screens, crushers and conveyors.

3.6.2 Summary of main conclusions

Based on the four case study assessments (in Italy, the Netherlands, Slovakia and Spain), the following key points can be drawn out:

- Permit ELVs have been set for water for two of the installations[17]. Where relevant BAT-AELs are available from the LVIC-AAF BREF, these permit ELVs are consistent with the BAT-AEL range. Emissions monitoring data were only available for water for one of these installations.

[17] In the case where ELVs for water were not included, this was because the installation units under assessment produced only very limited quantities of general sanitation water and recycled all process water into the system.

- In relation to air emissions, the majority of permit ELVs are consistent with the BAT-AEL ranges, with the following exceptions:
  - HCl (Italy);
  - CO (Slovakia);
  - Particulates (Slovakia, Spain).
- With regard to emissions monitoring, the monitoring undertaken generally complied with the permit conditions for all installations, with the exception of one installation where monitoring was not undertaken for some of the emission points.
- The LVIC-AAF BREF does not specify the averaging periods to be used. Little information was made available across all four installations regarding the averaging periods that are expected to apply to the permit ELVs and the monitoring data. Operators expressed that this was an area of uncertainty for them.
- Across the four installations, the monitoring data provided indicates that emissions appear to be below the permit ELVs and within the BAT-AEL ranges, with the following exceptions:
  - Emissions of particulates from several sources at both the Slovakian and Spanish installations are above the BAT-AEL range;
  - Emissions of ammonia are above the permit ELVs for two sources at the Slovakian installation and are above the BAT-AEL ranges for several sources at this installation.
- Inspections were undertaken by the competent authority for three of the installations, ranging from less than one per year to more than four per year, based on the year preceding the interviews. The remaining installation had not been inspected in that year.

The table below provides an indicative summary of the standards and emissions to air of key pollutants from this sector. In particular, it includes information on the relevant BREF BAT-AELs; ELVs set in permit conditions; and actual installation performance. This information is only intended to be indicative of the broad ranges of these values and the reader is referred to the assessments for each installation in the main report for further information on the emissions from specific sources and the applicable permit ELVs and BAT-AELs.

Table 3.10 Indicative information on emissions of certain air pollutants from NPK/CN fertiliser manufacture installations (BAT-AELs, permit ELVs and actual installation performance)

Member State	Pollutant	BAT-AEL (Note 1)	Permit ELVs (Note 1)	Actual emissions (Note 1)
Phosphate rock digestion, sand washing, CNTH filtration				
Italy	NO_x	100 - 425 mg/m^3	250 mg/m^3	8 - 22 mg/m^3
Italy	HF	0.3 - 5 mg/m^3	None	No data
Neutralisation, granulation, drying, coating, cooling.				
Italy	NH_3	5 - 30 mg/m^3	30 mg/m^3	19 - 26 mg/m^3
Netherlands	NH_3	5 - 30 mg/m^3	30 mg/m^3	0.1 mg/m^3
Slovakia	NH_3	5 - 30 mg/m^3	30 mg/m^3	0.25 - 870 mg/m^3
Spain	NH_3	5 - 30 mg/m^3	None	No data
Italy	HF	1 - 5 mg/m^3	None	No data
Netherlands	HF	1 - 5 mg/m^3	3 mg/m^3	2.7 mg/m^3
Slovakia	HF	1 - 5 mg/m^3	None	No data
Spain	HF	1 - 5 mg/m^3	5 mg/m^3	0.2 - 4 mg/m^3
Italy	Dust	10 - 25 mg/m^3	20 mg/m^3	1.2 - 6.1 mg/m^3
Netherlands	Dust	10 - 25 mg/m^3	20 mg/m^3	2.9 mg/m^3
Slovakia	Dust	10 - 25 mg/m^3	75 mg/m^3	1 - 59 mg/m^3
Spain	Dust	10 - 25 mg/m^3	50 mg/m^3	3 - 49.98 mg/m^3
Italy	HCl	4 - 23 mg/m^3	30 mg/m^3	0.4 - 0.5 mg/m^3
Netherlands	HCl	4 - 23 mg/m^3	30 mg/m^3	0.1 mg/m^3
Slovakia	HCl	4 - 23 mg/m^3	None	No data
Spain	HCl	4 - 23 mg/m^3	None	No data

Notes:

1) Where there are several points at which emissions are measured and ELVs set, the range is quoted. No averaging periods are specified in the LVIC-AAF BREF and no information was made available on the averaging periods applying to permit ELVs or emissions monitoring data.

4. Implementation in the mineral oil and gas refinery sector

4.1 Introduction

Task 3 of the project involved both an assessment of the overall state of implementation of the IPPC Directive in this sector and an assessment of individual installations. The overall assessment included a consideration of the extent to which the BAT conclusions of the BREF are being implemented, the current performance of installations compared with BAT as determined in the BREF and the possible differences amongst individual installations or more generally amongst Member States.

The general sector evaluation for refineries included:

- A literature review;
- A workshop (held in July 2008) which brought together experts from industry, authorities and other relevant bodies with practical experience of implementing IPPC in the mineral oil and gas refineries sector; and
- An assessment of the data in the European Pollutant Emissions Register (EPER) and from other sources.

This sector wide evaluation was then supported by the assessment of 11 individual refineries in 10 Member States.

4.2 Background to the sector

The purpose of a refinery is to transform crude oil into useful saleable products. In order to achieve this transformation, the raw materials are processed in a number of different process facilities. The combination of these processing units to convert crude oil into products, including its supporting units and facilities, is referred to as a refinery.

Petroleum refining processes and operations can be separated into five basic areas:

- Fractionation (distillation) is the separation of crude oil in atmospheric and sometimes also vacuum distillation towers into groups of hydrocarbon compounds of differing boiling-point ranges called “fractions” or “cuts”.
- Conversion processes change the size and/or structure of hydrocarbon molecules. These processes include:
  - Decomposition (dividing) by thermal and catalytic cracking;

  - Combining through alkylation and polymerization; and
  - Rearranging with isomerization and catalytic reforming.
- Treatment processes are intended to prepare hydrocarbon streams for additional processing and to prepare finished products.
- Formulating and blending is the process of mixing and combining hydrocarbon fractions, additives and other components to produce finished products with specific performance properties.
- Other Refining Operations include: light-ends recovery; sour-water stripping; solid waste and wastewater treatment; process-water treatment and cooling; storage and handling; product movement; hydrogen production; acid and tail-gas treatment; and sulphur recovery.

4.3 Main environmental impacts of the sector

Refinery installations are typically large and fully integrated. They generally manage huge amounts of raw materials and products making them intensive consumers of energy and water. In their storage and refining processes, refineries generate emissions to the atmosphere, to water and to soil, to the extent that environmental management has become a major factor for refineries. The type and quantity of refinery emissions to the environment are typically well known. Oxides of carbon, nitrogen and sulphur, particulates (mainly generated from combustion processes) and volatile organic carbons are the main air pollutants generated. Water is used intensively in a refinery as process water and for cooling purposes. Its use contaminates the water with oil products. The main water contaminants are hydrocarbons, sulphides, ammonia and some metals.

4.4 Conclusions from the sector wide analysis

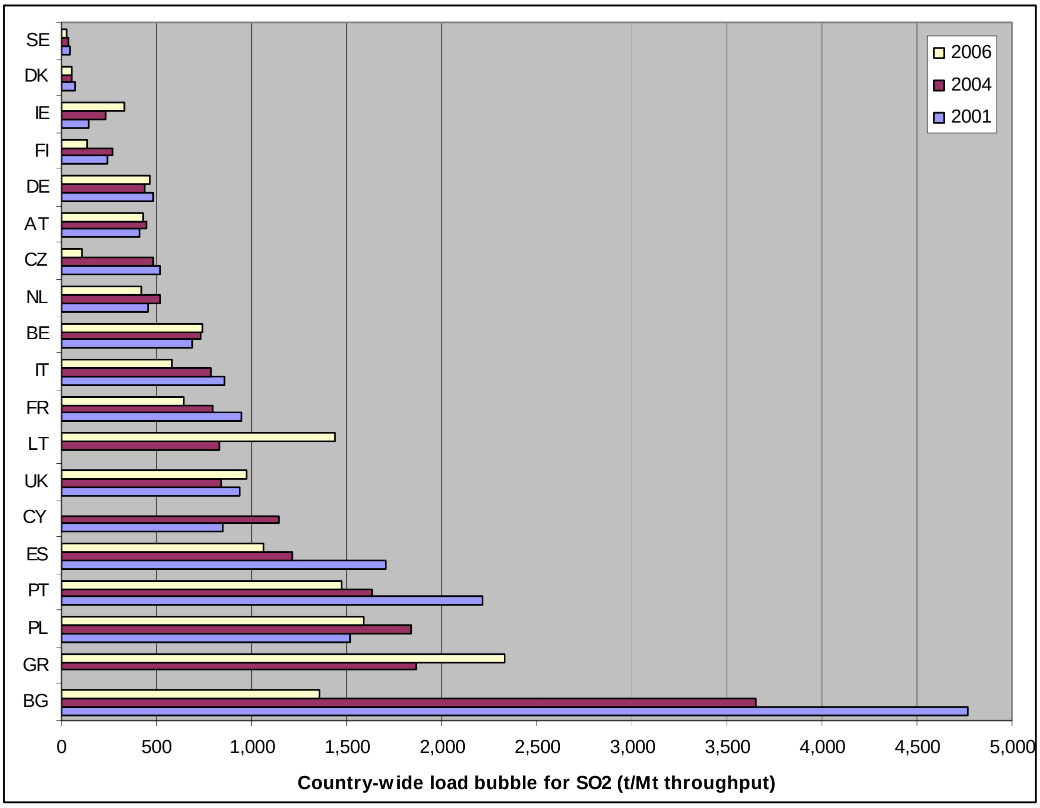
Overview

Information was collected from across the mineral oil and gas refinery sector to draw further conclusions on implementation of the IPPC Directive across the EU. Data on the extent of permitting progress indicate that, for a number of Member States, coming into line with the requirements of the IPPC Directive in terms of issue of the permits for refineries has largely taken place over the two to three years prior to 2008/9 when this analysis was undertaken. This might be partly due to the fact that the BREF document on mineral oil and gas refineries has only been available since 2003. Taking into account the fact that a number of measures can only be implemented during shut down or turn around of individual installations, the effect of IPPC on emissions from refineries might not yet be fully visible in publicly available data. Data for individual pollutants are considered below.

Sulphur dioxide (SO_2)

Based on historic data, the EU wide load bubble for SO_2 (emissions per tonne of crude throughput) is found to have decreased[18]. Data from various regions indicate that there is no clear correlation between the crude sulphur content and the SO_2 load bubble. Only a limited number of individual refineries fall within the SO_2 load bubble benchmark mentioned in the BREF (50-210 or 50-230t per Mt throughput on a yearly basis). These units are mainly located in the Scandinavian region (DK, FI, SE) and some in DE and the UK. Evaluation of the long term country-wide load bubbles for SO_2 indicates a decrease in FR, ES, PT and BG but also in DK and SE. Large differences exist between the country-wide load bubble benchmarks for SO_2 for various Member States as can be seen from the figure below.

Figure 4.1 Country wide average SO_2 load bubble (tonne/Mtonne$_{throughput}$)

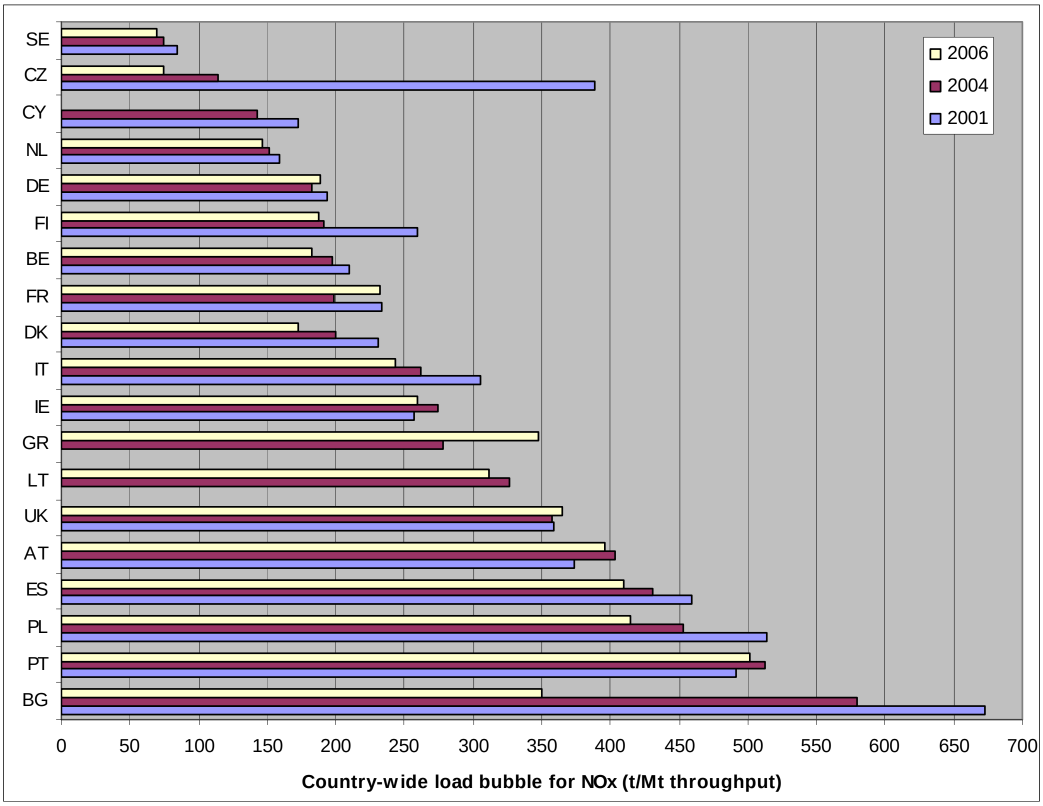


[18] Load bubbles represent the mass of pollutant emissions per mass of crude oil processed. Refinery capacity has been used as a surrogate for the latter in several instances in this assessment as the actual mass processed was not always available for refineries that were not covered by the 11 case studies. The refineries BREF includes 'benchmarks' for emissions load bubbles. Whilst these benchmarks do not have the same status as BAT-AELs, they do provide a useful basis for comparisons between installations and between Member States.

Nitrogen oxides (NO_x)

About a third of the individual refineries fall within the load bubble benchmark from the BREF for NO_x (20-150t per Mt throughput on a yearly basis) and some progress in reducing emissions is obvious during the period 2004-2006. On a country-wide basis, only NL, SE and CZ fall within the load bubble benchmark for NO_x mentioned in the BREF (20-150t per Mt throughput on a yearly basis), but a large number of Member States have realised a decrease in the country-wide NO_x load bubble over the period 2001-2006 (NL, DE, ES, IT, DK, LT, FI, BU, CZ, PL, BE). However, it is clear that large differences still exist between the country-wide load bubble benchmarks for NO_x for various Member States as shown in the figure below.

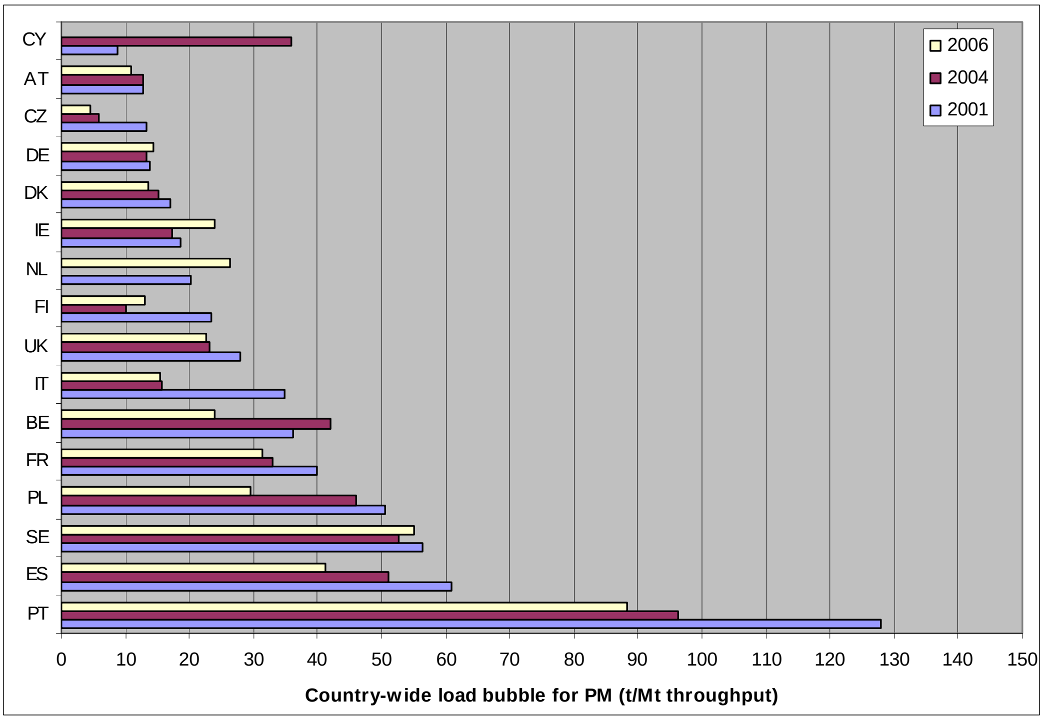
Figure 4.2 Country wide average NO_x load bubble (tonne/$Mtonne_{throughput}$)



Dust

Based on the data from individual refineries, an increase of the dust (PM) load bubble over the period 2004-2006 is the main tendency, which can partly be explained by increased monitoring efforts for this pollutant. The longer-term (since 2001) evolution of the country-wide load bubble benchmark for dust indicates a decrease for the Member States UK, DE, PT, ES, IT, FR, DK, PL and CZ. However, large differences still exist between the country-wide load bubble benchmarks for PM for various Member States, as shown in the figure below.

Figure 4.3 Country wide average PM load bubble (tonne/Mtonne$_{throughput}$)



NMVOC

Based on the data for individual refineries, the majority of installations have achieved a decrease of the NMVOC load bubble over the period 2004-2006. Most country-wide load bubbles for NMVOC show little variation, except for ES, PL, BG and CZ where there is a decrease over the period 2001-2006.

The wide variation observed in the individual refinery load bubbles of pollutant emissions to air according to region and the large differences that exist in country-average load bubbles of pollutant emissions to air, may reflect the different level of implementation of BAT. Based on the sector-wide evaluation and data available for the purposes of this study, it is not possible to say whether the late start of permit review and update in some Member States is an important reason for this, or whether the interpretation and implementation of the IPPC Directive is different from one Member State to another. On the other hand, even in Member States where the permitting or permit review process was already advanced in 2005/2006 (PL, UK, DE, BE), country-average load bubbles were still exceeding the BREF bubble benchmarks in 2006.

Emissions to water – TOC, phenols, N_{tot}, BOD and COD

The majority of the individual refineries have achieved a decrease in the TOC load bubble to water over the period 2004-2006. The situation is less clear for the phenols load bubble to water where about half of the individual installations have realised a decrease and the other half an increase of the load bubble to water, although EU-wide long term data indicate a decrease of the EU wide load bubble of phenols to water. More than 80% of the individual refineries have emissions below the BREF load bubble for N_{tot} to water. For BOD and COD, this share reaches 50 and 70% respectively, although this conclusion may be skewed because the data mainly come from a small number of Member States.

4.5 Conclusions from the installation-specific findings

Nine out of the 11 installations covered in this assessment received their permit over the period 2006 to 2008. Only the installations in CZ and in PL received their permit in 2003 and 2005 respectively. Permits for the installations in EL have been issued after 31/10/2007, which was the deadline for existing installations to be in line with the requirements of the IPPC Directive (and one of these permits was not formally issued at the time that the site visit and review took place).

Two of the permits examined (BE and DE) were issued as the result of an application for substantial changes from the operator. Use was made of this permit application to bring the existing permits in line with the requirements of the IPPC Directive. In two cases (FR and NL) the existing permits were reviewed based on an IPPC compliance check by the operator as requested by the competent authority, revealing that the existing permit and operations were not fully in line with the requirements of the IPPC Directive. In all other Member States (CZ, EL, PL, SK, ES and UK) a new permit has been issued for the installation as a result of the implementation of the IPPC Directive.

The approach taken to bring the permits in line with the IPPC Directive differs from Member State to Member State. By way of example:

- Some Member States (BE, FR, NL) have performed a BAT assessment and have updated permit conditions whenever existing permit conditions were not consistent with BAT.

- Other Member States (CZ, EL, PL, SK) have issued completely new permits for these installations according to a procedure which is in line with the legislation transposing the IPPC Directive in the particular Member State. In some Member States (e.g. BE, EL) a BAT assessment forms an integral part of a permit application.

The ELVs in the individual permits generally cover the main pollutants (SO_2, NO_x, PM and NMVOC emissions to air; BOD, COD, suspended solids and hydrocarbon emissions to water) and the most important sources (combustion sources (boilers, heaters and furnaces) as well as process emissions (catalytic cracker, VRU) to air). However, three of the permits do not specify ELVs for emissions of NMVOC to air.

Due to the fact that bringing the permits for existing installations in line with the IPPC Directive has started late (the majority of the permits being delivered over the period 2006-2008) and that certain modifications to installations can only be done during shutdown or turnaround (due to technical limitations), transition periods for implementing improvements – in some cases up to 4-8 years – have been granted on an individual permit level. As a result, some installations' emissions are not currently within the BAT-AEL ranges and/or benchmarks from the refineries BREF but this situation may improve as technical improvements are implemented.

By way of comparison with the sector-level evaluation, an analysis of the load bubbles for the case study refineries has been undertaken. Whilst there are uncertainties in the data used (as highlighted within the general sector evaluations), these data provide a basis for comparison of the case study installations with the wider sector conclusions.

The load bubbles for SO_2 and NO_x for the individual refineries assessed for 2004 and 2006 (2007 for UK) are illustrated in Figure 4.4 and Figure 4.5 and confirm the findings of the sector wide assessment. These figures show the mass of SO_2 and NO_x emissions in tonnes compared to the nameplate capacity of the refineries (in million tonnes of crude) (see the main report for further details):

- SO_2 load bubbles are the highest in EL, PL and ES;
- None of the installations fell within the SO_2 load bubble value described in the BREF in 2004[19];
- Only one installation fell within the SO_2 load bubble value described in the BREF in 2006/2007;
- Six of the eleven installations show an increase in their SO_2 load bubble over the period 2004-2006 while for three installations the SO_2 load bubble has decreased (data for the other two installations were not available for both years);
- Three out of the eleven installations fell within the NO_x load bubble value described in the BREF [20] in 2004 while only one still met the NO_x load bubble value in 2006/2007;
- Five of the eleven installations show an increase in the NO_x load bubble over the period 2004-2006 while for three installations the SO_2 load bubble has decreased;
- An improvement in the load bubbles to air could only be demonstrated for one of the two installations that were granted a permit in the period 2003-2005;
- It can be seen from both of the figures that complexity is not necessarily a marker for higher emissions.

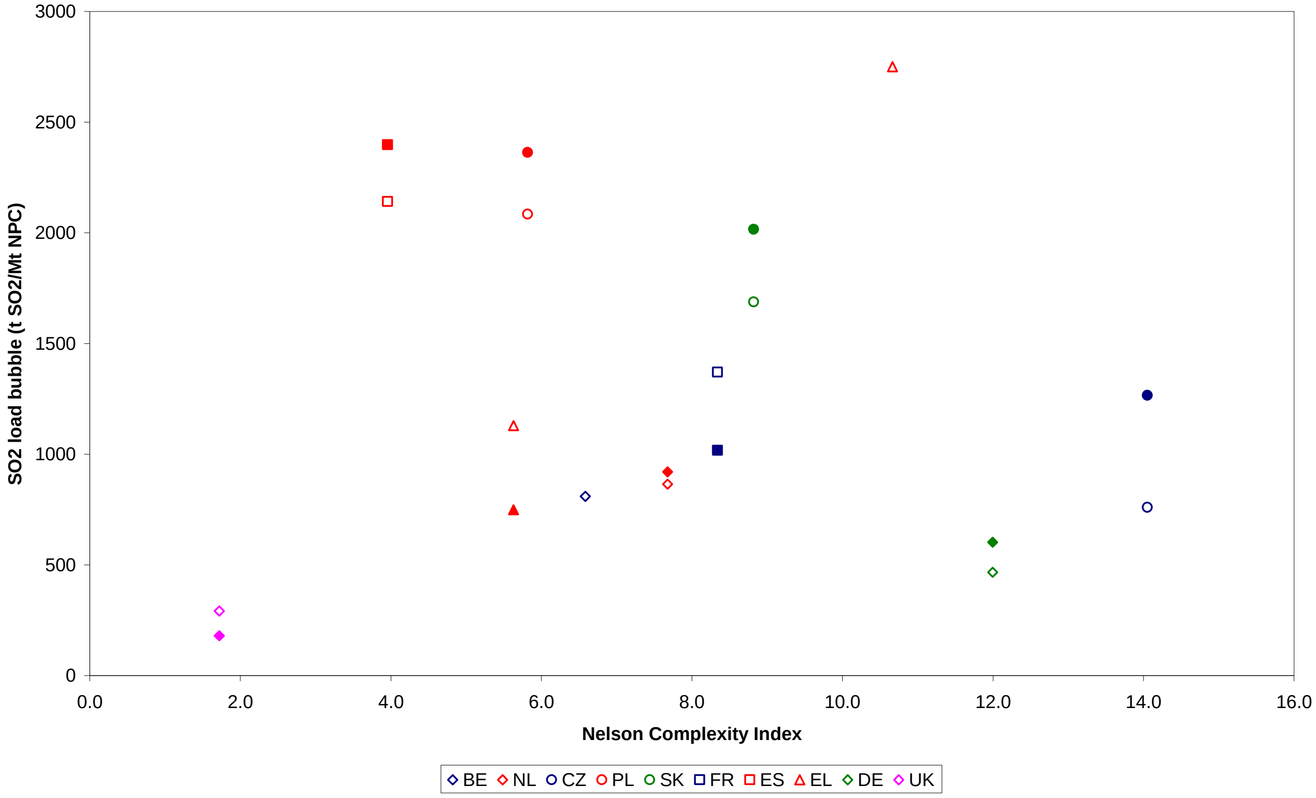
The uncertainties and differences in data collection methods mentioned in the general sector evaluation also apply here.

---

19 50 to 210 or 50 to 230 t SO_2/Mt throughput (see Table 4.3). Nameplate capacity is used as a surrogate for throughput in this part of the analysis.

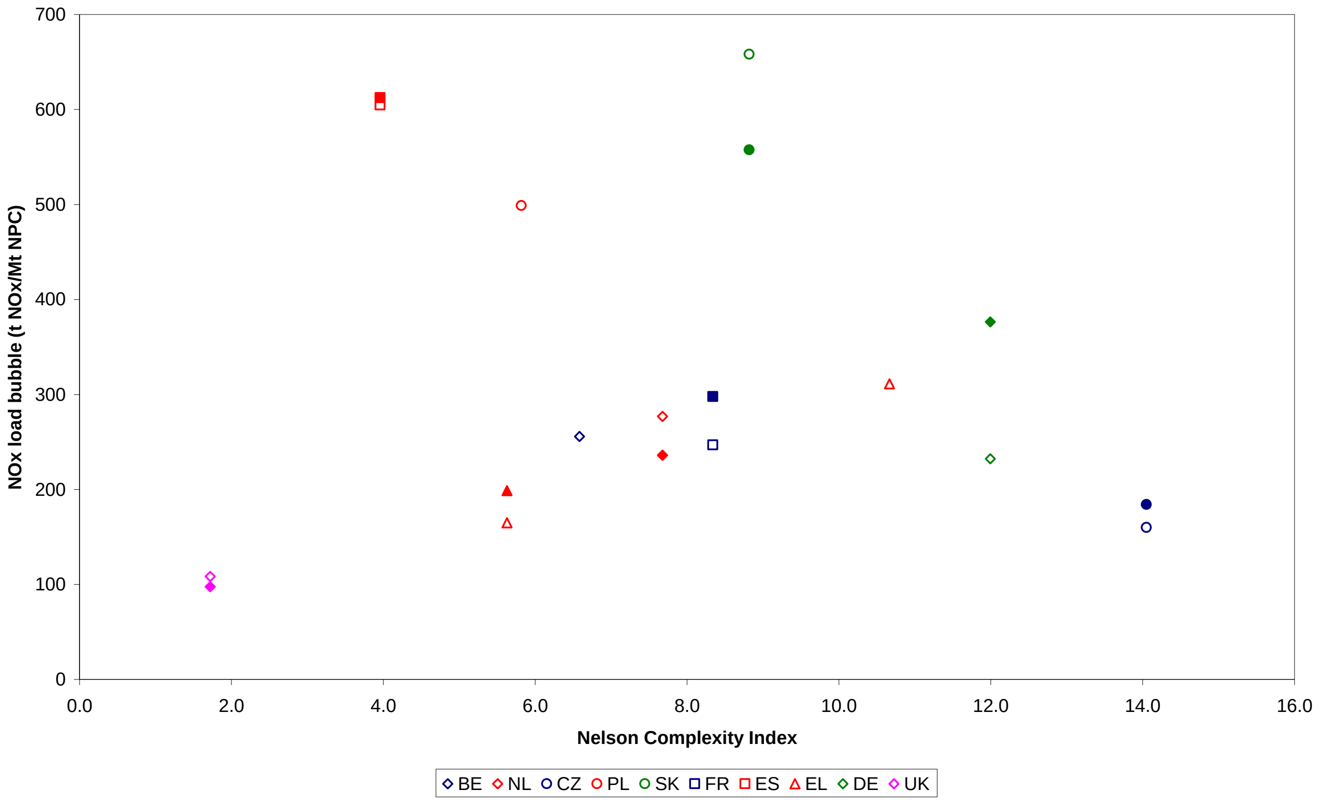
20 20 to 150 or 80 to 170 t NO_x/Mt throughput (see Table 4.4).

Figure 4.4 SO_2 load bubble (based on NPC) as a function of Nelson complexity index for the case study installations



Note: Non-shaded symbols in the figure are based on 2004 emissions data; shaded symbols are based on 2006 emissions data (2007 for the UK).

Figure 4.5 NO$_x$ load bubble (based on NPC) as a function of Nelson complexity index for the case study installations



Note: Non-shaded symbols in the figure are based on 2004 emissions data; shaded symbols are based on 2006 emissions data (2007 for the UK).

Of the Member States covered by the assessments, most (BE, ES, NL, PL, SK, EL, CZ, DE) apply GBRs to set emission limit values to air and/or water. These GBRs are not always consistent with BAT-AELs. One possible reason for such a discrepancy may be that, in certain Member States, modification of these GBRs involves a complex legal procedure (e.g. BE). However, it is not obvious that this is always the main reason why the GBRs are not commensurate with BAT-AELs.

In some Member States (NL, PL, DE, CZ) it is typical (or indeed required) to have a separate permit for discharges to water; this is typically because the Competent Authority is different from the authority responsible for other aspects of the permit (e.g. air, waste and noise). Coordination of competent authorities where more than one authority has responsibility for the permitting of the installation is required to ensure the integrated nature of IPPC implementation. Whilst in some Member States there seems to be good coordination between the various competent authorities involved in the permitting procedure, in others little evidence was provided to indicate the effective coordination of different authorities which may lead to inconsistencies when compared to Article 7 of the IPPC Directive.

Although all national legislation includes the requirement to use BAT, it is clear that, in eight out of 11 individual case study installations, ELVs are still set according to national legislation (GBRs) which often does not set ELVs consistent with the BAT-AELs, with consequent implications for actual emissions. For at least three out of the 11 case study installations the national legislation containing the relevant ELVs is the one transposing or implementing other EU legislation such as the LCP Directive or the NEC Directive including national programmes for reduction of emissions.

The Refineries BREF has not always been used in the setting of ELVs. The case studies in ES, EL, PL, SK and UK have identified that ELVs for emissions to air have been determined based on the requirements of legislation other than the IPPC Directive (national legislation/guidance, LCP Directive, 'National programme for reduction of emissions' under the NEC Directive, etc.). In at least three out of 11 case installations, the ELVs of the LCP Directive (or its transposition into national legislation) are imposed to limit the emissions from boilers, furnaces and heaters or from the installation as a whole[21].

Based on the data presented above and in the main report, it is evident that none of the refineries considered has permit ELVs that are all consistent with the BAT-AELs. Many of the refineries permits assessed set emission limits as bubble values, making direct comparison against the process specific BAT-AELs impracticable (in some cases, the permit contained both a bubble value and point-source ELVs). Benchmark values do exist in the BREFs and it was clear in a number of cases that the Competent Authority had referred to these in setting limits and conditions within the permits. Based on the data available, the number of permit ELVs (covering all 11 installations) consistent with the BAT-AELs is 72. The same number (72) of permit ELVs were set higher than the BAT-AELs. For a large number (165) of permit ELVs, there is no corresponding or comparable BAT-AEL in the relevant BREFs[22].

In terms of the current performance of the installations assessed against BAT-AELs, the monitoring data provided suggests that none of the installations achieved all emissions within the BAT-AEL ranges. The use of different reporting parameters (e.g. use of mass values, bubble values and load values) caused difficulty in clearly comparing emissions against BAT-AELs as set out in the BREF. Seven installations were judged to have a mixed outcome, with certain emissions below the upper range of the BAT-AELs and others not. In four of the assessments it was unclear because the data provided for the installation was incomplete or not comparable to BAT-AELs.

In terms of performance as compared to the BAT-AELs specified in the BREFs, there is a mixed picture for seven installations (with some reported emissions consistent with the BAT-AELs and others not) and an unclear picture for the remaining four installations.

---

[21] For example, in one case, the LCPD ELVs have been imposed on individual boilers, furnaces and heaters. In another case, a load bubble has been imposed for all boilers, furnaces and heaters present in the refinery and covered by the LCP Directive through the National Emission Reduction Plan for existing LCPs.

[22] These figures are based on the permit ELVs presented for the installations earlier in this chapter.

The table below provides an indicative summary of the BAT-AELs, permit ELVs and actual emissions to air and water for key pollutants of the refineries sector. This information is only intended to be indicative of the broad ranges of values observed in the various case studies and the reader is referred to the assessments for each installation in the main report for further information on the emissions from specific sources and the applicable permit ELVs and BAT-AELs.

Table 4.1 Indicative information on refineries for emissions of certain pollutants to air and water (BAT-AELs, permit ELVs and actual installation performance)

Member State	Pollutant	Source	BAT-AEL	Permit ELV	Actual emissions
Emissions to air					
BE	SO_2	Refinery concentration bubble	No comparable BAT-AEL	800 mg/Nm^3	770 mg/Nm^3
	NO_x	Refinery concentration bubble	No comparable BAT-AEL	300 mg/Nm^3	220 mg/Nm^3
	PM	Refinery concentration bubble	No comparable BAT-AEL	50 mg/Nm^3	39 mg/Nm^3
CZ *	SO_2	North flue duct	50 – 850 mg/Nm^3	900 mg/Nm^3	1-19 mg/Nm^3
	NO_x	North flue duct	20 – 150 mg/Nm^3	200 mg/Nm^3	157-167 mg/Nm^3
	SO_2	South flue duct	50 – 850 mg/Nm^3	900 mg/Nm^3	2-8 mg/Nm^3
	NO_x	South flue duct	20 – 150 mg/Nm^3	200 mg/Nm^3	163-171 mg/Nm^3
FR	SO_2	Refinery concentration bubble	No comparable BAT-AEL	1040 mg/Nm^3 (Y)	837.5 mg/Nm^3
	NO_x	Refinery concentration bubble	No comparable BAT-AEL	290 mg/Nm^3 (Y)	221.6 mg/Nm^3
	SO_2	Sulphur recovery unit 1	400 – 2000 mg/Nm^3	14000 mg/Nm^3	7152 mg/Nm^3
	SO_2	Sulphur recovery unit 1	400 – 2000 mg/Nm^3	20000 mg/Nm^3	15639 mg/Nm^3
	SO_2	Fluid catalytic cracking	10 – 350 mg/Nm^3	4000 mg/Nm^3	2385 mg/Nm^3
	PM	Fluid catalytic cracking	10 – 40 mg/Nm^3	50 mg/Nm^3	117 mg/Nm^3
DE	SO_2	Refinery load bubble	No comparable BAT-AEL	480 t/Mt	465 t/Mt
	NO_x	Refinery load bubble	No comparable BAT-AEL	390 t/Mt	355 t/Mt
EL1 *	SO_2	Existing LCPs under LCP Directive	50 – 850 mg/Nm^3	1700 mg/Nm^3	22 – 1594 mg/Nm^3
	NO_x	Existing LCPs under LCP Directive	55 – 300 mg/Nm^3	450 mg/Nm^3	117 – 306 mg/Nm^3
	PM	Existing LCPs under LCP Directive	5 – 30 mg/Nm^3	100 mg/Nm^3	3 – 84 mg/Nm^3
	SO_2	Fluid catalytic cracking	10 – 350 mg/Nm^3	200 mg/Nm^3	83 – 900 mg/Nm^3
	NO_x	Fluid catalytic cracking	100 – 300 mg/Nm^3	150 mg/Nm^3	19 – 299 mg/Nm^3

Member State	Pollutant	Source	BAT-AEL	Permit ELV	Actual emissions
	PM	Fluid catalytic cracking	10 – 40 mg/Nm^3	50 mg/Nm^3	4.7 – 49.7 mg/Nm^3
EL2 *	SO_2	Refinery concentration bubble	No comparable BAT-AEL	1700 mg/Nm^3 (Y)	1431 mg/Nm^3
	NO_x	Refinery concentration bubble	No comparable BAT-AEL	450 mg/Nm^3 (Y)	375 mg/Nm^3
NL	SO_2	Refinery load bubble	50 – 230 t/Mt 50 – 210 t/Mt	1010 t/Mt	921 t/Mt
	NO_x	Refinery load bubble	20 – 150 t/Mt 80 – 170 t/Mt	397 t/Mt	237 t/Mt
PL *	SO_2	Refinery	No comparable BAT-AEL	1394.9 t/yr	2402.6 t/yr
	NO_x	Refinery	No comparable BAT-AEL	534.05 t/yr	1218.9 t/yr
	SO_2	Boilers	No comparable BAT-AEL	18369.5 t/yr	21567.9 t/yr
	NO_x	Boilers	No comparable BAT-AEL	4854.0 t/yr	7992.8 t/yr
	PM	Boilers	No comparable BAT-AEL	542.9 t/yr	1268.7 t/yr
SK *	SO_2	Fluid catalytic cracking	10 – 350 mg/Nm^3	1700 mg/Nm^3	102 mg/Nm^3
	NO_x	Fluid catalytic cracking	100 – 300 mg/Nm^3	700 mg/Nm^3	68 mg/Nm^3
	PM	Fluid catalytic cracking	10 – 40 mg/Nm^3	50 mg/Nm^3	36 mg/Nm^3
ES *	NO_x	Refinery concentration bubble – combustion only	No comparable BAT-AEL	616 mg/Nm^3	234 mg/Nm^3
	PM	Refinery concentration bubble – combustion only	No comparable BAT-AEL	150 mg/Nm^3	25 mg/Nm^3
Emissions to water					
BE	BOD	Wastewater treatment	2 – 20 mg/l	35 mg/l	< dl
	COD	Wastewater treatment	30 – 75 mg/l 30 – 125 mg/l	250 mg/l	33.6 mg/l
	Total-N	Wastewater treatment	1.5 – 25 mg/l	35 mg/l	9.5 mg/l
	SS	Wastewater treatment	2 – 30 mg/l 2 – 50 mg/l	60 mg/l	3.9 mg/l
FR	BOD	Wastewater treatment	2 – 20 mg/l	40 mg/l	17 – 51 mg/l
	COD	Wastewater treatment	30 – 75 mg/l 30 – 125 mg/l	150 mg/l	82 – 260 mg/l
	Total-N	Wastewater treatment	1.5 – 25 mg/l	30 mg/l	23 mg/l
	SS	Wastewater treatment	2 – 30 mg/l 2 – 50 mg/l	30 mg/l	5 – 27 mg/l
EL2	BOD	Wastewater treatment	2 – 20 mg/l	60 mg/l	23.1 mg/l

Member State	Pollutant	Source	BAT-AEL	Permit ELV	Actual emissions
	COD	Wastewater treatment	30 – 75 mg/l 30 – 125 mg/l	180 mg/l	174 mg/l
	SS	Wastewater treatment	2 – 30 mg/l 2 – 50 mg/l	70 mg/l	16.9 mg/l
	Total HC	Wastewater treatment	0.05 – 1.5 mg/l	12 mg/l	7.2 mg/l
NL	BOD	Wastewater treatment	2 – 20 mg/l	20 mg/l	15 mg/l
	COD	Wastewater treatment	30 – 75 mg/l 30 – 125 mg/l	200 mg/l	125.4 mg/l
PL	COD	Wastewater treatment	30 – 75 mg/l 30 – 125 mg/l	125 mg/l	47.8 mg/l
	Total-N	Wastewater treatment	1.5 – 25 mg/l	30 mg/l	2.7 mg/l
	SS	Wastewater treatment	2 – 30 mg/l 2 – 50 mg/l	35 mg/l	7.8 mg/l
SK	BOD	Wastewater treatment	2 – 20 mg/l	20 mg/l	5.2 mg/l
	COD	Wastewater treatment	30 – 75 mg/l 30 – 125 mg/l	80 mg/l	40.5 mg/l
	SS	Wastewater treatment	2 – 30 mg/l 2 – 50 mg/l	20 mg/l	10.9 mg/l
	Total HC	Wastewater treatment	0.05 – 1.5 mg/l	2 mg/l	0.14 mg/l
ES	BOD	Wastewater treatment	2 – 20 mg/l	300 mg/l	76 mg/l
	COD	Wastewater treatment	30 – 75 mg/l 30 – 125 mg/l	700 mg/l	226 mg/l
	SS	Wastewater treatment	2 – 30 mg/l 2 – 50 mg/l	250 mg/l	58 mg/l

* Comparison of performance against BAT-AELs and/or permit ELVs has been based on incomplete information on the averaging periods that apply, either because of inconsistencies between parameters (e.g. different averaging periods used for actual operation compared to BREF BAT-AELs) or because information on averaging periods was not provided. See the detailed assessments for more details.

Technical characteristics (e.g. age of the plant) and economic limitations and the apparent good quality of the local environment were stated by operators and/or competent authorities as a justification for not imposing ELVs within the BAT-AEL ranges; but the full rationale behind the choice for less stringent ELVs has not always been provided (so the number of cases where such approaches have been applied cannot be quantified). In some Member States, the operator has to propose ELVs in the permit application, sometimes including a justification why ELVs consistent with BAT-AELs are not feasible, and these propositions appear to have been implemented in the permit in most cases[23].

Site closure measures are not specifically addressed in the permit application and permit for the 10 of the 11 case study installations. In four cases, site closure measures are dealt with by GBRs but are limited to soil sanitation and proper disposal of waste. In only one case, specific site closure measures are included in the permit, though in several others there is a requirement for the operator to submit a site closure plan. In one case, the operator has already drafted such a plan. In cases where the operator does not own the land (e.g. FR, NL), specific clauses relating to site closure are sometimes formulated in the contract between operator and land owner.

In most Member States, monitoring requirements are defined in GBRs. The type of monitoring data provided and/or their format did not always allow for a check to be made against permit ELVs and/or BAT-AELs. Checking against BAT-AELs and/or benchmark values on an installation-wide level is also hampered by the existence of split views in the BREF conclusions.

Five out of 11 installations appear to be operating fully in line with their permit ELVs; while for five others there were one or more reported exceedances of the permit conditions (the situation was unclear for one installation). The emissions to air of a proportion of the installations assessed exceed the BAT-AELs, although the format in which emissions were reported did not always allow for a direct comparison against BAT-AELs to be made.

Although, in several installations, exceedances of permit ELVs have been identified, the competent authorities do not appear to have taken strong enforcement measures. Actions taken by the CAs were mostly limited to writing an official notification urging the operator to put an end to the exceedance. In some cases the operator was requested to provide a study on how the problem would be solved.

The setting of BAT-based ELVs in the refinery sector is often not straightforward as, in many cases, a petrochemical plant (covered by the large volume organic chemicals BREF) is linked to and heavily integrated with the refinery. Whereas in most cases a split of the emissions to air over both types of installations is possible, this is often not the case for wastewater where one wastewater treatment plant treats the wastewater of all units[24]. The numerous split views on BAT-AELs in the refineries BREF document also do not contribute to a swift translation into permit conditions. The existence of these split views has been used as a justification by certain CAs for not setting ELVs consistent with BAT-AELs on certain sources. Clearer conclusions in the updated BREF document would also be likely to help to ensure more consistent implementation of the Directive across the EU and to improve the usability of the BREF overall.

Overall conclusions for the refineries sector are provided in the next section.

---

23 It was not clear in all cases whether the competent authorities had undertaken their own BAT assessment.

24 In such cases, the BREF on common waste water treatment applies.

5. Conclusions

5.1 Overview

This section provides overall conclusions on the implementation of the IPPC Directive for the installation case studies covered and for the refineries sector.

For the 31 IPPC installations covered by this report, quantitative conclusions are drawn in relation to the questions asked regarding implementation of the IPPC Directive across all installations (mainly for those questions that form part of the assessment where a "yes" or "no" response can be given).

As set out previously in this report, the number of installations included within the study does not necessarily allow representative conclusions to be drawn "horizontally" at either the sector or Member State level. However, common or recurring themes have been drawn out where possible.

5.2 Quantitative conclusions on status of implementation for all installations

5.2.1 Overview

This section provides a summary, for all of the installations assessed as part of Tasks 2 and 3 of this study, of the status of implementation against the key questions from Section 2 of this report where a quantifiable result can be readily provided. For each of the questions, the number of installations meeting the requirements for implementation is indicated, along with a number of comments and key themes relevant to each of the questions.

The main report provides a quantitative summary covering all of the installations and all of the main questions asked in the analyses. The conclusions are based on the case study assessments presented in the main report.

5.2.2 Assessment of permit determination procedures and permit conditions

Permit application

Permit issue date

The table below provides a summary of the date of issue of the main or most recent/relevant permit for the installations covered. It is of note that, for some of the installations, the permits were issued under previous regimes and may have been updated to reflect the requirement to comply with IPPC. In other cases, new permits have been issued in order to meet the requirements of the IPPC Directive.

Table 5.1 Summary of permit issue dates for installations covered in Tasks 2 and 3

Date	Number of installations
Prior to 2000	3
Between 2000 and 2005	6
2006	5
2007 – on or before 30 October	9
After 30 October 2007	8
Total	31

Note that the permit issue dates above do not necessarily imply that the installations did not have any environmental (or indeed integrated) permit prior to the dates stated.

In one case, the formal permit has not been issued and the CA/operator view and use the draft permit as if it applies officially.

As can be seen from the table above, it is evident that a significant number of the permits for the installations studied were only issued relatively recently (the assessments were undertaken mainly during the second half of 2008). This has implications for the extent to which it has been possible to assess performance of the installations against the conditions of their permit and also for the extent to which the requirement to comply with IPPC, through the permits, has influenced performance compared to BAT as set out in the BREFs.

As such, in some cases, full monitoring data that are comparable with the requirements of the permit have not been available (for example, where the permit was issued less than a year before the assessment was undertaken, a year's worth of relevant monitoring data has in some cases not been available).

Does the information provided by the applicant in relation to Article 6 appear to be comprehensive and accurate?

In quantitative terms, this has been interpreted to relate to whether all of the information required by Article 6 has been included in the operator's application for an IPPC permit (including in any additional information provided following requests from the competent authorities).

- Yes (or appears to) – 19 out of 31 installations.
- No – 11 out of 31 installations.
- Unclear – 1 out of 31 installations.

Issues related to the permit decision process

One of the main areas in cases where not of the aspects of Article 6 were covered relates to the main alternatives studied by the applicant (Article 6(1)(j))[25].

The case study assessments included consideration of issues such as: whether there was suitable dialogue between the operator and the Competent Authority during the permit determination process; whether co-ordination was required between Competent Authorities; whether there were any disagreements between the operator and Competent Authorities during permit development; and whether additional information was required prior to permit determination. The table below summarises the results of this analysis.

Table 5.2 Issues associated with permit decision process

	Yes	No	Mixed	Unclear
Was there suitable dialogue between the operator and the Competent Authority during the permit determination process?	29		1	1
Was co-ordination required between Competent Authorities?	26	4		1
Were there any disagreements between the operator and Competent Authorities during permit development?	12	15		4
Was additional information required prior to permit determination?	23	6		2

Whilst not necessarily statistically significant, the following conclusions can be drawn from these data, along with the timescales taken for permit development:

- For installations where there were disagreements between the operator and competent authority, the average time taken for permit development was 15 months, compared to 8 months where there were no reported disagreements;
- For permit applications where additional information was required, the average time taken for permit development was 12 months, compared to 8 months where there was no reported need for additional information.

[25] It is noted that the applicant may not have studied any alternatives and, if this aspect is excluded, the total number covering all of the requirements of Article 6 would be greater.

Permit conditions and permit determination process

Did the development meet the target timescales?

This relates to whether the permit development process (time between permit application and permit issue) met the target timescales set at a national level)[26]. There was considerable variation in the national target timescales, ranging from 1 month to 24 months.

- Yes or appears to – 15 out of 31 installations.
- No – 15 out of 31 installations.
- Unclear – 1 out of 31 installations.

In several cases, as detailed in the individual assessments, the competent authority has had to ask the operator to provide additional information to support their application because the initial information was deemed to be insufficient. This has led to delays in some cases in meeting the timescales (as highlighted above).

Another factor leading to the target timescales not being met was resource constraints amongst the competent authorities.

Does the permit include ELVs or equivalent parameters or technical measures (Article 9(3)) or reference to GBRs (Article 9(8))

- Yes – 27 out of 31 installations.
- No – 0 out of 31 installations.
- Mixed – 4 out of 31 installations.

It is evident that the permits for the majority of installations include ELVs (or equivalent) or reference to relevant GBRs. In cases where the inclusion of ELVs is assessed as mixed, examples of the gaps include:

- In one case, ELVs were not set for one pollutant because no monitoring data were available.
- In one case, ELVs were not set for certain parts of the plant where these are due to close in the future (and operating hours are limited under the large combustion plants directive; the installation also has a temporary derogation from the requirement to operate in accordance with ELVs based on BAT under the relevant Accession treaty).

[26] No such timescale exists within the Directive, where the deadline for implementation of the Directive itself was set as 30 October 2007.

- For two of the nitric acid plants, no emission limit values were set for emissions of nitrous oxide (in one case because the emissions of this pollutant are considered to be low and in the other because testing of abatement techniques for this pollutant was ongoing).
- ELVs or equivalent parameters were set in all cases but in four cases they had not been set for certain key parameters (e.g. nitrous oxide emissions from nitric acid manufacture, as indicated above).
- All permits contained at least some ELVs in line with the corresponding BAT-AELs (either for emissions to air, water or both) with three installations having all ELVs in line with BAT-AELs.

Are emission limits for the installation consistent with BAT-AELs (where defined) in the relevant BREF documents?

Based on a review of all of the data presented in the preceding sections of the report, the numbers of installations that have set emission limits consistent with the BAT-AELs where these have been defined in the relevant BREF documents are as follows:

- Yes – 2 out of 31 installations (all permit ELVs where there is a corresponding BREF BAT-AEL are at or below the upper end of the BAT-AEL range).
- No – 0 out of 31 installations.
- Mixed – 29 out of 31 installations (these installations have at least one permit ELV that is at or below the upper end of the BAT-AEL range).

In several cases, data were not provided on the averaging periods that apply to permit ELVs and/or monitoring data. Whilst the data provided have been used in this comparison, there are obviously inherent uncertainties given the lack of information on averaging periods.

The only two installations where – based on the information provided – all permit ELVs were consistent with the corresponding BAT-AELs were the coal-fired LCP and nitric acid plant in the Netherlands.

Does the permit or other supporting documentation show how BAT was taken into account in setting these conditions?

- Yes – 17 out of 31 installations.
- No – 3 out of 31 installations.
- Mixed – 6 out of 31 installations.
- Unclear – 5 out of 31 installations.

In the majority of cases, the relevant documentation either shows how BAT was taken into account for all ELVs or for some (i.e. “mixed” for the latter). With regard to those where this documentation does not show how BAT was taken into account, or where it is unclear, it should be noted that the level of information available for each of the installations is not necessarily comparable. For example, information was provided for some installations on the detailed rationale behind setting the permit conditions (i.e. a decision document) but not others. Likewise, the permit applications have not been made available in full for all of the installations[27]. However, it is clear in a number of cases that Member State interpretation of what BAT actually means in practice has led to discrepancies in implementation.

Have the relevant BREF documents been used in setting permit conditions?

- Yes – 16 out of 31 installations.
- No – 6 out of 31 installations.
- Mixed – 4 out of 31 installations.
- Unclear – 5 out of 31 installations.

For the majority of installations (20), the BREFs have either been used to set all or some of the permit conditions. For those where it is unclear, this generally relates to cases where there is no information from the relevant documentation or site visits/interviews that shows how the BREFs have been taken into account. However, whilst the BREFs have been used, this does not necessarily mean that all of the ELVs set in the permit are commensurate with the BAT-AELs as indicated in the relevant BREF.

In some cases where the BREFs have not been used in setting permit conditions, national guidance or legislation has been used. Such guidance or legislation has, in some cases at least, been developed taking into account (though not necessarily transposing the main elements of) the BREFs.

Is there evidence of consideration of the specific technical characteristics of the installation, its geographic location or local environmental conditions in the setting of emission limit values and equivalent technical parameters?

- Yes – 25 out of 31 installations.
- No – 5 out of 31 installations.
- Unclear – 1 out of 31 installations.

Such characteristics appear to have been taken into account for the majority of installations. In many cases, assessments have been made of the impacts of emissions from the installation on local environmental quality and this has been taken into account when setting permit conditions. There are examples of where this has led to permit

27 In some cases, the application was shown to the assessors briefly at the site visit but not made available otherwise.

ELVs that have been set above the upper end of the BAT-AEL ranges and where there has been, for example, reliance on minimum standards in national or Community sectoral legislation. There were also cases where ELVs have been set below the upper end of the BAT-AEL ranges due, for example, to local air quality problems to which the installation contributes (where the default approach would otherwise have been to set ELVs at the upper end of the BAT-AEL range).

It is noted that taking into account factors such as local environmental conditions appears to be interpreted in different ways for different installations. For example, the lack of an expected significant impact of an installation on the local environment was seen in some cases as a basis for setting permit ELVs that are above the upper end of the BAT-AEL ranges in the BREFs. Conversely, a potentially significant impact on the local environment, taking into account other sources of emissions, was used in some cases as a basis for setting stricter conditions than those achievable by the use of BAT as laid down in the BREFs.

Is there any evidence of factors influencing permit conditions not compatible with the Directive (e.g. operator's economic circumstances)?

- Yes – 5 out of 31 installations.
- No – 26 out of 31 installations.

Examples of where such factors appear to have influenced permit conditions include several cases where less stringent permit ELVs have been set due to the operator's own economic circumstances.

Does the permit contain release monitoring requirements that specify the full requirements of Article 9(5)?

- Yes – 23 out of 31 installations.
- No – 8 out of 31 installations.

This relates to specifying measurement methodology and frequency, evaluation procedure and an obligation to supply the competent authority with data required for checking compliance with the permit.

In some of the cases where this information is not included in the permit (i.e. "no" from above), reference has been made to GBRs that are reported to contain this information but where our assessment has not identified that all of these aspects are met (though the full details of all GBRs have not been translated or assessed in detail in all cases).

In one case, no information has been included on the methodology to be used for monitoring emissions to water. In another case, monitoring methods were specified in the operator's application but not in the permit.

Are the monitoring requirements sufficiently detailed?

- Yes – 20 out of 31 installations.
- No – 8 out of 31 installations.

- Unclear – 3 out of 31 installations.

One of the recurring examples of where monitoring requirements are not sufficiently detailed is in lack of information on averaging periods for monitoring. There are several cases where the BREFs do not include averaging periods and various case studies where the permits and/or monitoring data provided did not specify the averaging periods to be applied. This could cause difficulty in ensuring compliance with permit conditions and in any enforcement action deemed necessary.

In some cases where ELVs have not been set (see above), there are also no monitoring requirements and such cases are included in the "no" responses above.

Do the monitoring requirements take into account the details concerning monitoring contained within the BREF documents?

- Yes – 9 out of 31 installations.
- No – 5 out of 31 installations.
- Mixed – 6 out of 31 installations.
- Unclear – 11 out of 31 installations.

Does the permit include information on duration in relation to monitoring requirements?

- Yes – 24 out of 31 installations.
- No – 3 out of 31 installations.
- Mixed – 1 out of 31 installations.
- Unclear – 3 out of 31 installations.

In some cases where it is indicated in the above figures that information on duration is specified, this is actually set out in GBRs to which the permit refers, but not specifically within the permit.

Does the permit include measures relating to conditions other than normal operation? (Article 9(6))

- Yes – 23 out of 31 installations.
- No – 7 out of 31 installations.
- Mixed – 1 out of 31 installations.

Are there any GBRs implementing the IPPC Directive that govern control of the installation?

- Yes – 26 out of 31 installations.
- No – 5 out of 31 installations.

It is evident that, for the majority of the installations covered, GBRs apply to at least some aspects governing control of the installation. These take a variety of forms and in some cases include specific ELVs that apply directly to the installations and in others the GBRs apply to more procedural aspects (such as monitoring requirements).

The installations where no GBRs were identified that govern control of the installation were located in the UK, France and Spain (one installation).

Are there relevant Environmental Quality Standards that required stricter conditions than those achievable by the use of BAT?

- Yes – 3 out of 31 installations.
- No – 26 out of 31 installations.
- Unclear – 2 out of 31 installations.

Examples of cases where EQSs have led to setting stricter conditions include one installation required to use the techniques mentioned in the BREFs but at a larger scale/capacity than set out in the BREF[28] and one installation where a stricter limit was set for emissions to water to protect local river quality (the former relates to achieving a Community EQS and the latter a national EQS).

Is information on the period of validity of the permit included (as required under Article 13)?

- Yes – 22 out of 31 installations.
- No – 7 out of 31 installations.
- Unclear – 2 out of 31 installations.

In the majority of cases where information on the period of validity was not included in the permit itself, there were indications from the site visits and knowledge of national legislation/practice that there are procedures in place to review and update the permit conditions periodically.

---

28 For example, the Dutch LCP included a permit ELV for dust emissions to air at the bottom end of the BAT-AEL range (5-20 mg/Nm^3) and an ELV of 0.001 mg/l for mercury emissions to water (compared to the BAT-AEL of 0.01-0.02 mg/l).

The table below provides a breakdown of the period within which the permits must be reconsidered. This is based on those cases where the period of validity is explicitly mentioned in the permits and generally relates to the maximum period within which the permit must be reconsidered (in practice, permits may be considered more frequently and in many cases there are national rules on the frequency with which permits should be reconsidered, even if this is not explicitly stated in the permits). It is evident that permits will be reconsidered within 10 years for the majority of installations.

Table 5.3 Frequency of permit reconsideration

Frequency of permit reconsideration	Number of installations
0-5 years	6
6-10 years	15
11 or more years	1
Not specified	9

Installations where the permit reconsideration period/date is explicitly mentioned within the permit itself. Permits may be reconsidered sooner due to e.g. substantial changes and permits for installations marked "not applicable" may be reconsidered based on national rules.

Are/were the application/decision document and permit available on a public register?

- Yes – 30 out of 31 installations.
- No – 1 out of 31 installations.

For the one installation, where all of this information is not available on a public register[29], a non-technical summary of the permit and the competent authority's decision are available to the public.

Are/were monitoring records made available to the public?

- Yes – 24 out of 31 installations.
- No – 1 out of 31 installations.
- Unclear – 6 out of 31 installations.

In some cases, the documentation is actively published whereas in others it must be requested from the competent authority. In the one case where this information is understood not to be made available to the public, it is believed that a review is being undertaken at the Member State and competent authority level to address this.

[29] In some cases, the documentation is actively published whereas in others it must be requested from the competent authority.

5.2.3 Assessment of the actual installation operation when compared to permit conditions and BAT

Emissions monitoring

Does the emission monitoring comply with the permit conditions?

- Yes or appears to – 23 out of 31 installations.
- No – 0 out of 31 installations.
- Mixed – 6 out of 31 installations.
- Unclear – 2 out of 31 installations.

By way of example for the "mixed" cases, one of the installations is currently not applying continuous monitoring for one pollutant required in the permit; another has not undertaken monitoring for some sources.

Installation performance

Do the current emissions from the installation comply with the permit ELVs?

- Yes or appear to – 16 out of 31 installations.
- No – 0 out of 31 installations.
- Mixed (yes for some pollutants/data, no for others) – 12 out of 31 installations.
- Unclear – 3 out of 31 installations.

In the cases where the compliance with permit ELVs is "mixed", this generally relates to monitoring data suggesting that emissions of a small number of pollutants/sources are or have exceeded permit ELVs. In some cases, the monitoring data provided does not actually show breaches of these ELVs, such as where improvements have been made to achieve compliance with the ELVs. In the majority of these cases, most of the ELVs are met.

Cases where the results are mixed cover the majority of sectors covered, including fertilisers (2 installations), nitric acid (1), iron and steel (1), LCPs (3) and refineries (5).

Are current emissions from the installation consistent with BAT-AELs (where defined) in the relevant BREF documents?

- Yes or appear to be – 6 out of 31 installations.
- No – 0 out of 31 installations.

- Mixed – 20 out of 31 installations.
- Unclear – 5 out of 31 installations.

As can be seen from the figures above, emissions monitoring data from the majority of installations shows that emissions for some pollutants at least are consistent with the BAT-AELs (26 installations “yes” or “mixed”). However, only a small number of installations appear to have emissions that are all within the BAT-AELs. There is substantial variability amongst the installations falling into the mixed category (this includes installations where only one of several pollutant/source emissions are consistent with the BAT-AELs and others where the majority are consistent). However, as indicated earlier, four installations had no permit ELVs for certain key pollutants even though BAT-AELs are included in the BREFs.

Sanctions and ensuring compliance

Have sanctions or other measures been applied in cases of non compliance with the permit conditions?

- Yes – 6 out of 31 installations.
- No – 5 out of 31 installations.
- Not applicable – 14 out of 31 installations.
- Unclear – 6 out of 31 installations.

The range of sanctions applied varies significantly and some of those included in the figures above relate, for example, to fines levied for breaches of permit ELVs, but others relate to less stringent measures such as official warning letters (the latter have been used in the majority of cases). The mechanisms that exist or are available are generally fairly similar across the Member States.

Does the competent authority conduct on-site inspections?

- Yes – 28 out of 31 installations.
- No – 0 out of 31 installations.
- Unclear – 3 out of 31 installations.

For one of these installations, inspections had not been undertaken. This is understood to be because of significant ongoing changes at the installation making inspection difficult.

How many inspections have been undertaken in the past 12 months (prior to the installation assessment)?

- None – 10 out of 31 installations (this includes two where this was not clear or not applicable[30]).
- Between one and three – 11 out of 31 installations.
- Four or more – 10 out of 31 installations.

In interpreting these figures, it should be noted that the inspection frequency in the past 12 months (prior to the site visit) may not necessarily be representative of the normal inspection frequency for the installation, due to the nature of activities undertaken at the installation in the year concerned (e.g. if improvement works were being undertaken).

Furthermore, the inspection frequency does not allow full conclusions to be drawn on the overall extent to which the competent authority ensures compliance, as it does not reveal information on duration or quality of inspections. For some installations covered by this assessment there are many inspections each year (in some cases more than ten) whereas others may have only one, although in one case this inspection was understood to have lasted for three months.

In general, inspections have been taken to include site visits that included some form of inspection of the plant and/or of information relating to operation of the plant vis a vis IPPC).

5.2.4 Key findings by installation

A summary of some of the key conclusions for each of the 31 installations covered in this study is provided in the table below.

30 In the one case where this was not applicable, the installation was not yet operating, although a permit had already been issued.

Table 5.2 Summary of key findings for each permitted installation

Installation and reference number	1) Permit includes Emission Limit Values (ELVs) or equivalent?	2) Are ELVs consistent with BAT AELs?	3) Emissions consistent with BAT-AELs?	4) Emissions comply with permit ELVs?	5) Local conditions considered in setting conditions?	6) Permit available to the public?
Surface treatment (PCB manufacture)						
Italy (02/IT/18)	Mixed	Mixed	Mixed	Yes	No	Yes
United Kingdom (02/UK/25)	Yes	Mixed	Yes	Yes	Yes	Yes
Large combustion plant (coal and lignite fired)						
Greece (02/EL/12)	Yes	Mixed	Mixed	Mixed	Yes	Yes
Italy (02/IT/22)	Yes	Mixed	Unclear	Unclear	Yes	Yes
Netherlands (02/NL/14)	Yes	Yes	Yes	Mixed	Yes	Yes
Poland (02/PL/30)	Yes	Mixed	Mixed	Mixed	Yes	Yes
Slovakia (02/SK/15)	Mixed	Mixed	Mixed	Yes	Yes	Yes
Spain (02/ES/33)	Yes	Mixed	Mixed	Mixed	Unclear	Yes
United Kingdom (02/UK/34)	Yes	Mixed	Mixed	Yes	Yes	Yes
Iron and steel (blast furnace and sinter plant)						
Italy (02/IT/29)	Yes	Mixed	Yes	Yes	Yes	Yes
Netherlands (02/NL/02)	Yes	Mixed	Mixed	Mixed	Yes	Yes
Slovakia (02/SK/03)	Yes	Mixed	Mixed	Yes	Yes	Yes
Spain (02/ES/31)	Yes	Mixed	Mixed	Mixed	Yes	Yes
Nitric acid manufacture						
Italy (02/IT/09)	Mixed	Mixed	Mixed	Yes	No	Yes
Netherlands (02/NL/28)	Yes	Yes	Yes	Mixed	Yes	Yes
Spain (02/ES/32)	Mixed	Mixed	Mixed	Yes	Yes	Yes
Fertiliser (NPK/CN manufacture)						
Italy (02/IT/23)	Yes	Mixed	Yes	Yes	No	Yes
Netherlands (02/NL/24)	Yes	Mixed	Yes	Yes	No	Yes
Slovakia (02/SK/07)	Yes	Mixed	Mixed	Unclear	Yes	Yes
Spain (02/ES/08)	Yes	Mixed	Mixed	Yes	Yes	Yes
Oil and gas refineries						
Belgium (03/BE/13)	Yes	Mixed	Unclear	Yes	Yes	Yes
Czech Republic (03/CZ/02)	Yes	Mixed	Mixed	Mixed	Yes	No
France (03/FR/12)	Yes	Mixed	Mixed	Mixed	Yes	Yes

Installation and reference number	1) Permit includes Emission Limit Values (ELVs) or equivalent?	2) Are ELVs consistent with BAT AELs?	3) Emissions consistent with BAT-AELs?	4) Emissions comply with permit ELVs?	5) Local conditions considered in setting conditions?	6) Permit available to the public?
Germany (02/DE/16)	Yes	Mixed	Mixed	Mixed	No	Yes
Greece (03/GR/14)	Yes	Mixed	Mixed	Mixed	Yes	Yes
Greece (03/GR/17)	Yes	Mixed	Unclear	Unclear	Yes	Yes
Italy (03/IT/15)	N/A	N/A	N/A	N/A	N/A	N/A
Netherlands (03/NL/07)	Yes	Mixed	Unclear	Yes	Yes	Yes
Poland (03/PL/08)	Yes	Mixed	Unclear	Yes	Yes	Yes
Slovakia (03/SK/09)	Yes	Mixed	Mixed	Yes	Yes	Yes
Spain (03/ES/10)	Yes	Mixed	Mixed	Yes	Yes	Yes
United Kingdom (03/UK/11)	Yes	Mixed	Mixed	Mixed	Yes	Yes
Totals						
Yes	27	2	6	16	25	30
No	0	0	0	0	5	1
Mixed	4	29	20	12	N/A	N/A
Unclear	N/A	0	5	3	1	0
Total	31	31	31	31	31	31

Note: Full questions were as follows:

1) Does the permit include ELVs or equivalent parameters or technical measures (Article 9(3)) or reference to GBRs (Article 9(8))?

2) Are emission limits from the installation consistent with BAT-AELs (where defined) in the relevant BREF documents?

3) Are current emissions from the installation consistent with BAT-AELs (where defined) in the relevant BREF documents?

4) Do the current emissions from the installation comply with the permit ELVs?

5) Is there evidence of consideration of specific technical characteristics of installation, geographic location or local environmental conditions in the setting of emission limit values and equivalent technical parameters?

6) Are/were the application/decision document and permit available on a public register?

5.3 Summary of overall conclusions for refineries

Section 4 of this report and the main report on the study present the outputs of an assessment of the implementation of the IPPC Directive in the mineral oil refineries sector, both in terms of the findings for the case study

installations included in this study and in terms of a general sector evaluation. The main conclusions, based on both of these, are set out below[31].

- The implementation of the IPPC Directive in the mineral oil and gas refineries sector started relatively late and, based on the installations assessed, significant progress in the permitting process in some Member States was only made in the period 2006 to 2008. This is supported by the installation-specific findings and other work on review of permitting progress.

- All of the permits for the 11 case study installations include ELVs or equivalent parameters or technical measures or reference to GBRs.

- None of the installations had *all* ELVs contained in the permits consistent with the BAT-AELs. Of the 145 ELVs (for emissions to air as well as water) that could be assessed, 72 were consistent with the corresponding BAT-AELs, 72 were not and for 1 ELV it was unclear.

- From the installation-specific findings, it is clear that GBRs – which are sometimes based on the national transposition of other EU legislation such as the LCP Directive or the national programmes for reduction of emissions under the NEC Directive – are used to set ELVs for emissions to air in some Member States considered (PL, ES, EL).

- Technical (e.g. age of the plant) and economic limitations and the apparent good quality of the local environment were stated by operators and/or competent authorities in some cases as a justification for not imposing ELVs that are consistent with the BAT-AEL ranges; but the full rationale behind the choice for less stringent ELVs has not always been provided (so the number of cases where such approaches have been applied cannot be quantified). In some Member States, the operator has to propose ELVs in the permit application, sometimes including a justification why ELVs consistent with BAT-AELs are not feasible, and these propositions appear to have been implemented in the permit in most cases.

- In four of the eleven cases, the permit or other supporting documentation showed how BAT was taken into account in setting permit conditions. There were two cases where this was not the case, three cases where the picture was mixed and two cases where this was unclear.

- In 10 of the 11 cases, there was evidence of consideration of specific technical characteristics of the installation, geographic location or local environmental conditions in the setting of emission limit values and equivalent technical parameters. In some cases, this led to setting ELVs or other conditions that were either less or more stringent than BAT as specified in the BREFs. However, in other cases, whilst such factors were taken into account, this did not lead to setting less or more stringent conditions.

- In two of the cases, there was evidence of factors influencing permit conditions not compatible with the Directive (e.g. operator's economic circumstances).

[31] It is noted that the analysis of only one permit per Member State for the refinery sector (two in Greece) does not necessarily allow for representative conclusions to be drawn on the implementation of the IPPC Directive in the mineral oil and gas refineries sector for those specific Member States.

- For 10 of the 11 installations the permit contained release monitoring requirements that covered the full requirements of Article 9(5)[32].

- None of the installations provided monitoring data indicating that all emissions were within the BAT-AEL ranges. For seven out of eleven installations, however, emissions to air and/or water were consistent with at least some of the BAT-AEL ranges, while for the remaining four the situation was unclear.

- Five out of eleven installations that were considered in the installation-specific assessment operate in line with all of their permit conditions for emission to air and water. Monitoring data provided indicate that a further five installations achieved emissions within some permit ELVs but not others.

- As part of the general sector evaluation for the refineries sector, an analysis of the case study installations as well as emissions data from other sources was undertaken. This involved a consideration of the total emissions expressed as "load bubbles", both for individual installations and at a country-wide level[33]. Key findings from this analysis include:

    - The refineries BREF includes 'benchmarks' for emissions load bubbles. Whilst these benchmarks do not have the same status as BAT-AELs, it is clear that some installations have permit ELVs set on the basis of these benchmarks.

    - Regarding emissions to air, a wide variation of the total emissions expressed as "load bubbles" is obvious, both for individual installations as well as on a country-wide level[34]. Differences in the measured "load bubbles" cannot always be explained by refinery complexity and/or crude slate used. This suggests that legal requirements such as permit conditions set by Member States and/or GBRs also have a major influence on emissions to air.

---

32 Suitable release monitoring requirements, specifying measurement methodology and frequency, evaluation procedure and an obligation to supply the competent authority with data required for checking compliance with the permit.

33 For several of the refineries, the "bubble concept" for setting refinery emission limit values has been applied (sometimes in conjunction with concentration-based limits). The refineries BREF does not include BAT-AELs for the bubble concept as the technical working group was not able to identify a single range of emissions associated with the application of BAT under the bubble concept. Instead, the BREF includes benchmark values proposed by one or more members of the technical working group. The bubble concept is a regulatory tool applied in several Member States and reflects a "virtual single stack" for the whole refinery (or a defined group of plants within the refinery). It is most frequently used for air emissions of SO_2 but is also applied to NO_x, dust, CO and metals. The bubble can be defined either as an average concentration (concentration bubble) or as a total mass emission per unit of throughput (load bubble). The treatment of waste water in the refinery is typically done in a single waste water treatment plant (for technical and economic reasons). Thus, regulation of water emissions by setting ELVs for the discharges from the WWTP can conceptually be regarded as a similar approach to the "bubble" for air emissions. In the general sector evaluation, estimated load bubbles for individual refineries and for Member States as a whole have been calculated based on publicly available data.

34 By way of example, at a Member State level, the load bubbles for SO_2 varied from around 30 to 1,300 t/Mt throughput in 2006. The corresponding variation for NOx was 70 to 350 t/Mt throughput.

- Whilst it is apparent that progress in lowering the emissions to air has been made over recent years for SO_2 and NO_x, a significant number of installations are exceeding the annual load bubble benchmarks specified in the BREF document. This is confirmed by both the sector-wide analysis (80-90% of the installations exceed the SO_2 and 60-70% exceed the NO_x load bubble benchmarks) and the installation-specific findings.

- Regarding emissions to water, concentrations and load bubbles also vary widely on an individual installation level, but a significantly larger share of installations already meet the load bubble benchmarks specified in the BREF document compared to the situation with emissions to air.

- Provisions related to abnormal operating conditions, site closure measures, protection of soil and groundwater and monitoring of emissions were governed by GBRs in seven out of eleven installations.

- The setting of BAT-based ELVs in the refinery sector is often not straightforward as in many cases a petrochemical plant (covered by the large volume organic chemicals BREF) is heavily integrated with the refinery. The numerous split views on BAT-AELs in the refineries BREF document also do not contribute to a swift/consistent use of the BREF's conclusions in setting permit conditions and this has been used as a justification not to impose ELVs in line with the BAT-AELs by certain competent authorities. Clearer conclusions in the updated refineries BREF document would therefore be likely to help improve the usability of the BREF and thus to ensure a more consistent implementation of the IPPC Directive across the EU.

A summary of the conclusions for each of the refineries against key questions is provided below.

Table 5.3 Summary of key findings for each permitted installation in the refineries sector

Installation and reference number	1) Permit includes Emission Limit Values (ELVs) or equivalent?	2) Are ELVs consistent with BAT AELs?	3) Emissions consistent with BAT-AELs?	4) Emissions comply with permit ELVs?	5) Local conditions considered in setting conditions?	6) Permit available to the public?
Belgium (03/BE/13)	Yes	Mixed	Unclear	Yes	Yes	Yes
Czech Republic (03/CZ/02)	Yes	Mixed	Mixed	Mixed	Yes	No
France (03/FR/12)	Yes	Mixed	Mixed	Mixed	Yes	Yes
Germany (02/DE/16)	Yes	Mixed	Mixed	Mixed	No	Yes
Greece (03/GR/14)	Yes	Mixed	Mixed	Mixed	Yes	Yes
Greece (03/GR/17)	Yes	Mixed	Unclear	Unclear	Yes	Yes
Italy (03/IT/15)	N/A	N/A	N/A	N/A	N/A	N/A
Netherlands (03/NL/07)	Yes	Mixed	Unclear	Yes	Yes	Yes
Poland (03/PL/08)	Yes	Mixed	Unclear	Yes	Yes	Yes
Slovakia (03/SK/09)	Yes	Mixed	Mixed	Yes	Yes	Yes
Spain (03/ES/10)	Yes	Mixed	Mixed	Yes	Yes	Yes
United Kingdom (03/UK/11)	Yes	Mixed	Mixed	Mixed	Yes	Yes
Totals						
Yes	11	0	0	5	10	10
No	0	0	0	0	1	1
Mixed	0	11	7	5	N/A	N/A
Unclear	N/A	0	4	1	0	0
Total	11	11	11	11	11	11

Note: Full questions were as follows:

1) Does the permit include ELVs or equivalent parameters or technical measures (Article 9(3)) or reference to GBRs (Article 9(8))?

2) Are emission limits from the installation consistent with BAT-AELs (where defined) in the relevant BREF documents?

3) Are current emissions from the installation consistent with BAT-AELs (where defined) in the relevant BREF documents?

4) Do the current emissions from the installation comply with the permit ELVs?

5) Is there evidence of consideration of specific technical characteristics of installation, geographic location or local environmental conditions in the setting of emission limit values and equivalent technical parameters?

6) Are/were the application/decision document and permit available on a public register?

5.3.1 Limitations and uncertainties

Whilst all reasonable efforts have been made to undertake the assessments of individual installations and to obtain all of the information in the data collection templates developed for this project, there are a number of factors that have influenced the level of information that is available and hence the extent to which full conclusions can be drawn. These include:

- Limitations on the amount of time available for investigating each issue for each installation. Whilst the desk-based reviews prior to site visits in most cases allowed the site visit interviews to focus on the main outstanding issues, in several cases, information needed for the assessments was either only made available at the time of the site visit or made available afterwards, allowing less opportunity to explore specific issues. This also means that the level of information available for the different installations varies.

- Some of the sectors and installations studied are highly complex. Furthermore, the processes for permitting of some of these installations prevented the undertaking of a full assessment of all aspects of the installation (for example, there are several tens of IPPC permits for some of the individual installations examined and these could not all reasonably be reviewed within the time and resources available).

- There was significant variability amongst the case study installations in the availability, transparency and quality of the data provided. In particular:

  - Applications and permit decision documents were made available for some, but not all, of the installations (in some cases, the applications were made in the 1990s; for some installations no formal decision documents exist).

  - Similarly, the level of information available on emissions monitoring was highly variable. In some cases, emissions data available from the competent authorities only included total mass emissions to air and water and in several cases the data provided in permits and on actual emissions did not include details of the averaging periods used, both of which make comparison of emissions with permit ELVs and BAT-AELs problematic. In some cases, competent authorities did not have more detailed monitoring data whilst in others there was a reluctance to provide such data (however, in most cases, the competent authority and/or the operator were happy to provide data). Furthermore, in some cases, the monitoring data provided related to a period before the currently applied permit ELVs were introduced.

  - Furthermore, the permits themselves varied considerably in terms of level of detail. As can be seen from the quantitative conclusions above, a number of the installations were bound by general binding rules rather than specific permit conditions. Whilst many of these GBRs were reviewed, it was not possible to undertake a full review of all conditions of all of these GBRs (especially where translation was necessary).

- The case study assessments are, in most cases, not sufficient in number to allow any representative conclusions to be drawn regarding implementation of the Directive at a sector or Member State level. However, the findings of the case studies may serve as a basis for identifying areas where further investigation or support are required.

Furthermore, it should be recognised that this study does not constitute a check on compliance with the Directive and none of the findings of this report have been produced with the intention of instigating or informing any legal proceedings. With this in mind references to individual installations or employees of such installations have been excluded from the report.

This is a summary of the main report produced under this study. For further details, including other limitations and uncertainties regarding the data presented, the reader is referred to the main report.

6. References

Best available techniques reference documents (BREFs):

- Reference document on best available techniques for mineral oil and gas refineries (February 2003).
- Best available techniques reference document on the production of iron and steel (December 2001).
- Reference document on best available techniques for the manufacture of large volume inorganic chemicals – ammonia, acids and fertilisers (August 2007).
- Reference document on best available techniques for large combustion plants (July 2006).
- Reference document on best available techniques for the surface treatment of metals and plastics (August 2006).
- Reference document on best available techniques on surface treatment using organic solvents (August 2006).
- Reference document on economics and cross-media effects (July 2006).
- Reference document on the general principles of monitoring (July 2003).

Concawe (1994): Sulphur dioxide emissions from oil refineries and combustion of oil products in Western Europe (1992); Report no. 6/94, 40 pp.

Concawe (1998): Sulphur dioxide emissions from oil refineries and combustion of oil products in Western Europe and Hungary (1995); Report no. 3/98, 29 pp.

Concawe (2002): Sulphur dioxide emissions from oil refineries and combustion of oil products in Western Europe and Hungary (1998); Report no. 10/02, 32 pp.

Concawe (2004): Trends in oil discharged with aqueous effluents from oil refineries in Europe; Report no. 4/04, 10 pp.

Concawe (2007): Sulphur dioxide emissions from oil refineries and combustion of oil products in Western Europe and Hungary (2002); Report no. 2/07, 29 pp.

EPER (2001): Data from the EPER database for the reference year 2001.

EPER (2004): Data from the EPER database for the reference year 2004.

IVL (2005): Allowance allocation and CO2 intensity of the EU15 and Norwegian refineries.

Kirk Othmer (2005): Nitric acid, Kirk-Othmer Encyclopedia of Chemical Technology.

OGJ (2001): 2001 Worldwide refining survey; Oil & Gas Journal, Dec. 24, 2001.

Vito (2008): Beste beschikbare technieken voor beperking en behandeling van afvalwater van raffinaderijen; Report 2008/IMS/R/, 127 pp + annexes.

7. Glossary of acronyms

BAT	Best available techniques (as defined in Article 2(12) of the IPPC Directive)
BAT-AEL	BAT-associated emission level
BREF	Best available techniques (BAT) reference document
CA	Competent authority
CLRTAP	Convention on long-range transboundary air pollution
CN	Calcium Nitrate $Ca(NO_3)_2$ (and fertilisers based thereon)
CO	Carbon monoxide
COS	Carbonyl sulphide
DAA	Directly associated activity (as defined in Article 2(3) of the IPPC Directive)
EIA	Environmental impact assessment
ELV	Emission limit value (as defined in Article 2(6) of the IPPC Directive)
EMEP	European Monitoring and Evaluation Programme
EPER	European pollutant emission register
EQS	Environmental quality standard
ESP	Electrostatic precipitator
ETS	Emissions trading scheme
EU	European Union
EU15	European Union Member States prior to 2004 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, UK)
EU25	European Union Member States prior to 2007 (as EU15 plus Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia)
EU27	European Union Member States after 2007 (as EU25 plus Bulgaria, Romania)
FGD	Flue gas desulphurisation

GBR	General binding rule (provided for in Article 9(8) of the IPPC Directive). The definition applied herein is “limit values or other conditions (defined in particular in environmental laws, regulations and ordinances) at sector level or wider, that are given with the intention to be used directly to set permit conditions. They provide direct conditions or minimum standards. GBRs are binding either to the authority or to the operator. However, under certain conditions, some general rules may not be mandatory and deviation will be allowed, although the normal expectation would be that the rules be used directly.” (Based on a report for the European Commission conducted during the review of the IPPC Directive.)
HCl	Hydrogen chloride
HF	Hydrogen fluoride
IPPC	Integrated pollution prevention and control
JRC	Joint Research Centre
LCP	Large combustion plant
LDAR	Leak detection and repair
LVIC	Large volume inorganic chemicals
MoE	Ministry of Environment
MS	Member State
N/A	Not applicable
NCI	Nelson complexity index
NEC	National emission ceilings (Directive)
NeR	Netherlands emission guidelines for air
NH_3	Ammonia
NMVOC	Non-methand volatile organic compound
NO_x	Nitrogen oxides
NPC	Nameplate capacity
NPK	Compound/multinutrient fertiliser (based on nitrogen, phosporus, potassium)
PCB	Printed circuit board
PM	Particulate matter

SCR	Selective catalytic reduction
SME	Small and medium sized enterprises
SO_2	Sulphur dioxide
SNCR	Selective non-catalytic reduction
TOC	Total organic carbon
VOC	Volatile organic compound
VRU	Vapour recovery unit
WWTP	Wastewater treatment plant

Member State abbreviations

AT	Austria
BE	Belgium
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
EL	Greece
ES	Spain
FR	France
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LV	Latvia
LU	Luxembourg

MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
SE	Sweden
SI	Slovenia
SK	Slovakia (Slovak Republic)
UK	United Kingdom