European Commission

Analysis and summary of the Member States' emission inventories 2007-2009 and related information under the LCP Directive (2001/80/EC)



Final Report

AMEC Environment & Infrastructure UK Limited

February 2012

Copyright and Non-Disclosure Notice

Third-Party Disclaimer

Document Revisions

No.	Details	Date
1	Draft final report outline for client comment	21 April 2011
2	Updated draft final report outline taking into account client comments	3 May 2011
3	Draft final report for client comment	18 October 2011
4	Final report 11562i1	16 December 2011
5	Final report taking into account client comments 12071i1	24 February 2012

European Commission

Analysis and summary of the Member States' emission inventories 2007-2009 and related information under the LCP Directive (2001/80/EC)

Final Report

AMEC Environment & Infrastructure UK Limited

February 2012

Report for

DG Environment
European Commission
BE-1049 Brussels
Belgium

Contract 070307/2011/589752/C3

Main Contributors

Ben Grebot
Jenny Hill
Jin Lee
Tim Scarbrough

Issued by

.....

pp Tim Scarbrough

Approved by

.....

Ben Grebot

AMEC Environment & Infrastructure UK Limited

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

Doc Reg No. 29499-02

r:\projects\29499 ppaq ec lcp inventories\c client\reports\task 2 fr\issue 2\29499 task 2 final report 12071i1.doc

Certificate No. FS 13881 Certificate No. EMS 69090

Executive Summary

Introduction

This report has been produced for the purpose of providing the European Commission with an analysis of data submitted by Member States on large combustion plants (LCPs) for the reporting period 2007 to 2009. The data collated and analysed include those mandated by the LCP Directive 2001/80/EC, namely:

- inventories of total annual emissions of SO_2, NO_X and dust and total annual energy input (required by Annex VIII(B) of the LCP Directive), of which the Commission has also requested the annual plant-level inventories to be reported;
- lists of the 'opted out' plants, i.e. plants declared for eligibility under Article 4(4) (required by Annex VIII(B) of the LCP Directive); and
- reports of plants applying Article 5 or the provisions of the Nota Bene in Annex III or the footnotes in Annex VI.A (required by Article 15(3) of the LCP Directive).

In addition, further plant-level inventory data which are not required to be reported by the LCP Directive, such as rated thermal input, sector classification and age classification were also collated and analysed.

Data collection methodology, remaining data gaps and their limitations

The original data submitted by Member States to the Commission has been assessed and compared against the requirements set out in the LCP Directive. Lists of omissions and queries around these data ("data gaps") were prepared and discussed with the Member States. Where possible, this consultation has led to the correction of erroneous data and the filling of missing data, as well as the collection of additional non-obligatory information to support the analysis. Some data gaps were also filled using data submitted for the 2004 to 2006 reporting period.

On the whole, the collated dataset (relating to all three of the above bullet points) is almost complete in terms of meeting the legislative requirements. Key gaps remain with the Swedish 2007 and 2008 inventories (some additional data was provided too late for incorporation in this report) and minor gaps remain in the data provided by Belgium, the Netherlands, Poland, Spain and the United Kingdom. However, overall the remaining data gaps are less extensive than those which remained in the 2004 to 2006 inventories at the time of their analysis.[1] Some gaps also remain in the collated dataset around additional non-obligatory data that could help support the analysis, for example data on the sector in which the LCPs operate, and the age classification of the LCPs according to

[1] The data gaps that did exist for the 2004-6 inventories at the time of analysis have mostly since been filled.

Article 4. There also appears to be an improvement during this 2007 to 2009 reporting period, compared to the previous period of 2004 to 2006, of inventories being reported at the LCP (common stack) level rather than at the boiler or installation level.

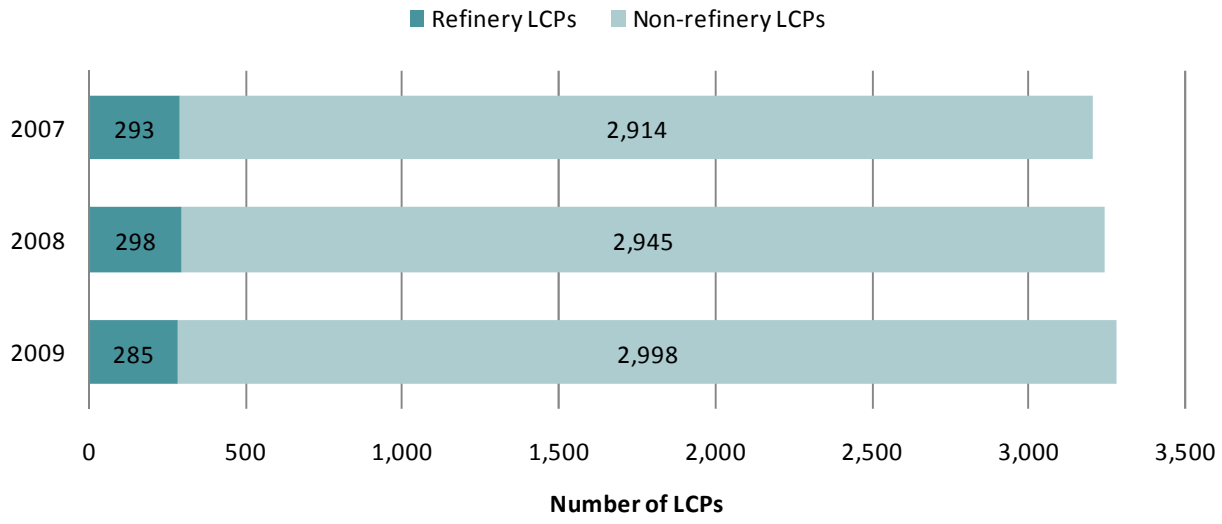
Section 2 provides an overview of the data received from Member States, and Section 3 explains which data gaps remain and implications for the analysis presented in this report.

Analysis of Annex VIII(B) inventories

The analysis undertaken in this report is of the collated dataset, i.e. after gap filling through consultation with Member States. Within the report (but not in this summary), the emissions inventory data for the 2007 to 2009 reporting period are also presented, where appropriate, alongside the data for the previous reporting period (2004 to 2006) to demonstrate trends over a six year period.

The total **number of LCPs** that Member States have reported in their emission inventories (Figure 1) has risen over the period 2007 to 2009. Member States are obliged to separately report LCPs within refineries from those that are not part of refineries. The number of reported refinery LCPs rose slightly from 2007 to 2008 and declined slightly from 2008 to 2009.

Figure 1 Number of LCPs in the EU-27 for each year 2007 to 2009, split as refinery LCPs and non-refinery LCPs

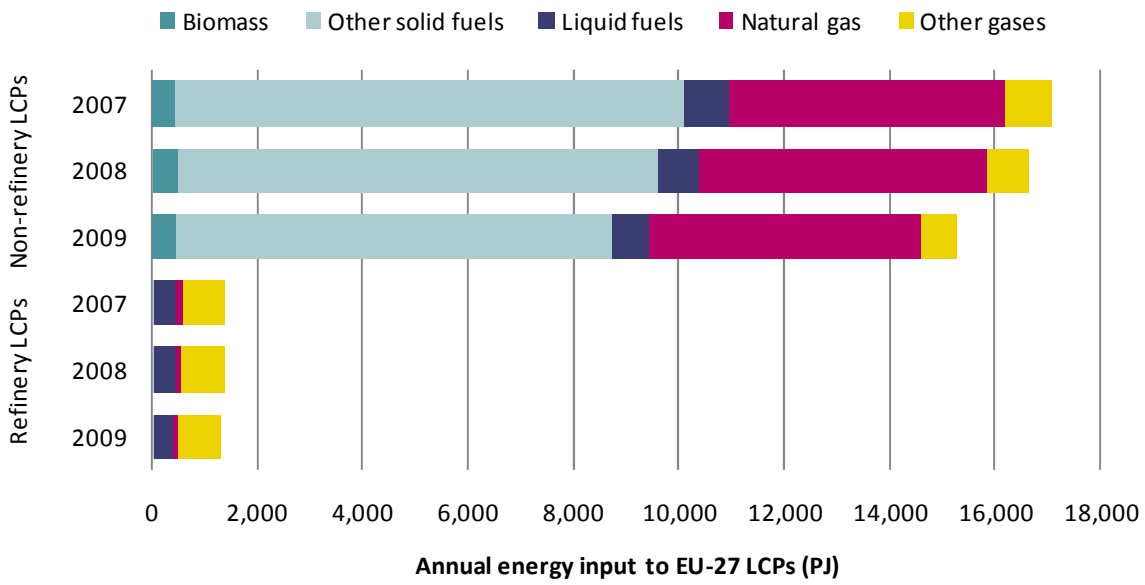


The total **energy input** related to net calorific value reported by Member States (Figure 2) fell between 2007 and 2008 by around 2%, and by a further 8% between 2008 and 2009. This decline has principally occurred in non-

refinery LCPs for which reported energy input fell by 10.4% over the period 2007 to 2009; energy input to refinery LCPs is reported to have decreased around 6% between 2007 and 2009.

Member States are obliged to report energy data separately for the five fuel categories of biomass, other solid fuels, liquid fuels, natural gas and other gases. The reported data suggests that the overall decline in total energy input is principally due to a decline of around 15% in the consumption of 'other solid fuels' (i.e. mainly coal and lignite), which makes up approximately half of the total energy input to LCPs in the EU. Biomass energy input is the only fuel type reported to increase (by 6%) over the period 2007 to 2009. Natural gas input has remained largely static (-1% from 2007 to 2009), whilst energy input of liquid fuels and other gases has declined by around 17% and 11% respectively between 2007 and 2009. As a result of these fuel consumption changes, the overall EU energy input mix to LCPs shows an increasing share for biomass and natural gas, a decreasing share for other solid and liquid fuels, and largely static share for gases other than natural gas.

Figure 2 **Total energy input to LCPs in the EU-27 for each year 2007 to 2009, separately for refinery and non-refinery LCPs, split into the five reported fuel categories**

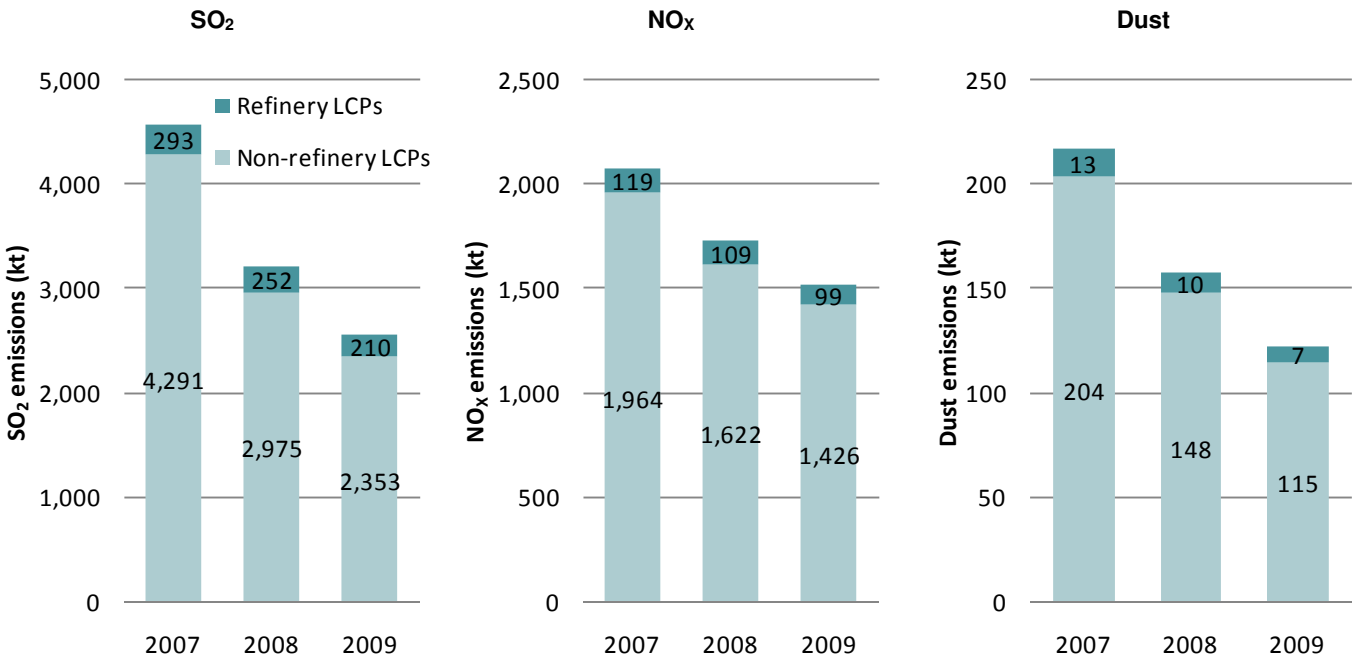


The total **SO_2, NO_X and dust emissions** from LCPs (Figure 3) reported by Member States have fallen sharply between 2007 and 2009, with the greatest decreases occurring between 2007 and 2008. The more significant decreases correspond to the coming into force on 1st January 2008 of the emission limit values (ELVs) for existing LCPs (those permitted prior to 1 July 1987).

Total SO_2 emissions are reported to have fallen by 44% over the period 2007 to 2009. Non-refinery LCPs have reported the most significant SO_2 emission reductions (45%), whilst SO_2 emissions from refinery LCPs have

reduced by 28%. The picture is similar for NO_X emissions, in that non-refinery LCPs have reduced NO_X emissions more than refinery LCPs, with a total NO_X emission reduction over the period 2007 to 2009 of 27%. Dust emissions are reported to have fallen by 44% over the period 2007 to 2009 in both refinery and non refinery LCPs.

Figure 3 **Total emissions of SO_2, NO_X and dust from LCPs in the EU-27 for each year 2007 to 2009, split into refinery and non-refinery LCPs**



Opted out plants

'Opted out' LCPs (Article 4(4)) are allowed by the LCP Directive to be exempted from the application of the emission limit values or included in a National Emission Reduction Plan if they operate no more than 20,000 hours in total between 1 January 2008 and 31 December 2015. The reports submitted by Member States on these opted out plants, which include from 2008 the number of hours each LCP has operated annually, have been integrated into the dataset of collated emission inventories. This integration allows for separate analysis of emissions and energy input data for LCPs (not) 'opted out'. The number of LCPs reported under Article 4(4) (Table 1) includes

those LCPs which are wholly 'opted out' as well as those LCPs for which Member States have opted out only part of an LCP (e.g. a boiler).[2]

Table 1 Number of opted out LCPs in the EU-27 for each year 2007 to 2009, split as refinery LCPs and non-refinery LCPs

Year	Opted out refinery LCPs	Opted out non-refinery LCPs
2007	3	215
2008	3	216
2009	3	214

Article 15(3) reports

Member States are obliged under **Article 15(3)** to provide annual reports to the Commission on: (i) low load plants that have been granted derogations for SO_2 ELV (Article 5(1)); (ii) the plants for which minimum desulphurisation rates have been applied in lieu of SO_2 ELVs (Nota Bene in Annex III); and (iii) the plants that have been granted higher NO_X ELVs due to low load factors or high volatile content of solid fuels (footnotes 2 and 3 of Annex VI.A). The numbers of LCPs reported by Member States as taking up these derogations are summarised in Table 2.

Table 2 LCPs reporting under Article 15(3)

Derogation	Number of LCPs reported as applying the derogation
Article 5	5
Nota Bene in Annex III	11 (Note 1)
Annex VI.A footnote 2	1
Annex VI.A footnote 3	20

Note 1: of which four LCPs are not considered to apply the derogation in practice. See section 4.6.

[2] It is remarked that the Commission takes the view that such 'partial' opt out is in fact not allowed under the LCP Directive, but data received seems to indicate that some Member States are taking this approach.

Further analysis

Further analysis has also been undertaken on the emission inventories, including:

- Calculation of average emission factors at a Member State and EU level (Section 4.2.5);
- Identification of 'top ten' LCPs in the EU in terms of energy input, emissions and emission factors (Section 4.3);
- Comparison of 2009 emissions with other emission inventories: (i) the European Pollutant Release and Transfer Register, and (ii) National Emission Ceiling Directive inventories (Section 4.4);
- Calculation of LCP emission factors for 2009 for single fuelled LCPs and comparison against LCP Directive ELVs and LCP BREF emission levels associated with best available techniques (BAT-AELs) (Section 4.7); and
- Comparison, where appropriate, of the reported emissions against intermediate pollutant ceilings set as transitional measures in the Accession Treaties (Section 4.8).

Recommendations

During consultation with Member States, feedback was provided on the reporting process, including suggestions for improvements to the data collection templates. Section 5 summarises this feedback and, in combination with our own views arising from the process of collating and analysing the data, proposes recommendations for future reporting.

Contents

1. Introduction

1.1 Purpose of this report

This final report has been produced for the purpose of providing the European Commission with findings on the collation and review of Member States' Large Combustion Plant (LCP) emission inventories and additional information for the reporting period 2007 to 2009 under the LCP Directive 2001/80/EC[3]. It provides an overview of the data that has been provided by each Member State, how initial data gaps were filled, what data gaps are outstanding and an analysis of the gap-filled dataset.

This report is an output of Task 2 of the following study which AMEC Environment and infrastructure UK [4] has been contracted to undertake: "Analysis and summary of the Member States' emission inventories 2007-2009 and related information under the LCP Directive (2001/80/EC) and support for developing the definition of start-up and shut-down periods for large combustion plants under the Industrial Emissions Directive (2010/75/EU)" (specific contract 070307/2011/589752/C3 implementing framework contract no ENV.C.4/FRA/2007/0011).

1.2 Project Context

1.2.1 LCP Directive

Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants (the LCP Directive) was set up to reduce the emissions of sulphur dioxide (SO_2), oxides of nitrogen (NO_X) and dust from existing and new combustion plants with a rated thermal input of 50 MW and more. Annex VIII(B) of this Directive requires Member States to establish an inventory of SO_2, NO_X and dust emissions from all plants covered by the Directive from 2004 on (prior to that date, different requirements applied in this respect).

> *Member States shall establish, starting in 2004 and for each subsequent year, an inventory of SO_2, NO_X and dust emissions from all combustion plants with a rated thermal input of 50 MW or more. The competent authority shall obtain for each plant operated under the control of one operator at a given location the following data:*
>
> – *the total annual emissions of SO_2, NO_X and dust (as total suspended particles); and*

[3] Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants.

[4] Previously known as Entec UK Ltd.

– *the total annual amount of energy input, related to the net calorific value, broken down in terms of the five categories of fuel: biomass, other solid fuels, liquid fuels, natural gas, other gases.*

A summary of the results of this inventory that shows the emissions from refineries separately shall be communicated to the Commission every three years within twelve months from the end of the three-year period considered. The yearly plant-by-plant data shall be made available to the Commission upon request. The Commission shall make available to the Member States a summary of the comparison and evaluation of the national inventories within twelve months of receipt of the national inventories.

The first summary report of the emission inventories covered the period 2004 to 2006. The Commission undertook an evaluation of the inventories (plant-by-plant data) submitted for that period and has published this report in 2008.[5] The second summary of the inventories covering the period 2007 to 2009 had to be sent to the European Commission by 31 December 2010. The Commission has also requested Member States to report the yearly plant-by-plant data for those three years and has confirmed that these inventories should include gas turbines licensed prior to 27 November 2002 (Article 2(7)(j) of the Directive).

Annex VIII(B) of the Directive also requires Member State to annually report from 2008 the number of operating hours of the LCPs declared to be 'opted out' according to Article 4(4) of the LCP Directive.

Commencing on 1 January 2008 Member States shall report annually to the Commission on those existing plants declared for eligibility under Article 4(4) along with the record of the used and unused time allowed for the plants' remaining operational life.

According to Article 15(3) of the LCP Directive, Member States are also obliged to report annually to the Commission on: (i) low load plants that have been granted derogations for SO_2 ELV (Article 5(1)); (ii) the plants for which minimum desulphurisation rates have been applied in lieu of SO_2 ELVs (Nota Bene in Annex III); and (iii) the plants that have been granted higher NO_X ELVs due to low load factors or high volatile content of solid fuels (footnotes 2 and 3 of Annex VI.A).

The Commission developed data collection templates that were distributed to the Member States, and invited them to use the templates to report their emission inventories, the opted out plants and the information under Article 15(3). The templates were designed to collect data at a plant level in each Member State for years 2007, 2008 and 2009 separately. The template includes fields for the mandatory requirements (as stated above) as well as inviting Member States to supply additional information such as rated thermal input (MW_{th}), classification by age according to Article 4, sector (expanding beyond the mandatory split of LCPs in refineries and non-refineries) and whether the LCP includes a gas turbine.

[5] Entec (2008) Evaluation of the Member States' emission inventories 2004-2006 for LCPs under the LCP Directive (2001/80/EC). Final report for the European Commission. September 2008.

1.3 Objectives

This report aims to summarise, compare and evaluate the emission inventories for the period 2007-2009 and additional information submitted by Member States under the LCP Directive.

1.4 Structure of this report

This report is structured according to the following sections:

- Section 2 presents a qualitative assessment of the emission inventories for the period 2007-2009 and additional information provided by Member States up to 2nd December 2011;
- Section 3 provides an overview of consultation undertaken with Member States to fill data gaps and of the implications of remaining data gaps;
- Section 4 presents the analysis of the data; and
- Section 5 presents recommendations.

2. Overview of data received from Member States

2.1 Introduction

This section provides a qualitative summary assessment of the inventories and additional information submitted by the Member States. This step has included the identification of key data gaps which has informed the consultation with Member State competent authorities.

2.2 Qualitative assessment

As a first step, the emission inventories and additional information that were originally reported by the Member States were qualitatively assessed against the requirements and provisions that are set in the LCP Directive.

The qualitative assessment judged the 'completeness' of the emission inventories and additional information by employing a 'traffic light' system, where 'completeness' refers to whether information submitted met the requirements of the LCP Directive, taking into account the request for plant-by-plant data by the Commission and the templates provided. This system uses colours green, orange and red to indicate the degree to which the Member State concerned has provided complete information. This provided a high level overview of the quality of the emission inventories and additional information and an initial understanding of the content of these inventories, and more importantly where data gaps existed and needed to be addressed (see Section 3). In addition, this preliminary analysis provided a better understanding of the difficulties in the reporting requirements and helped inform recommendations for improving reporting (see Section 5).

The qualitative assessment also reviewed the extent to which Member States provided any further information, beyond the requirements of the LCP Directive, following the template provided by the Commission, or otherwise, such as:

- rated thermal input of each LCP;
- sectoral classification of each LCP;
- age classification according to Article 4:
  - Article 4(1) – "new" plants – plants licensed on or after 1 July 1987, and on or before 27 November 2002 (and which are put into operation on or before 27 November 2003);
  - Article 4(2) – "new new" plants – plants licensed after 27 November 2002;
  - Article 4(3) – "existing" plants – plants licensed before 1 July 1987;
- whether the LCP includes a gas turbine.

Separate assessments were done concerning the information on those plants which have opted for the limited life time derogation in Article 4(4) of the LCP Directive, and on the reporting obligations under Article 15(3) of the LCP Directive.

The qualitative assessments shown in Table 2.1 (emission inventories), Table 2.2 (Article 15(3) reporting) and Table 2.3 (opted-out plants) below represent not only the status of inventories and additional information originally submitted to the Commission, but also take into account any additional data received from the Member States where clarifications and/or additional data have been requested (discussed in Section 3.2). The 'traffic light' colours system should be interpreted as follows:

- Green – indicates that a Member State has provided sufficient information against the reporting requirement and the data are clear and transparent;
- Orange – indicates that a Member State has provided some information against the reporting requirement but the data are incomplete and/or unclear;
- Red – indicates that a Member State has not provided any information against the reporting requirement; and
- NR – Not Relevant – indicates that the specific reporting requirement is not relevant to the Member State concerned.

Please note that where the colour green has been used it does not necessarily mean that the information provided is complete. For example, LCPs that should have been included but were not, for whatever reason, cannot be checked.

As a further example, an assessment of the completeness of inventories with respect to the 'common stack' interpretation of the definition of a combustion plant under the LCP Directive[6] is outside the scope of this work. Nevertheless, an informed speculation of which inventories appear to adopt alternative interpretations is possible for some Member States, and is included in Section 3.4.

Furthermore, no formal checking has been undertaken of the methodology by which Member States obtained the reported emission data. For example, data could have been obtained through measurement, calculation or estimation. The methodology selected will likely vary on a plant-by-plant basis, depending on monitoring systems used at each LCP, which are prescribed in Annex VIII of the Directive. Again, close assessment of the inventories and the derived emission factors can be used to indicate if an emission factor may have been used to estimate emissions from an LCP, or if a range of LCPs have used identical emission factors.

[6] http://ec.europa.eu/environment/air/pollutants/stationary/lcp_interpretation.htm

Table 2.1 Qualitative assessment of Annex VIII(B) LCP emission inventories, including subsequent submissions of additional data

LCP Directive reporting requirements		AT	BE	BG	CY	CZ	DE	DK	EE	EL	ES	FI	FR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Data provided for refinery LCPs separately					NR				NR									NR	NR	NR						NR		
Plant level annual emissions	SO_2																											
	NO_x																											
	Dust																											
Plant level energy input (5 categories)																												
Additional data provided (optional)																												
Rated thermal input																												
Age classification according to Article 4																												
Sector classification																												
Identification of gas turbines																												

Note: The key for this table is shown on page 9.

Table 2.2 Qualitative assessment of Article 15(3) reports, including subsequent submissions of additional data (Note 1)

Reporting requirement	AT	BE	BG	CY	CZ	DE	DK	EE	EL	ES	FI	FR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Data provided for years 2008 and 2009	NR	NR		NR	NR	NR	NR		NR			NR		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		
Article 5(1) derogations – operating hours	NR	NR	NR	NR	NR	NR	NR	NR	NR	Note 2		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
Article 5(1) derogations – SO_2 ELV	NR	NR	NR	NR	NR	NR	NR	NR	NR	Note 2		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
Nota Bene Annex III – SO_2 ELV	NR	NR		NR	NR	NR	NR		NR		NR	NR		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		NR
Nota Bene Annex III – Desulphurisation rate	NR	NR		NR	NR	NR	NR		NR		NR	NR		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		NR
Nota Bene Annex III – S input	NR	NR		NR	NR	NR	NR		NR		NR	NR		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		NR
Annex VI.A footnote 2 – operating hours	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Annex VI.A footnote 2 – NO_X ELV	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Annex VI.A footnote 3 – volatile content	NR	NR		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		
Annex VI.A footnote 3 – NO_X ELV	NR	NR		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		

Note 1: The key for this table is shown on page 9. Twenty Member States have confirmed – in most cases through consultation rather than from initial reporting – that they do not have any LCPs that apply any of the provisions that need to be reported under Article 15(3).

Note 2: Spain has reported two plants under Article 5(2), not Article 5(1).

Table 2.3 Qualitative Assessment of Article 4(4) reports, including subsequent submissions of additional data

Reporting requirement	AT	BE	BG	CY	CZ	DE	DK	EE	EL	ES	FI	FR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Opted out plants included in inventory	NR				NR	NR							NR	NR		NR	NR	NR		NR				NR			
Hours operated between 1 January 2008 and 1 January 2009	NR				NR	NR							NR	NR		NR	NR	NR		NR				NR			
Hours operated between 1 January 2008 and 1 January 2010	NR				NR	NR							NR	NR		NR	NR	NR		NR				NR			

Key for Qualitative Assessment tables

	indicates that sufficient information has been provided by the Member State against the reporting requirement and the data are clear and transparent
	indicates that some information has been provided by the Member State against the reporting requirement but the data are incomplete and unclear
	indicates that no information has been provided by the Member State against the reporting requirement
NR	Not Relevant – indicates that the specific reporting requirement is not relevant to the Member State. In the case of Article 15(3) reports, NR has been concluded following consultation with Member States and does not necessarily represent the submission or not of an Article 15(3) report.

For the obligatory LCP Directive reporting requirements in the top half of Table 2.1, the Member States with orange boxes have the following information missing from their inventories:

- Belgium: for three LCPs which began operation during one of the reporting years, no emissions data have been provided for that reporting year. The Flemish authorities have indicated that according to the Flemish Environmental Legislation (Vlarem II Art. 4.1.8.2 § 3) companies are not required to report the emissions in the year the installation came into production;
- The Netherlands: despite many requests, energy data have not been provided in the correct units for one installation (comprising four LCPs) in each inventory year;
- Spain: energy data for two LCPs appear to be in incorrect units; and
- Sweden: outstanding queries over missing energy and emissions data for a number of LCPs in 2007 and 2008. Swedish authorities have provided a resubmitted 2009 inventory, but the resubmissions of 2007 and 2008 inventories have not been available within time for consideration in this report.

2.3 Summary

For the reporting of **obligatory** data in the **emission inventories**, all 27 Member States have provided information following additional consultation.[7] In most cases, the information submitted was sufficient, but outstanding questions remain with four Member States: Belgium, the Netherlands, Spain and Sweden.

For the reporting of **additional** (non-mandatory) data in the **emission inventories,** all Member States provided data on rated thermal input. Regarding plant age and sector classification, seven and five Member States, respectively, provided only some or no data, mostly citing that centrally-gathered robust information does not exist.

Regarding the **Article 4(4) reports**, all but one Member State have provided information against the reporting requirement, although consultation was required with some Member States to clarify queries on the data reported initially. There remains an outstanding query for Poland regarding conflicting information from two Article 4(4) reports.

Twenty Member States have confirmed – in most cases through consultation rather than from initial reporting – that they do not have any LCPs that apply any of the provisions that need to be reported under **Article 15(3)**. For the remaining seven Member States that do apply one or more of the provisions, sufficient information has been received from five Member States, and some but insufficient information has been received from two Member States (Spain and the United Kingdom).

[7] Prior to consultation, 17 of the Member States' emission inventories had data gaps or queries regarding obligatory data and an additional 3 inventories had data gaps or queries regarding optional data. 12 of the Member States' Article 4(4) reports had data gaps or queries prior to consultation, and 23 Member States' Article 15(3) reports had data gaps or queries.

3. Data Gaps

3.1 Introduction

AMEC has reviewed the emission inventories, Article 4(4) reports and Article 15(3) reports originally submitted by Member States. Based on our initial assessment it is evident that some of the original submissions reported insufficient data, some submissions contained inconsistencies among reporting years, and some reported in a format that is inconsistent with the provisions set out in the LCP Directive. This chapter describes how these data gaps – whether null data, missing entries or inconsistencies among years of reporting – have been addressed, and the implications of those data gaps that haven't been addressed.

It should be stressed that this study does not aim to assess the formal compliance of the submitted inventories or other reports against the requirements of the LCP Directive. From the reported information and the assessment no final conclusions can be drawn about the completeness of the inventories, for example regarding the inclusion of all combustion plants which are covered by the LCP Directive taking into account the 'common stack' approach.

3.2 Gap-filling through consultation with Member States

Based on the original submissions, lists of data gaps were compiled for each Member State. Questions or statements related to both the requirements of the Directive, as well as additional information that would be of use for further analysis, were prepared and distributed to the relevant Member State in order to try and fill these data gaps. AMEC contacted the relevant Member State representatives directly to introduce the study and to request responses to the data gaps. This involved sending an introductory email with the data request, followed up by a telephone call where possible to confirm the receipt of the email and to discuss the request in more detail. Where answers to the data requests were not received within two months following additional email and/or telephone contact, AMEC requested the Commission to investigate with that Member State further.

Appendix A summarises the status (up to 2 December 2011) of consultations AMEC had with the Member States.

For a small number of data gaps, Member States have indicated not to be in possession of robust information (at national level), for example on sectoral classification or the age classification of LCPs according to Article 4. Where possible, AMEC has attempted to source this information from the 2004 to 2006 LCP emission inventories (for which similar data was gathered). This is summarised in Section 3.3.

3.3 Gap-filling using previous LCP inventory database

In many cases, gap filling has been undertaken by using data included elsewhere in the 2007-2009 inventories. For example, some Member States provided complete inventories with all additional data for one year, which has been used to provide the relevant data for the plants without information in the other years (e.g. an LCP with missing rated thermal input or sector or age information in one year). This gap-filling has been documented in the underlying database.

The key gaps that were identified for gap filling using previous inventories are listed in the table below.

Table 3.1 Summary of gap-filling of Member State 2007-2009 LCP inventories using previous LCP inventories

Member State	Data gap	Gap filling status
CY	Numbers of LCPs per installation	The number of LCPs reported in the 2009 inventory per installation (see clarification in Table 3.2) has been used to amend the number of reported LCPs per installation (one) in the 2007 and 2008 inventories.
FI	Sector	This has been gap-filled from the 2004 to 2006 inventory. Finland has indicated that this information will be provided in the 2010 inventory onwards.
DE	Age classification according to Article 4	Although this is partially included in the 2004 to 2006 inventory database, Germany has indicated during consultation for the 2007-9 inventories that no robust information on age classification exists. Therefore the 2007-9 inventories have not been gap-filled using older data.
PL	Sector	Gap-filled from 2004-6 inventory database
	Age classification according to Article 4	Gap-filled from 2004-6 inventory database
UK	Five LCPs without age classification according to Article 4	Gap-filled from 2004-6 inventory database
	One LCP without gas turbine data	Gap-filled from 2004-6 inventory database

3.4 Remaining data gaps

Table 3.2 summarises the outstanding data gaps for each Member State (and which have not been filled through consultation with Member States or gap-filled from previous inventories). The implications of these data gaps/inconsistencies on the analysis of the dataset are set out in Section 3.5. For those Member States not listed in the table the data provided do not appear to have potential gaps or inconsistencies.

Table 3.2 Summary of limitations of Member State LCP inventories

Member State	Limitation
AT	The NO_X emission factor for one LCP appears unusually high, but both the emissions and the energy input are low. The Member State has confirmed the data for this plant are correct.
BE	No emissions data for one LCP in 2007 and two LCPs in 2009. In all three cases, the plants began operation in the specified year.
CY	The reporting of the 2007 and 2008 inventories appears to be at the installation level, whereas the 2009 inventory reports multiple LCPs at each installation. The CY authorities replied that they had changed their approach after receiving a letter from the Commission in October 2010 and indicated that from 2009 onwards the inventory adopts the stack definition of the LCP Directive. The 2007 and 2008 inventories remain at the installation level apart from the number of LCPs (which has been gap-filled – see Table 3.1).
DE	No age classification according to Article 4.
DK	Installation-level reporting of rated thermal input, energy and emissions (the number of LCPs at each installation has however been captured).
ES	2007 and 2008 inventories appear to include some plants reported at the installation or site level (the 2009 inventory appears to be reported at the stack level). For one LCP it appears as though the plant has been extended according to Article 10. This does not readily fit as one of the categories used in the age classification. Emission factors for one LCP appear unusually high; it appears as though energy data for two LCPs may be in incorrect units. Missing some Article 15(3) data
FI	Reporting is at the boiler level at least for existing plants. Authorities indicate stack approach applied for plants permitted after 1987. However, individual boilers still appear to be reported for new plants. No sector classification
FR	Article 4(4) reports at boiler level (in contrast to the inventories).
HU	Missing age classification according to Article 4 for five LCPs.
IT	Unclear rated thermal input for five LCPs Age classification according to Article 4 not available. However, the IT authorities have indicated the date (or year) when the LCP began operation. These data have been used to interpret the age classification according to Article 4 using the following assumptions: • dates explicitly before 1 July 1987 = Article 4(3) • dates explicitly on or after 1 July 1987 and up to and including 27 November 2003 = Article 4(1) • dates after 27 Nov 2003 = Article 4(2) • if only the year 1987 or “before 1988” is stated , assumed Article 4(3) • “1959 and 5/4/2002” interpreted as “1959, extended in 2002”: assumed Article 4(1) No sector classification.
LT	No age classification according to Article 4.
NL	Erroneous energy data for four LCPs in all three reporting years. No age classification according to Article 4. No sector classification.

Table 3.2 (cont.) Summary of limitations of Member State LCP inventories

Member State	Limitation
PL	A separately communicated 2009 inventory of district heating boilers (with energy and emissions data) that have not been included by the PL authorities in the reported emission inventories, but which were named within 29 installations with derogations from the LCP Directive in the Accession Treaty, have been added to the LCP inventory. These have been added by aggregating the rated thermal input, energy and emissions data according to the 29 named installations with derogations. No similar inventory of district heating boilers for 2007 or 2008 has been incorporated, such that there is an inconsistency between PL inventories 2007/8 and 2009. In the total 2009 inventory for Poland, the district heating boilers comprise around 1% of total SO_2 and NO_X emissions, and around 8% of dust emissions. No age classification according to Article 4 for several LCPs. No sector classification for two LCPs. Conflicting information from 2008 and 2009 Article 4(4) reports for one LCP.
PT	2007 inventory reported at the installation level.
SK	Article 4(4) reports at boiler level in contrast to inventory.
SE	No rated thermal input data for 2 LCPs. No data in 2004-6 inventory with which to gap-fill. No age classification according to Article 4. Sector classification incomplete. Gas turbine classification incomplete Missing energy data for several LCPs in 2007 and 2008 Missing emissions data for several LCPs 2007 and 2008 inventories have been indicated by the authorities to include several plants which may not come within the LCP Directive scope, but these inventories have not been resubmitted in time for inclusion in this report.
UK	Unusually high emission factors for one LCP Missing some Article 15(3) data

3.5 Implications of inconsistencies among reporting approaches, remaining data gaps and uncertainties

3.5.1 Numbers of LCPs

The reporting of total numbers of LCPs is affected by the aggregation approach taken by the Member States. Whereas most Member States seem to have taken the plant=stack approach for inventory reporting, other reporting approaches have been adopted by some Member States in some years, including reporting at the boiler, installation or site level.

Reporting plants at the boiler level may lead to an overestimate of the number of LCPs when compared with the same set of plants reported at the stack level. However, depending on how the 50 MW_{th} threshold has been applied

in compiling such an inventory, all data about the LCPs (number, capacity, energy and emissions) could be an underestimate compared to a stack-level inventory. For example a boiler approach inventory which reports only boilers over 50 MW_{th} will exclude an LCP (single stack) of 120 MW_{th} that comprises three 40 MW_{th} boilers.

Inventories reported at an installation or site level may underestimate the number of LCPs when compared with the same set of plants reported at the stack level. However, depending on how the 50 MW_{th} threshold has been applied in compiling such an inventory, all data about the LCPs (number, capacity, energy and emissions) could be an overestimate compared to a stack-level inventory. For example an installation or site level approach inventory which reports all installations with a total capacity over 50 MW_{th} will include an installation of 120 MW_{th} that comprises three combustion plants (three stacks) of 40 MW_{th} each.

Specific information has been received from some Member States on this topic (see Section 3.4 for details):

- Cyprus: 2007 and 2008 inventories were reported at the installation (or site) level, but the number of LCPs at each installation has been taken into account;
- Denmark: although inventory reporting has been at the installation (or site) level, provisional information about the number of LCPs at each site has been taken into account in this analysis;
- Finland: the boiler approach appears to have been used at least for plants permitted before 1987;
- Portugal: inventories compiled before 2008 were at the installation level; and
- Slovakia: not all opted out plants in the inventories are reported using the common stack approach.

The identification in this report in Section 4.3 of 'top emitters' in terms of total energy input or emissions is more likely to (incorrectly) identify plants reported at installation level than LCP level if the installations comprise multiple LCPs (and thus sum the energy input and emissions from multiple LCPs). Similarly, such 'top emitters' lists are less likely to (incorrectly) identify plants reported at the boiler level than LCP level.

3.5.2 Energy input

There are some instances highlighted in Table 3.2 in which gaps in energy data remain. Therefore, the energy data presented in this report may be underestimates of actual energy input to LCPs.

See Section 3.5.4 below for implications of reported energy data on calculated emission factors.

3.5.3 Emissions

There are some instances highlighted in the above table in which gaps in emission data remain. Therefore, the emissions data presented in this report may be underestimates of actual emissions.

It has not been assessed whether each Member State has included the emissions from start-up and shut-down periods of the LCPs. The LCP Directive does not state that emissions from these periods should be excluded from the LCP emission inventories (while they shall be disregarded for checking compliance with the emission limit values). If some Member States have excluded such emissions, the emission estimates in the dataset and set out in this report may be underestimates.

See Section 3.5.4 below for implications of reported emissions data on calculated emission factors.

3.5.4 Emission factors

Where reported LCP emissions are erroneously high, the calculated LCP emission factors will consequently be erroneously high. Where reported LCP energy input data are erroneously low, the calculated emission factors will also consequently be erroneously high. In both cases, erroneous energy or emissions data may have led to the incorrect identification in this report of an LCP as a 'top emitter' in terms of emission factors. Although consultation with Member States has aimed to rectify identified erroneous data, some uncertainties remain either because the data were not identified as erroneous, or because Member States have not been able to resolve the query.

An LCP which has, for example, only been started and stopped in a year (without operation) and for which period(s) energy and emissions have been reported, the calculated emission factor for the LCP may appear high in comparison with LCPs which have been in operation. Therefore, where in this report 'top emitters' in terms of emission factors have been identified, it should be considered that such LCPs are not necessarily those with significant emissions and which may not necessarily have been operating for many hours.

3.5.5 Categorisation of LCPs by age, sector, gas turbine

Where Member States have not provided additional information of the sector of each LCP, the analysis in this report is limited to categorising LCPs according to whether they are part of a refinery ('refinery LCPs') or not ('non-refinery LCPs' or 'non-refineries'). One of the options in the reporting template for sector was combined heat and power (CHP). There has been varying interpretation by Member States as to how to apply the 'sector' of CHP, given that CHP plants can also be used to provide electricity and heat for both public use (which may overlap with sectors electricity supply industry and district heating) and for industrial sites .

The provision by Member States of supplementary information of the age of each LCP according to Article 4 allows an analysis of the reported data to be disaggregated by age. Where this additional information has not been available, analyses in this report have included such LCPs as being of 'unknown' age. The age categories provided in the LCP inventory reporting template did not include an option for those LCPs that had been extended according to Article 10 of the LCP Directive. There is therefore the possibility that LCPs may have been incorrectly classified in one age category. The age classification of Italian LCPs has been undertaken according to the date the LCP began operation, which is not strictly in accordance with the classification according to Article 4 (but which may be a reasonable estimate).

The provision by Member States of supplementary information about whether an LCP includes a gas turbine provides the possibility for an analysis of the reported data to be split into those which are gas turbines or not, as well as the possibility of excluding 'existing' gas turbines from an analysis.

3.5.6 Rated thermal input

Where rated thermal input data have not been provided, it has not been possible to categorise the LCP in question according to its capacity. As such, any analysis in this report which disaggregates data according to capacity class will necessarily exclude LCPs for which no rated thermal input data have been provided. For the 2007 to 2009 inventories, this data gap is not significant (missing for two LCPs).

3.5.7 Article 4(4) reports

In some cases, Member States have submitted Article 4(4) reports at a boiler level, whilst corresponding LCP inventories have been compiled at the LCP (stack) level. It is the Commission's opinion that it is not correct to opt out part of an LCP.

However, for the analysis in this report, operational hours reported for opted-out plants have been matched to the LCPs that are wholly or partly opted out. This matching has been undertaken by selecting the maximum number of operational hours reported from multiple boilers that comprise an LCP, and using this as the number of LCP operating hours. This selection could still be an underestimate of the actual LCP operating hours.

3.6 Summary

Formal reporting requirements

With regard to the formal reporting requirements the following observations can be made:

- **Inventories:** Twenty three Member State inventories require no further clarifications. Four Member State inventories have inconsistencies, gaps or other queries outstanding in formal reporting requirements (Belgium, the Netherlands, Spain and Sweden).
- **'Opted out' (Article 4(4)) reports:** All but one Member State (Poland) require no further clarifications.
- **Article 15(3) reports:** Twenty Member States do not apply any of the provisions, and all but two of the Member States (Spain and the United Kingdom) that apply any of the relevant provisions require no further clarifications.

Additional data

In terms of additional data which are not formal reporting requirements:

- Two Member State inventories are unclear or have incomplete data on rated thermal inputs;
- Five Member State inventories have either missing or incomplete sector classifications; and
- Seven Member State inventories have either missing or incomplete age classification according to Article 4.

4. Data Analysis

4.1 Introduction

This section presents an overview of the analysis that has been undertaken of the collated emission inventories and additional information. Although many of the data gaps initially present in Member State inventories have been filled and/or corrected, Section 3.4 lists the data gaps outstanding and Section 3.5 should be referred to for how these data gaps limit the analysis presented in the current section.

Where the analysis of the 2007 to 2009 inventories has been contextualised with the additional presentation of data from the 2004 to 2006 inventories, this has been carried out using inventories that have in some cases been updated since the publication of the analysis of the 2004 to 2006 inventories.[8] Specifically, major revisions/updates have been made to inventories of Italy, Latvia and the Netherlands.

4.2 Overview statistics of LCP inventories

This section presents an overview of the data provided by Member States in their LCP inventories and via consultation as part of this study to address key data gaps. It is important to note that these statistics include the following plants:

- All LCPs that Member States have included in their inventories, which includes in some cases gas turbines licensed before 27 November 2002; and
- Polish district heating plants that are covered by derogations granted within the Accession Treaty (this point is described in more detail in Table 3.2), for which only a 2009 inventory has been provided.

4.2.1 Number of LCPs

Table 4.1 presents the total number of LCPs reported by each Member State, separated into LCPs in refineries and LCPs not in refineries as set out in Annex VIII(B) of the Directive.

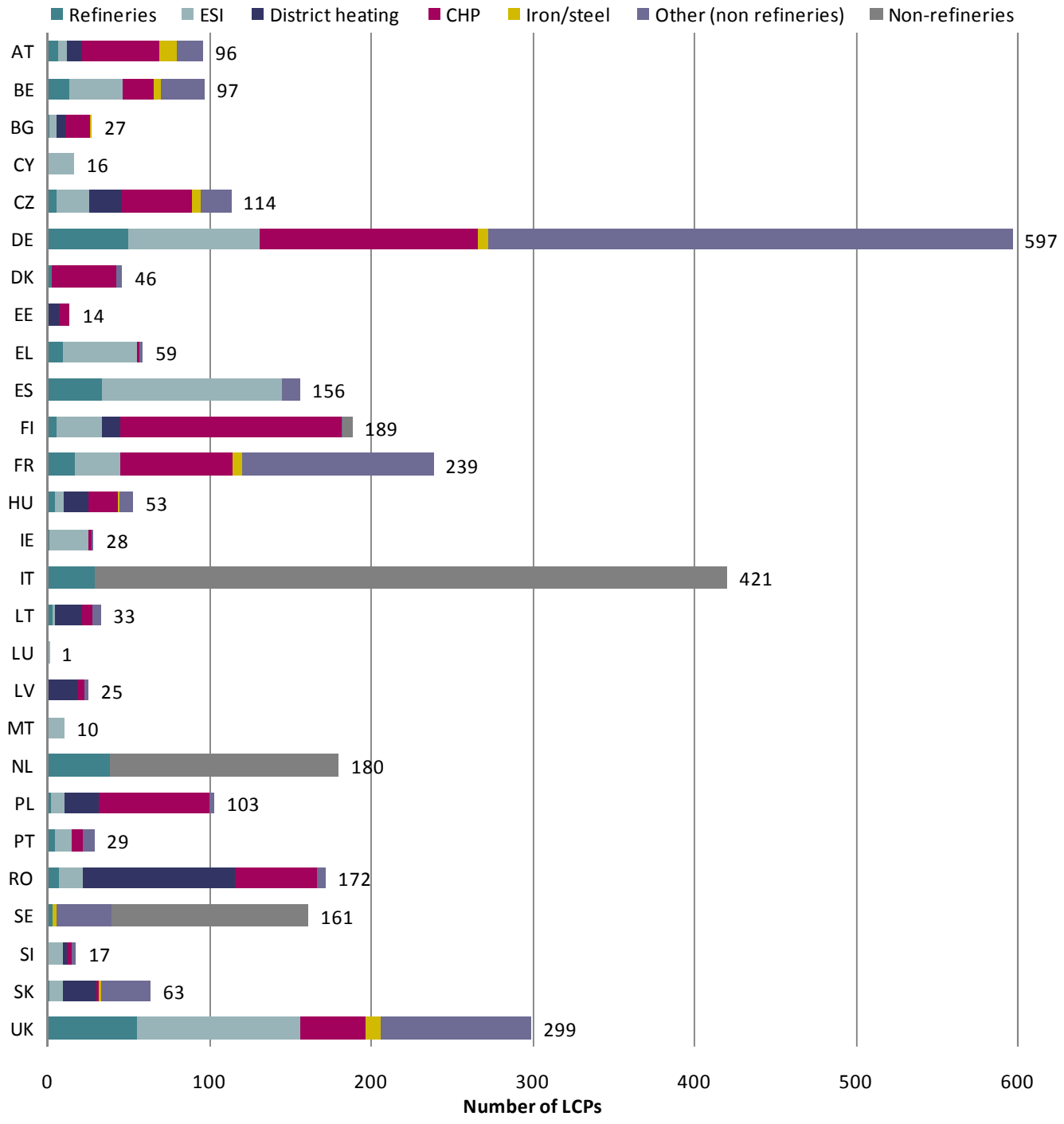
[8] Entec (2008) Evaluation of the Member States' emission inventories 2004-2006 for LCPs under the LCP Directive (2001/80/EC). Final report for the European Commission. September 2008.

Table 4.1 Total number of LCPs reported per Member State, split by refinery LCPs and non-refinery LCPs

Member State	Refinery LCPs			Non-refinery LCPs			Total number of LCPs		
	2007	2008	2009	2007	2008	2009	2007	2008	2009
AT	7	6	7	84	89	94	91	95	101
BE	13	13	13	83	83	85	96	96	98
BG	1	1	1	27	26	25	28	27	26
CY	0	0	0	16	16	16	16	16	16
CZ	6	5	5	113	107	105	119	112	110
DE	51	50	49	545	547	549	596	597	598
DK	2	2	2	44	44	44	46	46	46
EE	0	0	0	13	13	15	13	13	15
EL	9	9	9	48	50	51	57	59	60
ES	33	33	36	112	119	136	145	152	172
FI	5	5	5	185	187	179	190	192	184
FR	17	17	17	222	219	224	239	236	241
HU	4	4	4	47	47	52	51	51	56
IE	1	1	1	27	27	28	28	28	29
IT	26	31	30	384	395	396	410	426	426
LT	3	3	3	32	29	28	35	32	31
LU	0	0	0	1	1	1	1	1	1
LV	0	0	0	25	26	24	25	26	24
MT	0	0	0	10	10	10	10	10	10
NL	41	42	35	145	144	134	186	186	169
PL	2	2	2	93	93	118	95	95	120
PT	4	4	4	18	27	29	22	31	33
RO	7	7	7	167	164	165	174	171	172
SE	3	3	3	165	170	140	168	173	143
SI	0	0	0	16	18	18	16	18	18
SK	1	1	1	66	62	59	67	63	60
UK	57	59	51	226	232	273	283	291	324
EU-27	**293**	**298**	**285**	**2,914**	**2,945**	**2,998**	**3,207**	**3,243**	**3,283**

Figure 4.1 presents the numbers of LCPs from Table 4.1, as an average of 2007, 2008 and 2009 inventories, split by sector. This sectoral classification goes beyond the split of LCPs in refineries/non-refineries using data provided by Member States or through additional sources (previous inventories). LCPs without sector classification (in Finland, Italy, the Netherlands, Poland and Sweden) are listed as non-refineries.

Figure 4.1 Total number of LCPs reported per Member State split by sector (average 2007-2009)



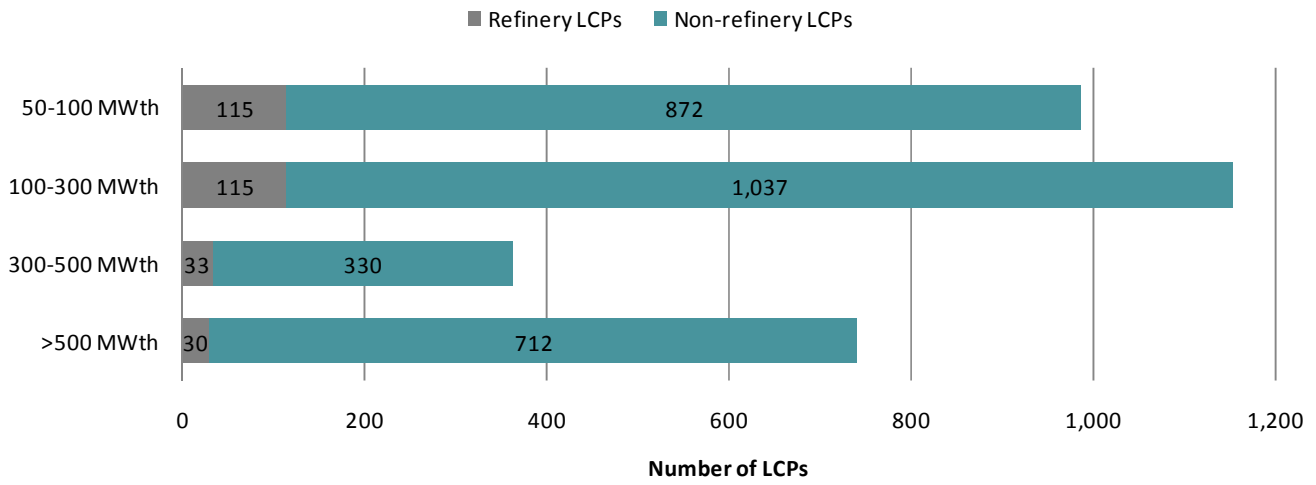
The total number of LCPs reported by each Member State is again shown in Table 4.2, averaged over the 2007 to 2009 period and split by sector (refinery LCPs/non-refinery LCPs), and further disaggregated by rated thermal input (capacity) classes. The capacity classes assumed throughout this report are 50 to 100 MW_{th}, 100 to 300 MW_{th}, 300 to 500 MW_{th} and greater than 500 MW_{th}. EU totals are included at the bottom. Limitations placed on this analysis are outlined in Section 3.4.

Table 4.2 **Number of LCPs reported per Member State, split as refinery LCPs and non-refinery LCPs and by capacity class (average 2007-2009)**

Member State	Refinery LCPs (numbers by capacity class - MW_{th})					Non-refinery LCPs (numbers by capacity class - MW_{th})				
	50-100	100-300	300-500	>500	Total	50-100	100-300	300-500	>500	Total
AT	3	2	2	1	**7**	38	34	10	7	**89**
BE	4	8	0	1	**13**	23	34	11	16	**84**
BG	0	0	0	1	**1**	3	7	4	12	**26**
CY	0	0	0	0	**0**	0	4	1	11	**16**
CZ	1	1	2	1	**5**	29	48	12	19	**108**
DE	16	22	4	8	**50**	165	215	45	122	**547**
DK	0	1	1	0	**2**	3	9	2	30	**44**
EE	0	0	0	0	**0**	3	6	2	3	**14**
EL	5	4	0	0	**9**	12	10	9	18	**50**
ES	18	10	4	2	**34**	5	21	16	81	**122**
FI	0	5	0	0	**5**	74	86	13	11	**184**
FR	4	3	5	5	**17**	104	82	14	21	**222**
HU	2	2	0	0	**4**	10	19	9	11	**49**
IE	0	1	0	0	**1**	1	5	10	11	**27**
IT	14	5	5	5	**29**	100	106	73	113	**392**
LT	0	1	2	0	**3**	9	10	4	6	**30**
LU	0	0	0	0	**0**	0	0	1	0	**1**
LV	0	0	0	0	**0**	9	13	2	2	**25**
MT	0	0	0	0	**0**	0	9	1	0	**10**
NL	24	14	0	1	**39**	61	41	8	31	**141**
PL	0	0	1	1	**2**	14	21	18	49	**101**
PT	0	4	0	0	**4**	9	3	3	10	**25**
RO	3	2	2	0	**7**	34	80	15	36	**165**
SE	0	2	1	0	**3**	55	68	15	19	**157**
SI	0	0	0	0	**0**	5	6	4	2	**17**
SK	0	0	0	1	**1**	23	23	6	10	**62**
UK	20	29	5	2	**56**	82	79	22	61	**244**
EU-27	**115**	**115**	**33**	**30**	**292**	**872**	**1,037**	**330**	**712**	**2,951**
EU-27 (%)	**39%**	**39%**	**11%**	**10%**	**100%**	**30%**	**35%**	**11%**	**24%**	**100%**

Figure 4.2 presents these data graphically for the EU as a whole.

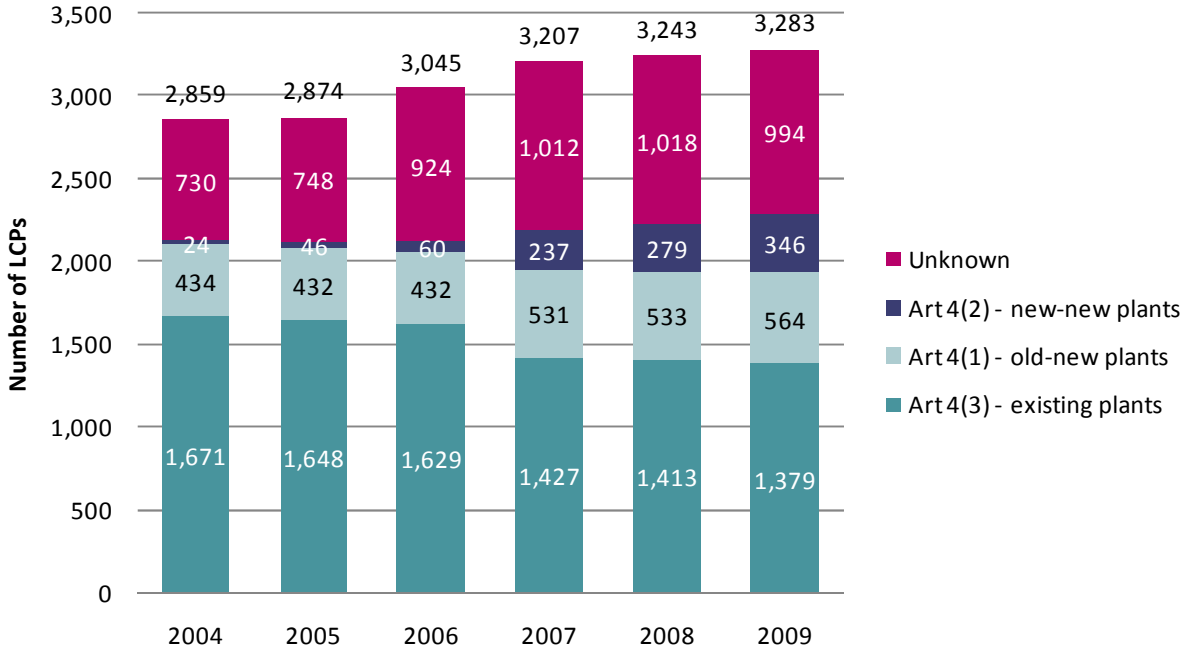
Figure 4.2 Number of LCPs reported in the EU, split as refinery LCPs and non-refinery LCPs and by capacity class (average 2007-2009)



In addition to the 2007 to 2009 statistics, Figure 4.3 shows the trend over the period 2004 to 2009 of the number of LCPs reported, split by age classification according to Article 4 of the LCP Directive. Due to the number of plants with unknown age classification, it is not possible to draw robust conclusions on the trends in age categories over time. What is evident, however, is that total LCP numbers reported across the EU-27 have increased year on year from 2004 to 2009. This rise in reported numbers may not be entirely attributable to newly built LCPs; it is considered possible that known changes in reporting approaches (e.g. increased number of inventories reporting strictly at plant (stack or boiler) level rather than an installation level approach) may play an important role in the increase in reported LCP numbers. An additional factor that may have contributed to the rise in reported LCPs is the more complete reporting of existing gas turbine LCPs in inventories.

Table 4.1 showed that this rise in reported LCPs is dominated by LCPs in installations other than refineries, as the number of refinery LCPs declined in 2009.

Figure 4.3 Total number of LCPs reported in the EU-27 across years 2004 to 2009, split by age classification



4.2.2 Installed Capacity

Although not a formal reporting requirement under the Directive, most Member States have reported the rated thermal input (in MW_{th}) of each LCP. The vast majority appear to have reported the nameplate capacity (indicated by unchanging MW_{th} from year to year).[9]

Table 4.3 presents the total installed thermal capacity of LCPs reported by each Member State, separated into LCPs in refineries and LCPs not in refineries as set out in Annex VIII(B) of the Directive.

[9] It may be the case that the reported capacities for LCPs in the Czech Republic are operating capacities, as indicated by comments supplied within the Czech Republic inventory. The likely impact on the analysis in this section of this difference in reporting approach is very small.

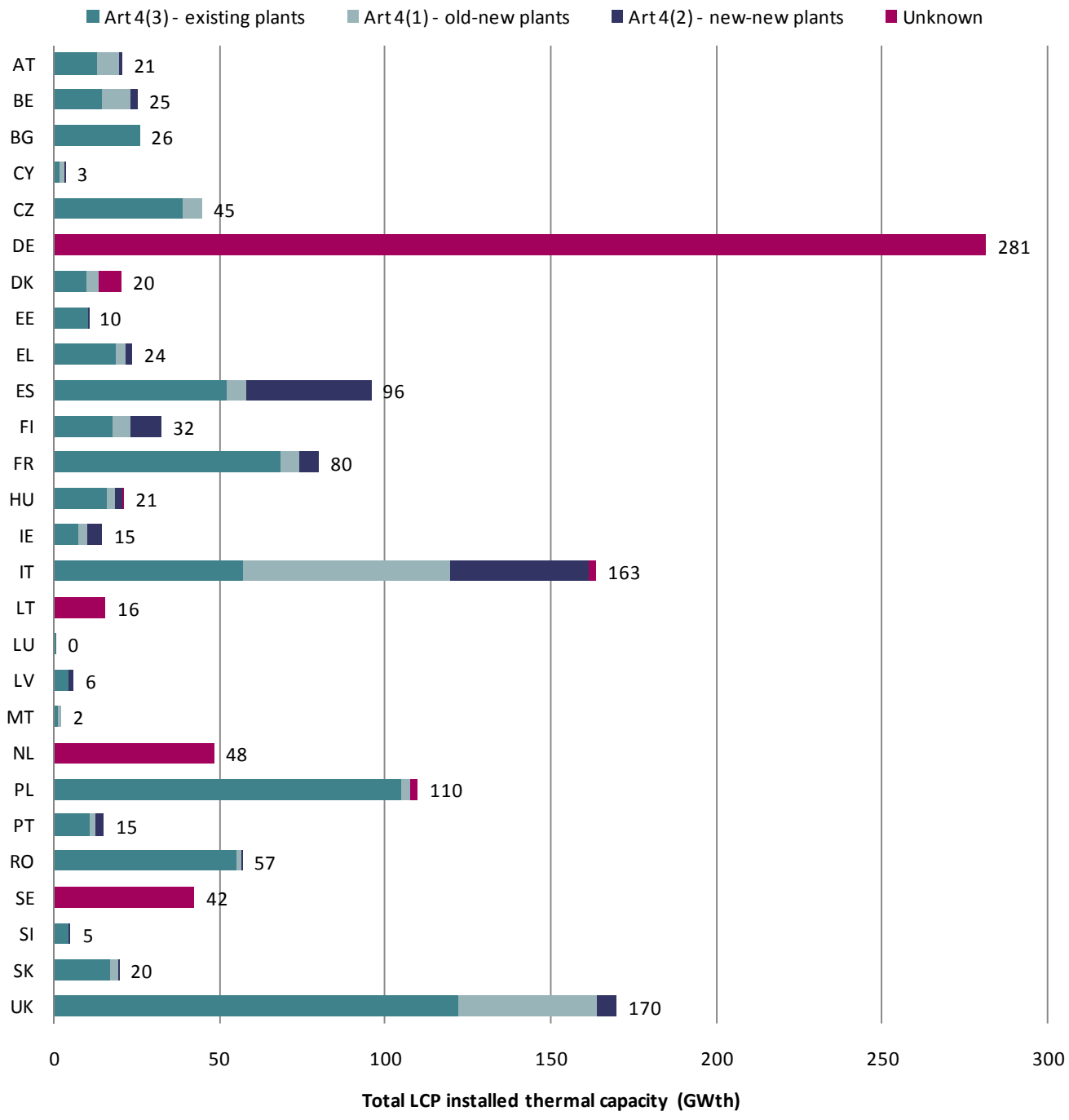
Table 4.3 Total capacity (in GW_{th}) of LCPs reported per Member State, split as refinery LCPs and non-refinery LCPs

Member State	Refinery LCPs			Non-refinery LCPs			All LCPs		
	2007	2008	2009	2007	2008	2009	2007	2008	2009
AT	1.9	1.3	2.0	17.9	18.5	20.0	19.8	19.9	22.1
BE	2.2	2.2	2.2	22.3	23.2	23.2	24.5	25.5	25.5
BG	1.8	1.8	1.8	25.1	24.0	22.9	26.9	25.8	24.7
CY	0	0	0	2.9	2.9	3.6	2.9	2.9	3.6
CZ	2.0	1.9	1.9	43.0	42.7	42.3	45.0	44.6	44.2
DE	13.0	12.9	12.7	267.1	269.2	268.3	280.1	282.1	281.1
DK	0.6	0.6	0.6	19.7	19.7	19.7	20.3	20.3	20.3
EE	0	0	0	10.1	10.1	10.3	10.1	10.1	10.3
EL	1.0	1.0	1.0	22.5	22.7	22.8	23.5	23.7	23.8
ES	5.5	5.5	5.7	87.2	93.5	89.7	92.7	99.0	95.4
FI	0.8	0.8	0.8	31.6	32.0	31.2	32.4	32.8	32.0
FR	8.4	8.4	8.4	69.7	70.5	74.2	78.1	78.9	82.6
HU	0.4	0.4	0.4	20.4	20.6	21.0	20.8	21.0	21.4
IE	0.2	0.2	0.2	14.1	14.1	14.9	14.4	14.4	15.1
IT	9.5	10.3	10.2	147.4	156.0	156.8	156.9	166.3	167.0
LT	1.2	1.2	1.2	14.8	14.4	14.2	16.0	15.6	15.4
LU	0	0	0	0.4	0.4	0.4	0.4	0.4	0.4
LV	0	0	0	5.3	6.1	5.9	5.3	6.1	5.9
MT	0	0	0	1.9	1.9	1.9	1.9	1.9	1.9
NL	4.6	4.7	4.1	44.3	44.1	43.1	48.9	48.8	47.2
PL	2.5	2.5	2.5	106.8	105.9	108.7	109.3	108.4	111.3
PT	0.7	0.7	0.8	14.3	14.3	14.6	15.0	15.0	15.4
RO	1.1	1.2	1.2	55.7	55.5	55.8	56.8	56.7	57.0
SE	0.7	0.7	0.4	48.2	47.5	29.8	48.9	48.3	30.1
SI	0	0	0	4.7	4.9	4.9	4.7	4.9	4.9
SK	0.7	0.7	0.7	19.0	18.8	18.6	19.7	19.5	19.3
UK	8.8	9.8	9.3	156.8	157.0	167.3	165.6	166.8	176.6
EU-27	**68**	**69**	**68**	**1,273**	**1,291**	**1,286**	**1,341**	**1,360**	**1,354**

Figure 4.4 displays the total installed thermal capacity of reported LCPs for each Member State, as an average of 2007-2009 reported capacities. The totals are split by age classification according to Article 4 where possible to

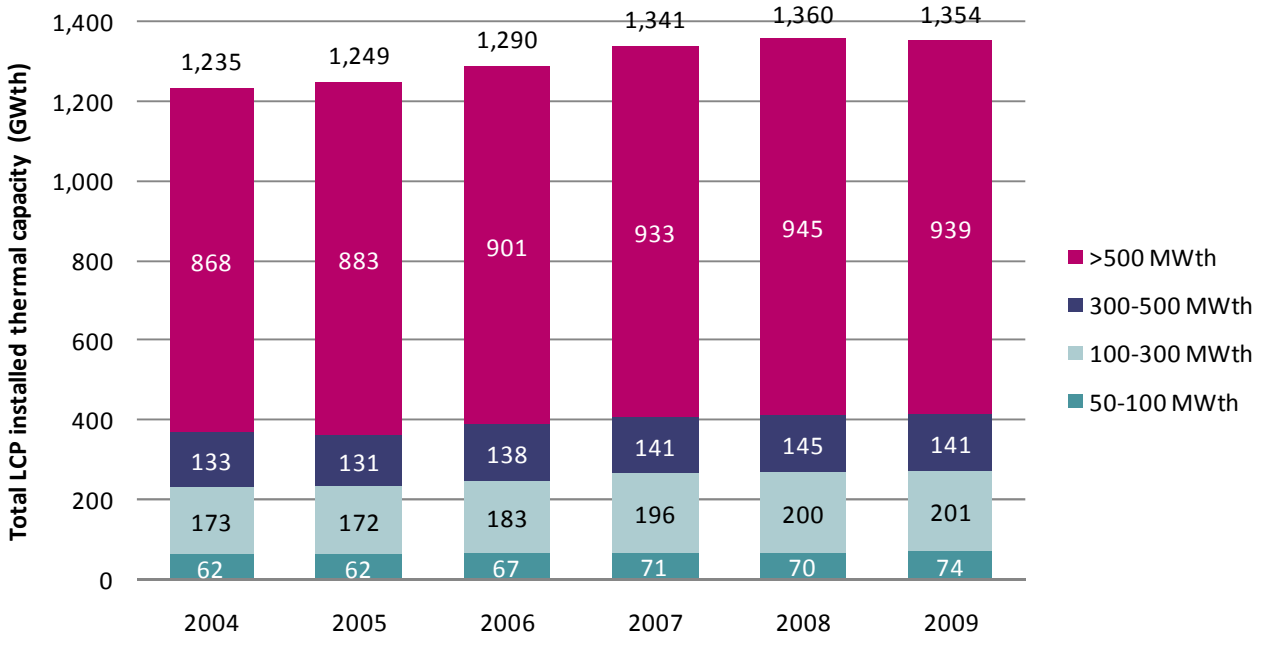
show the broad age profile of LCPs. Not all Member State hold robust information on this matter; in these instances, the Figure shows this capacity as 'Unknown'.

Figure 4.4 Total rated thermal input (GWth) of reported LCPs per Member State, split by age classification where possible (average 2007-2009)



In addition to the 2007 to 2009 statistics, Figure 4.5 shows the trend over the period from 2004 to 2009 of the total capacity (rated thermal input) of LCPs reported, split according to capacity class. This Figure shows an increase over time of reported LCP total capacity, and that this growth is evident across all capacity classes. There is only marginal growth from 2008 to 2009. As with the growth in reported numbers of LCPs over time, this increase may not wholly be due to actual increases in installed capacity; a contributing reason may be changes in the reporting approach over time, for example an increase in reported number of existing gas turbine LCPs.

Figure 4.5 Total EU rated thermal input (GW_{th}) of reported LCPs from 2004 to 2009, split by capacity class



4.2.3 Total energy input and energy mix

Member States are required to report for each LCP the annual energy input relating to net calorific value broken down into five fuel categories: biomass, other solid fuels, liquid fuels, natural gas and other gases.

Table 4.4 and Table 4.5 provide the total reported energy input for refinery LCPs and non-refinery LCPs respectively in the EU over the period 2004 to 2009. Total reported energy data per Member State for each year 2007 to 2009 are provided in Appendix B.

Table 4.4 Total EU reported energy input relating to net calorific value for refinery LCPs, split by fuel type

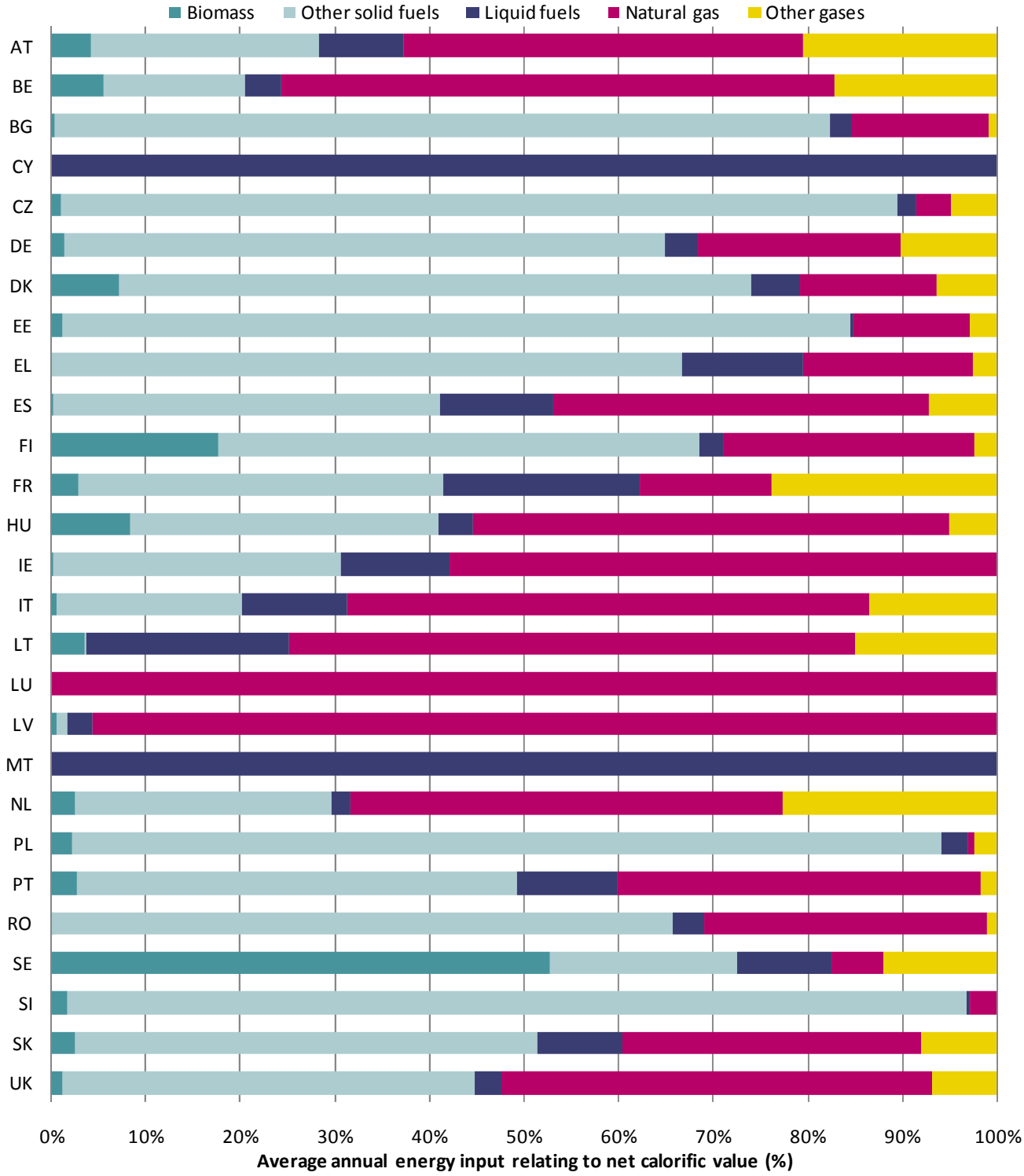
Year	Biomass		Other solid fuels		Liquid fuels		Natural gas		Other gases		Total
	PJ	%	PJ	%	PJ	%	PJ	%	PJ	%	PJ
2004	0	0%	50	4%	464	34%	80	6%	757	56%	**1,352**
2005	0	0%	45	3%	444	32%	85	6%	803	58%	**1,378**
2006	0	0%	40	3%	436	31%	108	8%	812	58%	**1,396**
2007	0	0%	49	4%	432	31%	84	6%	823	59%	**1,387**
2008	0	0%	43	3%	413	30%	104	7%	829	60%	**1,388**
2009	0	0%	41	3%	365	28%	88	7%	808	62%	**1,302**

Table 4.5 Total EU reported energy input relating to net calorific value for non-refinery LCPs, split by fuel type

Year	Biomass		Other solid fuels		Liquid fuels		Natural gas		Other gases		Total
	PJ	%	PJ	%	PJ	%	PJ	%	PJ	%	PJ
2004	340	2%	10,003	60%	1,118	7%	4,313	26%	795	5%	**16,569**
2005	393	2%	9,670	58%	1,066	6%	4,603	28%	901	5%	**16,633**
2006	423	3%	9,762	59%	1,044	6%	4,641	28%	786	5%	**16,656**
2007	438	3%	9,685	57%	820	5%	5,238	31%	863	5%	**17,044**
2008	499	3%	9,123	55%	767	5%	5,465	33%	783	5%	**16,637**
2009	465	3%	8,276	54%	668	4%	5,164	34%	690	5%	**15,264**

Figure 4.6 displays the average total energy input for each Member State (averaged over the three reporting years 2007, 2008 and 2009), split into the five fuel categories, but expressed as a percentage to show the fractional split by fuel type (energy mix).

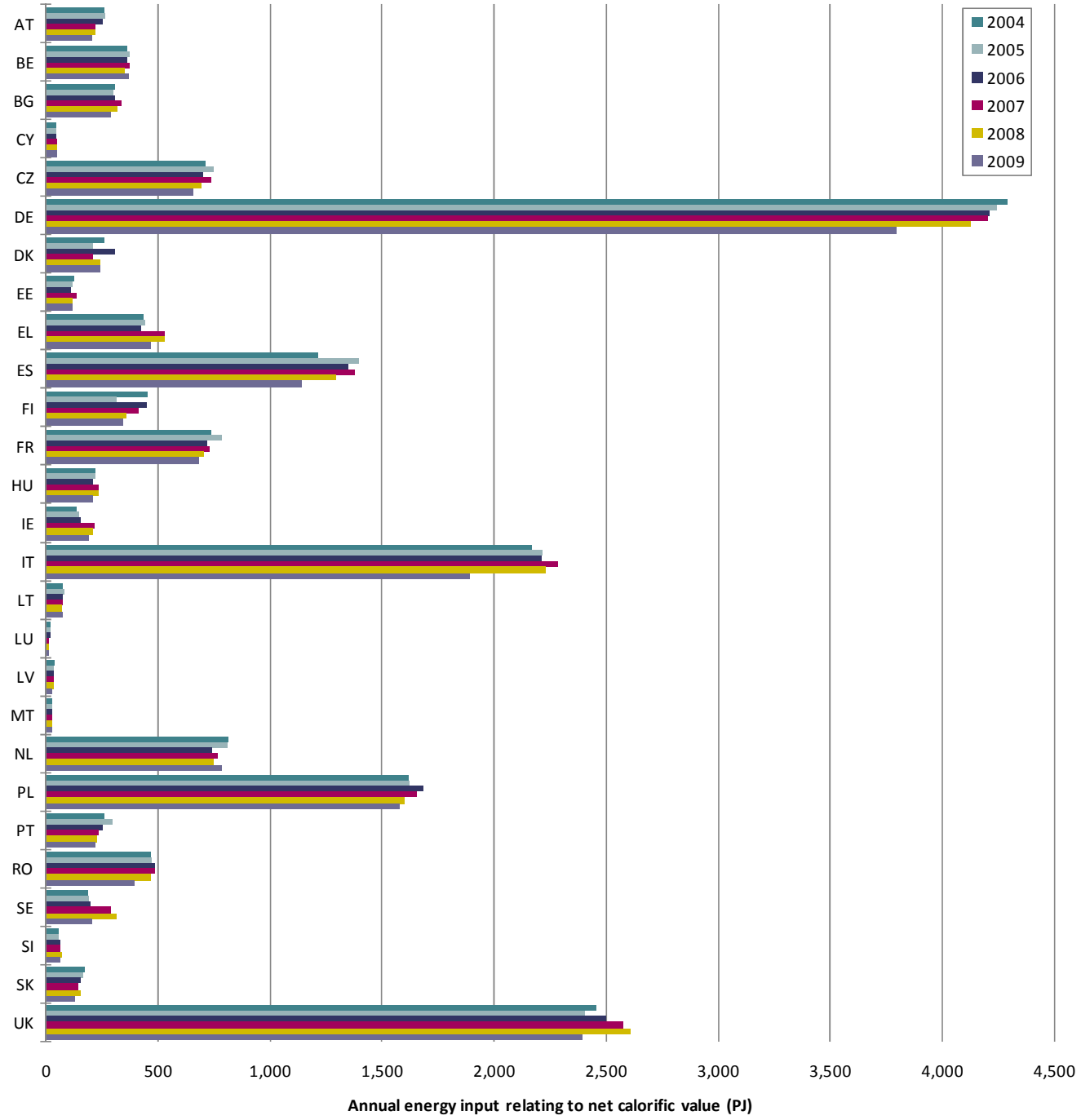
Figure 4.6 Share (%) of fuel types in reported energy input per Member State (2007-2009 average)



The energy input data presented in Figure 4.6 indicates the strong reliance of LCPs in many Member States on solid fuels ('other solid fuels', covering mainly hard coal and lignite: 51% for the EU) as well as the importance of

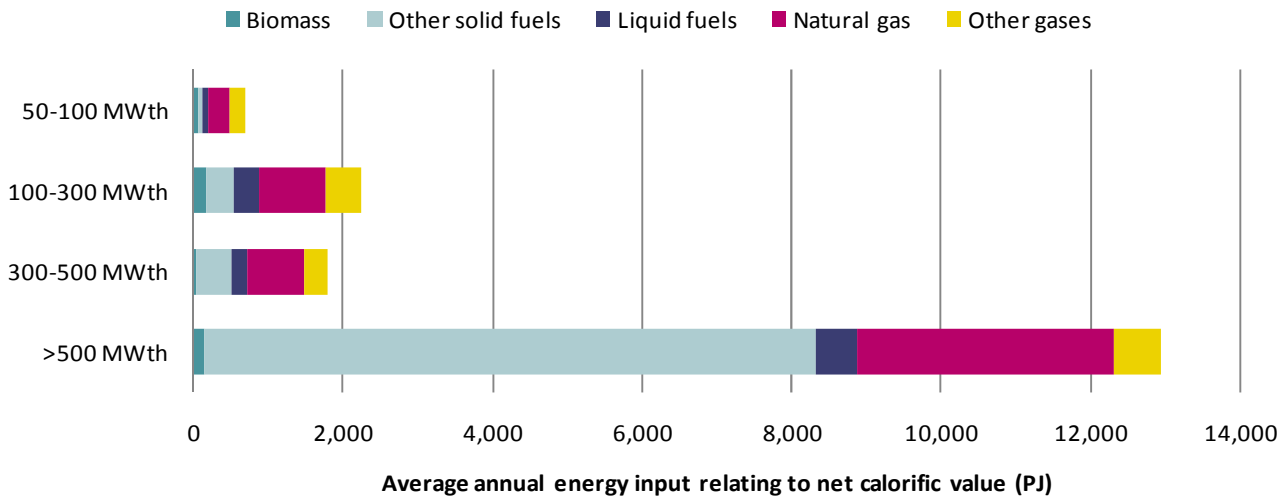
natural and 'other gases' (combined: 30% for the EU). The total annual energy input data from 2004 to 2009 for each Member State but without the fuel type split is displayed in Figure 4.7. This plot helps to illustrate trends in fuel use over the period. For some Member States, the reductions in energy input between 2008 and 2009 could be a reflection of the impacts of the economic recession.

Figure 4.7 Total reported energy input (PJ, 10^{15}J) relating to net calorific value per Member State from 2004 to 2009



The total EU energy input for reported LCPs, split by capacity class and by fuel type is shown in Figure 4.8, calculated as an average of 2007, 2008 and 2009 data. The data show the greater reliance on 'other' solid fuels (coal and lignite) for LCPs of higher capacities, and that LCPs of rated thermal input greater than 500 MW dominate the total EU fuel consumption.

Figure 4.8 Total EU reported energy input for all LCPs split by capacity class (2007-2009 average)



The total energy input (i.e. not split by fuel type) for reported LCPs from each Member State, split by capacity class and shown as an average of 2007, 2008 and 2009 data, is listed in Table 4.6.

Table 4.6 Total energy input per Member State for all LCPs (2007-2009 average), split by capacity class (PJ and %)

Member State	50-100 MW_{th}		100-300 MW_{th}		300-500 MW_{th}		>500 MW_{th}		Total
	PJ	%	PJ	%	PJ	%	PJ	%	PJ
AT	44	20%	62	29%	42	19%	69	32%	**215**
BE	25	7%	90	25%	66	18%	186	51%	**367**
BG	1	0%	23	7%	16	5%	277	87%	**317**
CY	0	0%	9	18%	7	13%	35	69%	**51**
CZ	14	2%	105	15%	78	11%	499	72%	**697**
DE	119	3%	461	11%	223	6%	3,241	80%	**4,044**
DK	3	1%	21	9%	10	4%	198	86%	**232**
EE	8	7%	6	5%	3	2%	107	86%	**125**
EL	16	3%	35	7%	67	13%	389	77%	**507**
ES	32	3%	92	7%	96	8%	1,051	83%	**1,271**
FI	33	9%	184	50%	78	21%	77	21%	**371**
FR	59	8%	149	21%	100	14%	397	56%	**704**
HU	8	4%	34	15%	37	17%	145	65%	**224**
IE	1	1%	19	9%	46	22%	141	68%	**207**
IT	77	4%	271	13%	332	16%	1,455	68%	**2,135**
LT	4	6%	11	15%	12	16%	46	63%	**73**
LU	0	0%	0	0%	16	100%	0	0%	**16**
LV	3	9%	12	43%	3	9%	11	39%	**29**
MT	0	0%	17	65%	9	35%	0	0%	**26**
NL	89	12%	133	17%	69	9%	475	62%	**767**
PL	6	0%	33	2%	78	5%	1,494	93%	**1,611**
PT	16	7%	23	10%	24	11%	167	72%	**231**
RO	8	2%	39	9%	30	7%	374	83%	**451**
SE	33	12%	117	43%	57	21%	60	22%	**269**
SI	2	3%	2	4%	16	24%	45	70%	**65**
SK	10	7%	26	18%	17	12%	91	63%	**143**
UK	95	4%	270	11%	266	11%	1,896	75%	**2,527**
EU-27	**705**	**4%**	**2,243**	**13%**	**1,796**	**10%**	**12,927**	**73%**	**17,674**

Member States with highest energy input

Table 4.7 presents, for each of the five fuel types and for the total energy input, the five Member States with the highest absolute energy input to LCPs for the period 2007 to 2009.

Table 4.7 The five Member States with highest absolute energy input for each fuel type, and for all fuels (2007-2009 average)

Biomass	Other solid fuels	Liquid fuels	Natural gas	Other gases	Total all fuels
1. SE (1)	1. DE (1)	1. IT (1)	1. IT (1)	1. DE (1)	**1. DE (1)**
2. FI (2)	2. PL (2)	2. ES (2)	2. UK (2)	2. IT (2)	**2. UK (2)**
3. DE (3)	3. UK (3)	3. FR (3)	3. DE (3)	3. NL (4)	**3. IT (3)**
4. PL (9)	4. CZ (5)	4. DE (4)	4. ES (5)	4. UK (3)	**4. PL (4)**
5. UK (4)	5. ES (4)	5. UK (5)	5. NL (4)	5. FR (5)	**5. ES (5)**

Note: the number in brackets after each Member State is the rank of that Member State in the 2004 to 2006 reporting period.

Table 4.8 lists the five Member States with the highest energy input for each fuel type as a percentage of the total Member State LCP energy input over the period 2007 to 2009. This is equivalent to identifying from Figure 4.6 those Member States with the highest fractional use of each fuel.

Table 4.8 The five Member States with highest energy input for each fuel type expressed as a fraction of total energy input (2007-2009 average)

Biomass		Other solid fuels		Liquid fuels		Natural gas		Other gases	
MS	% MS total	MS	% MS total	MS	% MS total	MS	% MS total	MS	% MS total
1. SE (1)	53%	1. SI (1)	95%	=1. CY (1)	100%	1. LU (1)	100%	1. FR (2)	24%
2. FI (2)	18%	2. PL (2)	92%	=1. MT (1)	100%	2. LV (2)	96%	2. NL (1)	23%
3. HU (5)	8%	3. CZ (4)	88%	3. LT (6)	21%	3. LT (3)	60%	3. AT (7)	21%
4. DK (4)	7%	4. EE (3)	83%	4. FR (4)	21%	4. BE (4)	58%	4. BE (3)	17%
5. BE (8)	6%	5. BG (6)	82%	5. EL (11)	13%	5. IE (16)	58%	5. LT (5)	15%

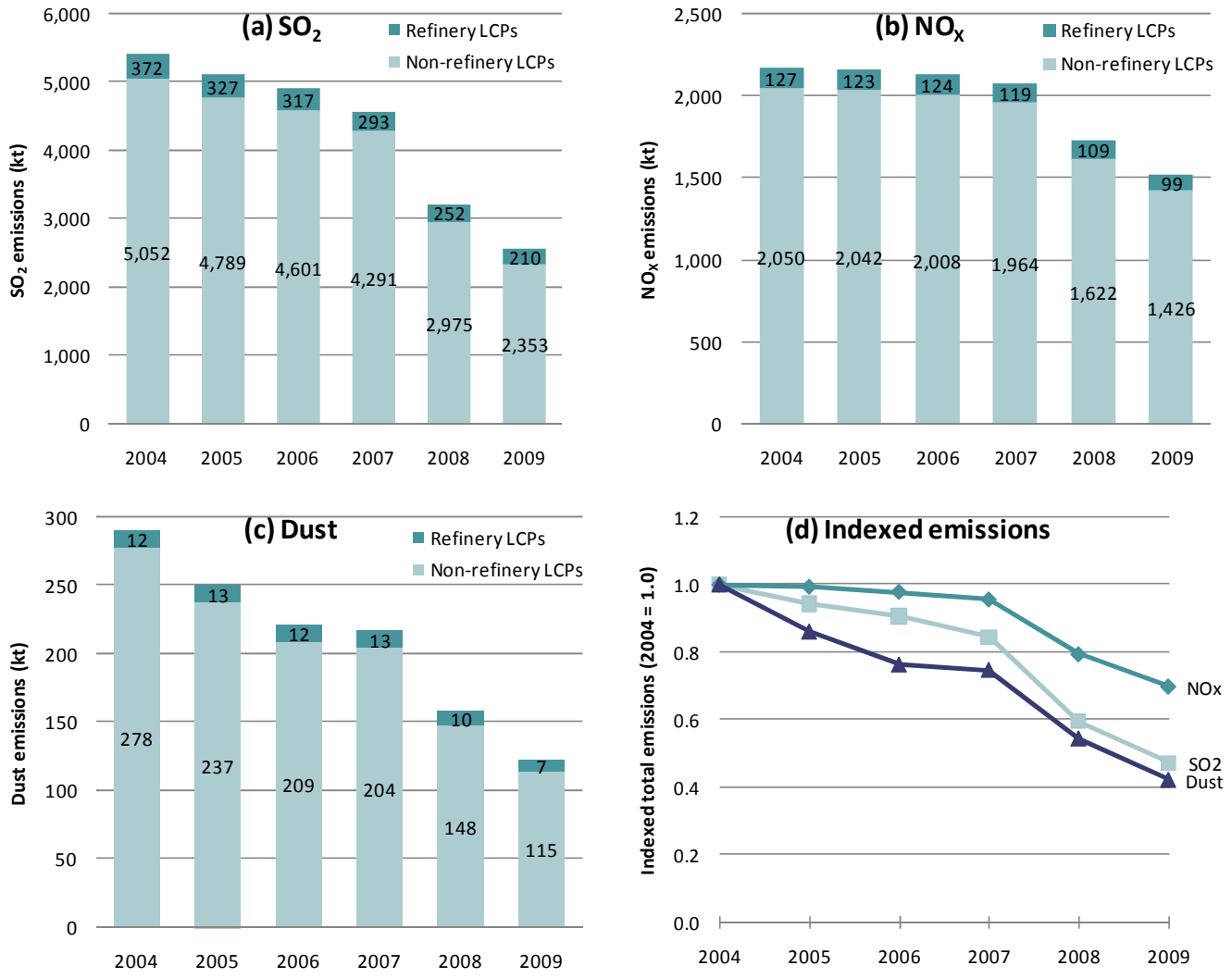
Note: the number in brackets after each Member State is the rank of that Member State in the 2004 to 2006 reporting period.

4.2.4 Total emissions

The total SO_2, NO_X and dust emissions from LCPs covered by the LCP Directive as reported by all 27 Member States for the years 2007 to 2009 are shown below in plots (a), (b) and (c) respectively of Figure 4.9, split according to whether the emissions are from refinery LCPs or LCPs other than in refineries. Also presented alongside the 2007 to 2009 reporting period are data from the previous reporting period (2004 to 2006). Figure 4.9(d) shows the indexed trends of total emissions of each pollutant from LCPs in the EU-27 over the period 2004

to 2009, indexed to 2004 emission levels (i.e. values below 1 indicate a reduction in emissions since 2004). The data clearly show reductions in total year-on-year emissions of all pollutants.

Figure 4.9 **(a) SO_2 (b) NO_X and (c) dust emissions from refinery and non-refinery LCPs in the EU from 2004 to 2009. Plot (d) shows total emissions for each pollutant indexed to 2004 emissions**



The total SO_2 emissions from each Member State LCP inventory are shown in Table 4.9, showing emissions from each inventory year (2007, 2008 and 2009) as well as data for the years 2004 to 2006. Emissions are shown split by LCPs in refineries and LCPs not in refineries. Table 4.10 and Table 4.11 show in the same format the total NO_X and dust emissions from each Member State LCP inventory, respectively.

Table 4.9 SO_2 emissions for each Member State from refinery and non-refinery LCPs from 2004 to 2009

Member State	SO_2 emissions from refinery LCPs (kt)						SO_2 emissions from non-refinery LCPs (kt)					
	2004	2005	2006	2007	2008	2009	2004	2005	2006	2007	2008	2009
AT	3.7	3.4	3.5	3.0	0.8	0.5	4.3	4.3	4.4	2.8	2.7	2.6
BE	13.2	8.9	8.8	9.8	6.7	3.9	35.9	31.3	27.0	20.1	8.8	5.0
BG	18.0	11.2	5.8	9.0	4.3	5.2	767.0	766.0	759.5	706.3	590.1	420.9
CY	0	0	0	0	0	0	31.4	34.0	27.5	25.2	21.0	15.5
CZ	10.4	10.4	9.5	8.3	6.7	6.9	148.2	148.1	145.3	151.9	119.6	115.9
DE	28.6	26.2	24.2	27.5	24.1	21.4	201.5	185.6	178.0	172.3	151.4	141.4
DK	0.4	0.5	0.4	0.4	0.4	0.3	10.7	6.1	8.5	8.4	5.8	4.0
EE	0	0	0	0	0	0	77.6	66.8	60.2	76.8	56.6	43.4
EL	9.8	9.8	9.7	8.0	7.7	7.2	362.3	386.2	341.3	368.7	326.9	294.7
ES	60.0	50.0	51.9	52.2	37.4	34.5	942.0	924.1	819.8	821.9	178.1	97.1
FI	3.5	2.9	2.4	2.0	1.4	1.1	36.7	20.1	33.9	32.9	22.0	20.7
FR	69.1	54.5	55.1	51.3	48.1	37.0	144.6	159.8	139.5	138.4	112.0	101.7
HU	0.0	0.0	0.0	0.3	0.2	0.2	96.5	9.8	8.6	12.7	13.7	10.8
IE	0.7	0.9	1.0	1.0	1.0	0.9	47.9	46.3	38.1	32.8	26.6	16.5
IT	46.7	45.8	39.1	36.3	35.1	30.5	188.2	146.9	149.5	111.6	80.3	61.8
LT	7.2	8.1	6.5	3.4	2.6	3.0	9.2	8.7	7.5	8.9	3.5	4.6
LU	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
LV	0	0	0	0	0	0	2.0	1.6	1.0	1.0	0.7	0.7
MT	0	0	0	0	0	0	11.6	11.9	12.1	10.6	8.9	6.4
NL	18.8	17.5	18.0	12.4	11.0	5.1	12.2	11.1	11.1	9.8	6.9	7.0
PL	28.2	26.7	30.4	19.8	19.4	19.4	718.9	705.4	753.0	703.2	481.0	365.2
PT	11.0	9.7	9.1	11.1	10.1	4.3	92.1	104.3	82.0	76.6	33.0	9.8
RO	3.0	3.4	3.9	2.4	2.0	1.4	490.4	514.4	561.5	443.4	450.9	394.1
SE	0.5	0.4	0.2	0.7	0.4	0.1	8.1	7.6	7.4	3.6	4.7	3.3
SI	0	0	0	0	0	0	39.8	31.7	8.8	8.0	7.1	6.1
SK	7.3	6.8	8.9	6.6	6.6	7.6	66.1	60.9	57.0	45.8	46.5	44.0
UK	31.4	29.9	28.3	27.8	25.6	19.9	507.2	395.9	358.3	297.6	215.9	160.1
EU-27	**372**	**327**	**317**	**293**	**252**	**210**	**5,052**	**4,789**	**4,601**	**4,291**	**2,975**	**2,353**

Table 4.10 NO_X emissions for each Member State from refinery and non-refinery LCPs from 2004 to 2009

Member State	NO_X emissions from refinery LCPs (kt)						NO_X emissions from non-refinery LCPs (kt)					
	2004	2005	2006	2007	2008	2009	2004	2005	2006	2007	2008	2009
AT	3.4	2.9	3.2	2.9	1.1	0.9	10.7	10.9	9.9	8.5	8.7	7.3
BE	5.5	4.8	4.5	3.3	2.7	1.8	35.7	32.7	27.4	25.1	17.6	16.5
BG	3.5	2.6	2.0	3.0	1.1	1.4	56.0	56.9	59.6	64.8	65.0	53.2
CY	0	0	0	0	0	0	6.6	6.9	7.1	7.6	8.0	5.2
CZ	8.3	5.1	5.0	4.6	4.6	4.5	107.8	100.8	104.0	107.5	95.8	90.1
DE	16.8	17.1	16.0	18.0	16.4	15.4	261.8	254.0	247.7	242.7	230.5	211.6
DK	1.3	1.2	1.5	1.4	1.4	1.6	29.4	27.5	32.8	23.2	14.2	10.7
EE	0	0	0	0	0	0	12.3	10.7	9.4	12.8	11.0	9.4
EL	2.1	2.3	2.7	2.4	2.9	2.5	71.4	75.9	68.2	83.8	80.8	78.3
ES	13.3	13.6	14.1	13.4	11.8	11.7	286.4	290.0	243.7	253.9	148.6	99.0
FI	1.1	1.1	1.1	1.0	1.1	1.1	50.3	29.6	49.0	43.4	35.8	33.6
FR	15.8	16.8	16.6	15.8	15.5	14.9	92.2	110.9	97.5	98.5	72.1	68.9
HU	0.3	0.0	0.0	0.5	0.4	0.3	20.4	18.8	15.8	17.0	18.0	15.9
IE	0.8	0.9	0.8	0.9	0.8	0.7	30.2	30.6	27.2	28.3	22.8	13.8
IT	15.0	15.7	17.1	15.1	15.5	14.0	124.9	114.5	108.8	103.4	90.5	75.7
LT	2.7	2.9	2.4	1.1	1.2	1.4	3.8	4.2	3.7	3.7	3.6	3.4
LU	0	0	0	0	0	0	0.6	0.6	0.6	0.5	0.4	0.5
LV	0	0	0	0	0	0	3.2	3.1	3.0	2.7	2.3	1.8
MT	0	0	0	0	0	0	5.4	5.4	5.5	4.9	4.8	4.3
NL	5.6	5.4	6.7	4.9	4.4	2.6	42.7	41.7	39.1	32.5	28.1	25.5
PL	5.2	5.5	6.2	5.4	5.0	5.0	254.8	259.1	266.5	261.4	238.3	242.8
PT	4.1	2.5	2.1	2.6	2.3	1.5	46.4	56.7	49.4	41.7	30.8	25.8
RO	1.2	1.3	1.7	1.4	1.3	0.6	92.8	93.6	99.0	84.4	83.5	63.4
SE	1.3	1.3	1.4	1.3	1.1	0.9	8.8	8.9	9.1	10.0	12.5	8.9
SI	0	0	0	0	0	0	12.3	12.1	12.3	11.5	11.3	10.0
SK	2.1	2.0	2.0	1.8	1.9	1.9	27.7	26.6	23.3	20.4	18.7	17.3
UK	18.0	17.5	16.9	17.8	16.7	14.4	355.6	358.8	388.2	369.8	268.4	232.8
EU-27	**127**	**123**	**124**	**119**	**109**	**99**	**2,050**	**2,042**	**2,008**	**1,964**	**1,622**	**1,426**

Table 4.11 Dust emissions for each Member State from refinery and non-refinery LCPs from 2004 to 2009

Member State	Dust emissions from refinery LCPs (kt)						Dust emissions from non-refinery LCPs (kt)					
	2004	2005	2006	2007	2008	2009	2004	2005	2006	2007	2008	2009
AT	0.11	0.10	0.10	0.09	0.04	0.04	0.87	0.79	0.74	0.47	0.40	0.37
BE	0.85	0.66	0.58	0.67	0.19	0.12	3.79	2.62	2.04	1.19	0.62	0.72
BG	0.37	0.23	0.14	0.22	0.00	0.00	22.03	21.74	21.38	20.21	18.55	14.40
CY	0	0	0	0	0	0	0.50	0.73	0.75	0.60	0.61	0.81
CZ	0.28	0.27	0.22	0.29	0.22	0.16	5.15	4.86	5.32	4.69	3.62	3.38
DE	0.60	0.61	0.55	0.59	0.46	0.41	11.94	10.53	8.84	7.57	5.79	4.67
DK	0.08	0.09	0.02	0.11	0.12	0.11	0.95	0.81	0.67	0.80	0.61	0.57
EE	0	0	0	0	0	0	17.69	10.45	5.26	12.47	6.60	4.80
EL	0.53	0.58	0.71	0.43	0.37	0.28	51.66	35.21	28.63	35.75	25.93	20.78
ES	1.83	1.94	1.82	1.55	0.94	1.09	31.88	29.47	24.25	25.03	9.80	4.82
FI	0.14	0.13	0.11	0.11	0.06	0.05	2.78	1.85	2.80	2.60	2.32	1.49
FR	2.34	2.74	2.92	3.42	2.58	2.28	9.41	10.67	9.43	9.06	6.36	5.68
HU	0.00	0.00	0.00	0.07	0.05	0.03	3.16	0.51	0.45	0.47	0.41	0.76
IE	0	0	0	0	0	0	9.83	2.79	1.46	1.95	1.38	0.90
IT	2.03	2.06	1.54	1.41	1.25	1.01	6.50	4.96	4.45	3.91	3.21	2.59
LT	0.02	0.02	0.02	0.01	0.25	0.19	0.27	0.23	0.20	0.25	0.22	0.19
LU	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00
LV	0	0	0	0	0	0	0.03	0.02	0.02	0.04	0.05	0.05
MT	0	0	0	0	0	0	0.75	0.77	0.78	0.28	0.26	0.22
NL	0.21	0.14	0.09	1.19	0.97	0.10	0.55	0.79	0.71	0.47	0.46	0.48
PL	0.40	0.50	0.80	0.63	0.51	0.44	45.98	41.74	40.73	38.40	25.38	21.78
PT	0.67	0.68	0.57	0.69	0.60	0.21	2.79	3.64	3.38	2.65	1.74	0.58
RO	0.07	0.22	0.19	0.13	0.12	0.07	26.00	26.35	24.67	21.26	20.42	16.27
SE	0.10	0.10	0.10	0.09	0.07	0.04	1.29	1.32	0.63	1.02	2.36	0.68
SI	0	0	0	0	0	0	2.31	0.76	0.30	0.39	0.33	0.31
SK	0.08	0.09	0.08	0.08	0.10	0.10	8.48	12.17	8.10	1.28	1.10	1.02
UK	1.49	1.40	1.55	1.45	0.80	0.68	11.47	11.49	13.52	10.99	9.94	6.88
EU-27	**12.2**	**12.6**	**12.1**	**13.2**	**9.7**	**7.4**	**278**	**237**	**209**	**204**	**148**	**115**

The total SO_2, NO_X and dust emissions from EU LCPs over the period 2004 to 2009 are shown in Figure 4.10, Figure 4.11 and Figure 4.12 respectively. Emissions are disaggregated by rated thermal input class (50-100MW, 100-300MW, 300-500MW and >500MW) where possible; exceptions to this are Denmark (2004 to 2006), part of the Netherlands inventory (2004 to 2006) and Sweden (2004 and 2005), all of which are not included in the figures.

Figure 4.10 SO_2 emissions from EU-27 LCPs from 2004 to 2009, split by capacity class

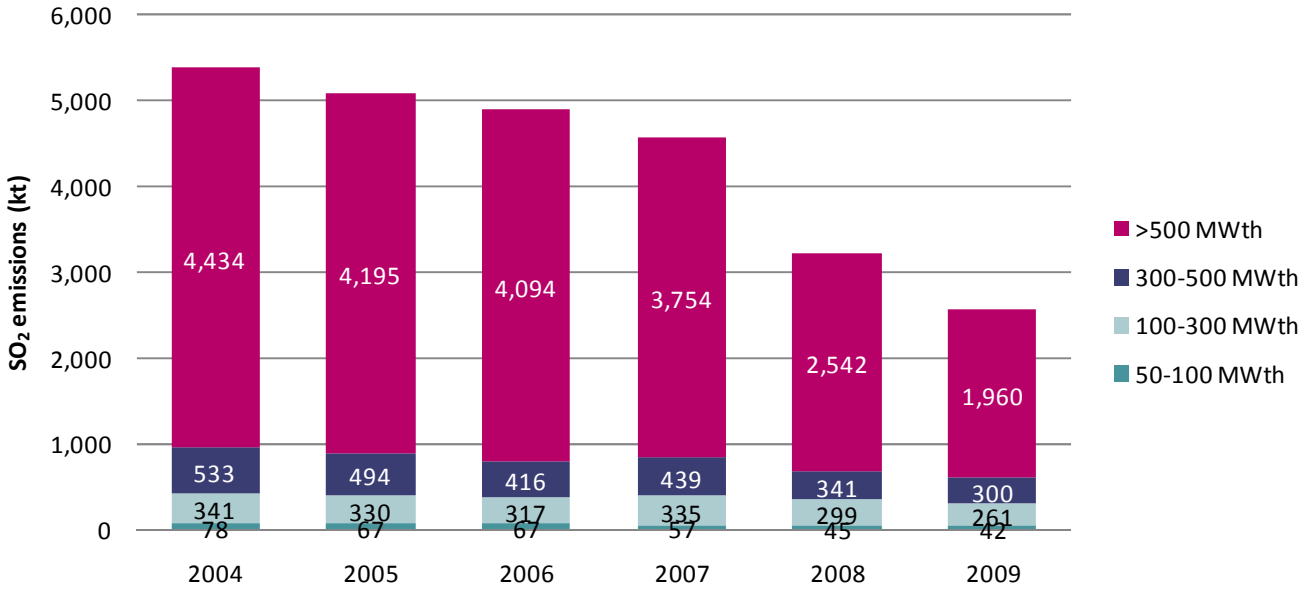


Figure 4.11 NO_X emissions from EU-27 LCPs from 2004 to 2009, split by capacity class

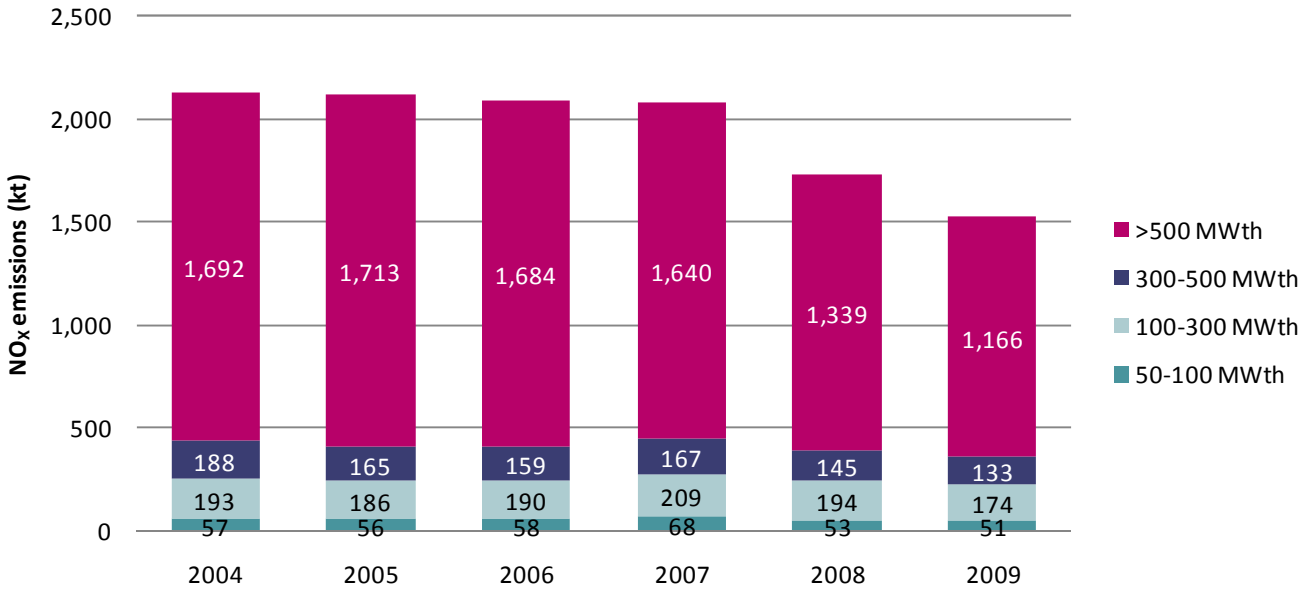
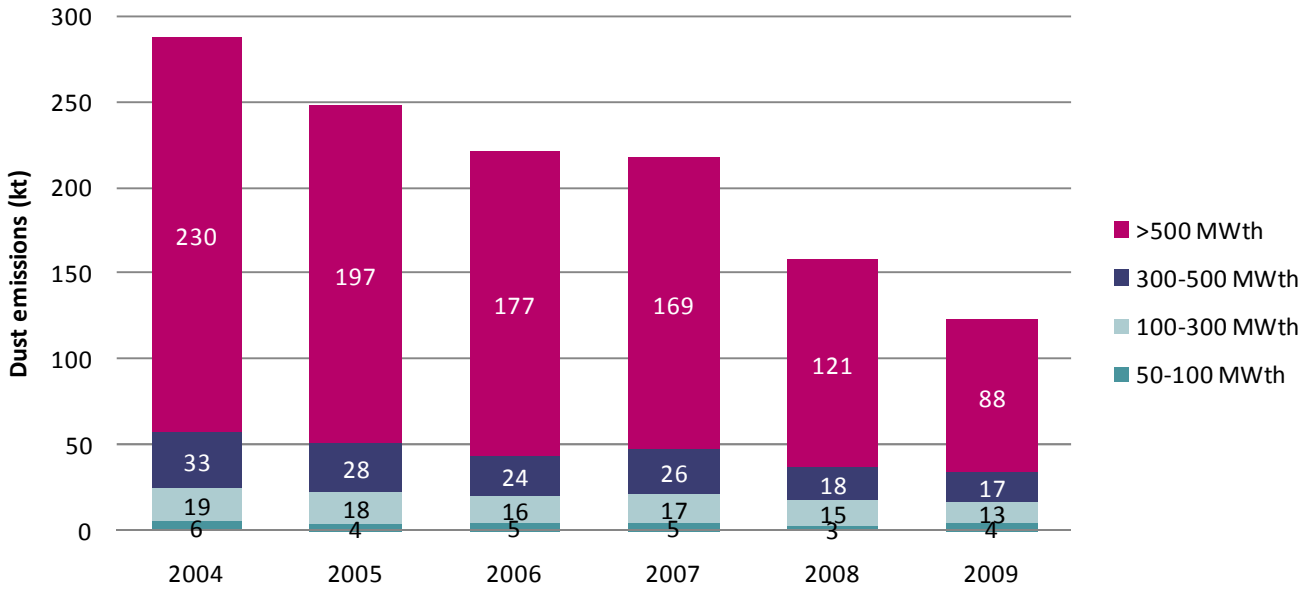


Figure 4.12 Dust emissions from EU-27 LCPs from 2004 to 2009, split by capacity class



The total SO_2 emissions (in kilotonnes) from LCPs in each Member State are shown in Figure 4.13, showing emissions from each year of the reporting period 2007 to 2009 to enable trends between years to be more easily highlighted. Emissions have been disaggregated according to reported rated thermal input classes. Similarly, Figure 4.14 and Figure 4.15 display the total NO_X and dust emissions in the same fashion. The three figures highlight the following observations:

- As would be expected, the majority of SO_2, NO_X and dust emissions are from the largest plants, the >500MWth capacity class, which are mostly electricity generation plants.
- Significant SO_2, NO_X and dust emission reductions are observed for several Member States between 2007 and 2008, which reflects the coming into force of the LCP Directive ELVs for existing plants (as well as IPPC permit limits). In some cases further significant emission reductions are reported between 2008 and 2009, which may reflect the ongoing implementation of the Directive. These reductions appear to be due to reductions at individual plants year on year (in some cases, a select few plants) rather than closures of plants that have significant emissions. For some Member States a very significant proportion of the total reduction between years can be attributed to emission reductions reported at just a handful of plants: for example the SO_2 emissions from just two LCPs in Bulgaria (which are neither subject to Accession Treaty derogations nor are 'opted out') reduced by 107kt between 2007 and 2008, out of the total SO_2 emission reduction for Bulgaria between 2007 and 2008 of 121 kt.
- At a national level, the following observations can be made:
  - Bulgaria, Poland, Spain and the United Kingdom report significant **SO_2 emission** reductions between 2007 and 2008 and between 2008 and 2009.

- France, Poland, Spain and the United Kingdom report significant **NO_X emission** reductions between 2007 and 2008; of these Spain and United Kingdom report further significant reductions between 2008 and 2009.

- Bulgaria, Estonia, France, Germany, Greece, Poland, Spain and the United Kingdom report significant **dust emission** reductions between 2007 and 2008; of these Bulgaria, Greece, Poland, Spain and the United Kingdom also report further significant reductions between 2008 and 2009. Romania additionally reports a significant dust emission reduction between 2008 and 2009.

- There are a few instances where Member States report very significant reductions in emissions year-on-year. For example, SO_2 emissions from Spanish LCPs are reported to drop from over 874 kt in 2007 (the highest total among Member States for 2007) to 132 kt in 2009.

Analysis of the percentage reductions in Member State LCP emissions is covered after Figures 4.13, 4.14 and 4.15.

Figure 4.13 SO_2 emissions from each Member State for years 2007, 2008 and 2009, split by capacity class

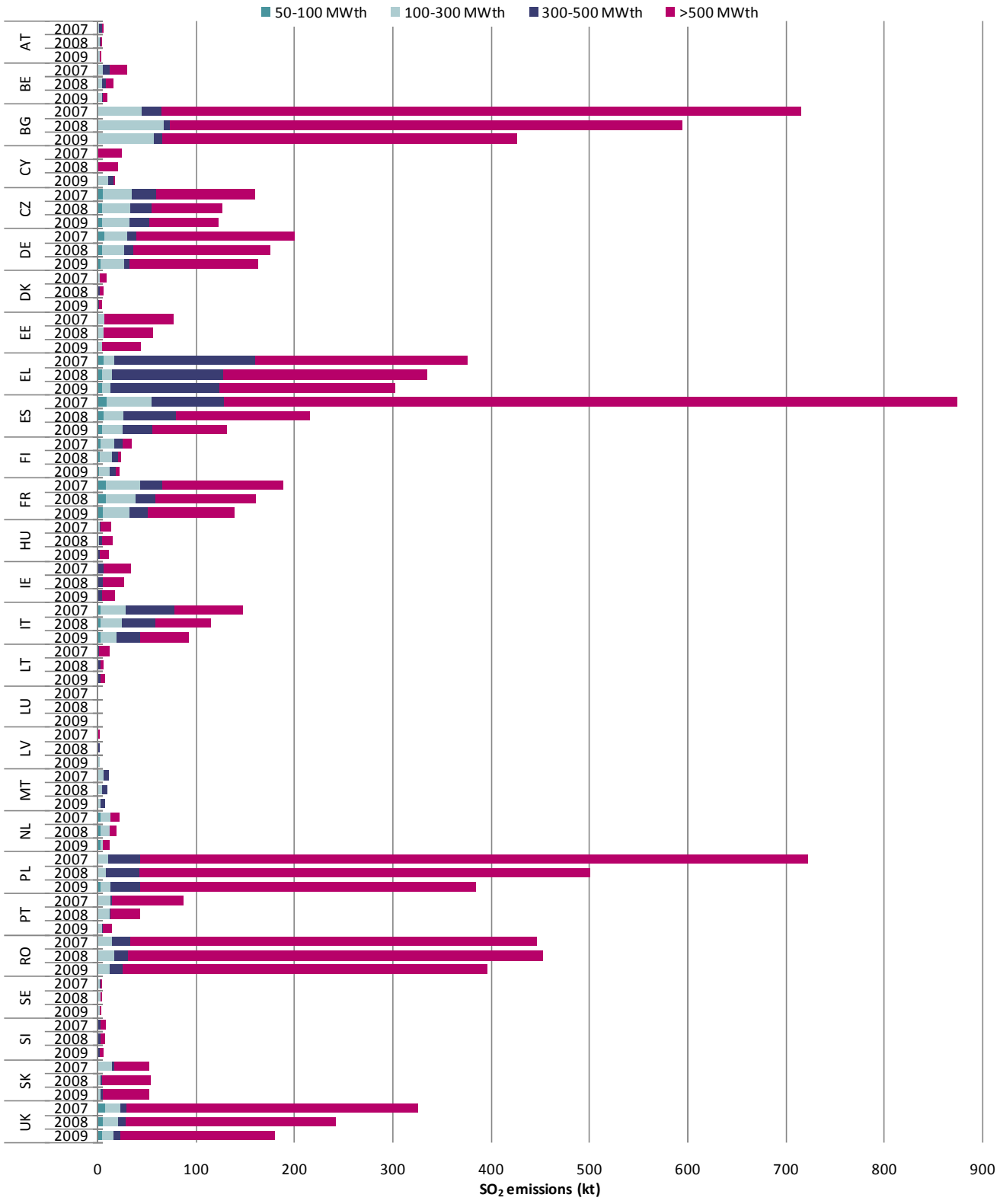


Figure 4.14 NO_X emissions from each Member State for years 2007, 2008 and 2009, split by capacity class

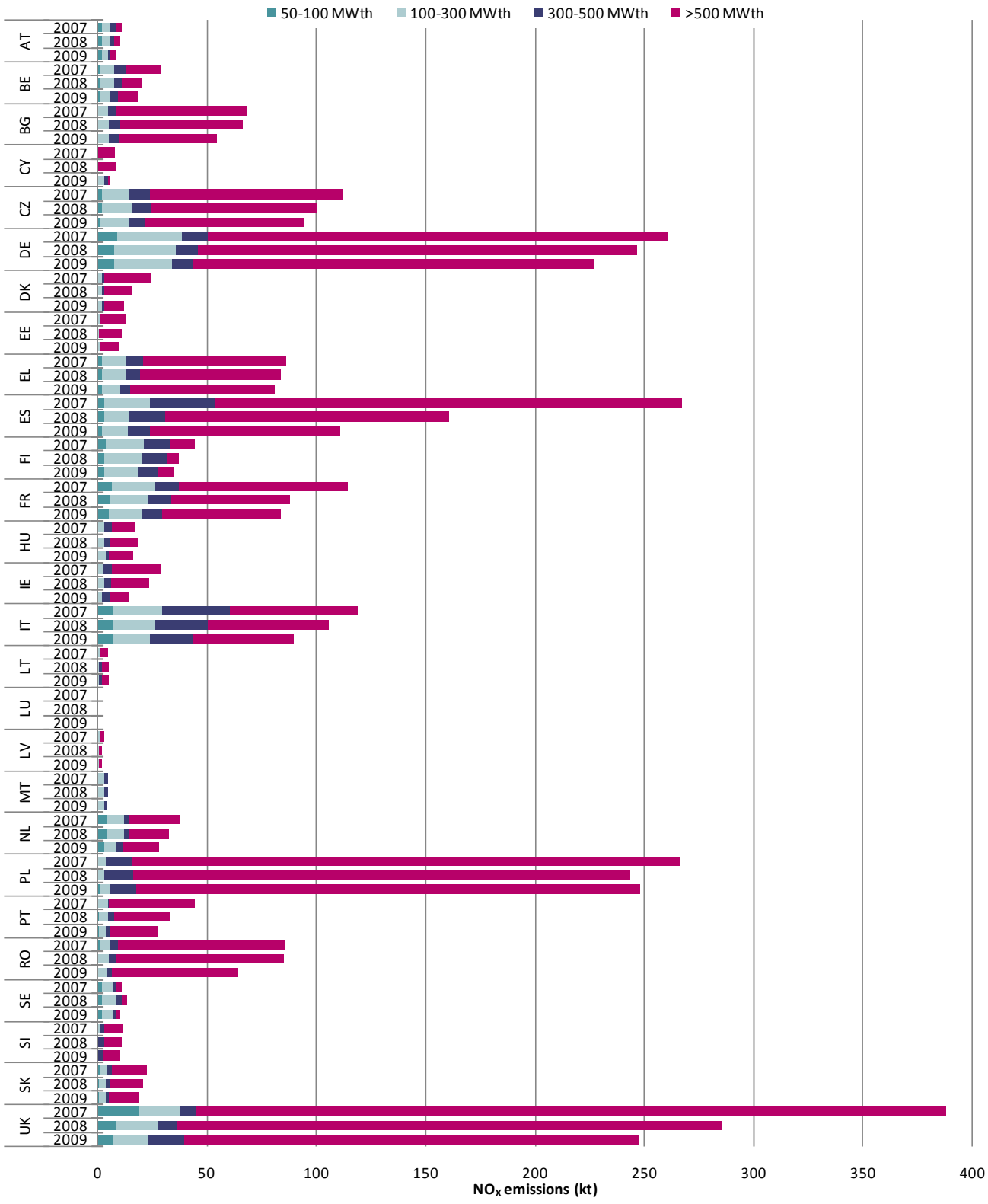
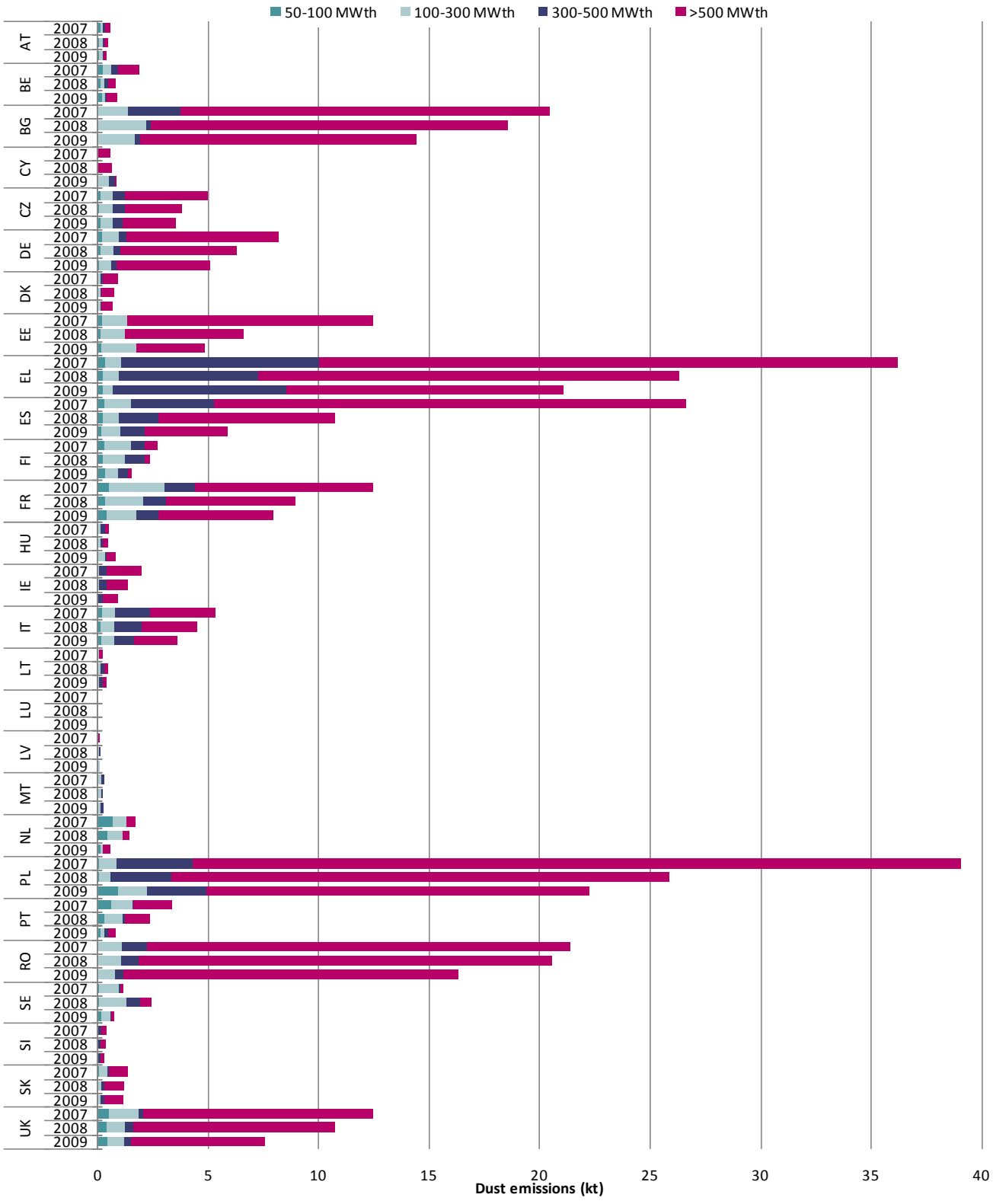


Figure 4.15 Dust emissions from each Member State for years 2007, 2008 and 2009, split by capacity class



The percentage change for each Member State (and total EU) emissions over the reporting period, and the extended period from 2004 to 2009, has been plotted for SO_2, NO_X and dust in Figure 4.16, Figure 4.17 and Figure 4.18 respectively. These percentage changes can be either positive or negative: negative values indicate decreasing LCP emissions over time; positive values indicate increasing LCP emissions over time.

Figure 4.16 shows that all Member States reported lower SO_2 emissions in 2009 than in 2007, and that all but one Member State also report reductions over the period 2004 to 2009. (The exception to this is Luxembourg, where SO_2 emissions from the single (natural gas fired) LCP are reported to be less than 5 tonnes in all years.)

Figure 4.17 shows that all but one Member State reported lower NO_X emissions in 2009 than in 2007: Lithuania reports very slightly higher emissions in 2009 than in 2007. All but one Member State also report reductions over the period 2004 to 2009; Greece reports a 10% increase in NO_X emissions over the period 2004 to 2009.

Figure 4.18 shows that 23 Member States report reduced dust emissions over the periods 2007 to 2009 and between 2004 and 2009. The remaining four Member States (Cyprus, Hungary, Lithuania and Latvia) all report significant percentage increases either solely over the period 2007 to 2009 or also over the period 2004 to 2009. It is unclear whether these are real increases or evidences of misreporting. It is important to note that, in absolute terms, total dust emissions reported from LCPs in 2009 from these four Member States make up 2% of the EU-27 total from all LCPs.

All three of these Figures show that the vast majority of Member States report decreases of emissions over the period 2007 to 2009 which are for many Member States significant decreases (over 50%). These decreases reflect the coming into force of the LCP Directive provisions for existing plants on 1 January 2008 (ELVs and NERP).

Analysis and comparison with the trends in energy input and emission factors (sections 4.2.3 and 4.2.5 respectively) shows that most of the emission reduction can be attributed to reductions in the emission factors rather than reductions in energy input (for example, reduced activity due to the economic recession). More specifically, the total reported energy input to EU LCPs only dropped by 2% between 2007 and 2008 whereas the emission factors dropped by 28%, 15% and 26% respectively for SO_2, NO_X and dust in the same period. Between 2008 and 2009, the balance shifts slightly further towards reductions in energy input: the reduction in energy input between 2008 and 2009 was 8%, compared to reductions in emission factors of 14%, 4% and 16% for SO_2, NO_X and dust, respectively.

Figure 4.16 Percentage change in reported LCP SO_2 emissions for each Member State over time

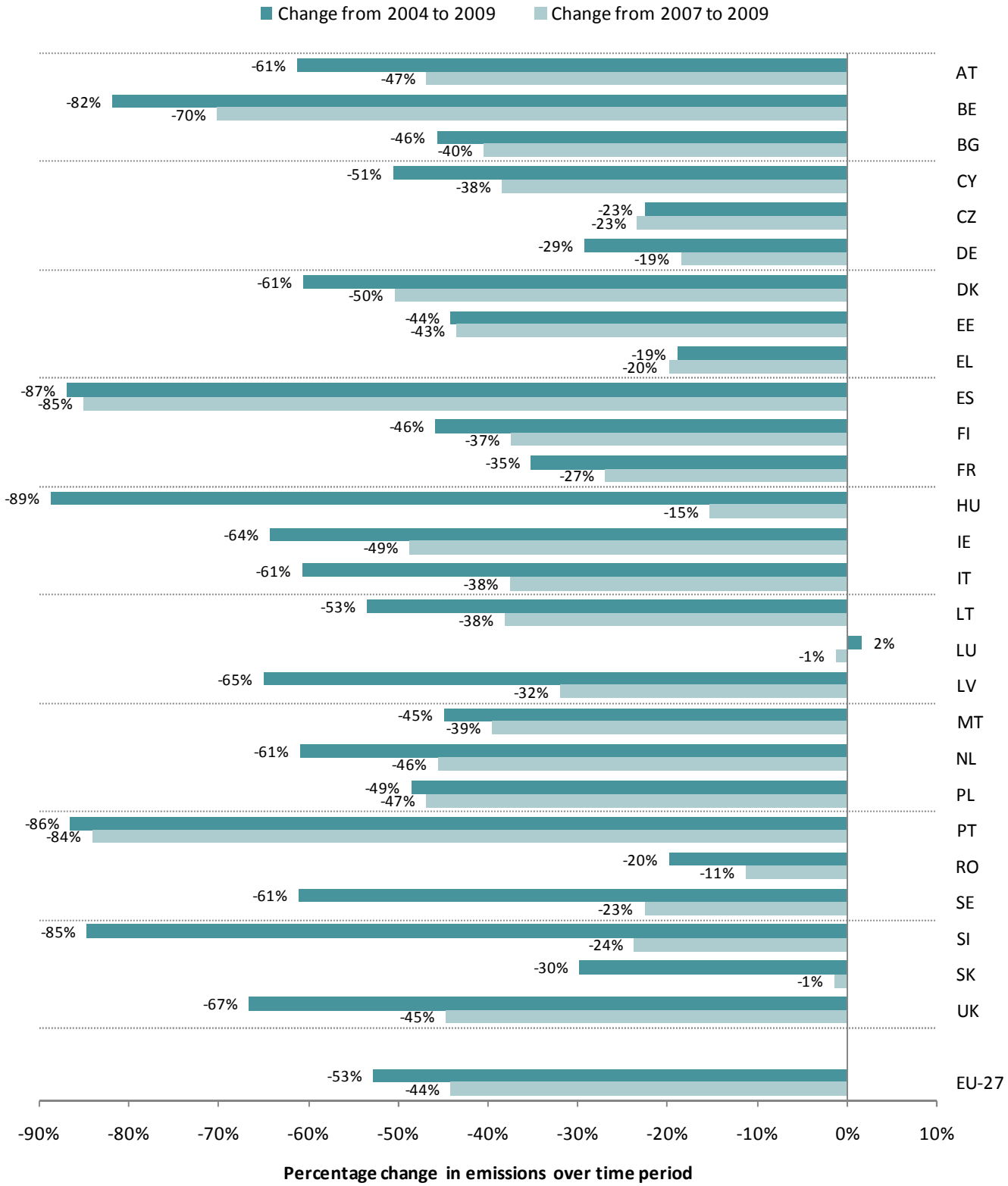


Figure 4.17 Percentage change in reported LCP NO_X emissions for each Member State over time

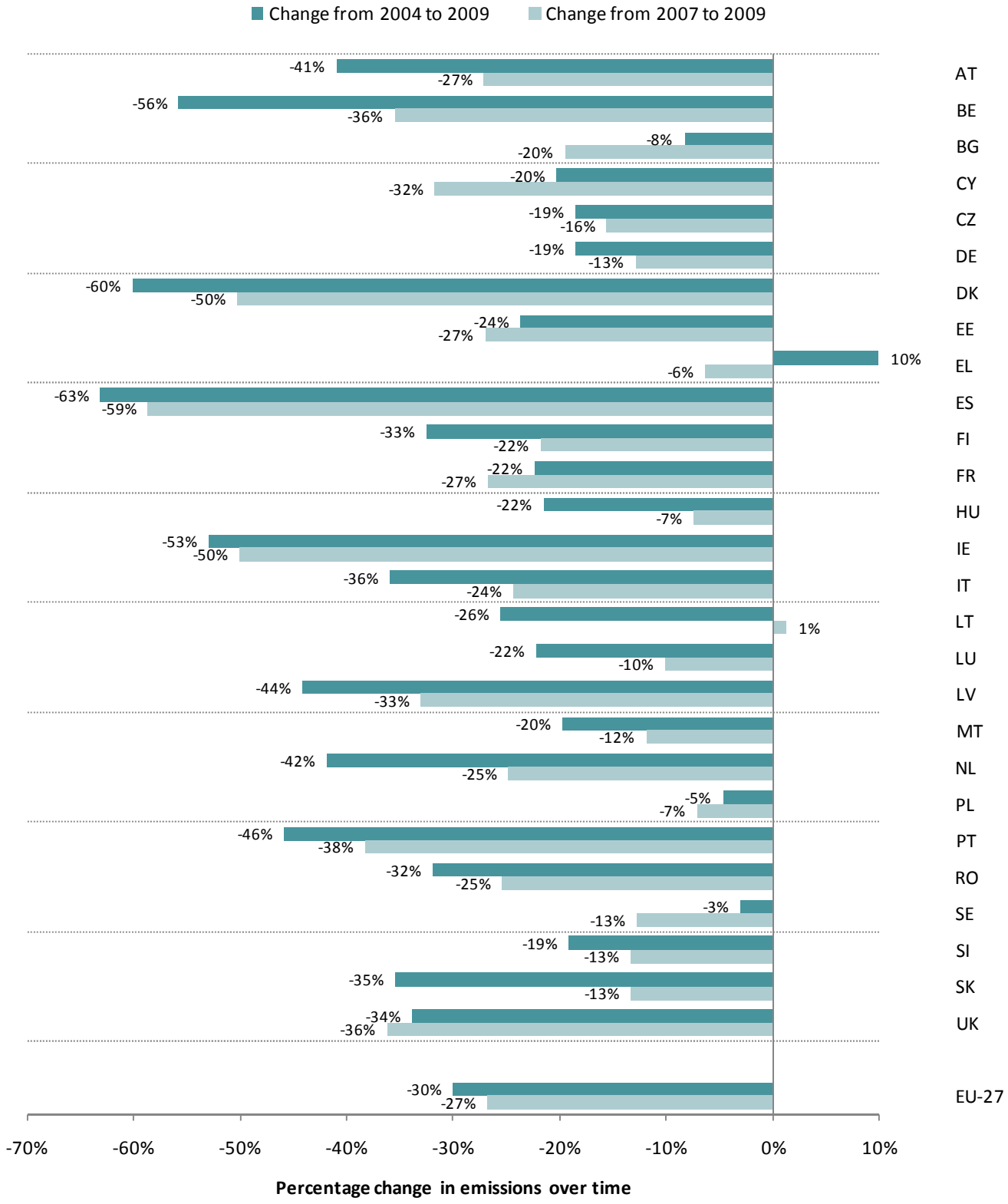
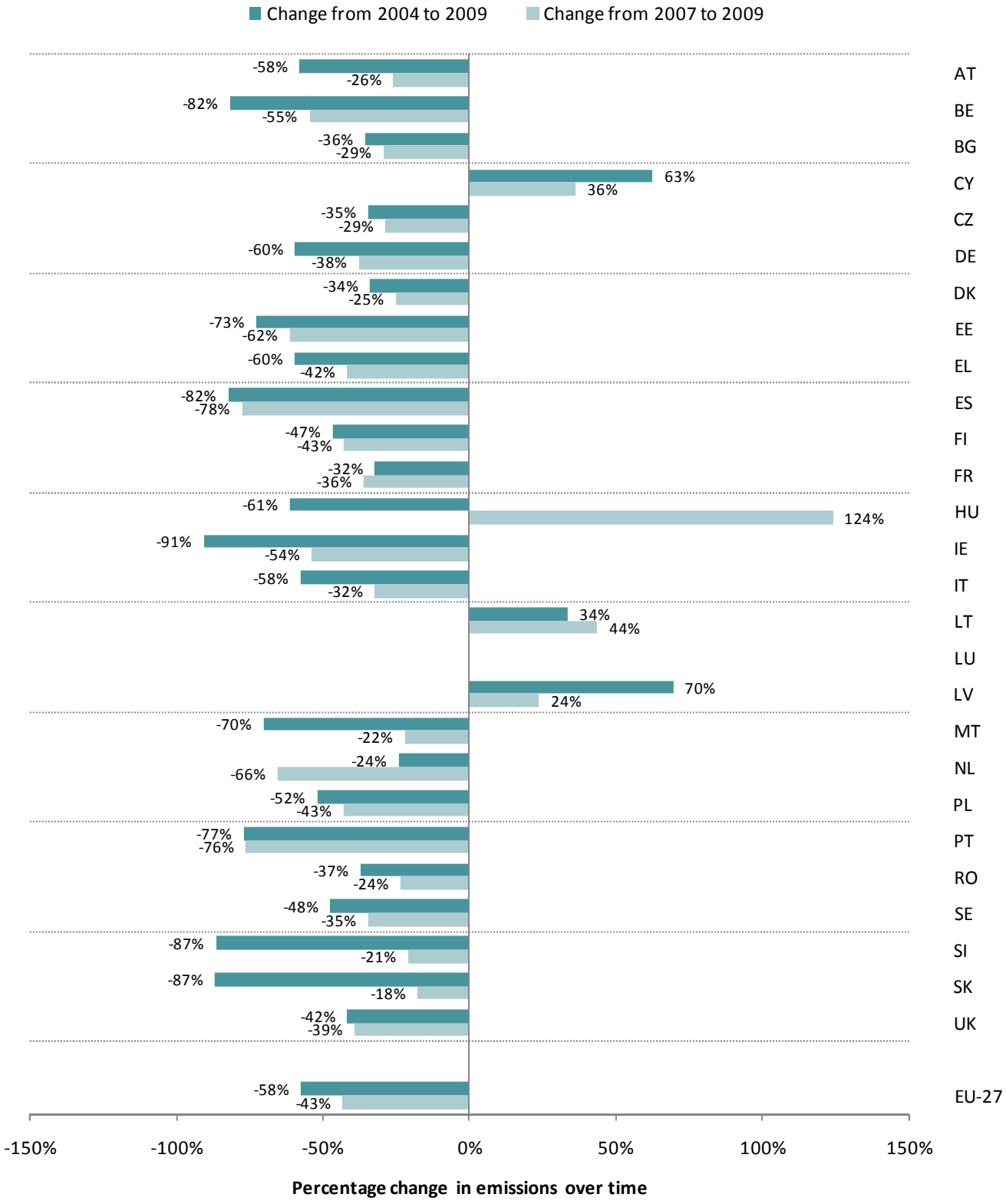


Figure 4.18 Percentage change in reported LCP dust emissions for each Member State over time



Member States with highest total emissions

The top five ranked Member States in terms of highest emissions of each pollutant from all LCPs in 2009 are shown below in Table 4.12. The table also shows the percentage contribution that the Member State's LCP emissions make up of the total EU emissions from all LCPs, as well as the percentage change from the 2004 LCP inventory.

The table shows that all of the Member States listed have reduced emissions between 2004 and 2009, and most have reduced emissions by significant amounts. The table also shows that one Member State (Poland) features in the top five for all three pollutants (SO_2, NO_X and dust). Four Member States feature in the top five for two pollutants: Bulgaria, Greece, Romania and the United Kingdom. Compared to the similar analysis of 'top five' Member States in the analysis of 2004 to 2006 inventories, one Member State (Spain) has reported greater emission reductions than other Member States and consequently no longer appears in the 'top five' list for SO_2 and dust emissions (Spain has moved from rank 1st in 2004-06 to rank 8th in this 2009 analysis for SO_2 emissions, and similarly from 3rd to 7th for dust emissions). For the 'top five' list of Member States for NO_X emissions, Italy was ranked 5th in the 2004-6 analysis but has reported reductions in NO_X emissions such that in 2009 it is no longer ranked in the 'top five' (ranked 6th).

Table 4.12 The five Member States ranked in terms of highest emissions of SO_2, NO_X and dust from LCPs in 2009

Member State	2009 SO_2 emissions			Member State	2009 NO_X emissions			Member State	2009 dust emissions		
	kt	% of EU-27	% change from 2004		kt	% of EU-27	% change from 2004		kt	% of EU-27	% change from 2004
1. BG	426	17%	-46%	1. PL	248	16%	-5%	1. PL	22.2	18%	-52%
2. RO	396	15%	-20%	2. UK	247	16%	-34%	2. EL	21.1	17%	-60%
3. PL	385	15%	-49%	3. DE	227	15%	-19%	3. RO	16.3	13%	-37%
4. EL	302	12%	-19%	4. ES	111	7%	-63%	4. BG	14.4	12%	-36%
5. UK	180	7%	-67%	5. CZ	95	6%	-19%	5. FR	8.0	6%	-32%

4.2.5 Emissions per unit energy (emission factors)

Calculating an emission factor (EF) of mass of pollutant emitted per unit energy input allows for a comparison of the environmental performance of LCPs. This can, for example, be undertaken at the EU or Member State level, if total emissions are divided by total energy input, or at the individual LCP level. EFs disaggregated by fuel type are presented in Section 4.7.

Emission factors at Member State and EU level

For the purposes of this report, EU and Member State level EFs have been calculated from the total EU/Member State emissions divided by the total EU/Member State energy input. The calculated SO_2, NO_X and dust EFs are shown in Table 4.13 for each Member State and for the EU for the reporting period 2007 to 2009 as well as the EFs from the 2004 to 2006 reporting period.

Table 4.13 include shading within each cell in a table that corresponds to the value contained within the cell. The shading is not applied in discrete bands (e.g. $x <$ value $< y$) but instead is applied as a continuous colour gradient from the lowest value in the table (or part table e.g. for each pollutant) to the highest value in the table (or part table), as shown below.

Table 4.13 Calculated Member State and EU average SO_2, NO_X and dust emission factors for the period 2004 to 2009 (Note 1)

Member State	SO_2 emission factor (g[SO_2]/GJ)						Member State	NO_X emission factor (g[NO_X]/GJ)						Member State	Dust emission factor (g[dust]/GJ)					
	2004	2005	2006	2007	2008	2009		2004	2005	2006	2007	2008	2009		2004	2005	2006	2007	2008	2009
AT	30	29	31	26	16	15	AT	54	53	51	52	44	40	AT	3.7	3.4	3.3	2.5	2.0	2.0
BE	136	108	98	80	44	24	BE	114	100	88	76	58	49	BE	12.8	8.8	7.2	5.0	2.3	2.3
BG	2543	2592	2509	2113	1846	1462	BG	193	198	202	200	205	187	BG	72.6	73.3	70.6	60.3	57.6	49.4
CY	719	736	577	501	401	306	CY	150	150	150	152	153	103	CY	11.5	15.8	15.8	11.9	11.6	16.0
CZ	223	212	221	217	182	187	CZ	163	142	156	152	144	144	CZ	7.6	6.9	7.9	6.7	5.5	5.4
DE	54	50	48	47	43	43	DE	65	64	63	62	60	60	DE	2.9	2.6	2.2	1.9	1.5	1.3
DK	43	31	29	41	26	18	DK	118	135	111	116	65	50	DK	4.0	4.2	2.2	4.3	3.0	2.8
EE	636	576	545	557	475	370	EE	100	92	85	93	93	80	EE	144.9	90.1	47.6	90.4	55.4	40.9
EL	853	900	824	710	637	649	EL	168	178	166	163	159	174	EL	119.6	81.4	68.9	68.2	50.0	45.3
ES	827	697	646	633	167	116	ES	247	217	191	194	124	97	ES	27.8	22.5	19.3	19.2	8.3	5.2
FI	89	73	81	85	66	63	FI	113	97	112	108	103	100	FI	6.4	6.3	6.5	6.6	6.7	4.5
FR	289	274	271	260	227	204	FR	146	163	159	157	124	123	FR	15.9	17.1	17.2	17.1	12.7	11.7
HU	435	44	40	56	60	53	HU	93	84	75	76	79	78	HU	14.2	2.3	2.1	2.3	2.0	3.8
IE	352	318	253	155	130	91	IE	224	213	182	134	111	77	IE	71.2	18.8	9.5	8.9	6.5	4.7
IT	108	87	85	65	52	49	IT	65	59	57	52	48	47	IT	3.9	3.2	2.7	2.3	2.0	1.9
LT	209	205	185	168	89	98	LT	83	86	80	65	70	63	LT	3.6	3.1	2.9	3.6	6.7	4.9
LU	0	0	0	0	0	0	LU	34	36	32	32	31	29	LU	0.0	0.0	0.0	0.0	0.0	0.0
LV	55	49	28	32	22	28	LV	90	93	84	86	76	72	LV	0.9	0.7	0.5	1.4	1.5	2.1
MT	453	459	461	401	340	263	MT	209	208	207	186	184	177	MT	29.2	29.5	29.6	10.8	9.9	9.1
NL	38	35	39	29	24	15	NL	59	58	62	49	43	36	NL	0.9	1.1	1.1	2.2	1.9	0.7
PL	462	452	465	437	313	244	PL	161	163	162	161	152	157	PL	28.7	26.1	24.7	23.6	16.2	14.1
PT	402	382	361	370	186	63	PT	197	199	204	187	143	122	PT	13.5	14.5	15.6	14.1	10.1	3.5
RO	1057	1100	1166	914	965	999	RO	201	202	208	176	181	162	RO	55.9	56.4	51.3	43.9	43.8	41.3
SE	47	42	39	15	16	17	SE	55	54	53	39	43	49	SE	7.5	7.5	3.7	3.8	7.7	3.6
SI	666	530	145	129	100	100	SI	206	203	203	185	158	162	SI	38.6	12.8	4.9	6.3	4.6	5.0
SK	418	407	424	368	343	388	SK	169	172	163	156	133	144	SK	48.7	73.9	52.7	9.6	7.7	8.4
UK	219	177	155	126	93	75	UK	152	156	162	150	109	103	UK	5.3	5.4	6.0	4.8	4.1	3.2
EU-27	**303**	**284**	**272**	**249**	**179**	**155**	**EU-27**	**122**	**120**	**118**	**113**	**96**	**92**	**EU-27**	**16.2**	**13.9**	**12.3**	**11.8**	**8.8**	**7.4**

Note 1: Pollutant specific colour shading represents the value of the EF in a linear continuum from the highest value (represented by darkest red) to the lowest value (darkest green).

Table 4.13 clearly shows reductions across the EU and for many Member States in the emission factors for all three pollutants over the two reporting periods 2004 to 2006 and from 2007 to 2009. However, between Member States there is considerable variation in absolute emission factors.

The **SO_2** emission factors vary considerably both among Member States and over time for some Member States. The five Member States with the highest SO_2 emission factors in 2009 are (highest first) Bulgaria, Romania, Greece, Slovakia and Estonia. The data show that the average SO_2 emission factor for the EU dropped by 49% from 2004 to 2009 from 303g/GJ to 155g/GJ, with the most significant drop from 2007 to 2008. The impact of the introduction of the LCP Directive ELVs for existing plants in 2008 is manifest for many Member States by a significant reduction in the EF of 2008 compared to 2007.

The **NO_X** emission factors for Member States are spread over a narrower range than for SO_2. The five Member States with the highest NO_X emission factors in 2009 are (highest first) Bulgaria, Malta, Greece, Slovenia and Romania. The data show that the average NO_X emission factor for the EU dropped by around a quarter from 2004 to 2009 from 122g/GJ to 92g/GJ, with the most significant drop from 2007 to 2008 (from 113g/GJ to 96g/GJ, a 15% fall), corresponding with the coming into force of LCP Directive obligations for existing plants. Large further reductions in NO_X emission levels are expected in advance of the introduction of the IE Directive ELVs from 2016 (which are the same as the LCP Directive would have introduced for large solid fuel fired plant from 2016).

The five Member States with highest **dust** emission factors in 2009 are (highest first) Bulgaria, Greece, Romania, Estonia and Cyprus. The data show that the average EU dust emission factor dropped by over half from 2004 to 2009 from 16.2g/GJ to 7.4g/GJ.

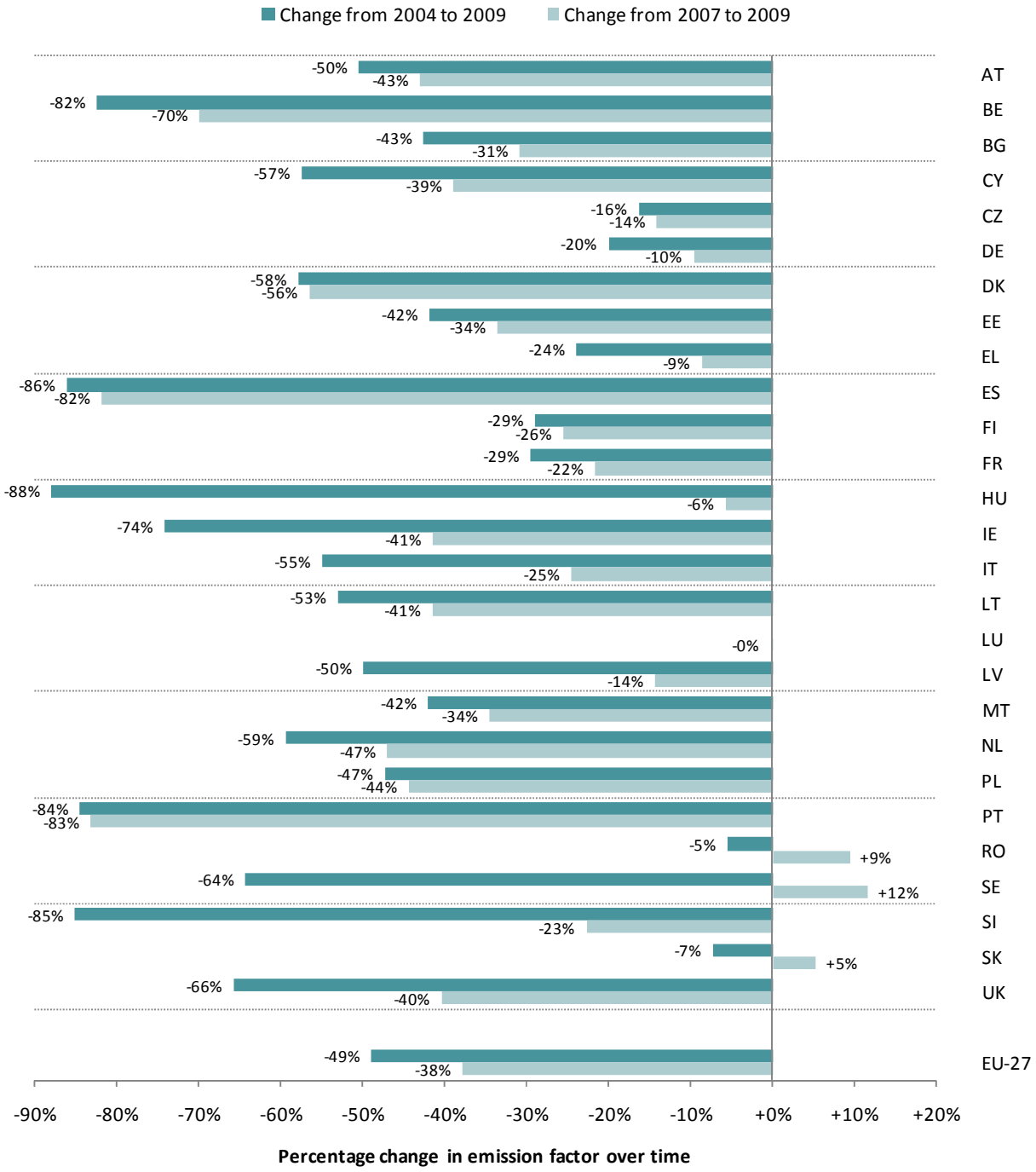
The reductions in SO_2 and dust emission factors (and to a lesser extent NO_X) over time are likely to be strongly linked to two changes: (i) shifts away from high sulphur fuels such as coal and lignite to cleaner burning fuels such as natural gas, and (ii) the installation of abatement measures to directly reduce such emissions (either by installing scrubbing equipment or through using lower sulphur content fuels). Due to the simple nature of SO_2 emissions arising from the sulphur content of certain fuels, it is possible to produce a basic estimate of the proportion of the calculated reduction in SO_2 emission factor that could be attributed each of these two changes. With the assumption that SO_2 emissions arise solely from combustion of 'other solid fuels' and liquid fuels[10], a revised SO_2 emission factor calculated from the total SO_2 emissions divided by the energy input from only other solid and liquid fuels decreases between 2007 and 2009 by 34%. This decrease compares to the reduction of total SO_2 emission factor of 38%, which suggests that most of the reduction in SO_2 emission factor over the period 2007 to 2009 is due to the LCPs that used other solid fuels and/or liquid fuels in 2007 having either switched to lower sulphur solid/liquid fuels, or having fitted abatement equipment to scrub the SO_2 emissions over the period 2007 to 2009.

To show more clearly the relative change in Member State (and total EU) emission factors over the reporting period, and the extended period from 2004 to 2009, the percentage change in EF has been plotted for SO_2, NO_X and dust in Figure 4.19, Figure 4.20 and Figure 4.21, respectively. These percentage changes can be either positive or

[10] This assumes that gaseous fuels other than natural gas have no sulphur content. In practice some gaseous fuels can contain non-negligible levels of sulphur – such as coke oven gas used in steelworks – but the quantities of such gases used is small.

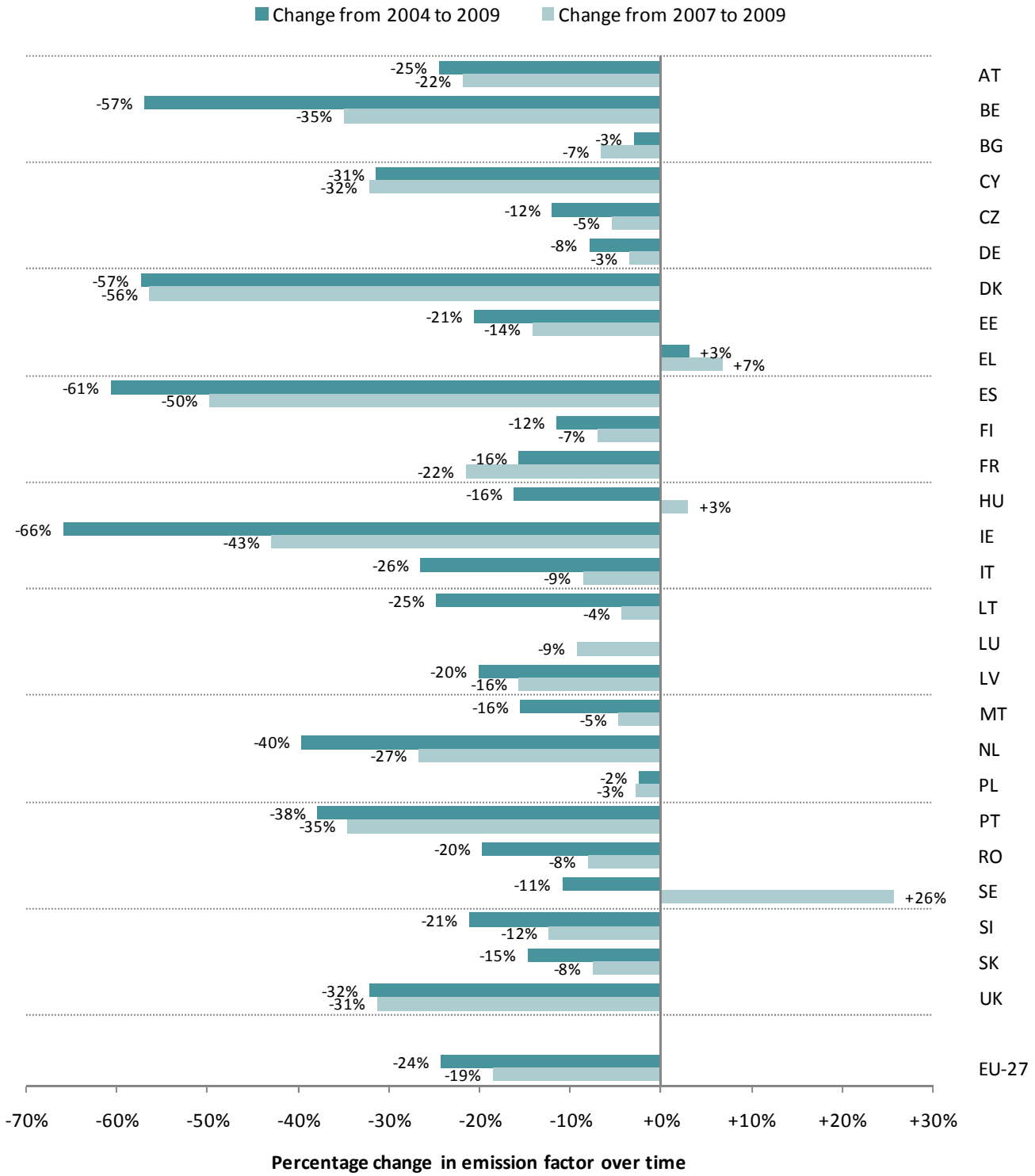
negative: negative values indicate decreasing LCP emissions per unit of energy input over time; positive values indicate deteriorating environmental performance over time.

Figure 4.19 Change in SO_2 emission factors over time



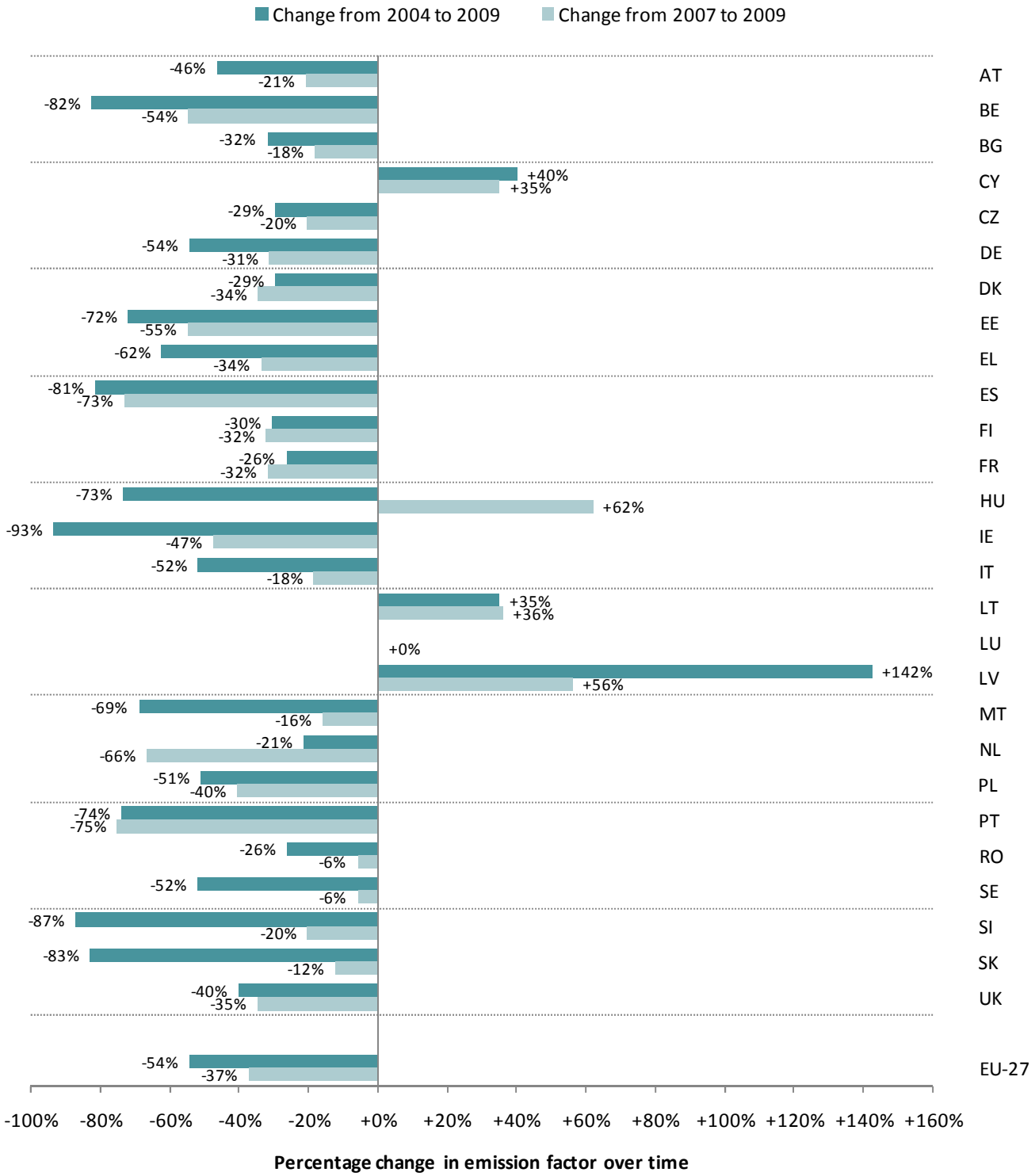
Negative values indicate environmental performance improvement over time; positive values indicate increasing LCP SO_2 emissions per unit energy input.

Figure 4.20 Change in NO_X emission factors over time



Negative values indicate environmental performance improvement over time; positive values indicate increasing LCP NO_X emissions per unit energy input.

Figure 4.21 Change in dust emission factors over time



Negative values indicate environmental performance improvement over time; positive values indicate increasing LCP dust emissions per unit energy input.

Figure 4.19 confirms more clearly that almost all Member States have decreasing **SO_2** emission factors over the reporting period 2007 to 2009 (with the exception of Romania, Sweden and Slovakia which show small increases) and all have decreasing factors over the extended period 2004 to 2009. Many Member States show significant percentage decreases with five Member States (Belgium, Hungary, Portugal, Slovenia and Spain) reporting reductions of over 80% in their average SO_2 emission factor between 2004 and 2009, and two of these Member States have reported these significant percentage decreases in the 2007 to 2009 reporting period (Portugal and Spain). The significant percentage decreases are consistent with the ELVs (or NERP) coming into force for existing plant from 1 January 2008. Only three Member States have reported data that shows increases in the SO_2 emission factor during the 2007 to 2009 reporting period (Romania, Slovakia and Sweden), and all of these increases were less than 15%.

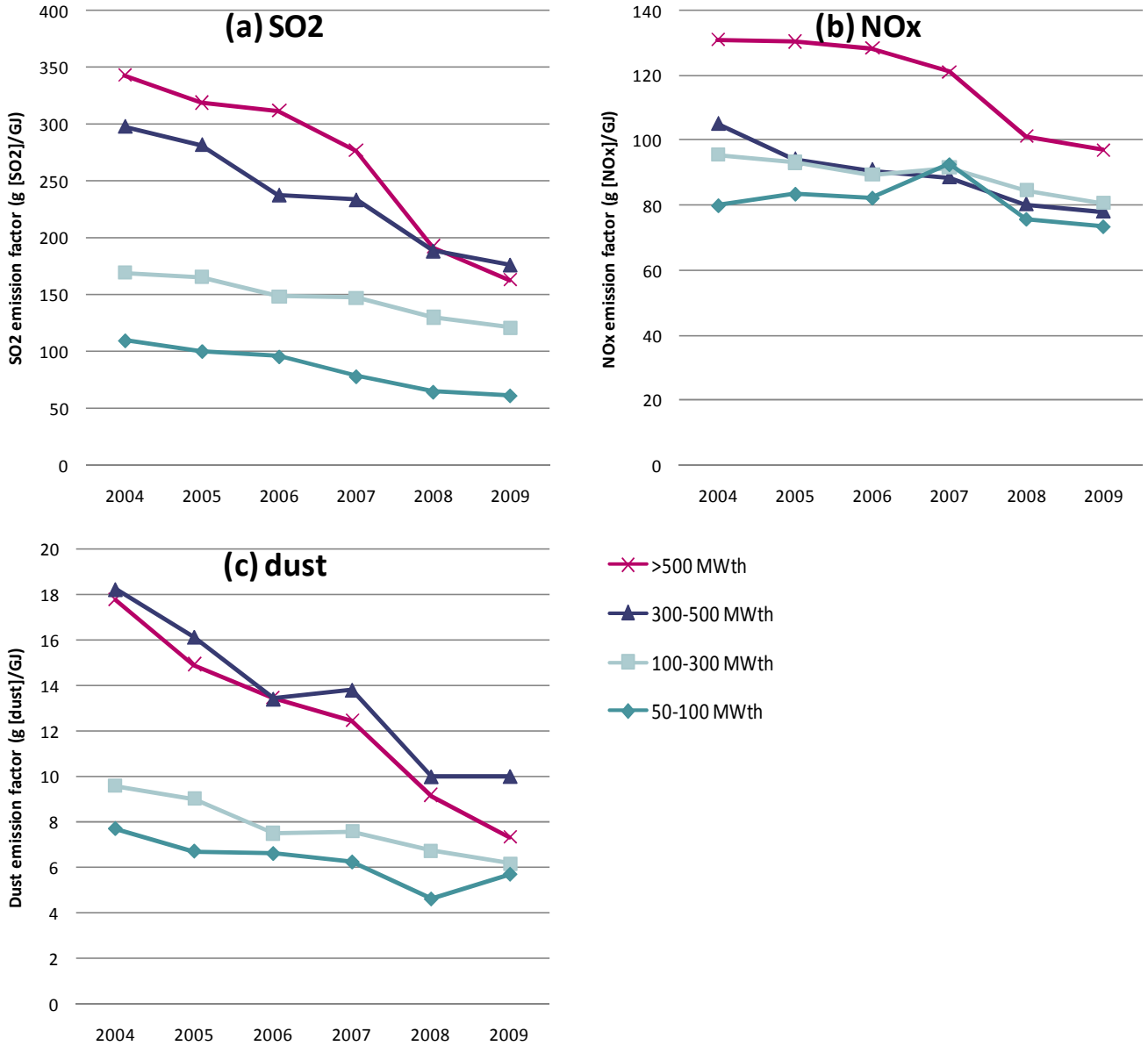
Figure 4.20 indicates that the **NO_X** emission factor has followed a declining trend for most Member States over the period 2004 to 2009, and that most of this decline occurred in the reporting period 2007 to 2009. Some Member States show significant declines in the NO_X EF over the period 2007 to 2009, in particular Cyprus, Denmark, Ireland, Portugal, Spain and the UK. Three Member States had an increase in their LCP NO_X emission factor over the 2007 to 2009 reporting period (Greece by 7%, Hungary by 3% and Sweden by 26%), although two of these Member States have emission factors below the EU average (Hungary and Sweden). Greece's NO_X emission factor also increased over the entire period 2004 to 2009 by 3% which is significant as in 2009 it had the third highest emission factor among all Member States.

Figure 4.21 shows much greater variation among Member States in the trends of **dust** emission factors over the period 2004 to 2009 and during the reporting period from 2007 to 2009. Almost all Member States show declines in the dust emission factor over the period 2007 to 2009, with the most significant percentage reductions occurring in Estonia, Ireland, Poland, Portugal and Spain. Four Member States (Cyprus, Hungary, Lithuania and Latvia) have increasing dust emission factors over the period, and for two of these (Hungary and Latvia), the increase is significant (+60%). It is not clear what may have caused these sharp percentage increases.

Emission factors split by capacity class

An EU-level analysis of the emission factors for each pollutant, split by capacity class, is shown in Figure 4.22. This plot includes data from both reporting periods 2004 to 2006 and 2007 to 2009. Each of the plots in this figure shows that, in general, LCPs in smaller capacity classes have lower pollutant emission factors than those of higher rated thermal input capacity classes (exception: average dust EF from 300-500 MW_{th} exceeds that for the >500 MW_{th} capacity class). Although this may seem counterintuitive when considering that the ELVs set out in the LCP Directive are generally more stringent for LCPs of higher rated thermal input, this could reflect the higher proportion of LCPs in the smaller capacity classes that are fired by natural gas (rather than solid fuels). Averaged over the 2007 to 2009 reporting period the other solid fuel fraction of total energy input rises from 10% for the 50-100MW_{th} capacity class, through 17% for 100-300MW and 25% for 300-500MW, to 63% for the class >500MW_{th}.

Figure 4.22 (a) SO_2 (b) NO_X (c) dust emission factors for the EU from 2004 to 2009, split by capacity class.



Plot (a) SO_2 of Figure 4.22 shows that the 2004 to 2006 trend of declining SO_2 emission factor across the EU continues from 2007 to 2009. All capacity classes demonstrate this decline, with the most marked decrease in emission factors evident for the largest LCPs (rated thermal input greater than 500 MW), which is to be expected considering the abatement measures typically installed (e.g. FGD) to comply with the ELVs for existing plants in the LCP Directive from 1 January 2008.

Plot (b) NO_X of Figure 4.22 shows a declining trend in NO_X emission factor over the entire period 2004 to 2009 for the two larger capacity classes only. Similarly to SO_2, there is a marked decrease in the NO_X emission factor for LCPs >500MW_{th} from 2007 to 2008. For the two smaller capacity classes, there is a rise in the EU NO_X average emission factors between 2006 and 2007, followed by declines from 2007 to 2009. A possible cause of the rise

between 2006 and 2007 may be due to two LCPs (one 50-100 MW_{th} LCP in the UK, and one 100-300 MW_{th} LCP in Spain) with high emission factors and emissions that are skewing the total results.

Plot (c) dust of Figure 4.22 shows, in general, that the declining trend in the dust emission factor across the EU over the period 2004 to 2006 continued to 2009 for all capacity classes. The exceptions to this are slight rises in the EF between 2006 and 2007 for capacity classes 100-300 and 300-500 MW_{th}, no change to the EF between 2008 and 2009 for the 300-500 MW_{th} capacity class, and a marked increase between 2008 and 2009 for the smallest capacity class. It is unclear what is causing this latter marked increase.

Table 4.14 on the following page presents SO_2, NO_X and dust emission factors (mass of pollutant emitted per unit of energy input) for each capacity class within each Member State, expressed as an average of the reporting period 2007 to 2009. As per Table 4.13, colour shading is applied to more easily highlight those Member States with higher and lower average emission factors. It is important to re-iterate that inventory entries with errors in either energy input or emissions data which have not been corrected could skew the results.

Table 4.14 Calculated annual average (2007 to 2009) Member State and EU SO_2, NO_X and dust emission factors for each capacity class (Note 1)

Member State	SO_2 emission factor (g[SO_2]/GJ)					Member State	NO_X emission factor (g[NO_X]/GJ)					Member State	Dust emission factor (g[dust]/GJ)				
	50-100	100-300	300-500	>500	Total		50-100	100-300	300-500	>500	Total		50-100	100-300	300-500	>500	Total
AT	14	26	31	10	19	AT	48	51	53	35	45	AT	2.3	2.2	1.9	2.3	2.2
BE	33	45	55	51	49	BE	66	59	63	60	61	BE	7.2	2.6	2.7	3.1	3.2
BG	144	2448	716	1842	1823	BG	71	220	260	193	198	BG	4.1	76.0	58.8	54.4	56.1
CY	-	394	231	437	402	CY	-	123	87	149	136	CY	-	19.1	14.4	11.4	13.2
CZ	345	273	280	162	196	CZ	127	123	112	158	147	CZ	7.2	5.6	6.7	5.8	5.9
DE	40	50	36	44	44	DE	68	61	48	61	61	DE	1.1	1.4	1.2	1.7	1.6
DK	105	51	23	25	28	DK	77	86	107	73	75	DK	6.4	6.1	7.2	2.8	3.3
EE	12	904	0	495	472	EE	33	82	37	95	89	EE	18.6	202.6	0.0	60.7	63.8
EL	328	281	1828	515	666	EL	128	281	94	168	165	EL	18.4	17.5	115.2	49.4	54.9
ES	212	311	555	303	320	ES	83	161	196	136	141	ES	7.6	10.0	23.2	10.5	11.3
FI	63	68	89	67	72	FI	101	91	139	100	104	FI	8.5	5.2	8.3	4.4	6.0
FR	130	204	205	263	231	FR	98	118	102	156	135	FR	7.4	12.4	11.5	16.0	13.9
HU	5	45	38	67	56	HU	60	90	63	79	77	HU	1.7	5.5	3.4	1.9	2.7
IE	0	54	87	150	127	IE	59	132	73	117	108	IE	0.0	2.7	6.3	7.6	6.8
IT	37	77	109	40	56	IT	93	72	76	36	49	IT	2.0	2.2	3.7	1.7	2.1
LT	32	70	149	130	119	LT	72	56	79	64	66	LT	4.2	6.7	10.2	3.4	5.0
LU	-	-	0	-	0	LU	-	-	30	-	30	LU	-	-	0.0	-	0.0
LV	129	30	2	6	27	LV	86	59	78	98	79	LV	8.4	1.9	0.0	0.1	1.6
MT	-	272	455	-	336	MT	-	174	198	-	182	MT	-	9.5	10.8	-	10.0
NL	34	56	2	14	23	NL	44	53	38	40	43	NL	4.6	3.6	0.1	0.7	1.6
PL	218	279	414	330	333	PL	88	113	157	158	157	PL	55.7	27.3	37.8	16.6	18.0
PT	12	399	64	222	209	PT	56	153	80	170	151	PT	22.2	27.7	5.2	6.2	9.4
RO	42	370	520	1072	957	RO	95	118	87	188	173	RO	3.7	24.3	26.2	47.2	43.1
SE	18	15	8	25	16	SE	59	51	27	33	43	SE	3.8	7.1	4.1	4.0	5.3
SI	60	151	147	96	109	SI	189	108	158	174	168	SI	6.4	4.9	6.8	4.7	5.3
SK	23	276	113	475	365	SK	112	107	112	164	144	SK	3.5	8.5	7.1	9.4	8.5
UK	57	53	27	117	99	UK	120	67	41	140	121	UK	4.9	3.6	1.1	4.5	4.1
EU-27	**68**	**133**	**200**	**213**	**196**	**EU-27**	**81**	**86**	**83**	**107**	**101**	**EU-27**	**5.6**	**6.8**	**11.4**	**9.8**	**9.4**

Note 1: Pollutant specific colour shading represents the value of the EF in a linear continuum from the highest value (represented by darkest red) to the lowest value (darkest green).

4.3 LCPs with highest energy input, emissions and emission factors

This section presents data that is not aggregated to the Member State or EU-27 level, instead focussing on 'top ten' lists of LCPs in terms of their reported energy input, reported emissions, and calculated emission factors.

4.3.1 LCPs with highest energy input

Table 4.15 lists the ten LCPs with the highest ranked average annual energy input over the period 2007 to 2009. The rank from the similar analysis over the 2004 to 2006 period is shown alongside and is unchanged from the previous reporting period. The ten consist entirely of LCPs from Germany (6), Poland (3) and the UK (1). The LCPs are all primarily fired with other solid fuels (eight of the ten LCPs have greater than 99% of their total energy input from other solid fuels) and none of them are refinery LCPs. The total average annual energy input from the ten LCPs sums to 1,792 PJ, which represents 10.1% of the total energy input to all EU LCPs.

It is important to note that the ranking of this list may be impacted by the stack configuration of installations as well as by the aggregation level used for reporting emissions by each Member State (see Section 3.4). It is understood that Germany and the UK have reported at the stack level, whilst Poland has reported at the boiler level for existing plant and at the stack level for new plants.

Table 4.15 The ten ranked LCPs with highest annual energy input (average 2007-2009)

Rank (04-06 rank)	Member State	LCP name, location	LCP capacity (MW_{th})	Annual energy input (average 2007-2009) (PJ)
1. (1)	PL	BOT Elektrownia Bełchatów S.A., Rogowiec	12,600	261
2. (2)	DE	KW Niederaußem (A26), Bergheim	9,742	243
3. (3)	UK	Drax Power Station, Selby	10,000	236
4. (4)	DE	KW Jänschwalde (A431), Peitz	9,144	214
5. (5)	DE	KW Weisweiler (A175), Eschweiler	8,443	178
6. (6)	DE	KW Frimmersdorf (A218), Grevenbroich	6,665	159
7. (7)	DE	KW Neurath (A219), Grevenbroich	5,974	155
8. (8)	PL	BOT Elektrownia Turów S.A., Bogatynia	5,607	118
9. (9)	DE	KW Lippendorf (A69), Böhlen	4,800	117
10. (10)	PL	Elektrownia "Kozienice" S.A., Kozienice	6,812	112
Subtotal				**1,792 (10.1% of EU-27 total)**

4.3.2 LCPs with highest biomass energy input

The ten LCPs with highest average annual biomass energy input over the reporting period are shown in Table 4.16. Only two of the LCPs in the table (ranked 1st and 3rd) were in the comparable 'top ten' list in the 2004 to 2006 reporting period. Table 4.16 includes a number of large LCPs, which contrasts significantly with the typical capacity of LCPs that made up the top ten list for the 2004 to 2006 reporting period. The average rated thermal input of the top ten plants for 2007 to 2009 is 1,912 MW_{th} compared to a value of 283MW_{th} for the 2004 to 2006 period. Of the plants included in Table 4.16, all except one are either pure biomass plants (combusting >98% biomass) or have reported increasing % biomass fuel input over the period 2004 to 2009. Those plants reporting an increase in the proportion of biomass fuel input over time appear to have replaced other solid fuels with biomass.

Table 4.16 The ten ranked LCPs with highest annual biomass energy input (average 2007-2009)

Rank	Member State	LCP name, location	LCP capacity (MW_{th})	Annual biomass energy input (average 2007-2009) (PJ)
1. (1)	DE	IKW Arneburg (A13), Arneburg	660	14.3
2. (41)	SE	Korsnäs AB, Korsnäsverken, Gävle	396	11.4
3. (2)	DE	IKW Blankenstein (A62), Blankenstein	359	8.0
4. (-)	NL	Essent Energie Productie BV (Amer), Installation 45371, Geertruidenberg	1,420	7.8
5. (99)	BE	Electrabel Centrale Rodenhuize Desteldonk	745	6.1
6. (20)	BE	Centrale Elec. Electrabel Awirs t4, Flemalle	330	5.7
7. (34)	PL	Elektrownia Połaniec Spółka Akcyjna - Grupa Electrabel Polska, Połaniec	4,769	5.5
8. (112)	SE	Norrsundets bruk, Gävle	275	5.5
9. (82)	UK	Drax Power Station, Selby	10,000	5.5
10. (92)	SE	Karlsborgs bruk, Kalix	169	5.3
Subtotal				**75.2 (16% of EU-27 biomass total)**

The total number of reported biomass plants (combusting >95% biomass energy input) is 64 in 2007, rising to 87 in 2009, whilst the total number of LCPs reported to use any amount of biomass is approximately five times higher: 358 in 2007 rising to 412 in 2009. The total biomass energy input of the ten plants reported in Table 4.16 makes up almost half (47%) of the total biomass input of LCPs firing biomass only.

4.3.3 LCPs with highest emissions

This section identifies the ten LCPs with highest total emissions for each pollutant in 2009. Each of the three tables also indicates for each LCP listed whether the LCP is 'opted out' according to Article 4(4) of the LCP Directive, or if the LCP is subject to any derogations listed in the Treaties of Accession. Where necessary, the tables' footnotes list the additional LCPs that would be appended to a 'top ten' list that excluded LCPs which are 'opted out' or which have Accession Treaty derogations.

LCPs with highest SO_2 emissions

The ten LCPs with highest SO_2 emissions in 2009 are presented in Table 4.17. None of the LCPs listed in this table are in refineries (the refinery LCP with highest SO_2 emissions in 2009 emitted 18kt SO_2 and is ranked 29th). The primary fuel type of all but one of the LCPs is 'other solid fuels'. One LCP in this list is also listed in the 'top ten' list for energy input (Table 4.15). The total SO_2 emissions in 2009 from these ten LCPs sum to 691 kt/y, which represents 27% of the 2,564 kt/y emitted by all EU LCPs in 2009. Beyond the 'top ten' percentiles, in 2009 50% of total EU SO_2 emissions from reported LCPs were caused by 1% of plants and 90% of total EU SO_2 emissions from reported LCPs were caused by 10% of plants.

Table 4.17 The ten LCPs with highest SO_2 emissions in 2009 in the EU (Note 1)

Rank (2004-06 rank)	Member State	LCP name, location	Rated thermal input (MW_{th})	SO_2 emissions in 2009 (kt)	Remarks
1. (1)	BG	TPP "Maritsa Iztok 2", Kovachevo	4,312	183	
2. (6)	EL	PPC S.A. - Megalopoli ST III, Arcadia	839	78	
3. (9)	BG	TPP "Brikel", Gulubovo	1,020	76	Opted out
4. (8)	BG	TPP "Bobov dol", Golemo selo	1,950	57	Accession treaty derogation for SO_2 at unit 2 until 31.12.2011 and at unit 3 until 31.12.2014
5. (19)	EL	PPC S.A. - Megalopoli ST I, Arcadia	360	53	Opted out
6. (15)	EL	PPC S.A. - Megalopoli ST II, Arcadia	360	52	Opted out
7. (5)	PL	BOT Elektrownia Bełchatów S.A., Bełchatów	12,600	51	Accession treaty derogation for SO_2 until 31.12.2015
8. (14)	RO	S.C. Complexul Energetic Turceni S.A.nr. 2, Turceni	1,578	51	Accession treaty derogation for SO_2 until 31.12.2010
9. (22)	RO	S.C. Complexul Energetic Craiova S.E. Isalnita,	1,892	45	Accession treaty derogation for SO_2 until 31.12.2012
10. (13)	RO	S.C. Complexul Energetic Rovinari S.A. nr. 1, Rovinari	1,756	44	Accession treaty derogation for SO_2 until 31.12.2013
Subtotal				**691 kt (27% of EU total)**	

Note 1: A top ten list of non-opted out LCPs without Accession Treaty derogations would exclude the LCPs ranked 3, 4, 5, 6, 7, 8, 9 and 10 above and instead append the following LCPs:

15.	UK	Longannet Power Station, Scotland	32 kt SO_2
19.	UK	Drax Power Station, Selby	27 kt SO_2
20.	EL	PPC S.A. - Ag. Dimitrios ST III-IV, Kozani	25 kt SO_2
21.	EL	PPC S.A. - Ag. Dimitrios ST I-II, Kozani	23 kt SO_2
23.	DE	KW Jänschwalde (A431), Peitz	21 kt SO_2
25.	EL	PPC S.A. - Amyntaio ST I-II, Florina	20 kt SO_2
36.	DE	KW Lippendorf (A69), Böhlen	14 kt SO_2
37.	ES	CT Litoral G 2, Carboneras-Almeria	14 kt SO_2

LCPs with highest NO_X emissions

The ten LCPs with highest NO_X emissions in 2009 are presented in Table 4.18. None of the LCPs listed in this table are refinery LCPs; all are in the electricity supply industry (where the sector is known). The primary fuel type of all these LCPs is 'other solid fuels'. Five LCPs in this list are also listed in the 'top ten' list for energy input (Table 4.15). None of these ten LCPs are 'opted out' or have Accession Treaty derogations. The total NO_X emissions in 2009 from these ten LCPs sum to 218 kt, which represents 14% of the 1,525 kt emitted by all EU LCPs in 2009. Beyond the 'top ten' percentiles, in 2009 50% of total EU NO_X emissions from reported LCPs were caused by 3% of plants and 90% of total EU NO_X emissions from reported LCPs were caused by 27% of plants.

Table 4.18 The ten LCPs with highest NO_X emissions in 2009 in the EU.

Rank (2004-06 rank)	Member State	LCP name, location	Rated thermal input (MW_{th})	NO_X emissions in 2009 (kt)
1. (2)	PL	BOT Elektrownia Bełchatów S.A., Bełchatów	12,600	42.9
2. (1)	UK	Drax Power Station, Selby	10,000	38.2
3. (5)	PL	Elektrownia "Kozienice" S.A., Kozienice	6,812	21.2
4. (4)	UK	Aberthaw Power Station, Wales	4,500	19.5
5. (6)	UK	Cottam Power Station, England	2,000	18.2
6. (12)	DE	KW Jänschwalde (A431), Peitz	9,144	18.2
7. (17)	DE	KW Niederaußem (A26), Bergheim	9,742	15.4
8. (13)	PL	Elektrownia Rybnik S.A., Rybnik	4,712	15.1
9. (10)	UK	Longannet Power Station, Scotland	6,400	15.0
10. (26)	CZ	CEZ, a.s. - Elektrarna Prunerov 2, Kadan	2,956	14.4
Subtotal				**218 kt (14% of EU total)**

LCPs with highest dust emissions

The ten LCPs with highest dust emissions in 2009 are presented in Table 4.19. None of the LCPs listed in this table are refinery LCPs; all are in the electricity supply industry or are CHP (where the sector is known). The primary fuel type of all these LCPs is 'other solid fuels'. None of the LCPs in this list are listed in the 'top ten' list for energy input (Table 4.15). The total dust emissions from these ten LCPs in 2009 sum to 30 kt, which represents 25% of the 123 kt emitted by all EU LCPs in 2009. Beyond the 'top ten' percentiles, in 2009 50% of total EU dust emissions from reported LCPs were caused by 1% of plants and 90% of total EU dust emissions from reported LCPs were caused by 11% of plants.

Table 4.19 The ten LCPs with highest dust emissions in 2009 in the EU (Note 1).

Rank (2004-06 rank)	Member State	LCP name, location	Rated thermal input (MW_{th})	Dust emissions in 2009 (kt)	Remarks
1. (10)	BG	TPP "Maritsa Iztok 2", Kovachevo	4,312	5.25	
2. (13)	EL	PPC S.A. - Megalopoli ST II, Arcadia	360	3.59	Opted out
3. (33)	EL	PPC S.A. - Ptolemaida ST IV, Kozani	763	3.52	
4. (18)	EL	PPC S.A. - Megalopoli ST I, Arcadia	360	3.12	Opted out
5. (8)	EE	Narva Elektrijaamad AS, Eesti Elektrijaam, Ida-Virumaa	4,400	2.84	Accession treaty derogation for dust until 31.12.2015
6. (23)	PL	BOT Elektrownia Turów S.A. , Bogatynia	5,607	2.71	Opted out
7. (27)	RO	S.C. Electrocentrale Oradea S.A nr. 2, Oradea	869	2.61	Opted out
8. (25)	RO	S.C. Electrocentrale Deva S.A. nr.2, Mintia	1,056	2.38	Accession treaty derogation for dust until 31.12.2011
9. (29)	BG	TPP "Brikel", Gulubovo	1,020	2.31	Opted out
10. (22)	BG	TPP "Bobov dol", Golemo selo	1,950	2.12	Accession treaty derogation for dust until 31.12.2011 for unit 2 and until 31.12.2014 for unit 3
Subtotal				**30 kt (25% of EU total)**	

Note 1: A top ten list of non-opted out LCPs without Accession Treaty derogations would exclude the LCPs ranked 2, 4, 5, 6, 7, 8, 9 and 10 above and instead append the following LCPs:

11.	EL	PPC S.A. - Kardia ST I, Kozani	1.94	kt dust
12.	EL	PPC S.A. - Ptolemaida ST I-II, Ptolemaida, Kozani	1.88	kt dust
13.	PL	BOT Elektrownia Bełchatów S.A., Rogowiec	1.81	kt dust
15.	EL	PPC S.A. - Kardia ST II, Kozani	1.60	kt dust
17.	EL	PPC S.A. - Amyntaio ST I-II, Amyntaio, Florina	1.54	kt dust
18.	BG	TPP "Maritsa Iztok 3", Mednikarovo	1.52	kt dust
20.	RO	S.C. Complexul Energetic Craiova S.E. Isalnita, Isalnita	1.21	kt dust
21.	PL	Elektrownia Adamow, Turek	1.17	kt dust

4.3.4 LCPs with highest emission factors

Emission factors for each pollutant in each inventory year for each LCP have been calculated from the reported inventories. Very high or low emission factors can indicate possible erroneous energy input or emissions data, for example order of magnitude errors. This review was carried out as part of the data gap filling process, but some data gaps remain (as set out in Section 3.4). It should be noted in particular that according to data reported for one site comprising four LCPs in the Netherlands (Shell Nederland Chemie B.V., Moerdijk), which are known to be erroneous, these LCPs would otherwise appear at the top of the 'top ten' lists presented in this section. The operator of this site has not provided correct energy data to allow accurate emission factors to be calculated.

Similarly to section 4.3.3, the tables of ten LCPs ranked highest in terms of emission factors in this section also indicate for each LCP listed whether it is 'opted out' according to Article 4(4) of the LCP Directive, subject to any derogations listed in the Treaties of Accession or any other applicable remark made by the Member State in the inventory. Where necessary, the table footnotes list the additional LCPs that would be appended to the 'top ten' list if LCPs which are 'opted out' or which have Accession Treaty derogations were excluded.

Table 4.20 lists the ten LCPs in the EU with highest SO_2 emission factors in 2009, as calculated by total mass of pollutant emitted divided by the total energy input. For those plants for which the sector was reported, they are all either in the electricity supply industry or are combined heat and power plants, and six of them are 'opted out' under Article 4(4). All but one of the LCPs are large plants with capacities greater than 300 MW_{th}. All ten LCPs are fired with greater than 95% other solid fuels except the LCP ranked tenth which is fired with around 91% other solid fuels.

Table 4.20 The ten LCPs with highest SO_2 emission factors in the EU in 2009 (Note 1)

Rank (2004-06 rank)	Member State	LCP name, location	Rated thermal input (MW_{th})	SO_2 emission factor in 2009 ($g[SO_2]/GJ$)	Remarks
1. (1)	EL	PPC S.A. - Megalopoli ST I, Arcadia	360	5,655	Opted out
2. (3)	EL	PPC S.A. - Megalopoli ST II, Arcadia	360	5,579	Opted out
3. (5)	BG	TPP "Brikel", Gulubovo	1,020	5,375	Opted out
4. (2)	EL	PPC S.A. - Megalopoli ST III, Arcadia	839	4,997	
5. (9)	BG	TPP "Maritsa 3", Dimitrovgrad	300	4,651	Opted out
6. (10)	BG	TPP "Sliven", Sliven	144	4,443	
7. (7)	ES	C.T. Escucha, Escucha-Teruel	485	3,799	Opted out
8. (13)	SK	Slov.elektrárne, Zemianske Kostoľany ENO Bl. 3,4, Zemianske Kostoľany	872	2,800	Opted out
9. (11)	BG	TPP "Bobov dol", Golemo selo	1,300	2,661	Accession treaty derogation until 31.12.2011 for unit 2 and until 31.12.2014 for unit 3
10. (20)	RO	S.C. Electrocentrale Oradea S.A nr. 2, Oradea	869	2,096	Accession treaty derogation until 31.12.2013

Note 1: A top ten list of non-opted out LCPs without Accession Treaty derogations would append the following LCPs to the LCPs numbered 1, 2, 3, 5, 7, 8, 9 and 10 above:

13.	BG	TPP "Maritsa Iztok 2", Kovachevo	2,041	$g[SO_2]/GJ$
15.	BG	TPP "Republika", Pernik	1,793	$g[SO_2]/GJ$
30.	UK	BASF 3, Seal Sands, Middlesbrough	1,121	$g[SO_2]/GJ$
32.	PL	MEGATEM EC-Lublin Sp. z o.o., Lublin	1,075	$g[SO_2]/GJ$
39.	BG	TPP "Sviloza", Svistov,	925	$g[SO_2]/GJ$
43.	FR	1640, BERRE-L'ETANG	860	$g[SO_2]/GJ$
44.	CZ	Cukrovary a lihovary TDD, a.s., Cukrovar, Ceske Mezirici	819	$g[SO_2]/GJ$
45.	UK	BASF 2, Seal Sands, Middlesbrough	798	$g[SO_2]/GJ$

Table 4.21 lists the ten LCPs in the EU with highest NO_X emission factors in 2009. The 'top two' LCPs in this list appear to have exceedingly high emission factors due to very low usage. The irregular use of a combustion plant, for example a single start-up and shut-down without significant operational time, can lead to high emission factors and bring such plants in to this list even though their total mass emissions are low.

Table 4.21 The ten LCPs with highest NO_X emission factors in the EU in 2009 (Note 1)

Rank (2004-06 rank)	Member State	LCP name, location	Primary fuel type	Rated thermal input (MW_{th})	NO_X emission factor in 2009 (g[NO_X]/GJ)	Remarks
1. (1435)	UK	GTs, National Grid Wisbech	Natural Gas	54	100,000	Plant only operated for a test run in 2009
2. (27)	AT	EVN AG, EVN AG Kraftwerk Theiß Gedersdorf, KWT Maschine 1, Gedersdorf	Natural Gas	245	7,222	Plant only operated for a test run in 2009
3. (1634)	LT	Ateities DB-8, Vilnius	Natural Gas	348	1,723	
4. (2612)	UK	Kemsley CHP A3, Sittingbourne ME10 2TD	Natural Gas	248	1,595	
5. (-)	SE	Bäckelundsverket, Borlänge	Liquid fuels	52	1,304	
6. (4)	UK	BASF 3, BASF, Seal Sands, Middlesbrough	Natural Gas	130	877	
7. (1745)	HU	Nitrogénművek Zrt. II sz. Gyár, Pétfürdő	Natural Gas	160	855	
8. (677)	EL	PPC S.A. - Chania CC, Chania	Liquid fuels	298	842	
9. (1078)	RO	CET Arad Lignit nr.2, Arad	Multi-fuel	160	803	Opted out and Accession treaty derogation for NO_X until 31.12.2011
10. (183)	SE	Gunnarsbo Kraftverk, Östhammar	Liquid fuels	130	709	

Note 1: A top ten list excluding LCPs that are opted out or which have derogations under the Accession Treaty would append the following LCP to the LCP numbered 9 above:

11.	UK	BASF 1, Seal Sands, Middlesbrough	675	g[NO_X]/GJ

Table 4.22 lists the ten LCPs in the EU with highest dust emission factors in 2009. The table contains a number of LCPs that have derogations under the Accession Treaties, or are opted out under Article 4(4) of the LCP Directive.

Table 4.22 The ten LCPs with highest dust emission factors in the EU in 2009 (Note 1)

Rank (2004-06 rank)	Member State	LCP name, location	Primary fuel type	Rated thermal input (MW_{th})	Dust emission factor in 2009 (g[dust]/GJ)	Remarks
1. (4)	EE	Kohtla-Järve Soojus AS, Ahtme Elektrijaam, Kohtla-Järve	Other Solid Fuels	290	1,048	Accession treaty derogation for dust until 31.12.2010; opted out
2. (-)	PL	Ciepłownia Kalisz-Piwonice, Kalisz	Other Solid Fuels	138	461	Accession treaty derogation for dust until 31.12.2017
3. (10)	EL	PPC S.A. Megalopoli ST II, Arcadia	Other Solid Fuels	360	382	Opted out
4. (13)	EL	PPC S.A. Megalopoli ST I Arcadia	Other Solid Fuels	360	330	Opted out
5. (50)	PL	MEGATEM EC-Lublin Sp. z o.o., Lublin	Other Solid Fuels	374	324	
6. (-)	PL	LUBREM SC - Ciepłownia Centralna, Dęblin	Other Solid Fuels	73	272	Accession treaty derogation for dust until 31.12.2017
7. (18)	RO	S.C. Electrocentrale Oradea S.A nr. 2, Oradea	Multi-fuel	869	260	Accession treaty derogation for dust until 31.12.2013
8. (-)	PL	MPEC Leszno - Ciepłownia ZATORZE, Leszno	Other Solid Fuels	78	233	Accession treaty derogation for dust until 31.12.2017
9. (19)	RO	CET Arad Hidrocarburi nr.8, Arad	Liquid fuels	116	196	
10. (14)	EE	Fortum Termest AS, Pärnu	Multi-fuel	70	190	

Note 1: A top ten list of non-opted out LCPs without Accession Treaty derogations would append the following LCPs to the LCPs numbered 1, 2, 3, 4, 6, 7 and 8 above:

11	EL	PPC S.A. - Ptolemaida ST IV, Kozani	187 g[dust]/GJ
12	PL	EC Bydgoszcz I, Bydgoszcz	180 g[dust]/GJ
13	RO	CET Arad Hidrocarburi nr.9, Arad	173 g[dust]/GJ
16	BE	TIENSE SUIKERRAFFINADERIJ, Tienen	162 g[dust]/GJ
23	BG	TPP "Republika", Pernik	142 g[dust]/GJ
24	FR	2050, MIMIZAN	140 g[dust]/GJ
25	EL	PPC S.A. - Ptolemaida ST I-II, Kozani	133 g[dust]/GJ

4.4 Comparison with other emission inventories

4.4.1 E-PRTR

The European Pollutant Release and Transfer Register (E-PRTR)[11] is a Europe-wide register of environmental data on industrial facilities. The online database includes annual data from 2007 onwards. Among the information regarding emissions to air, data on SO_X, NO_X and PM_{10} emissions are included. The database covers a wide range of activities including LCPs. This online database[12] has been used to compare the emissions reported with the results of the LCP inventory. Minor adjustments have been made to the published E-PRTR dataset due to perceived errors.[13]

However, there are a number of differences between the two datasets which may limit the comparison. These are:

i. For emissions of oxides of sulphur, E-PRTR lists SO_X emissions, whereas the LCP inventories list only sulphur dioxide (SO_2) emissions;

ii. For emissions of particulates, E-PRTR lists PM_{10} emissions, whereas the LCP Directive requires the reporting of dust emissions as total suspended particles (PM_{TSP}). E-PRTR reports that, of the total 2009 PM_{10} emissions reported, 61% were derived by calculation, 3% by estimation and 36% by measurement. This suggests that the majority of PM_{10} emissions may be determined from a correction factor applied to PM_{TSP};

iii. E-PRTR includes many more facilities than just combustion plants, and its listed activity most comparable to LCPs is '1.(c) Thermal power stations and other combustion installations' which is within the Energy Sector. This category could include combustion plants which are excluded from the scope of the LCP Directive, such as existing gas turbines, engines, or plants smaller than $50MW_{th}$ as the definition and threshold used in E-PRTR is as per the IPPC Directive, i.e. combustion installations (aggregated at site level) greater than $50MW_{th}$;

iv. LCPs which are part of industrial installations (e.g. iron and steel, refineries, pulp) may have been reported in E-PRTR under an activity other than 1.(c), as E-PRTR reporting is done at the facility level (covering the various plants which are part of that facility). For example, LCPs at refineries may be included under '1.(a) Mineral oil and gas refineries', although such facilities would have to report the secondary E-PRTR activities next to the primary activity. The number of facilities and their emissions reproduced in the tables below are for the main activity 1(c) only;

[11] http://prtr.ec.europa.eu

[12] Version 3.2, published 17 October 2011.

v. The LCP Directive adopts the stack approach (although as noted in Section 3.4, not all Member States have applied this approach consistently). This contrasts with E-PRTR which is compiled at the facility level. A 'facility' refers to industrial complexes with one or more installations on the same site, where one operator carries out one or more E-PRTR Annex I activities. For large power stations, it is not expected that the different approaches used to compile the LCP inventories and E-PRTR should lead to different scopes of emissions. However, for more complex sites, the scope of the two databases may differ; and

vi. Member States are not obliged to report emissions from facilities that do not exceed the emission thresholds applied in E-PRTR. The annual emission thresholds for reporting are 150 t SO_X, 100 t NO_X and 50 t PM_{10}. Therefore, low emission figures of certain pollutants may not be included in E-PRTR whereas no thresholds should have been applied by Member States for compiling the LCP inventories. A second consequence at the facility level in E-PRTR is that emissions may not always be reported for all three LCP Directive pollutants.

Table 4.23 lists the total SO_2, NO_X and dust emissions from each Member State's LCP inventory for 2009 alongside the E-PRTR SO_X, NO_X and PM_{10} emissions totals per Member State for 2009 from activity '1.(c) thermal power stations and other combustion installations'.

The table indicates broad agreement between the two datasets at an EU level. For both sulphur and nitrogen oxides, the E-PRTR totals are on average greater than the LCP inventory totals, which may be explained by point iii. or point v. in the above list (or both). For particulates, the reverse is true – i.e. the LCP inventory of dust emissions is higher on average than the E-PRTR totals of PM_{10} emissions – which would be expected due to the fact that PM_{10} is a fraction of PM_{TSP} (point ii. in the above list).

[13] The adjustments are: (1) to take account of assumed misreporting of Czech Republic SO_2 emissions for facility Teplárna Strakonice, which have been assumed to be 1000 times too large; (2) reinstatement of PM_{10} reports for Hungary and Sweden from the previous published E-PRTR dataset.

Table 4.23 Comparison of LCP inventory emissions with E-PRTR activity 1.(c) emissions (2009)

Member State	Number of LCPs/facilities		Emissions of sulphur oxides (kt)		Emissions of nitrogen oxides (kt)		Emissions of particulates (kt)	
	LCP inventory [LCPs]	E-PRTR 1.(c) [facilities]	LCP inventory [SO_2]	E-PRTR 1.(c) [SO_X]	LCP inventory [NO_X]	E-PRTR 1.(c) [NO_X]	LCP inventory [dust]	E-PRTR 1.(c) [PM_{10}]
AT	101	25	3.1	0.6	8.3	4.1	0.41	0.06
BE	98	37	8.9	3.9	18.3	15.0	0.84	0.2
BG	26	26	426.2	530.4	54.5	51.3	14.40	15.3
CY	16	3	15.5	16.1	5.2	7.4	0.81	0.5
CZ	110	66	122.8	107.0	94.6	84.5	3.54	2.2
DE	598	242	162.8	131.7	227.0	193.1	5.07	3.3
DK	46	28	4.4	2.6	12.3	11.3	0.68	0.2
EE	15	9	43.4	43.3	9.4	8.9	4.80	2.6
EL	60	26	301.9	306.7	80.8	116.6	21.06	17.1
ES	172	137	131.5	104.4	110.7	158.7	5.90	3.0
FI	184	76	21.8	22.0	34.7	31.2	1.55	0.2
FR	241	137	138.7	90.6	83.8	102.7	7.96	3.8
HU	56	33	11.0	10.2	16.2	14.2	0.79	0.1
IE	29	21	17.4	15.6	14.6	13.1	0.90	0.3
IT	426	177	92.3	53.5	89.7	70.1	3.59	1.1
LT	31	11	7.6	1.8	4.9	2.3	0.38	No report
LU	1	1	0.0	No report	0.5	0.5	0.00	No report
LV	24	7	0.7	0.6	1.8	1.5	0.05	No report
MT	10	2	6.4	7.9	4.3	5.3	0.22	0.2
NL	169	62	12.1	5.9	28.1	23.0	0.57	0.2
PL	120	203	384.5	354.3	247.8	234.3	22.22	13.8
PT	33	19	14.0	17.3	27.3	46.8	0.79	0.9
RO	172	31	395.6	393.1	64.0	62.6	16.34	12.7
SE	143	65	3.4	1.2	9.8	3.1	0.73	0.4
SI	18	7	6.1	6.5	10.0	10.9	0.31	0.2
SK	60	29	51.6	43.6	19.2	13.9	1.12	No report
UK	324	227	180.1	160.5	247.1	295.5	7.55	4.8
EU-27	**3,283**	**1,707**	**2,564**	**2,431**	**1,525**	**1,582**	**123**	**83**
Percentage difference from E-PRTR	**+92.3%**		**+5.5%**		**-3.6%**		**+47.4%**	

The data contained in Table 4.23 for emissions of SO_2, NO_X and dust in 2009 are plotted separately in Figure 4.23, Figure 4.24 and Figure 4.25 respectively as absolute emissions. These Figures provide a good indication of how well the two data sources match.

Figure 4.23 shows that many Member States appear to have fairly closely correlating LCP inventory SO_2 emissions and E-PRTR SO_X emissions data. For those Member States with significant SO_2 emissions from LCPs (greater than 100 kt in 2009 LCP inventory), the notable exceptions to this general trend are (i) Bulgaria, for which the LCP inventory is 20% lower than E-PRTR, and (ii) Germany, France and Spain, for which the LCP inventories are 24%, 53% and 26% higher than E-PRTR respectively. Table 4.23 indicates that overall for the EU the LCP inventory-reported SO_2 emissions are 5.5% higher than E-PRTR reported SO_X emissions from activity 1.(c).

Table 4.23 indicates that overall for the EU the LCP inventory-reported NO_X emissions are around 4% lower than E-PRTR NO_X emissions data for 1.(c), and appear well correlated. Table 4.23 indicates that overall for the EU the LCP inventory-reported NO_X emissions are slightly lower than E-PRTR reported NO_X emissions from activity 1.(c), but Figure 4.24 shows that eighteen Member States (including many smaller emitting Member States) report higher NO_X emissions from the LCP inventory than E-PRTR.

Table 4.23 indicates that overall for the EU the LCP inventory-reported dust emissions are around 47% higher than E-PRTR PM_{10} emissions data for 1.(c). There are more significant differences between the two inventories for some Member States, including three Member States (Austria, Finland and Hungary) for which the LCP inventory dust emissions are more than a factor of five times higher than the E-PRTR PM_{10} emissions. For the Member State with the highest dust emissions (Poland), the LCP inventory dust emissions are over 60% higher than the E-PRTR PM_{10} emissions. There are only two Member States which have reported lower LCP inventory dust emissions than E-PRTR PM_{10} emissions: Bulgaria (6% lower) and Portugal (12% lower).

Figure 4.23 2009 SO_X emissions from E-PRTR and SO_2 emissions from the LCP inventory for each Member State

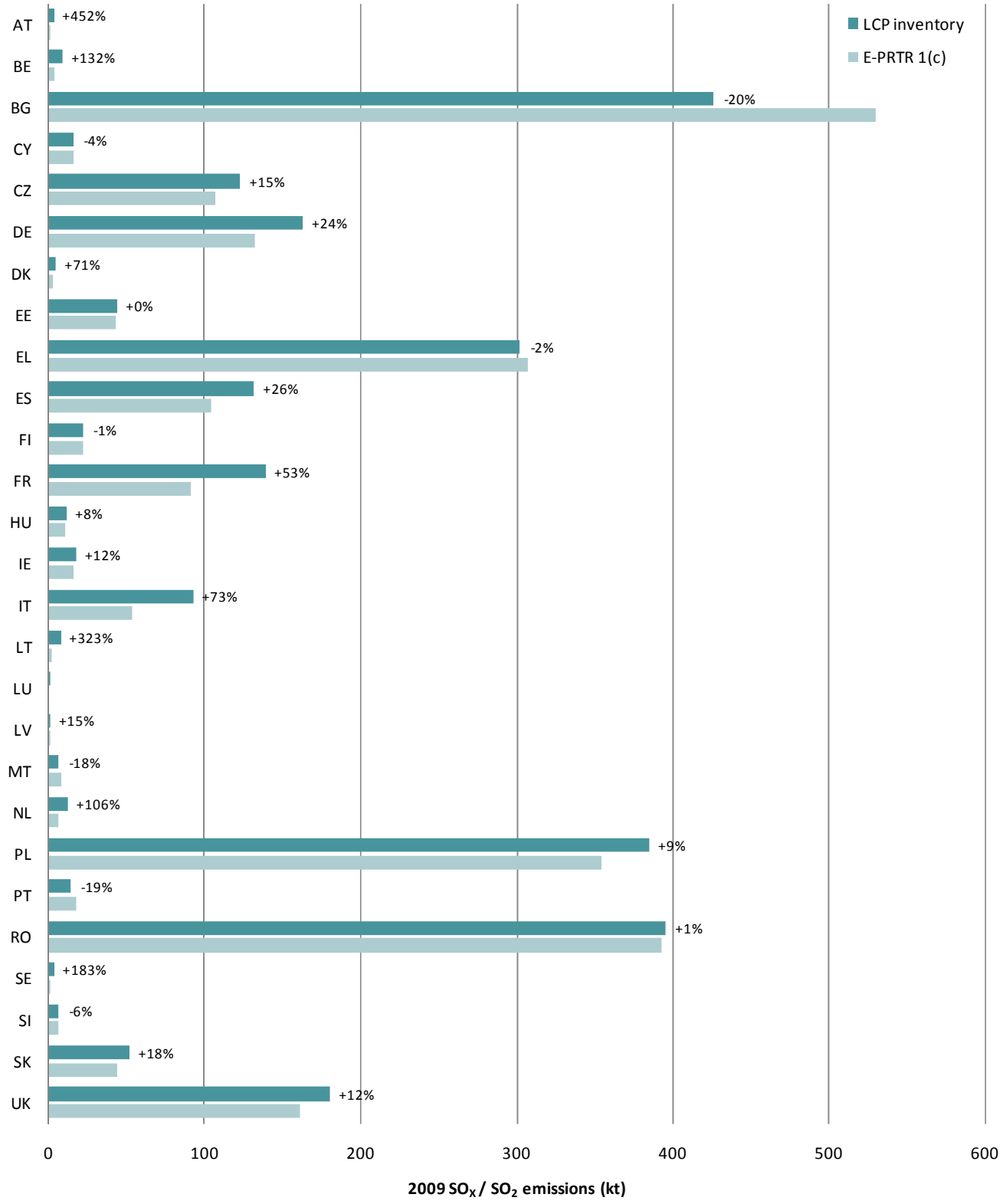


Figure 4.24 2009 NO_X emissions from E-PRTR and the LCP inventory for each Member State

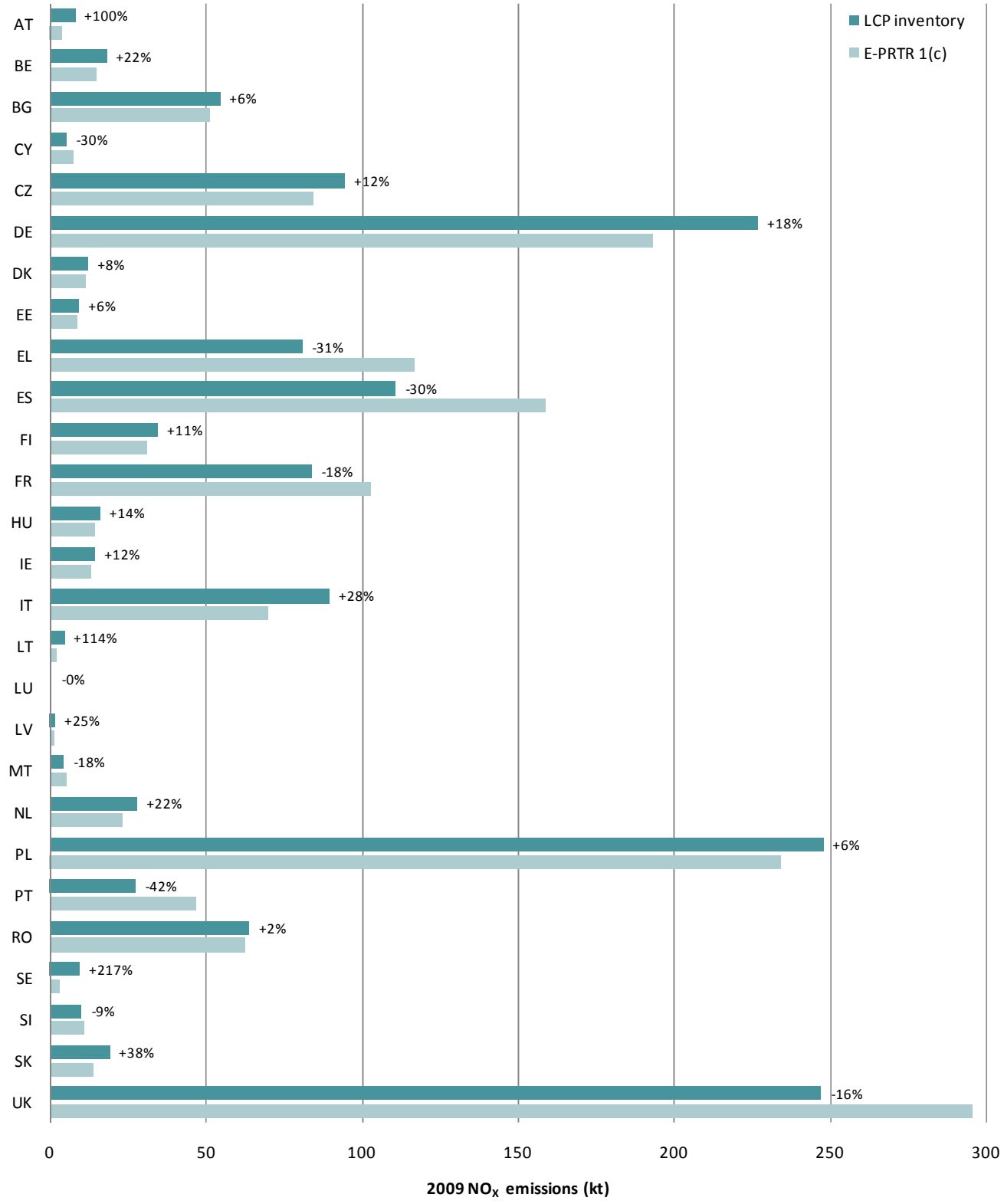
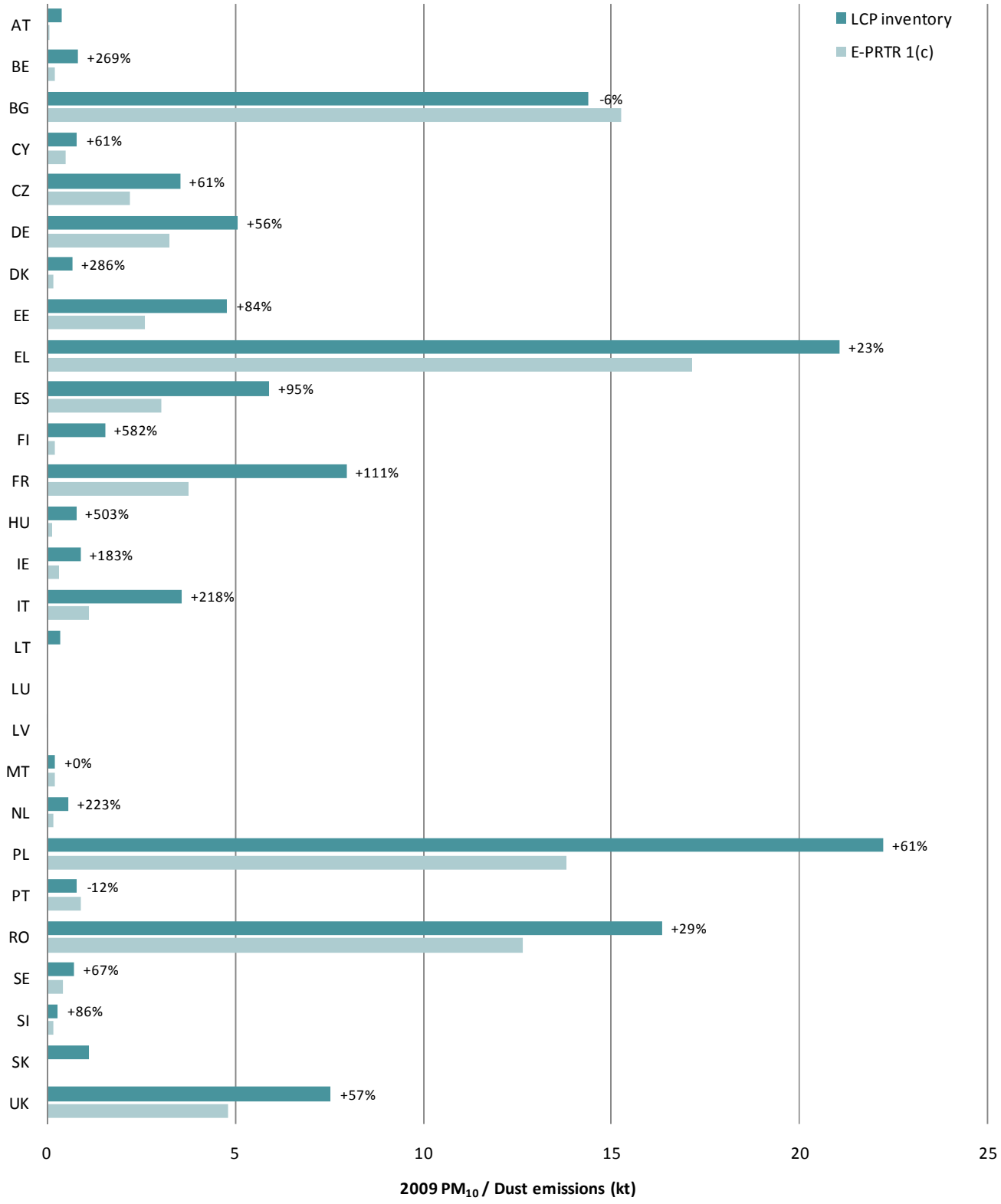


Figure 4.25 2009 PM_{10} emissions from E-PRTR and dust emissions from the LCP inventory for each Member State



4.4.2 National Emission Ceilings Directive 2001/81/EC (NECD) inventories

The National Emission Ceilings Directive (NECD, 2001/81/EC) sets pollutant-specific emission ceilings for each Member State to be met by 2010. It also lays down the requirements for the Member States to compile and report their national inventories, projections and programmes. As part of these requirements, Member States prepare and annually update national emission inventories and emission projections for 2010 for four air pollutants (SO_2, NO_x, NH_3, VOCs). It is therefore possible to compare SO_2 and NO_x emissions reported in the LCP inventories to the Member State's national NECD inventories.

The most recent Member State national inventories have been taken from the NECD status report 2010[14] Annex 1[15] and are for the year 2009. The year 2009 has been selected as being both the most recent LCP inventory available, as well as being the most complete NECD dataset (only one Member State report is missing: Malta). The reporting categories use the NFR classification system, as defined in the guidelines for reporting emission data under the Convention on Long-range Transboundary Air Pollution (CLRTAP).

Comparisons of the LCP inventory with the following NECD categories have been made:

- Comparison with **total emissions**: the total LCP reported emissions can be compared to the total NECD inventory emissions to show the importance of LCPs in each Member State; and
- Comparison with **total industrial emissions**: the total LCP reported emissions can be compared to the total NECD industrial combustion emissions (NFR codes 1A1a, 1A1b, 1A1c, 1A2a, 1A2b, 1A2c, 1A2d, 1A2e, 1A2fi)[16] to show the fraction that LCP emissions are of total industrial combustion emissions.

The following other comparisons of the LCP inventory with certain NECD categories were also considered, but not undertaken:

- Comparison of 1A1a (Public Electricity and Heat Production) with the sum from the following sectors in the LCP inventory: electricity supply industry, district heating and CHP. However, given that CHP plants can also be used to provide electricity and heat to e.g. industrial sites (i.e. not public), there has been varying interpretation by Member States as to how to apply the 'sector' of CHP. Initial analyses of the inventory data suggest that such a comparison is not sufficiently robust due to this interpretative issue. So although this analysis was previously undertaken for the 2004-6 inventories, it has not been undertaken for this reporting period;

[14] http://www.eea.europa.eu/publications/nec-directive-status-report-2010

[15] http://www.eea.europa.eu/publications/nec-directive-status-report-2010/annex-1-ms-sectoral-inventories.zip

[16] NFR codes 1A1a (Public Electricity and Heat Production), 1A1b (Petroleum refining), 1A1c (Manufacture of solid fuels and other energy industries), 1A2a (Stationary combustion in manufacturing industries and construction: Iron and steel), 1A2b (Stationary combustion in manufacturing industries and construction: Non-ferrous metals), 1A2c (Stationary combustion in manufacturing industries and construction: Chemicals), 1A2d (Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print), 1A2e (Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco), 1A2fi (Stationary combustion in manufacturing industries and construction: Other).

- 1A1b (Petroleum refining): this is not directly comparable to the reported LCP refinery emissions because petroleum refineries incorporate LCPs, combustion plants smaller than 50MW_{th} and other emission sources (process emissions). There can therefore be significant differences between total refinery emissions and refinery LCP emissions so no comparison has been made between reported LCP refinery emissions and NECD reported category 1A1b emissions.

- 1A2 (Stationary combustion in manufacturing industries and construction): similarly to refineries, this NFR category includes all combustion plants, not just those with combined stack thermal capacities greater than 50MW. Furthermore, different Member States may have reported process emissions from these relevant industries here (or reported combustion emissions under other NFR categories). In addition, it is not considered that the data capture in the LCP inventory is sufficiently detailed to fully disaggregate accurately by sectors such as 'Iron/Steel'. This comparison is not presented.

Comparison of total LCP emissions with NECD inventory national total emissions

For SO_2 and NO_x, total emissions for each Member State from the 2009 LCP inventory have been compared to the 2009 National Total emissions from the NECD inventory. Note no comparisons have been made for Malta due to missing NECD data.

Figure 4.26 shows this comparison for SO_2 with absolute emissions of LCPs and the NECD total (plotted on the left hand y-axis) and the percentage that the LCP emissions are of the NECD total (plotted on the right hand y-axis). This percentage contribution of LCPs varies from 0% (Luxembourg) to 91% (Bulgaria) and the average for the EU as a whole (total LCP emissions/total NECD emissions) is 51%. This is a reduction from the 60% contribution in 2005, as indicated in the analysis of the 2004 to 2006 LCP inventories.

Figure 4.26 2009 LCP inventory and NECD total SO_2 emissions, per Member State, including LCP emissions expressed as a percentage of the NECD total

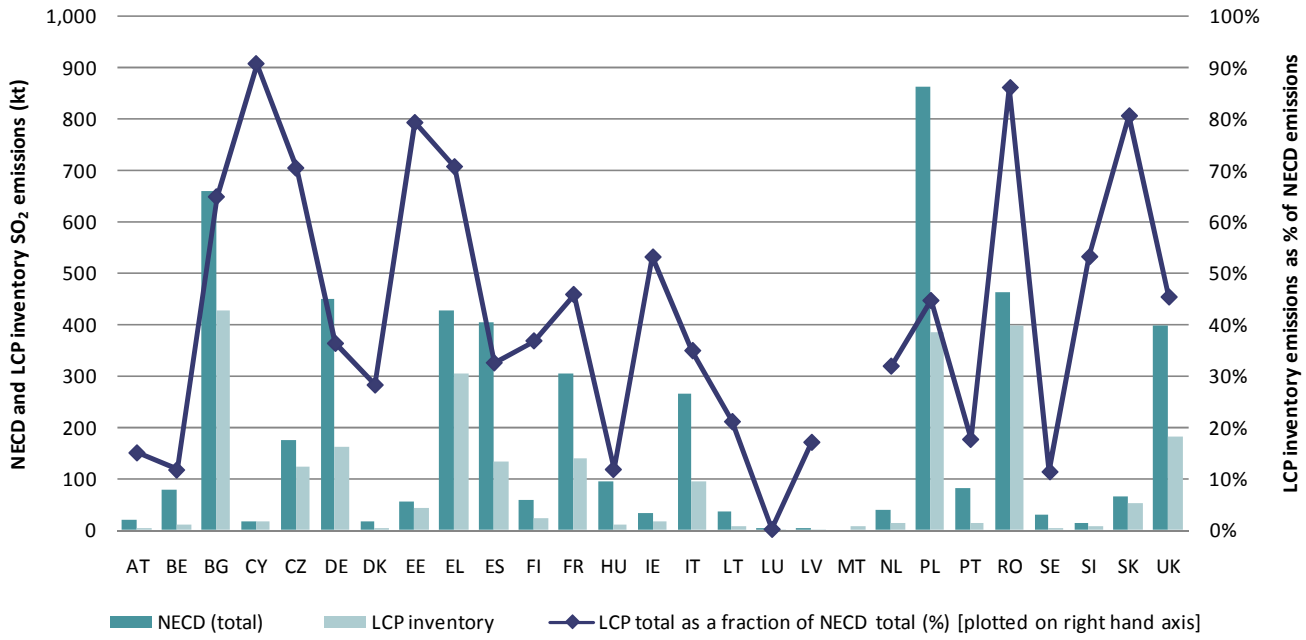
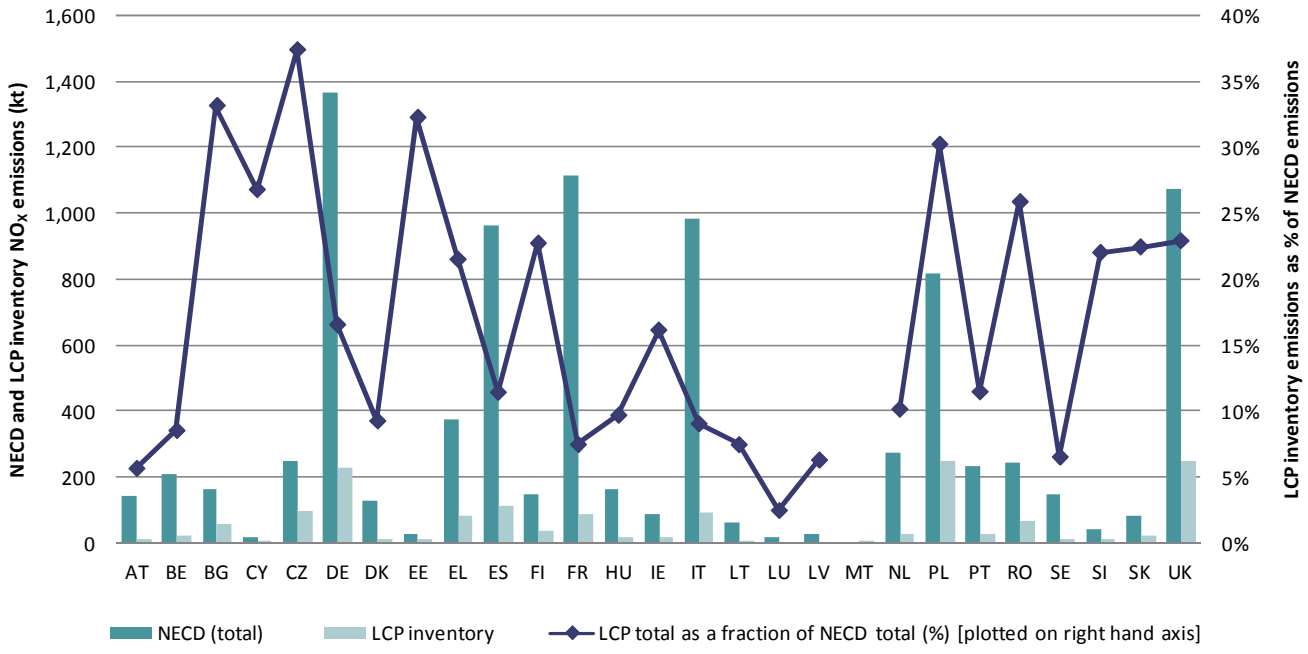


Figure 4.27 shows this comparison for NO_X with absolute emissions of LCPs and the NECD total (plotted on the left hand y-axis) and the percentage that the LCP emissions are of the NECD total (plotted on the right hand y-axis). This percentage contribution of LCPs varies from 3% (Luxembourg) to 37% (Czech Republic) and the average of the EU is 17% (total LCP emissions/total NECD emissions). This is a slight reduction from the 19% contribution in 2005, as indicated in the analysis of the 2004 to 2006 LCP inventories.

Figure 4.27 2009 LCP inventory and NECD total NO_X emissions, per Member State, including LCP emissions expressed as a percentage of the NECD total



Comparison of total LCP emissions with NECD 'total industrial combustion' emissions

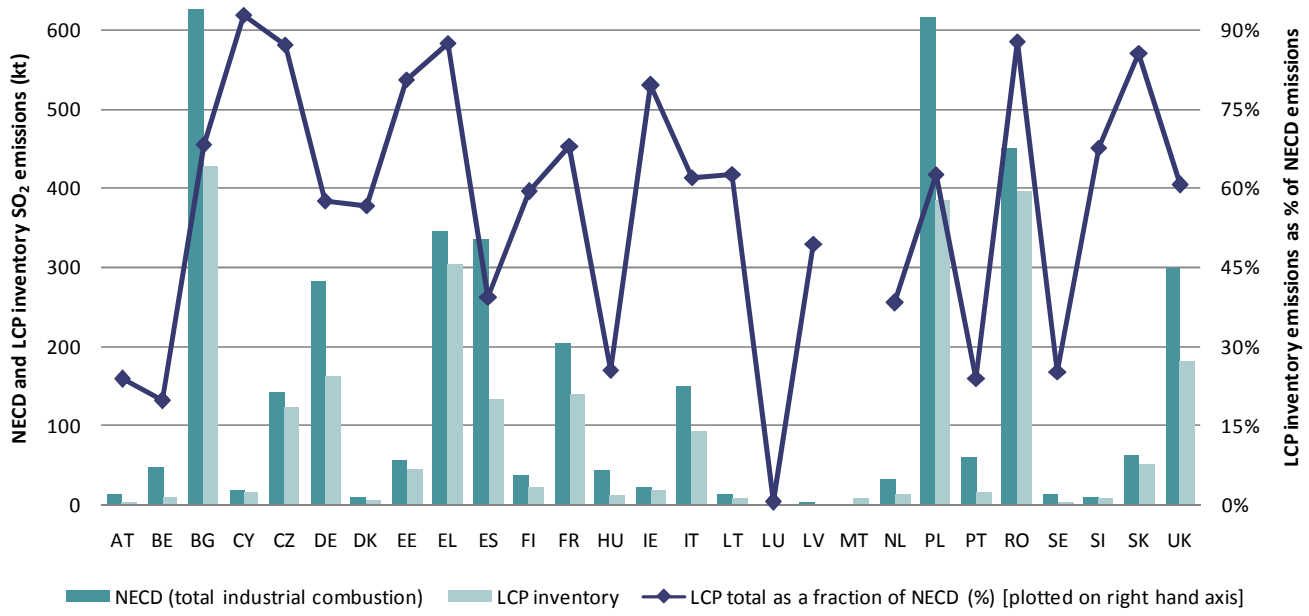
This analysis compares total Member State emissions in the 2009 LCP inventory against the Member State total emissions reported in the 2009 NECD inventories from the following NFR codes:

- 1A1a (Public Electricity and Heat Production);
- 1A1b (Petroleum refining);
- 1A1c (Manufacture of solid fuels and other energy industries);
- 1A2a (Stationary combustion in manufacturing industries and construction: Iron and steel);
- 1A2b (Stationary combustion in manufacturing industries and construction: Non-ferrous metals);
- 1A2c (Stationary combustion in manufacturing industries and construction: Chemicals);
- 1A2d (Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print);
- 1A2e (Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco); and
- 1A2fi (Stationary combustion in manufacturing industries and construction: Other).

These codes have been assumed for the purposes of this study to make up total industrial combustion emissions. Not all Member States have provided the emissions for all these NFR codes in their NECD reports; in many instances the inventories state emissions are "included elsewhere". It may be that the emissions are included in one of the other NFR categories that make up this analysis, in which case the data would be captured by this analysis. However, those instances in which the emissions are included in NFR categories that do not form this analysis would lead to a limitation of this comparison.

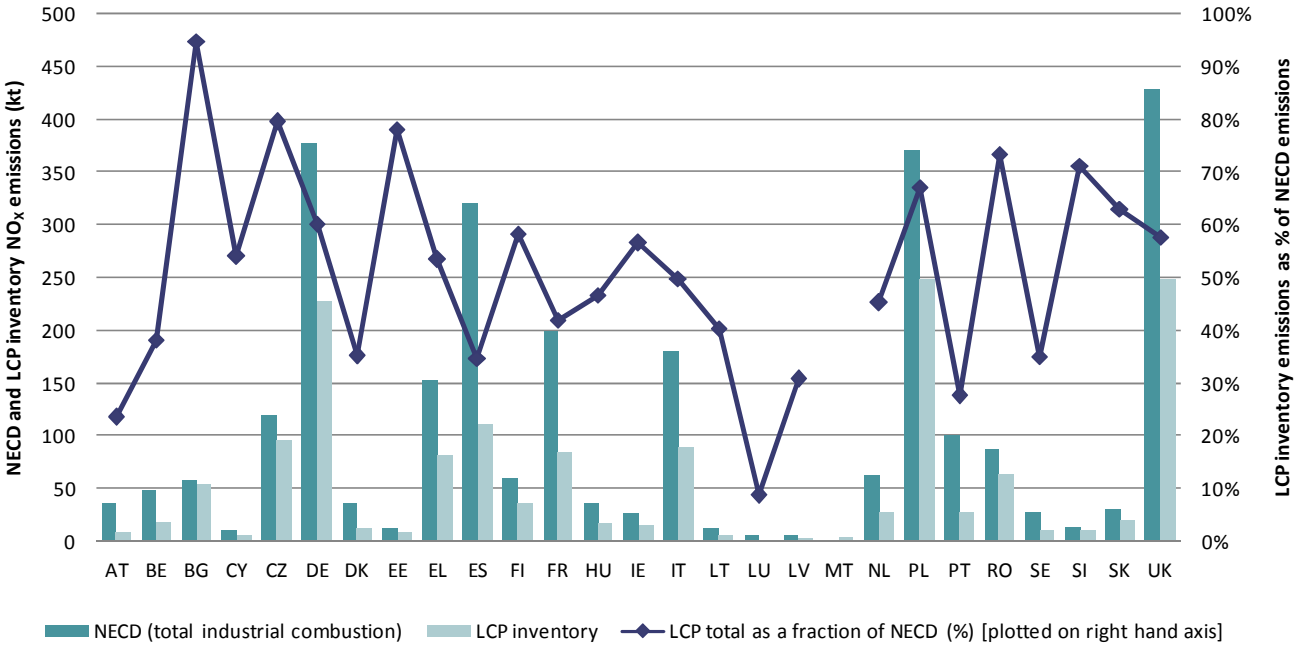
This comparison, for SO_2 emissions, is shown in Figure 4.28. The proportion that the LCP emissions are of the NECD total industrial combustion emissions are plotted on the right hand y-axis. This percentage contribution of LCPs varies from 0% (Luxembourg) to 93% (Cyprus) and the average for the EU as a whole (total LCP emissions/total NECD industrial combustion emissions) is 66%. Note no comparison has been made for Malta due to missing NECD data.

Figure 4.28 2009 LCP inventory and NECD total industrial combustion SO_2 emissions, per Member State, including LCP emissions expressed as a percentage of NECD



The comparison for NO_X emissions is shown in Figure 4.29. The proportion that the LCP emissions are of the NECD total industrial combustion emissions are plotted on the right hand y-axis. This percentage contribution of LCPs varies from 9% (Luxembourg) to 95% (Bulgaria); the average for the EU as a whole (total LCP emissions/total NECD industrial combustion emissions) is 54%. Note no comparison has been made for Malta due to missing NECD data.

Figure 4.29 2009 LCP inventory and NECD total industrial combustion NO_X emissions, per Member State, including LCP emissions expressed as a percentage of NECD



4.5 Opt-outs under Article 4(4) of the LCP Directive

The LCP Directive requires those LCPs that have chosen to 'opt out' under Article 4(4) and therefore may operate no more than 20,000 hours in total between 1 January 2008 and 31 December 2015. Member States are required to report to the Commission on which LCPs have chosen to opt-out, and from 2008 the number of hours each LCP has operated annually. Information was available for all Member States on which (if any) LCPs have chosen to opt-out. For limitations of data gathered, see Section 3.5.

Ten Member States have indicated that no LCPs have chosen to opt-out under Article 4(4) of the LCP Directive: Austria, the Czech Republic, Germany, Hungary, Ireland, Latvia[17], Lithuania, Luxembourg, the Netherlands and Sweden.

For the remaining seventeen Member States, Table 4.24 provides an overview of the total number, capacity and SO_2, NO_X and dust emissions of the opted out LCPs as a proportion of Member State totals. It is important to note that some Member States (France, Poland, Slovakia and Spain) have indicated that for a number of LCPs only a proportion of units at that plant have opted-out and not the entire combustion plant. According to the views of the Commission, this approach is not in line with Article 4(4) of the LCP Directive, as the possibility to opt out from the Directive's provisions applies to combustion plants (common stack approach) and not to parts thereof. The

[17] Latvia had previously declared opted out plants.

thermal capacity of the opted out plants are presented both as total capacity of the LCPs that are partially opted out, and as the total reported capacity of the opted out plant. However, in terms of emissions, insufficient detail has been gathered to disaggregate these units from the remainder of the LCP so the emissions presented for these Member States in Table 4.24 are likely to be overestimated.

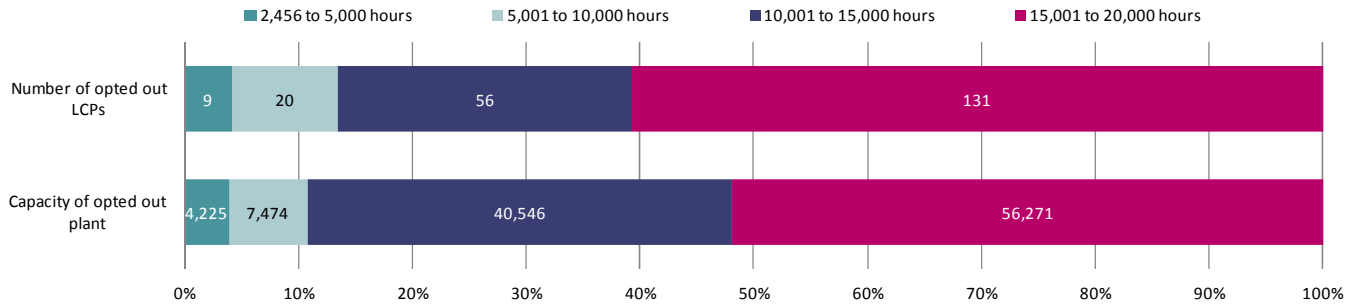
Table 4.24 Number, capacity and emissions of LCPs that are opted out (or partly opted out) for each Member State (2009 inventory)

Member State	Number of LCPs		Capacity of LCPs		Capacity of opted out plant		SO_2 emissions of LCPs		NO_X emissions of LCPs		Dust emissions of LCPs	
	Number	% MS/EU total	MW_{th}	% MS/EU total	MW_{th}	% MS/EU total	kt	% MS/EU total	kt	% MS/EU total	Kt	% MS/EU total
BE	2	2%	1,089	4%	1,089	4%	1.6	18%	1.7	9%	0.3	33%
BG	2	8%	1,320	5%	1,320	5%	111.8	26%	2.3	4%	2.7	19%
CY	6	38%	768	21%	720	20%	2.2	14%	1.0	19%	0.1	16%
DK	3	7%	1,794	9%	854	4%	0.8	19%	0.9	8%	0.2	23%
EE	2	13%	2,740	27%	1,414	14%	2.6	6%	1.0	10%	1.8	37%
EL	4	7%	946	4%	946	4%	106.6	35%	2.1	3%	6.8	32%
ES	19	11%	13,472	14%	10,580	11%	27.0	21%	7.3	7%	1.1	19%
FI	22	12%	2,804	9%	2,800	9%	0.5	2%	0.5	1%	0.0	3%
FR	24	10%	30,457	37%	16,542	20%	64.2	46%	38.6	46%	3.7	47%
IT	20	5%	5,759	3%	5,579	3%	8.7	9%	3.7	4%	0.2	7%
MT	4	40%	941	50%	941	50%	2.9	46%	1.8	41%	0.1	56%
PL	34	28%	34,414	31%	10,214	9%	128.5	33%	59.7	24%	7.9	36%
PT	6	18%	4,634	30%	4,634	30%	1.9	14%	1.8	7%	0.1	14%
RO	41	24%	11,681	20%	11,680	20%	66.2	17%	9.4	15%	2.6	16%
SI	2	11%	419	9%	419	9%	0.0	0%	0.0	0%	0.0	0%
SK	10	17%	7,875	41%	2,906	15%	37.9	74%	9.5	49%	0.7	62%
UK	17	5%	35,919	20%	35,830	20%	42.1	23%	28.1	11%	2.1	28%
EU	**218**	**7%**	**157,032**	**12%**	**108,246**	**8%**	**606**	**24%**	**169**	**11%**	**31**	**25%**

From the reported number of operational hours for years 2008 and 2009 (as reported by Member States) for each opted-out LCP, the maximum number of operational hours remaining until 31 December 2015 for each opted out LCP in the EU has been included in the LCP inventory. The data are summarised in Figure 4.30, split the opted out plants into four categories depending on the number of hours remaining. The data show that more than half of the opted out plants (by number and capacity of opted out plant) have used up 5,000 hours or fewer in the years 2008 and 2009.

Where operational hours have been reported by the Member State per unit (e.g. boiler), special provision was necessary to incorporate these data at the LCP level. This is described in Section 3.5.7.

Figure 4.30 Breakdown of opted out LCPs according to maximum number of operational hours remaining until 31 December 2015 as at 1 January 2010



4.6 Data submitted under Article 15(3) of the LCP Directive

Article 15(3) requires Member States to report annually to the Commission if any of the following are applied:

- Article 5;
- the provisions of the Nota Bene in Annex III; or
- the footnotes in Annex VI.A.

The Commission's template for the Member States included the following data to be submitted from 2008 on for each of these LCPs:

- Article 5(1): operating hours and the SO_2 ELV applied;
- Nota Bene in Annex III: the SO_2 ELV applied, the desulphurisation rate and the sulphur input;
- Annex VI.A footnote 2: operating hours and the NO_X ELV applied; and
- Annex VI.A footnote 3: the volatile content of the fuel and the NO_X ELV applied.

Not all Member States have provided Article 15(3) reports. However all Member States have been asked explicitly whether any of the provisions that need to be reported under Article 15(3) have been applied.

Article 5

Article 5 provides for two separate derogations from Annex III regarding SO_2 ELVs.

Article 5(1) states that:

> *Plants, of a rated thermal input equal to or greater than 400 MW, which do not operate more than the following numbers of hours a year (rolling average over a period of five years),*
> *— until 31 December 2015, 2 000 hours;*
> *— from 1 January 2016, 1 500 hours;*
> *shall be subject to a limit value for sulphur dioxide emissions of 800 mg/Nm^3. This provision shall not apply to new plants for which the licence is granted pursuant to Article 4(2).*

Five LCPs have been reported to take up the provisions of Article 5(1), one in Finland and four in the United Kingdom. The data reported on these LCPs are shown in Table 4.25. All the LCPs are existing plants under Article 4(3) and are primarily using 'other solid fuels'.

Table 4.25 Data reported on LCPs applying the provisions of Article 5(1)

Member State	LCP name, location	Rated thermal input (MW_{th})	Operating hours 2008	Operating hours 2009	SO_2 ELV (mg/Nm^3)
FI	Fortum Power and Heat Oy, Inkoo Power Plant Boiler 3, Inkoo	650	103	124	800
UK	Ferrybridge C Units 3 & 4, England	2,630	2,027	Not reported	800
UK	Fiddlers Ferry, England	5,448	1,993	Not reported	800
UK	Rugeley, England	2,650	960	Not reported	800
UK	RWE npower Aberthaw PS, Wales	4,500	516	Not reported	800

From the data reported, all LCPs appear to meet the Directive's requirements for this derogation in terms of being fired with solid fuel and having rated thermal input greater than 400 MW. There is insufficient data reported to assess against the requirement not to operate more than 2000 hours per year (as a five year rolling average).

Article 5(2) states that:

> *Until 31 December 1999, the Kingdom of Spain may authorise new power plants with a rated thermal input equal to or greater than 500 MW burning indigenous or imported solid fuels, commissioned before the end of 2005 and complying with the following requirements:*

(a) in the case of imported solid fuels, a sulphur dioxide emission limit value of 800 mg/Nm^3;
(b) in the case of indigenous solid fuels, at least a 60 % rate of desulphurisation,

provided that the total authorised capacity of such plants to which this derogation applies does not exceed:

— 2 000 MWe in the case of plants burning indigenous solid fuels;
— in the case of plants burning imported solid fuels either 7 500 or 50 % of all the new capacity of all plants burning solid fuels authorised up to 31 December 1999, whichever is the lower.

Spain has reported two plants from its inventory as having taken up the derogation of Article 5(2). Spain has reported the data listed in Table 4.26 in this regard.

Table 4.26 Data reported on LCPs applying the provisions of Article 5(2)

Member State	LCP name, location	Rated thermal input (MW_{th})	Age classification	Primary fuel type	Operating hours 2008	Operating hours 2009	SO_2 ELV (mg/Nm^3)
ES	CT LITORAL I-II, Carboneras-Almeria (Andalucia)	3,034	CT LITORAL I: Art 4(1) – existing plants CT LITORAL II: Art 4(3) – old-new plants	Other solid fuels	6,837	Not reported	800
ES	CT ALCUDIA III-IV, Mallorca (Islas Baleares)	740	Art 4(1) - old-new plants	Other solid fuels	8,112	Not reported	800

Given the data that Spain has reported for these Article 5(2) plants, it is not possible to fully check against the Article 5(2) criteria. However, the following points can be noted:

- Both LCPs are fired with solid fuels (meets requirements of the derogation);
- One of the LCPs ('Alcudia') appears to be commissioned before the end of 2005 (meets requirements of the derogation). The other LCP ('Litoral') appears to comprise two parts, one part of which is 'existing' and another part which is 'old-new'. It is presumed that the more recent part, of rated thermal input 1571 MW, is that which comes under the derogation because Article 5(2) relates to the commissioning of new plant. However, it is not clear whether it is correct to apply the derogation to part of an LCP;
- Both LCPs have rated thermal input greater than 500 MW (meets requirements of the derogation); and
- Given the reported limit values are 800 mg/Nm^3, it is assumed that the solid fuels are imported and not indigenous.

The additional information that would be needed to be reported in order to fully check against the requirements of the Directive are: (i) whether the solid fuels are imported or indigenous; (ii) if indigenous fuels are used what the

rate of desulphurisation is; and (iii) the total capacity of all plants burning solid fuels authorised up to 31 December 1999 from the date of the LCP Directive coming into force.

Nota Bene in Annex III

The nota bene in Annex III provides the possibility for LCPs to apply minimum desulphurisation rates in lieu of SO_2 ELVs. The provisions of the nota bene are:

A [new and existing plants]

> *Where the emission limit values above cannot be met due to the characteristics of the fuel, a rate of desulphurisation of at least 60 % shall be achieved in the case of plants with a rated thermal input of less than or equal to 100 MW_{th}, 75 % for plants greater than 100 MW_{th} and less than or equal to 300 MW_{th} and 90 % for plants greater than 300 MW_{th}. For plants greater than 500 MW_{th}, a desulphurisation rate of at least 94 % shall apply or of at least 92 % where a contract for the fitting of flue gas desulphurisation or lime injection equipment has been entered into, and work on its installation has commenced, before 1 January 2001.*

B [new new plants]

> *Where the emission limit values above cannot be met due to the characteristics of the fuel, installations shall achieve 300 mg/Nm^3 SO_2, or a rate of desulphurisation of at least 92 % shall be achieved in the case of plants with a rated thermal input of less than or equal to 300 MW_{th} and in the case of plants with a rated thermal input greater than 300 MW_{th} a rate of desulphurisation of at least 95 % together with a maximum permissible emission limit value of 400 mg/Nm^3 shall apply.*

Eleven LCPs have been reported as applying the provisions of the nota bene in Annex III. The data reported on these LCPs are shown in Table 4.27 and Table 4.28. All the LCPs are existing plants under Article 4(3).

Table 4.27 Data reported on LCPs applying the provisions of the nota bene in Annex III

Member State	LCP name, location	Rated thermal input (MW_{th})	Primary fuel type	SO_2 ELV (mg/Nm^3)	Desulphurisation rate (%)	Sulphur input (t)	Member State comments
BG	TPP "Maritsa Iztok 2", Kovachevo	4,312	Other solid fuels	-	94%	2008: 2.275; 2009: 2.29 (Note 1)	92% efficiency of FGD put in operation before 2002
BG	TPP "Maritsa Iztok 3", Mednikarovo	2,420	Other solid fuels	-	94%	2008: 1.87; 2009: 1.86 (Note 1)	
HU	Bakonyi Bioenergia Kft, Ajka	176	Biomass	1,695.2	75%	2008: 8.5; 2009:15.2	
HU	Bakonyi Erőmű Zrt., Ajka	264.3	Biomass / Other solid fuels	1,342.8	75%	2008: 59.7; 2009: 34.3	
HU	VÉRT Oroszlányi Erőmű, Oroszlány	760	Biomass / Other solid fuels	400	94%	2008: 42,440; 2009: 30,502	
SK	Chemes, a.s. Humenne Tepláren, Humenné	2008: 361.3; 2009: 342.8 (see remarks)	Other solid fuels / natural gas	1,700	75%	2008: 61.0; 2009: 92.1	Derogation applies for one boiler (boiler 4, 58.8MW_{th}) at the LCP only. Derogation only applies in case of fuel with S-content >0.71%; S-content in fuel in 2009 0.353% (Note 2)
SK	Žilinská teplárenská, a.s. Žilinská teplárenská, a.s., Žilina	2008: 405.7; 2009: 484.3	Other solid fuels	1,332.4	75%	2008: 1,616; 2009: 2,000	Derogation applies for three boiler (boilers 1, 2 and 5 of total MW_{th} 267MW_{th}) at the LCP only (Note 2)

Note 1: The reported sulphur input data do not appear to be in units of tonnes. They may be in units of % sulphur.
Note 2: The Slovakian authority's comments here are assumed to indicate that part of each of the two LCPs reported apply the provisions of the nota bene of Annex III.

The nota bene of Annex III requires that – where the ELVs cannot be met due to the characteristics of the fuel – plants of rated thermal input between 100 and 300 MW should achieve a rate of desulphurisation of 75%. Both the LCPs in this capacity class in Table 4.27 meet this desulphurisation requirement, although it is unclear from the inventory what fuels these two LCPs are using that have been reported in the biomass category and how the properties of that fuel would hamper compliance with the ELVs.

For LCPs of rated thermal input between 300 and 500MW the LCP Directive requires in the nota bene of Annex III that a desulphurisation rate of 90% is required. The two Slovakian LCPs in Table 4.27are in this capacity class, but have reported desulphurisation rates of 75%. It appears as though only parts of these two Slovakian LCPs apply this derogation (see the Member State comments in the table), and that these parts are less than 300MW_{th}. However, the Member State has also reported that ELVs have also been set for these LCPs, so it is unclear whether the derogation has been applied.

For the remaining LCPs in Table 4.27, which are over 500 MW_{th}, the nota bene requires a desulphurisation rate of at least 94%, or at least 92% if the FGD installation began before 2001. Potentially conflicting data on desulphurisation rates have been reported for one of the Bulgarian LCPs: a stated desulphurisation of 94% has been reported, together with the SO_2 abatement efficiency of 92% of the FGD plant installed in 2002; it is unclear from these comments whether the requirements of the nota bene have been met. The remaining LCPs have reported permit conditions that meet the Directive's desulphurisation requirement.

From the data requested on sulphur input in the Article 15(3) report and the output emissions of SO_2 reported in the inventory, the total rate of desulphurisation (as defined in Article 2(4)) can theoretically be calculated from the following equation:

$$rate_{desulphurisation} = 1 - \frac{\frac{32}{64} \times output_{SO2}}{input_S}$$

The calculated rate of desulphurisation can then be compared to the rates of desulphurisation reported in the Article 15(3) reports. This calculation and comparison was attempted for the LCPs listed in Table 4.27. However, it did not produce reliable results due to the nature of the data reported. Specific problems with the data included:

- For the Bulgarian LCPs, it appears that the percentage sulphur input may have been reported. In order to calculate $rate_{desulphurisation}$ from this requires assumptions to be made on the calorific value of the fuels used.
- For the Hungarian LCPs, it appears as though for two plants, the reported sulphur input data may be in incorrect units.
- For the Slovakian LCPs, due to the derogations having been applied to parts of the LCP only, insufficient data has been provided to assess the desulphurisation achieved for those parts of the LCP.

Further to the LCPs listed in Table 4.27, two additional Member States have included LCPs in their Article 15(3) reports as applying the provisions of the nota bene in Annex III, but these LCPs in practice do not need to meet the ELVs in Annex III for other reasons. Specifically, Estonia has included two LCPs in its report, but these named plants have a derogation set out in the Accession Treaty from meeting the ELVs of Annex III until 31 December 2015. Similarly, Spain has listed two LCPs which in practice do not need to meet the ELVs of Annex III, as the plants are covered under Article 4(6) as operating within the Spanish National Emission Reduction Plan (NERP). The LCPs referred to in this paragraph are included below in Table 4.28. For these LCPs, analysis of compliance with the nota bene requirements has not been undertaken.

Table 4.28 Data on LCPs reported as applying the provisions of the nota bene in Annex III, but which in practice do not need to meet the requirements of Annex III

Member State	LCP name, location	Rated thermal input (MW_{th})	Primary fuel type	SO_2 ELV (mg/Nm^3)	Desulphurisation rate (%)	Sulphur input (t)	Member State comments
EE	Narva Elektrijaamad AS, Eesti Elektrijaam, Auvere, Ida-Virumaa	4,400	Other solid fuels	10	2008: 75% 2009: 70%	2008: 130,867; 2009: 124,683	ELV SO_2 10 mg/Nm^3 is just for fluidised bed combustion. There is no ELV for pulverised combustion. Desulphurisation rate in permit is 70-80%. (Note 1)
EE	Narva Elektrijaamad AS, Balti Elektrijaam, Elektrijaama tee 59, Narva	2,450	Other solid fuels	10	2008: 75% 2009: 70%	2008: 31,583; 2009: 3,114	ELV SO_2 10 mg/Nm^3 is just for fluidised bed combustion. There is no ELV for pulverised combustion. Desulphurisation rate in permit is 70-80%. (Note 1)
ES	CT TERUEL I-II-III, Andorra-Teruel (Aragon)	3,300	Other solid fuels	(See MS comment)	92%	Not reported	No ELV (NERP)
ES	CT AS PONTES I-II-III-IV, A Coruña (Galicia)	3,800	Other solid fuels	(See MS comment)	94%	Not reported	No ELV (NERP)

Note 1: It is unclear from the comments by the Estonian authorities as to what the range of reported desulphurisation rates in the permit means, as to whether it is unknown what the actual permitted desulphurisation rate is (apart from being between 70% and 80%) or if the permit includes a range of desulphurisation rates for example for different units at the LCP.

Annex VI.A footnote 2

The second footnote of Annex VI.A sets higher NO_X ELVs for large (>500MW_{th}) existing plants that operate a low number of operating hours. Specifically, its provisions are:

> *Until 31 December 2015 plants of a rated thermal input greater than 500 MW, which from 2008 onwards do not operate more than 2 000 hours a year (rolling average over a period of five years), shall:*
>
> *— in the case of plant licensed in accordance with Article 4(3)(a), be subject to a limit value for nitrogen oxide emissions (measured as NO_2) of 600 mg/Nm^3;*
>
> *— In the case of plant subject to a national plan under Article 4(6), have their contribution to the national plan assessed on the basis of a limit value of 600 mg/Nm^3.*

One LCP has been reported as applying the provisions of footnote 2 of Part A of Annex VI. It is the same LCP as has opted for the Article 5(1) derogation as reported above. The data reported on this LCP are shown in Table 4.29. The reported data appear to meet the requirements of footnote 2 of Part A of Annex VI.

Table 4.29 Data reported on the LCP applying the provisions of footnote 2 of Part A of Annex VI

Member State	LCP name, location	Rated thermal input (MW_{th})	Age classification	Primary fuel type	Operating hours	NO_X ELV (mg/Nm^3)
FI	Fortum Power and Heat Oy, Inkoo Power Plant Boiler 3, Inkoo,	650	Art 4(3) - existing plants	Other solid fuels	2008: 103 2009: 124	600

Annex VI.A footnote 3

The third footnote of Annex VI.A provides a higher NO_X ELV for plants firing on solid fuels with low volatile contents. Specifically, its provisions are:

> *Until 1 January 2018 in the case of plants that in the 12 month period ending on 1 January 2001 operated on, and continue to operate on, solid fuels whose volatile content is less than 10 %, 1 200 mg/Nm^3 shall apply.*

Twenty LCPs have been reported as applying the provisions of footnote 3 of Part A of Annex VI. The data reported on this LCP are shown in Table 4.30. All the LCPs are existing plants under Article 4(3).

Table 4.30 Data reported on the LCPs applying the provisions of footnote 3 of Part A of Annex VI

Member State	LCP name, location	Rated thermal input (MW_{th})	Primary fuel type	% volatile content 2008	% volatile content 2009	NO_X ELV (mg/Nm^3)
BG	TPP "Varna", Ezerovo	3,582	Other solid fuels	8.41	6.86	1200
BG	TPP "Sviloza", Svistov	330	Other solid fuels	9.35	8.78	1200
BG	TPP "Deven", Devnya	1,180	Other solid fuels	9.7	9.3	1200
BG	TPP "Rousse Iztok", Rousse	1,333	Other solid fuels	9	7.82	1200
BG	TPP "Vidahim", Vidin	157	Other solid fuels	5.12	8.06	1200
SK	Chemes, a.s. Humenne Tepláren, Humenné	361	Other solid fuels	9.96	7.41	1200
SK	Slovenské Elektrarne, a.s. EVO I, Vojany	1,844	Other solid fuels	8.6	8.8	1200
SK	TEKO a.s. Košice TEKO II, Košice (*Note 1*)	613	Other solid fuels	9.83	9.13	1200
ES	CT Compostilla I (G 2 y 3), Leon (Castilla y Leon)	1,332	Other solid fuels	below 10%	Not reported	1200
ES	CT Compostilla II (G 4 y 5), Leon (Castilla y Leon)	1,675	Other solid fuels	below 10%	Not reported	1200
ES	CT La Robla I, La Robla (León)	789	Other solid fuels	below 10%	Not reported	1200
ES	CT Robla II, La Robla (León)	1,003	Other solid fuels	below 10%	Not reported	1200
ES	CT Narcea I, Tineo (Oviedo)	240	Other solid fuels	below 10%	Not reported	1008
ES	CT Narcea II, Tineo (Oviedo)	472	Other solid fuels	below 10%	Not reported	1200
ES	CT Narcea III, Tineo (Oviedo)	984	Other solid fuels	below 10%	Not reported	1200
ES	CT Anllares, Palacios del Sil (león)	1,002	Other solid fuels	below 10%	Not reported	1200
ES	CT Velilla 1, Velilla del Rio Carrión - Palencia (Castilla y Leon)	434	Other solid fuels	below 10%	Not reported	1200
ES	CT Velilla 2, Velilla del Rio Carrión - Palencia (Castilla y Leon)	966	Other solid fuels	below 10%	Not reported	1200
ES	C.T. Puente Nuevo, Puentenuevo-Córdoba (Andalucia)	976	Other solid fuels	below 10%	Not reported	1200
UK	RWE npower Aberthaw Power Station, Wales	4,500	Other solid fuels	Not reported	13.5%	1200

Note 1: This plant has derogated specific boilers labelled PK3 and PK4 of total rated thermal input 323MW.

From the above data, it is obvious that there are many LCPs for which the volatile content of the fuel data has not been provided. Therefore it is not possible to assess whether the LCP Directive requirements of less than 10% volatile content in the solid fuel have been fulfilled. Additional data has been requested from the Spanish and British authorities but no further data has been reported. For the data that has been provided on the volatile content of the fuel used (five Bulgarian LCPs, three Slovakian LCPs, one UK LCP) all but one LCP has reported volatile contents less than 10% (ranging from 5.12% to 9.96%). One LCP (Aberthaw power station in the UK) has reported volatile content as an average for 2009 of 13.5%, which clearly exceeds the requirements of footnote 3 of Annex VI.A. No data has been reported for year 2008 for this LCP.

4.7 Comparison of LCP emissions against LCP Directive ELVs and BAT-AELs

This section provides a comparison of LCP emission factors based on reported energy input and emissions against the LCP Directive ELVs. These emission factors were also compared to the LCP BREF Best Available Techniques Associated Emission Levels (BAT-AELs).

4.7.1 Approach

For single-fuelled plants a fuel specific emission factor (EF) can be calculated based on total emissions of each pollutant and total energy input (e.g. g SO_2 per GJ of coal energy input). These can be compared against the LCP Directive ELVs and upper and lower BAT-AELs (which are all in units of mg/Nm^3) by using the fuel specific flue gas volumes involved with each fuel type.

The following considerations have been made to undertake the comparison described above:

- LCP inventory data for year 2009 has been used to compare performance against the LCP Directive ELVs and BAT-AELs from the LCP BREF. This year has been chosen as the most recent year in this reporting period. Furthermore, not using year 2007 data means that the data for existing plants can be compared to LCP Directive ELVs which came into force on 1 January 2008;
- The comparisons have been made against the LCP Directive ELVs for Article 4(1) new and Article 4(3) existing plants separately from those for Article 4(2) ‘new new’ plants;
- NO_X EFs have been compared against the LCP Directive ELVs applicable from 2008 and not the more stringent ELV for large solid fuelled plants from 2016 onwards;
- Only ‘single-fuelled’ plants have been considered in the analysis due to the difficulty in apportioning emissions to multiple fuels consumed and the complexities in determining LCP Directive ELVs or BREF BAT-AELs for multi-fuelled plants. A ‘single-fuelled’ plant has been defined as one that uses greater than 95% of a single fuel by energy input;
- In addition, the comparison excludes the following plants (except where stated):

- LCPs not operating in both 2008 and 2009;
- opted-out LCPs (under Article 4(4) of the LCP Directive);
- LCPs with Accession Treaty derogations for the specific pollutant being considered;
- LCPs with no reported rated thermal input and/or energy data and/or emissions data;
- LCPs without reported age classification according to Article 4.

- The analysis includes existing LCPs which are included in National Emission Reduction Plans;
- The focus of the analysis has been on biomass, other solid fuels, liquid fuels and natural gas. Due to the range of gases that can be included in the category 'other gases', and the associated range of applicable ELVs, no analysis has been undertaken on this fuel type;
- The analysis for other solid fuels cannot separately analyse hard coal from brown coal (lignite) as this information is not captured in the LCP inventories. However, as there are relatively minor differences between the assumed specific flue gas volumes and subsequent fuel specific emission factors for hard and brown coal, this is not considered a limitation of the analysis;
- Gas turbines have been presented separately where data are available from Member States. The NO_X ELV for Article 4(2) gas turbines used for the comparison was 50 mg/Nm^3. Existing gas turbines are only compared to relevant BAT-AELs;
- No account is taken of specific derogations (such as those reported under Article 15(3)), other than from Accession Treaties. In practice this means that any LCPs that do have derogations other than from the Accession Treaties are also included in the plots and are compared to the default ELVs. This may therefore for these few plants mean an overestimation of numbers of plants concluded to be operating above the relevant ELVs. However, this overestimation is considered too small to affect the conclusions of this analysis because the number of LCPs reported under Article 15(3) as having taken up derogations (see Section 4.6) is small; and
- As determined by the available data, the comparison is based on annual emissions performance. Compliance with LCP Directive ELVs is required on a monthly basis for existing plants, and BAT-AELs are defined in the LCP BREF as daily averages.

Taking into account the above considerations, the analysis in the following sections includes approximately 38% of all plants by number reported in Member States' LCP emission inventories.

In order to convert the LCP Directive ELVs and LCP BREF BAT-AELs into fuel specific emission factors for comparison with actual plant emission factors, the same fuel specific flue gas volumes as used for the analysis of the 2004 to 2006 LCP inventories have been applied. Although it had been recognised that this analysis would benefit from the use of more up-to-date volumes, in particular for specific fuels such as lignite used in some Member States, a literature review and consultation with certain Member States that are known to use lignite (Greece and Bulgaria) has not yielded any alternative volumes. The fuel-specific flue gas volumes that have been applied are presented in Table 4.31. These values are on a dry basis at the reference oxygen content indicated and using the gross calorific values for each fuel.

Table 4.31 Fuel specific flue gas volumes used in this analysis

Fuel	Excess air (% oxygen)	Specific flue gas volume (m^3/GJ) (Note 1)
Biomass	6	331 (Note 2)
Other solid fuels (an average of hard and brown coal)	6	370
Liquid fuels	3	279
Natural gas (boilers)	3	251
Natural gas (gas turbines)	15	760

Note 1: Source of figures is the evaluation of the 2004-06 inventories (Entec, 2008) – see footnote 5. Assuming a dry basis at the reference oxygen content and using gross calorific values for each fuel.
Note 2: The category biomass encompasses a wide range of fuel types and associated combustion properties. This figure has been calculated based on analysis of a range of common biomass fuels.

4.7.2 Results

Figure 4.31, Figure 4.32 and Figure 4.33 provide an overview of the comparison undertaken between 2009 LCP emission factors and the LCP Directive ELVs and LCP BREF BAT-AELs for SO_2, NO_X and dust respectively, disaggregated by fuel type and capacity class. Figure 4.31 (SO_2) and Figure 4.33 (dust) only summarise new and existing plants (Article 4(1) and Article 4(3) respectively); Figure 4.32 includes, where specified, summaries for 'new new' plants (Article 4(2)). Overall the comparisons show the following patterns for each pollutant:

- For SO_2 19% of LCPs in this analysis have emission factors above the corresponding LCP Directive ELVs, 49% were below the ELVs but above the upper BREF BAT-AEL and a further 15% between the lower and upper BAT-AELs. Only 11% of LCPs appear to have been operating below the lower BREF BAT-AEL. For biomass, as there is no BAT-AEL for SO_2 emissions, Figure 4.31 only indicates that no biomass plants appeared to operate above the LCP Directive ELVs;
- For NO_X the proportion of LCPs with emission factors above the corresponding LCP Directive ELVs is slightly higher than for SO_2: 21%. Also, 37% of LCPs appear to have been operating between the LCP Directive ELVs and upper BREF BAT-AEL range, and (existing gas turbines only) 11% have been operating above the upper BREF BAT-AEL range. A smaller proportion appear to have operated at lower emission levels: approximately 18% and 13% between the upper and lower BREF BAT-AELs and below the lower BAT-AEL, respectively.
- For dust the numbers of LCPs in each category are spread more evenly: approximately one quarter of LCPs appear to have emission factors above the corresponding LCP Directive ELVs, and a further quarter appear to have been operating between the LCP Directive ELVs and upper BREF BAT-AEL.

Figure 4.31 Summary of LCP SO_2 EFs in 2009 compared to LCP Directive ELVs and BREF BAT-AELs (Article 4(1) and Article 4(3) plants)

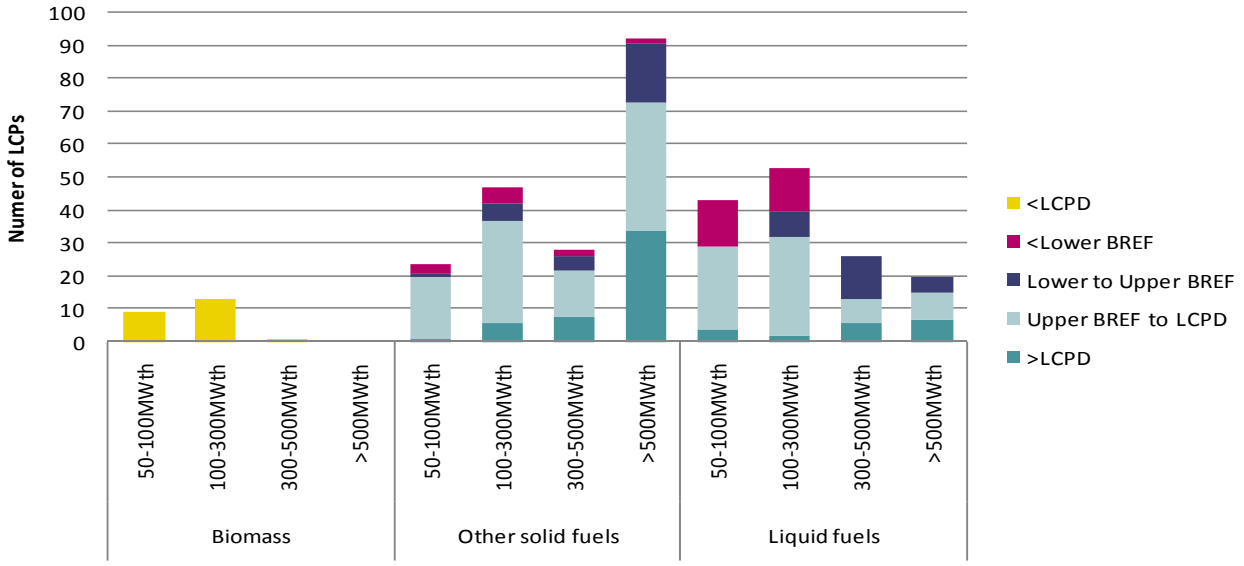


Figure 4.32 Summary of LCP NO_X EFs in 2009 compared to LCP Directive ELVs and BREF BAT-AELs

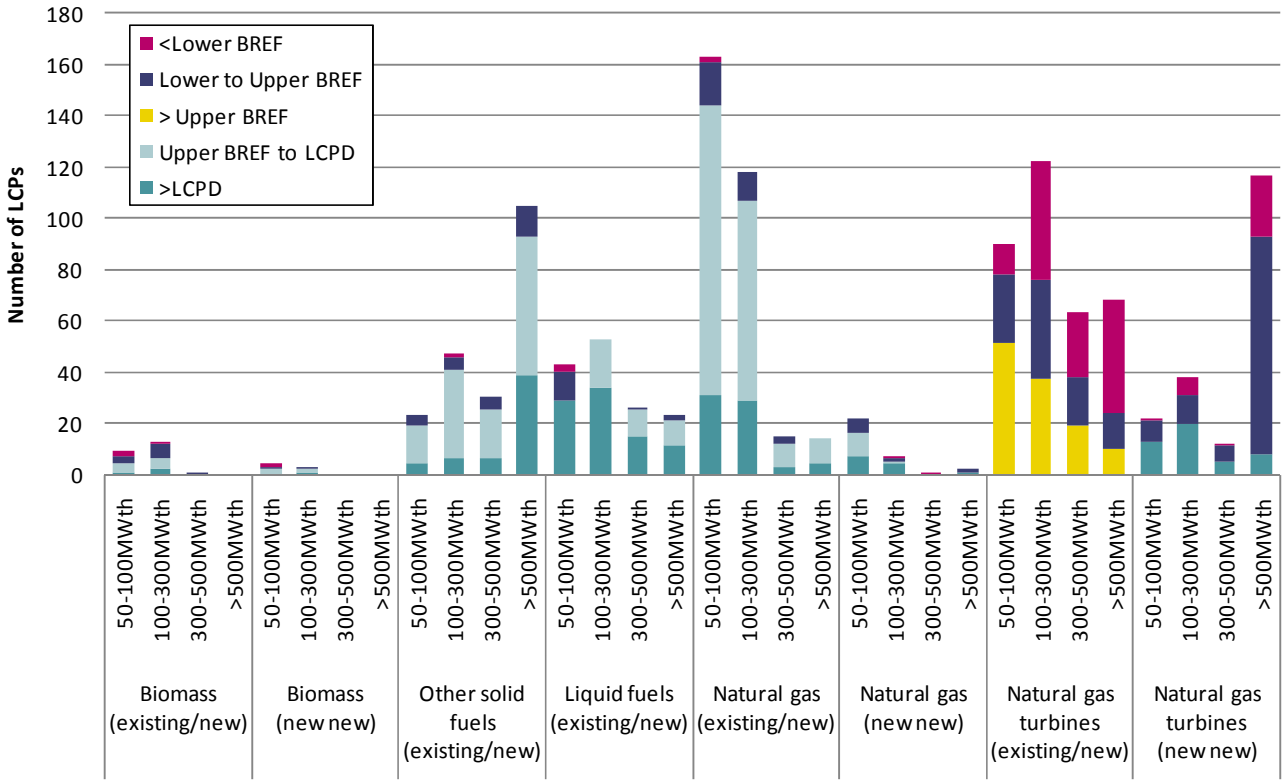
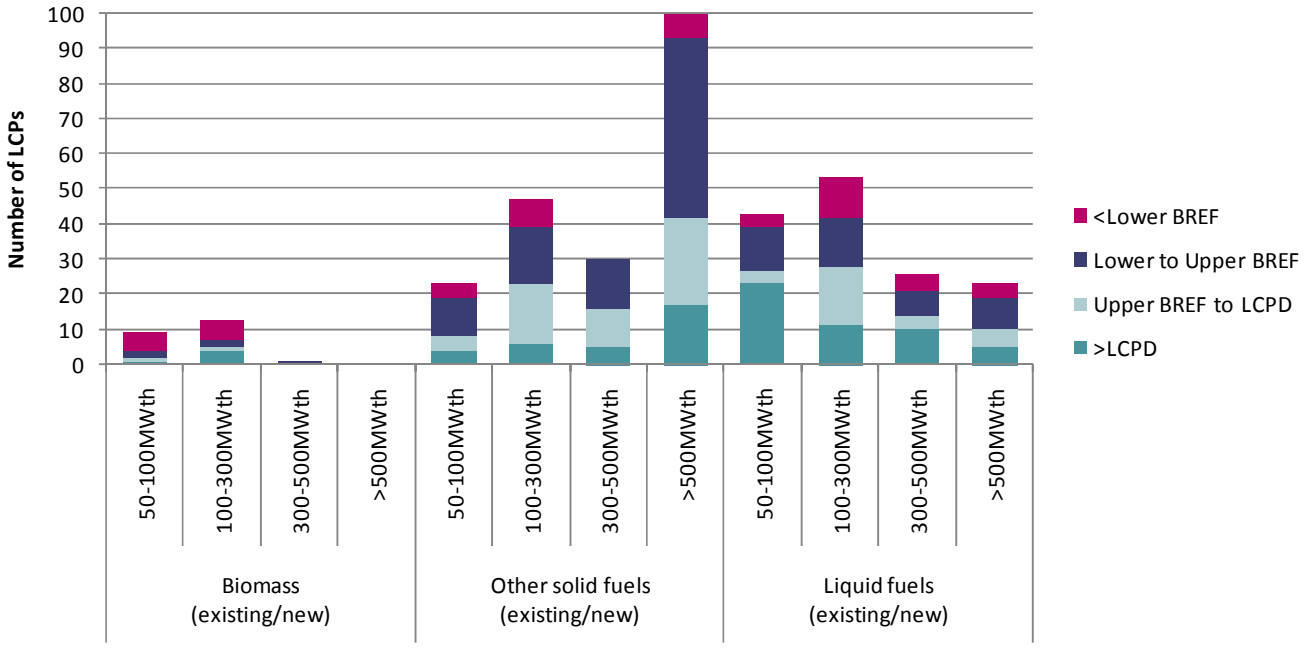


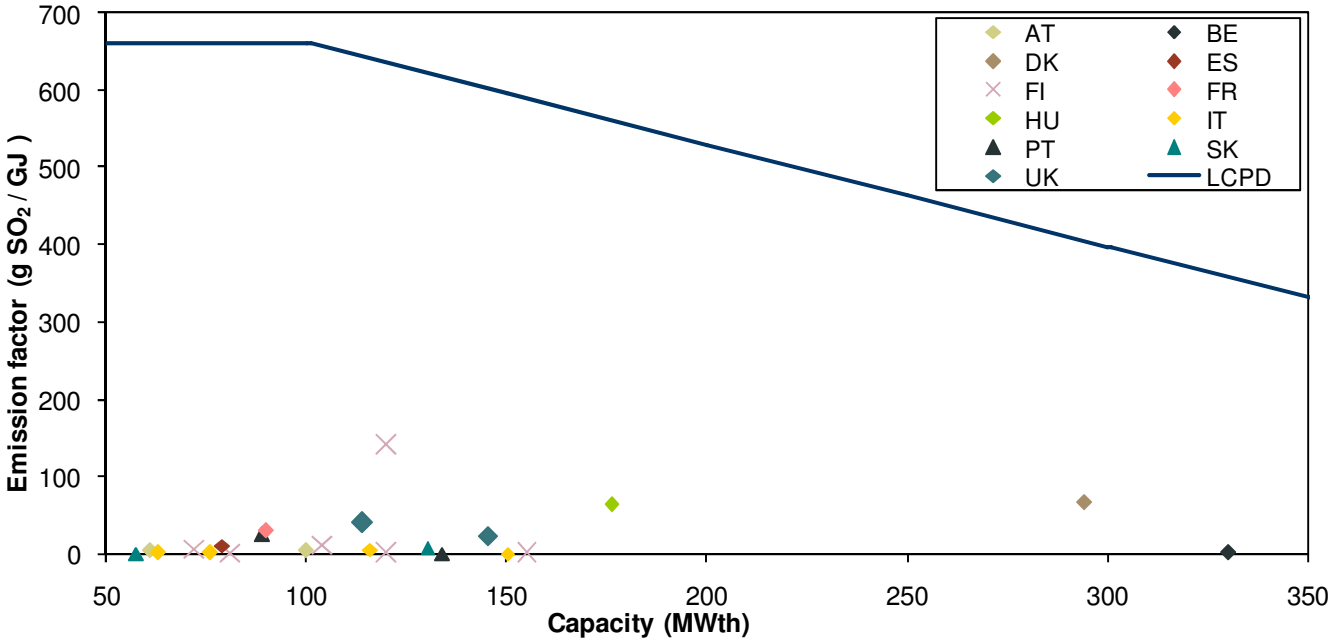
Figure 4.33 Summary of LCP dust EFs in 2009 compared to LCP Directive ELVs and BREF BAT-AELs



The following sub-sections present the plant-level results of the comparison for each fuel and pollutant based on 2009 data. The figures in each subsection plot the emission factors (in g [pollutant] / GJ [fuel]) of all LCPs that were included in the analysis, split by Member State, against rated thermal input (capacity, in MWth). Included on the plots are the calculated equivalents (in g/GJ) of the relevant LCP Directive ELVs, and the lower and upper BREF BAT-AELs. Note that some outliers have been excluded from the figures for presentational purposes. The results for natural gas fired plants have been split into LCPs that are reported to be gas turbines, and those that do not include gas turbines.

Biomass

Figure 4.34 Biomass LCP SO_2 EFs in 2009 vs. LCP Directive ELVs (Article 4(1) and Article 4(3) plants)



Note: there are no BREF BAT-AELs for SO_2 emissions from biomass.

Figure 4.35 Biomass LCP NO_X EFs in 2009 vs. LCP Directive ELVs and BAT-AELs (Article 4(1) and Article 4(3) plants)

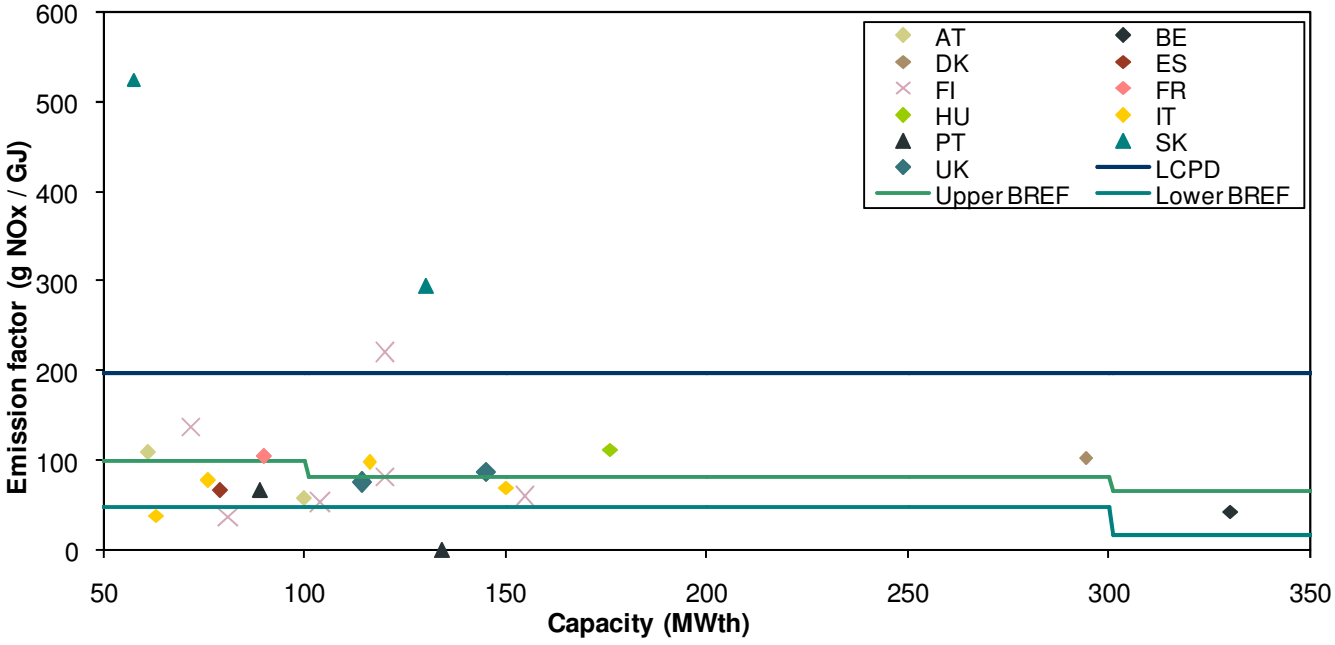


Figure 4.36 Biomass LCP NO_X EFs in 2009 vs. LCP Directive ELVs and BAT-AELs (Article 4(2) plants)

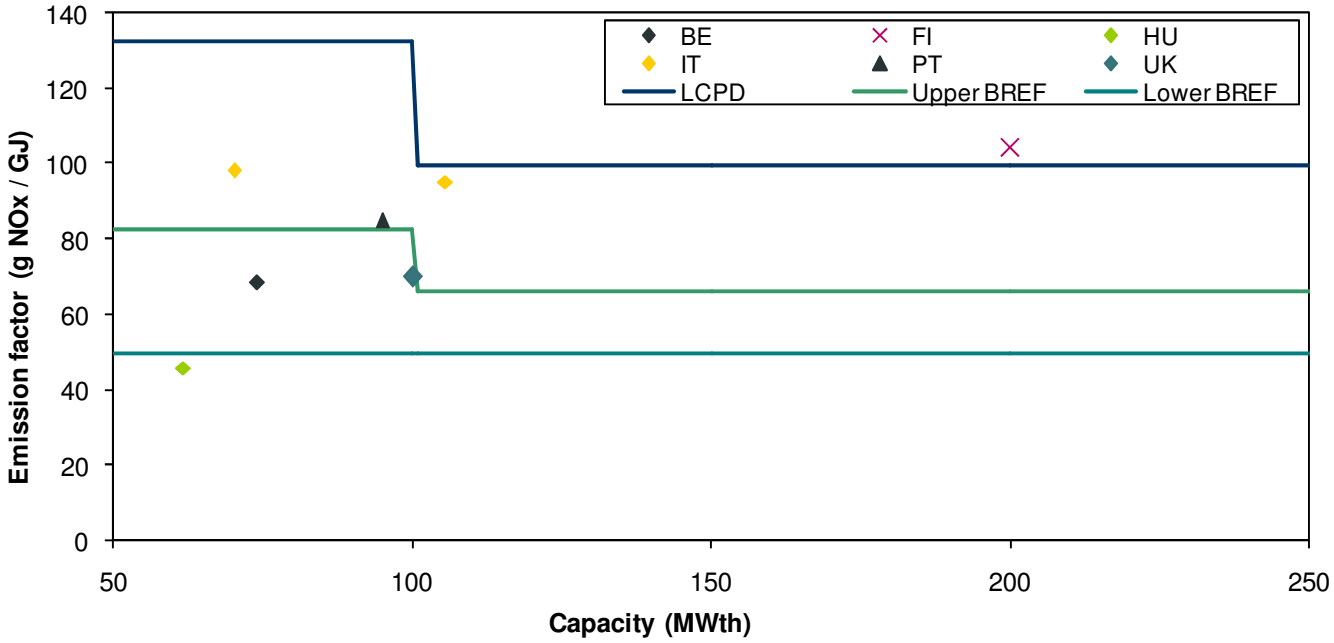
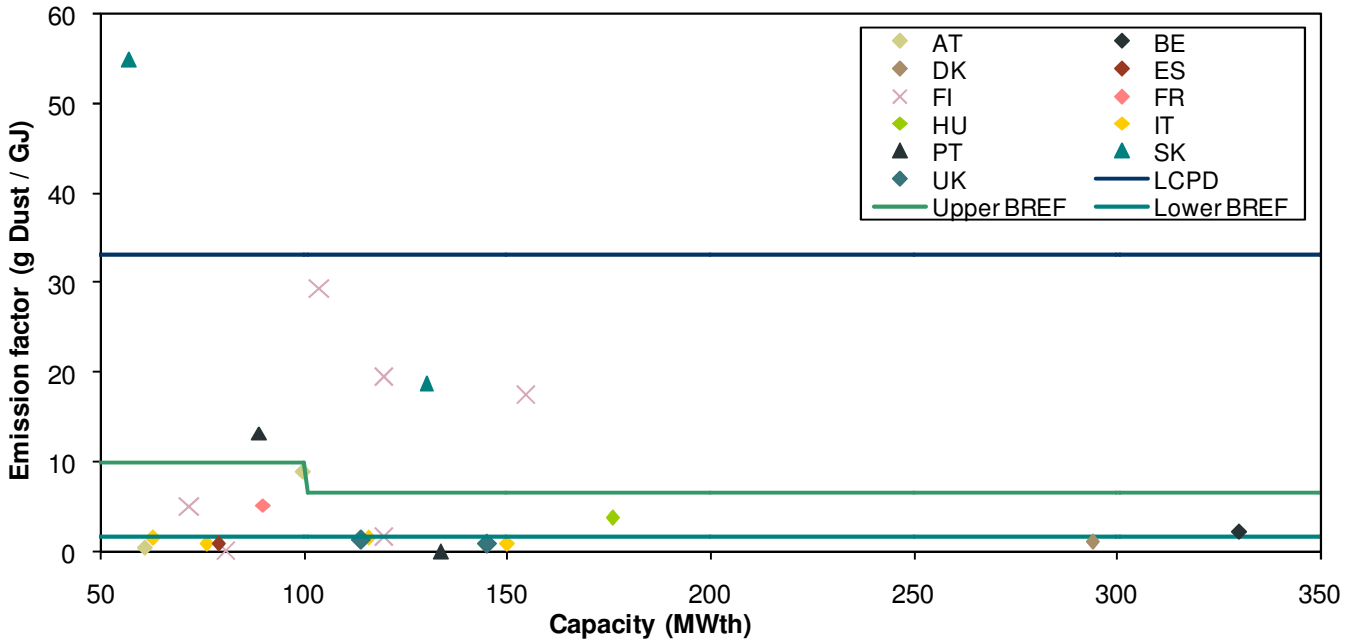
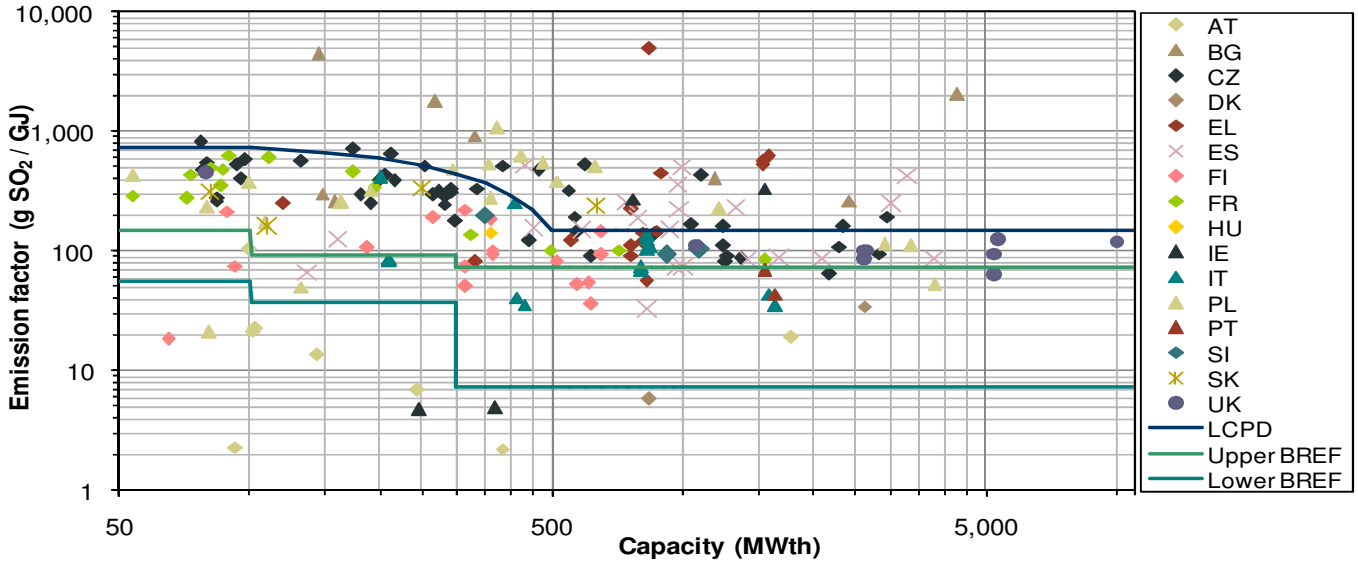


Figure 4.37 Biomass LCP dust EFs in 2009 vs. LCP Directive ELVs and BAT-AELs (Article 4(1) and Article 4(3) plants)



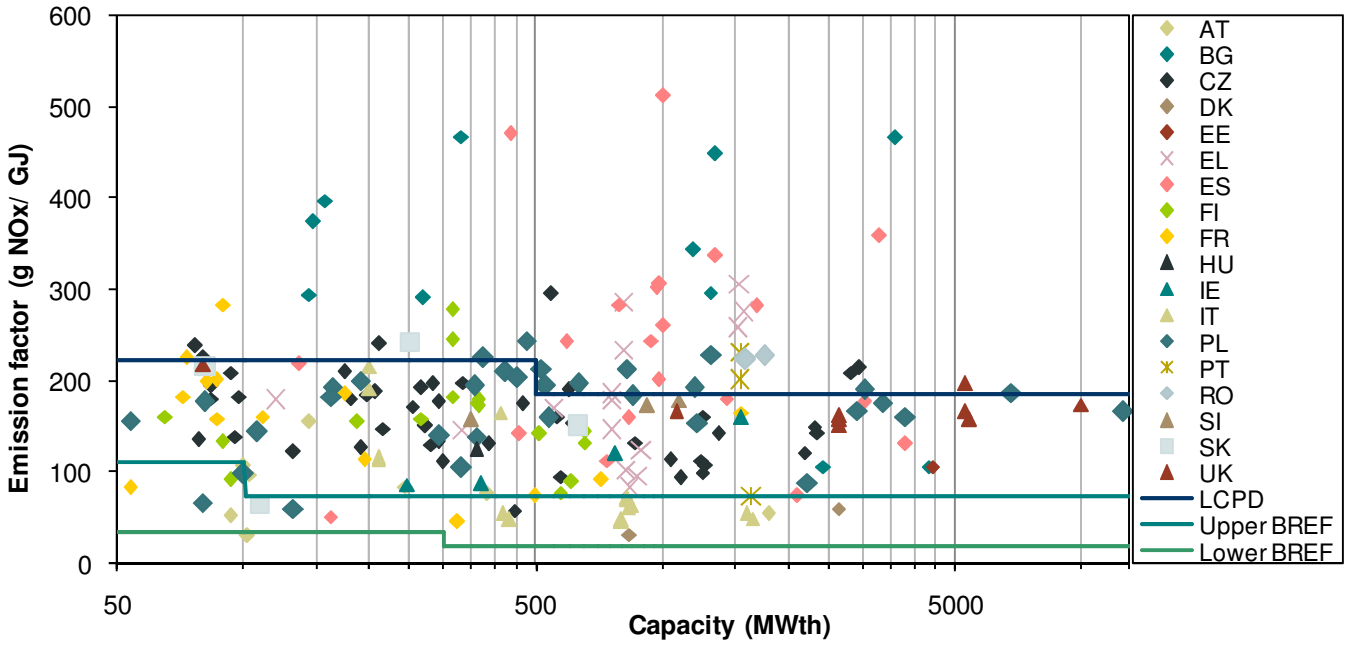
Other solid fuels

Figure 4.38 Other solid fuel LCP 2009 SO_2 EFs vs. LCP Directive ELVs and BAT-AELs (Article 4(1), Article 4(3) plants)



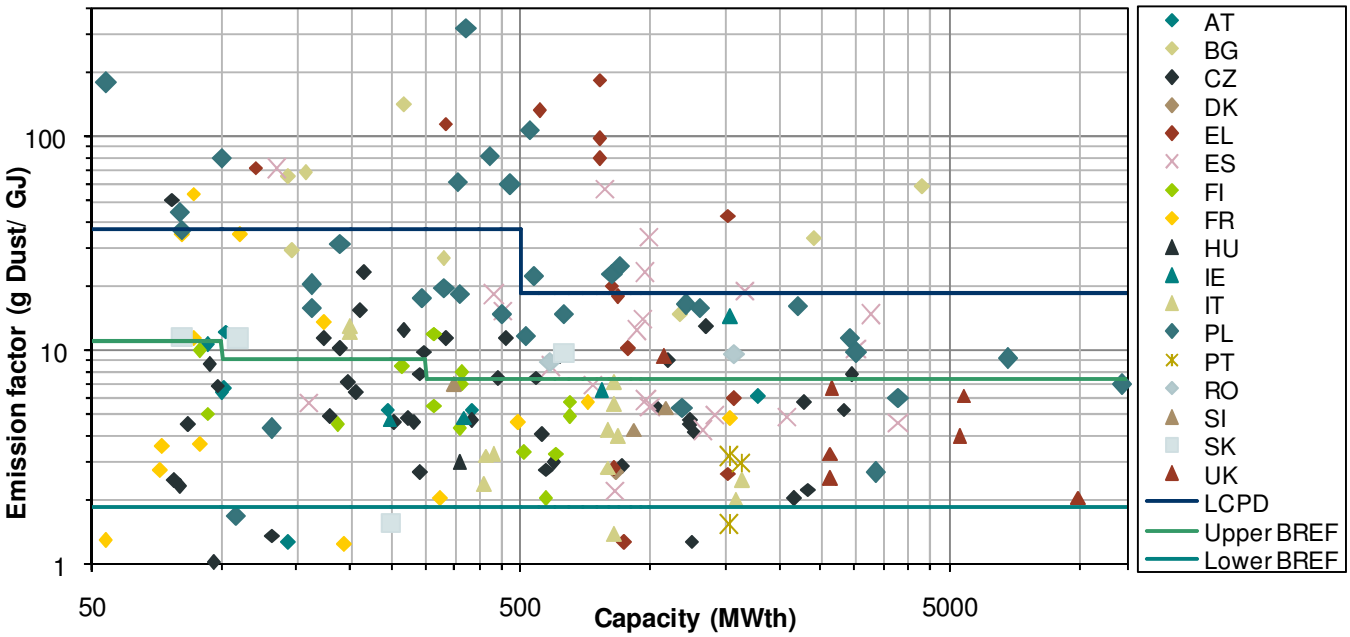
Note: Both axes are shown with logarithmic scales in order to show more clearly the distribution of LCPs.

Figure 4.39 Other solid fuel LCP 2009 NO_X EFs vs. LCP Directive ELVs and BAT-AELs (Article 4(1), Article 4(3) plants)



Note: The x-axis is shown with a logarithmic scale in order to show more clearly the distribution of LCPs.

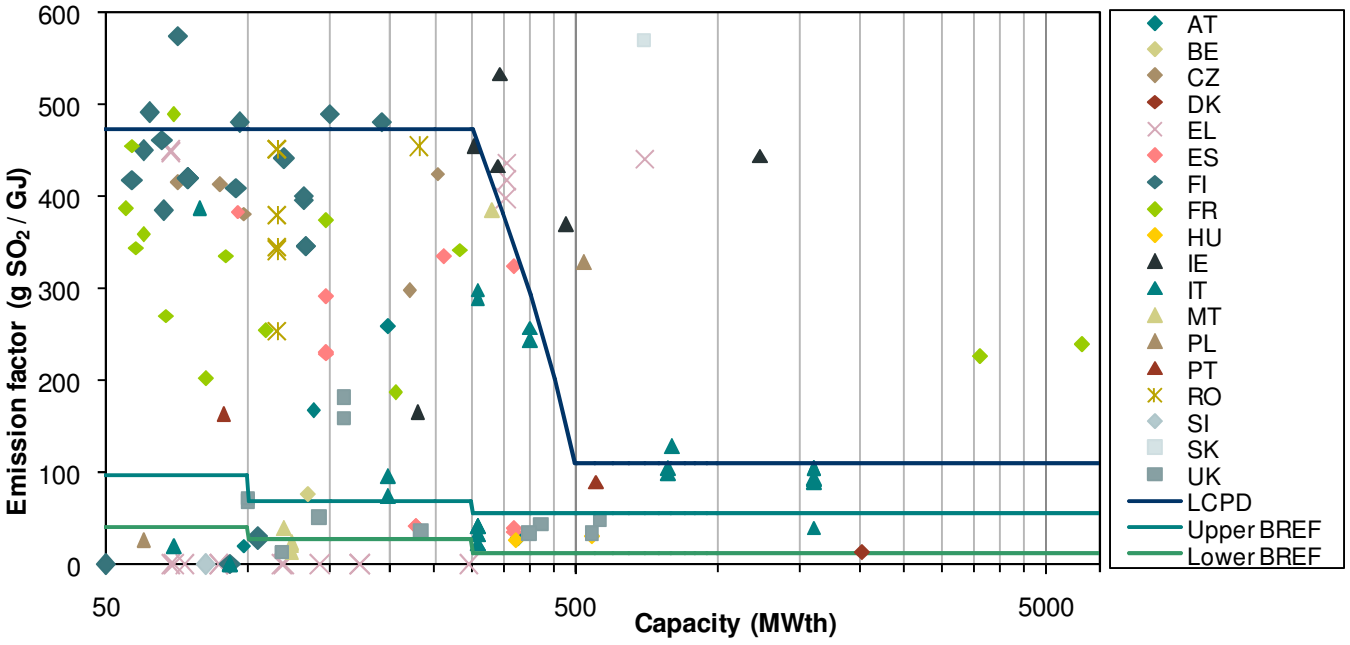
Figure 4.40 Other solid fuel LCP 2009 dust EFs vs. LCP Directive ELVs and BAT-AELs (Article 4(1), Article 4(3) plants)



Note: Both axes are shown with logarithmic scales in order to show more clearly the distribution of LCPs.

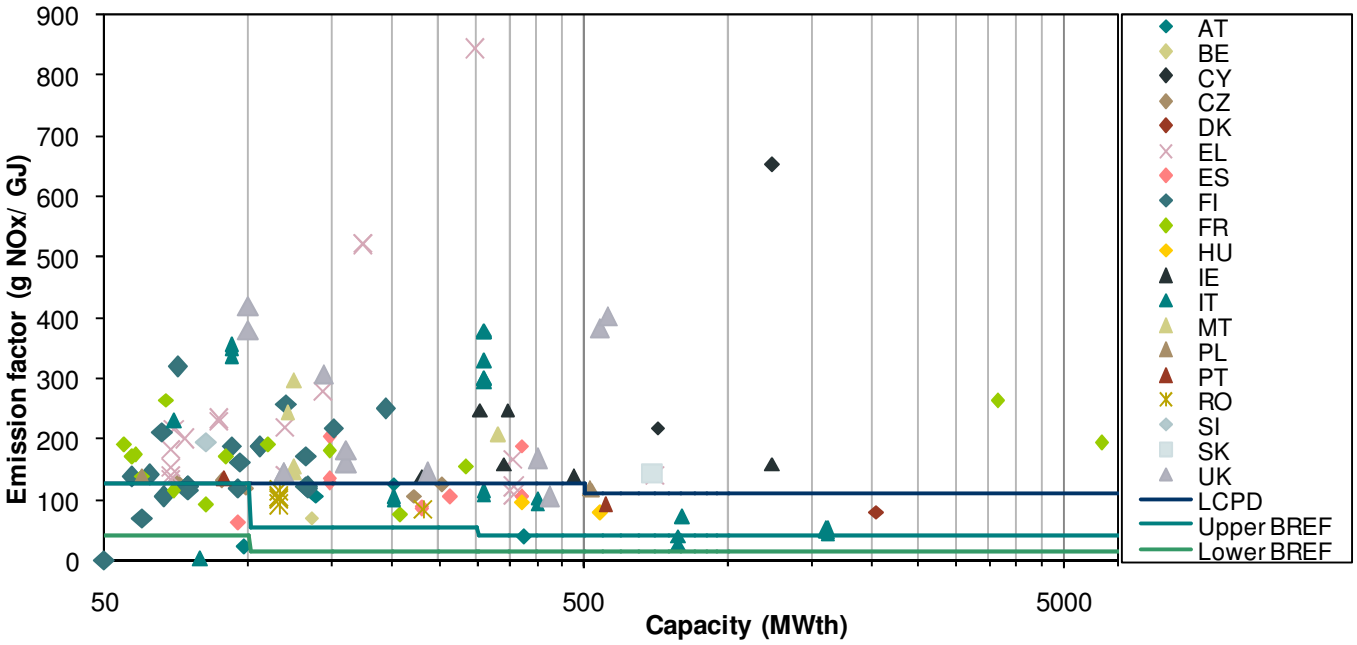
Liquid fuels

Figure 4.41 Liquid fuel LCP SO_2 EFs in 2009 vs. LCP Directive ELVs and BAT-AELs (Article 4(1), Article 4(3) plants)



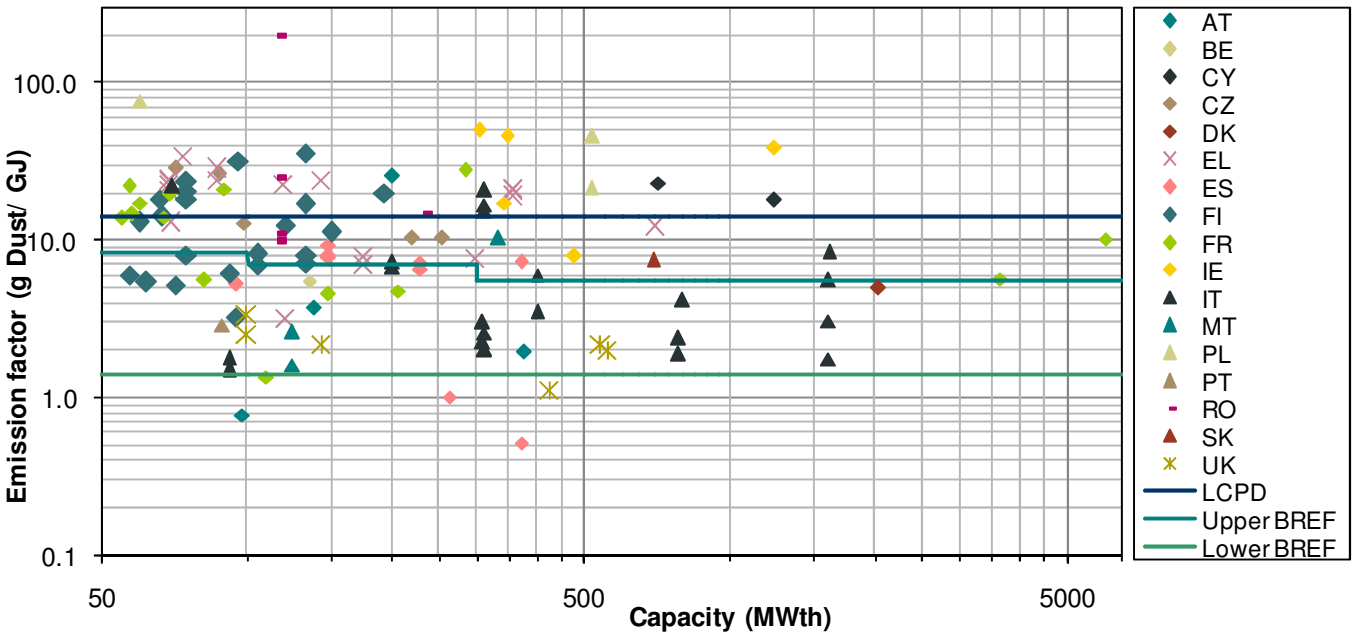
Note: The x-axis is shown with a logarithmic scale in order to show more clearly the distribution of LCPs.

Figure 4.42 Liquid fuel LCP 2009 NO_X EFs vs. LCP Directive ELVs and BAT-AELs (Article 4(1), Article 4(3) plants)



Note: The x-axis is shown with a logarithmic scale in order to show more clearly the distribution of points.

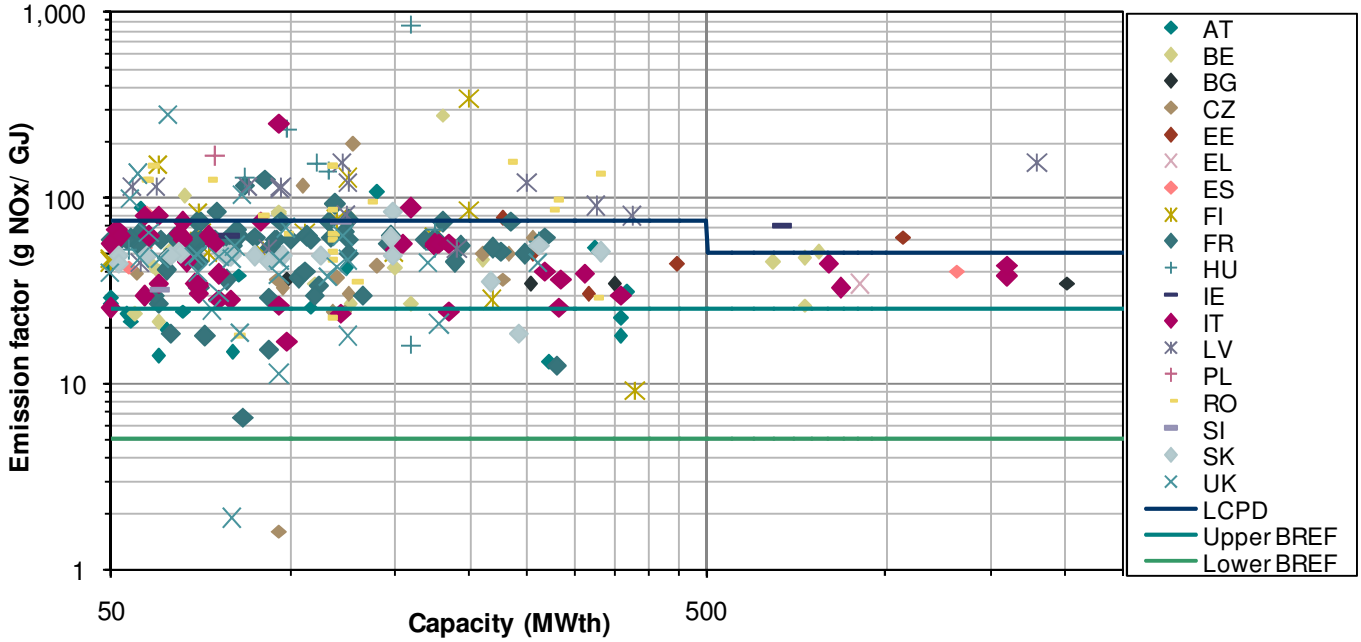
Figure 4.43 Liquid fuel LCP 2009 dust EFs vs. LCP Directive ELVs and BAT-AELs (Article 4(1), Article 4(3) plants)



Note: Both axes are shown with logarithmic scales in order to show more clearly the distribution of LCPs.

Natural gas

Figure 4.44 Natural gas LCP 2009 NO_X EFs vs. LCP Directive ELVs and BAT-AELs (Article 4(1), Article 4(3) plants, excluding gas turbines)



Note: Both axes are shown with logarithmic scales in order to show more clearly the distribution of LCPs.
Note: one outlier of EF 7,222g NO_X/GJ (identified in Table 4.21) is not shown on this plot.

Figure 4.45 Natural gas LCP 2009 NO_X EFs vs. LCP Directive ELVs and BAT-AELs (Article 4(2) plants, excluding gas turbines)

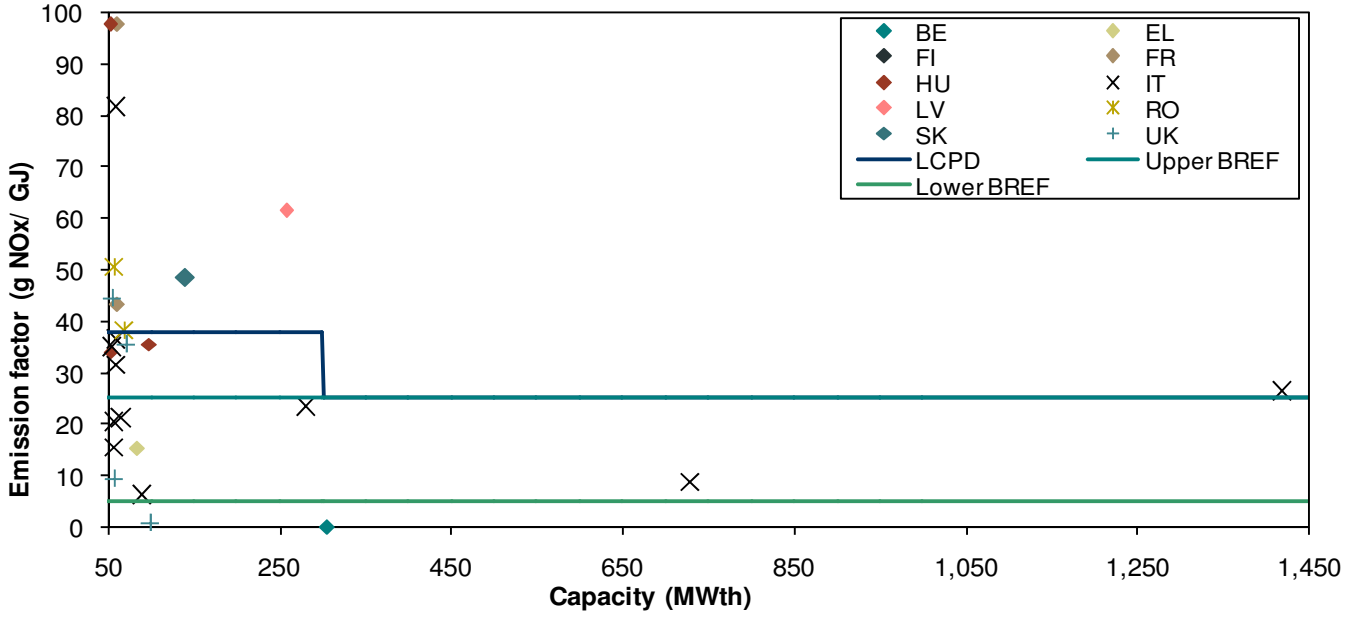
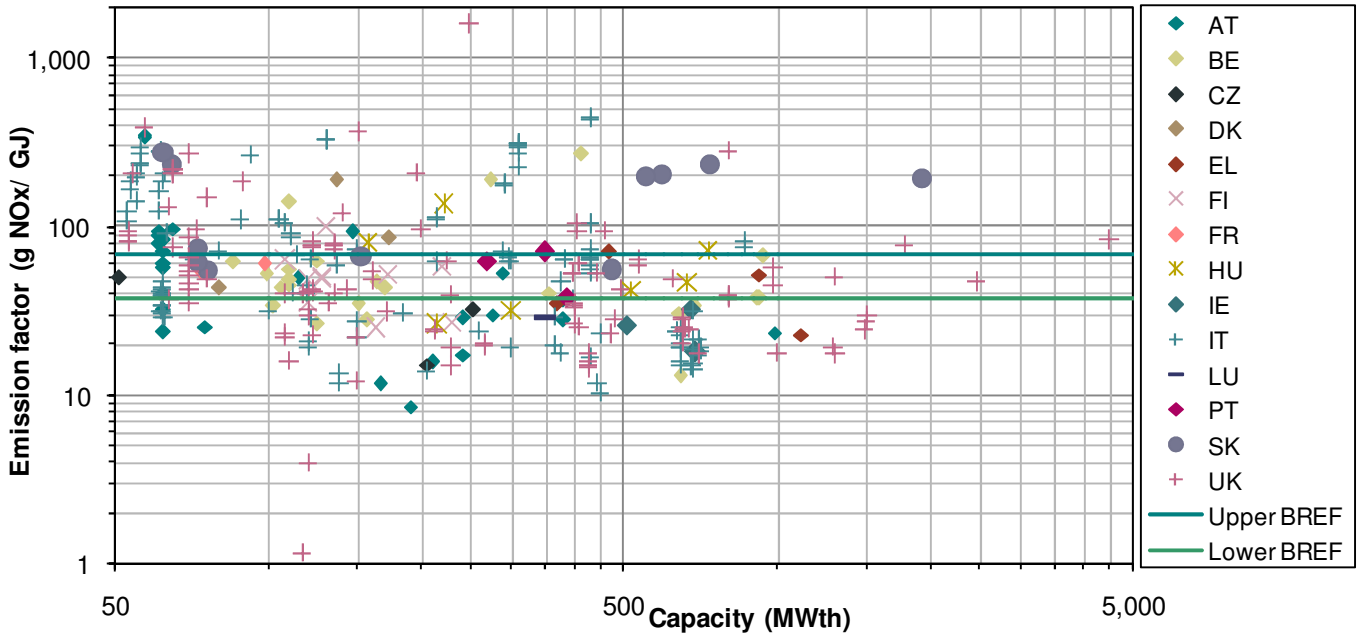
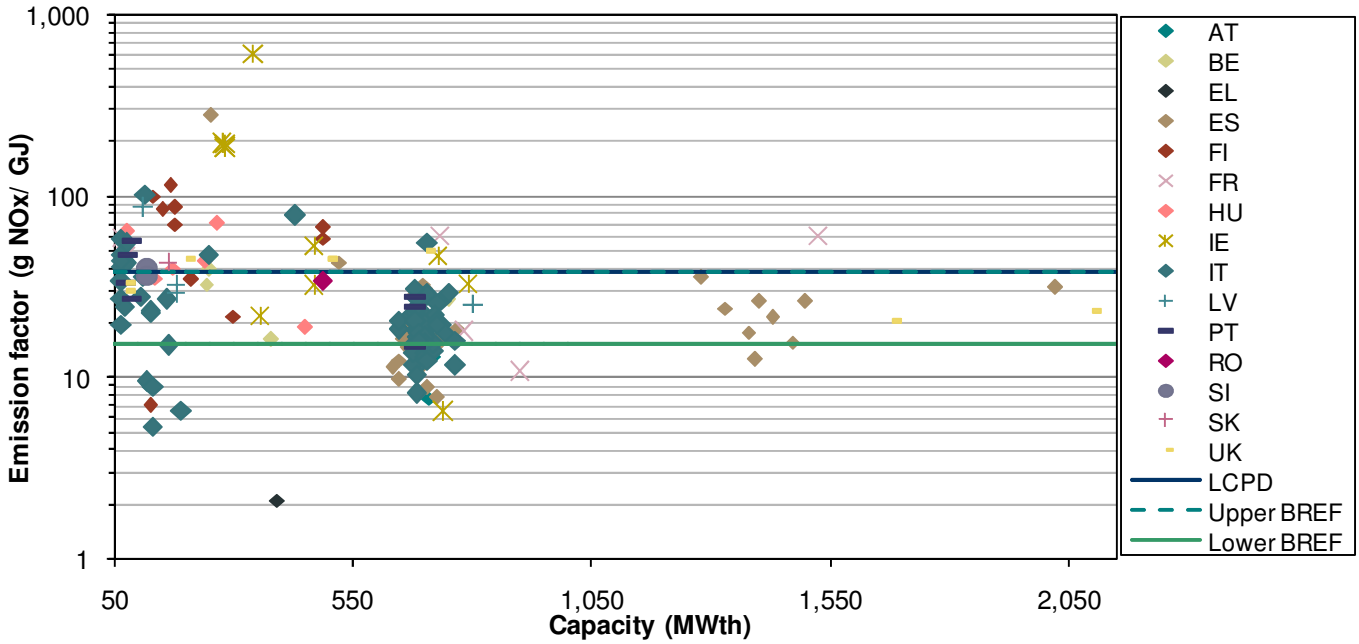


Figure 4.46 Natural gas LCP 2009 NO_X EFs vs. BAT-AELs (Article 4(1) and Article 4(3) gas turbine plants)



Note: Both axes are shown with logarithmic scales in order to show more clearly the distribution of LCPs.
Note: one outlier of EF 100,000g NO_X/GJ (identified in Table 4.21) is not shown on this plot.

Figure 4.47 Natural gas LCP 2009 NO_X EFs vs. LCP Directive ELVs and BAT-AELs (Article 4(2) gas turbine plants)



Note: the y-axis is shown with a logarithmic scale in order to show more clearly the distribution of LCPs.

4.8 Comparison of Member State reported emissions against Accession Treaty obligations

The Accession Treaty of 2003[18] set out transitional measures for the accession of the Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovakia. The Accession Treaty of 2005[19] set out transitional measures for the accession of Bulgaria and Romania. For several of the new Member States, these measures included derogations for individual LCPs from the requirements (ELVs) of the LCP Directive. In some cases, these derogations have been made subject to meeting intermediate ceilings for emissions of SO_2, NO_X and / or dust from some or all LCPs. The LCP inventory can be used to compare the actual emissions with the intermediate transition ceiling.

The Accession Treaty provisions are compared against the relevant data from the LCP inventories in Table 4.32. The comparison shows that:

- Estonia's 2007 to 2009 annual SO_2 emissions from oil shale fired combustion plants are decreasing, but are still much higher than the 2012 target;
- Lithuania met its 2008 SO_2 and NO_X ceilings;
- Poland exceeded its 2008 SO_2 ceiling and met its 2008 NO_X ceiling. The 2009 emissions were below the 2010 SO_2 and NO_X ceilings.
- Bulgaria significantly exceeded its 2008 SO_2, NO_X and dust ceiling. The 2009 inventory data show emission levels considerably higher than the 2008 and 2012 ceilings.
- Romania met its 2008 SO_2, NO_X and dust ceilings. The 2009 NO_X and dust emissions are already below the 2010 ceiling, but Romania's 2009 SO_2 emissions were 60kt higher than the 2010 ceiling.

[18] OJ L236 (Volume 46), of 23 September 2003

[19] OJ L157 (Volume 48), of 21 June 2005

Table 4.32 Summary of intermediate pollutant ceilings from Accession Treaties

(Accession) Member State	Accession Treaty criteria/criterion			LCP inventory	
	Pollutant	Year	Emission ceiling (kt)	Year	Pollutant emissions (kt)
EE	SO_2 emissions from oil shale fired combustion plants	2012	25	2007	77 (Note 1)
				2008	57(Note 1)
				2009	43(Note 1)
LT	SO_2 emissions relating to electricity generation from the Lithuanian Thermal Power Plant, the Vilnius Combined Heat and Power Plant CHP-3, the Kaunas Combined Heat and Power Plant and the Mažeikiai Combined Heat and Power Plant	2008	21.5	2008	3.2 (Note 2)
	NO_X emissions relating to electricity generation from the Lithuanian Thermal Power Plant, the Vilnius Combined Heat and Power Plant CHP-3, the Kaunas Combined Heat and Power Plant and the Mažeikiai Combined Heat and Power Plant	2008	5.0	2008	2.5 (Note 2)
PL	SO_2 emissions from all LCPs	2008	454	2008	500
		2010	426	2009	385
	NO_X emissions from all LCPs	2008	254	2008	243
		2010	251	2009	248
BG	SO_2 emissions from all LCPs	2008	179.7	2008	594
		2012	103	2009	426
	NO_X emissions from all LCPs	2008	42.9	2008	66
		2012	33.3	2009	55
	Dust emissions from all LCPs	2008	8.9	2008	18.5
		2012	6	2009	14.4
RO	SO_2 emissions from all LCPs	2008	530	2008	453
		2010	336	2009	396
	NO_X emissions from all LCPs	2008	125	2008	85
		2010	114	2009	64
	Dust emissions from all LCPs	2008	33.8	2008	20.5
		2010	23.2	2009	16.3

Note 1: Sum of all oil-shale fired LCPs.
Note 2: These are emissions related to electricity generation from the LCPs mentioned.

5. Recommendations

5.1 Member State Feedback

During the course of the study some Member States provided feedback on the reporting process and the template provided by the Commission. The following points were raised:

- Not all the conditional formatting of the template for Article 15(3) reporting was correctly functioning, such that confusion arose when trying to report such LCPs;
- The Article 15(3) field on the template around sulphur input was not clear to some Member States;
- Since many Member State submitted letters (not spreadsheets) to indicate that they didn't apply any provisions that needed to be reported under Article 15(3), there was no need to need to fill in a spreadsheet on them. Perhaps a tickbox option (or something similar) could be provided to indicate this when reporting the wider inventory;
- Spanish authorities needed to report Article 5(2) data but had to put it in the Article 5(1) template;
- There should be greater clarity on classification of a gas turbine. Since a gas turbine is at the unit level, and an LCP can comprise multiple (different) units, it is not clear how to report e.g. an LCP that comprises boilers and turbines; and
- For situations in which plants were extended after 27 November 2002 (according to Article 10 of the Directive), it is not clear if this has been taken into account in the age classification of LCPs.

5.2 Proposed Recommendations

The formal reporting requirements are set out in Annex VIII of the LCP Directive. The recommendations presented in this section aim to improve consistency in reporting and aid the analysis of inventories and additional information, keeping in mind that the provisions of the IED will replace the reporting obligations under the LCP Directive from 2016 on.

Table 5.1 outlines the proposed recommendations for future reporting based on the issues encountered during this study and direct feedback from Member State representatives (as summarised above).

Table 5.1 Proposed recommendations for future reporting under the LCP Directive

Problem	Recommendation	Discussion
P1. A number of Member States reported issues with using the data collection template provided by the Commission in that it was not clear exactly what information needed to be reported. This included specifically problems with the Article 15(3) reporting template (conditional formatting).	R1. Develop revised template with interactive guidance which is more user-friendly and easier to complete (see later recommendations for further details of ways in which template can be revised). Specifically for the Article 15(3) reports this could: • correct the conditional formatting error in the template; • add sulphur input reporting guidance; and • clarify the units of data that are to be reported for Annex III nota bene derogations.	The data submitted by Member States in Article 15(3) reports regarding the nota bene in Annex III were not robust enough to enable an assessment of total desulphurisation rates. Barriers that were faced in the analysis included, for example, unclear units of data, incorrect data being reported (% sulphur rather than absolute sulphur input), and insufficiently detailed data for LCPs for which derogations have been applied to parts of the LCP only. Revisions to the template would not need to be significant.
P2. Some Member States' inventories appear to continue to not use the common stack approach for reporting. Some appeared to report data according to a boiler or installation interpretation of combustion plant rather than at the common stack level.	No recommendation.	Some Member States (e.g. Portugal, Spain, UK) have indicated that improvements to address this issue are included in the 2007-2009 reporting period. Other Member States have indicated that work is still on-going on this topic (e.g. Denmark, Slovakia, Sweden). The topic has not been raised explicitly with Member States as part of this work.
P3. A number of errors and data gaps appeared in inventories submitted.	R2. Much of this can be avoided by developing a spreadsheet that includes automatic checking of data to identify gaps as it is being entered. This could be incorporated in online reporting, for example.	Prior to consultation undertaken with Member States in this study, 17 inventories had data gaps or queries regarding obligatory data and an additional 3 inventories had data gaps or queries regarding optional data. 12 of the Member States' Article 4(4) reports had data gaps or queries prior to consultation, and 23 Member States' Article 15(3) reports had data gaps or queries.
P4. Current data collection template is disaggregated by year (i.e. separate worksheets in the excel workbook). This does not allow the user to identify inconsistencies between inventory years on a plant level (e.g. erroneous data) and has required considerable effort to fill data gaps.	R3. Include single worksheet for all three years rather than disaggregated. R4. Include additional status column for each year which can be unticked if a particular plant does not operate in one or more years that the inventory covers (default = operational for all three years). If a box for a particular year is deselected then the associated cells (e.g. emissions, fuel consumption) could be shaded so that no data is entered by mistake.	Reporting data for all three years on a single sheet should reduce and hopefully prevent inconsistencies at a plant level between years. This should make reporting simpler for Member States (i.e. reporting on a single worksheet rather than three) and also reduce the amount of time and resources required to collate and review the data reported. However, Member States may already request data per year, such that changes to Member State approaches may be necessary (e.g. adding subsequent years' data alongside previous data). This could be further enhanced through automated error checking (R2).

Problem	Recommendation	Discussion
P5. Member States have expressed confusion over how to report sector and gas turbine information.	R5. Use NFR codes (or other recognised approach) for sector information. Provide guidance on reporting of gas turbines.	Regarding sector classification, Member States asked for guidance about how to classify LCPs. E.g. whether an electricity generation plant, which also produces heat, should be classed as ESI or CHP. Since a gas turbine is at the unit level, and an LCP can comprise multiple (different) units, it is not clear how to report e.g. an LCP that comprises boilers and turbines.
P6. Lengthy data collection and analysis	R6. Analysis could be streamlined through automation of the data collection template i.e. data reported by Member States could be inputted into a master spreadsheet which could automatically collate and produce the relevant overview statistics. R7. Member States could upload data to an online database.	Automating the spreadsheet will reduce the time and resources required to collate and review the inventory data. In addition, allowing Member States to report via an online database could save them time and could allow for automatic collation and checking.
P7: LCPs that have been extended according to Article 10 cannot strictly be categorised into one of the three Article 4 age categories used in this study.	R8: Consider amending the template to capture in future reporting periods information at a plant level of whether a plant has been extended according to Article 10.	The process should be kept as simple as possible for Member States to gather these data.

Appendix A
Status of consultation with each Member State

Table A1 below summarises the status of consultation AMEC has had with each Member State, including communications with Member States up to 2 December 2011. A list of remaining data gaps for each Member State was included in Table 3.2.

Table A.1 Overview of status of discussions with each Member State

Member State	Status of discussions
Austria	Final clarification received 17th November for all queries submitted.
Belgium	Final clarification received 5th September for all but one of the queries submitted. An outstanding data gap remains on emissions from three LCPs.
Bulgaria	Final clarification received 5th July for all queries submitted. Additional consultation undertaken regarding flue gas volumes on 4th October.
Cyprus	Final clarification received 1st August for all queries submitted.
Czech Republic	Final clarification received 20th July for all queries submitted.
Denmark	Final clarification received 12th August for all queries submitted. Competent authority indicated that the provision of an inventory compiled at LCP-level would not be available in time for this report.
Estonia	Final clarification received 10th August for all queries submitted.
Finland	Final clarification received 14th November for all queries submitted.
France	Final clarification received 8th August for all queries submitted.
Germany	Final clarification received 10th October. Data gaps remain for optional data.
Greece	Final clarification received 10th August for all queries submitted. Additional consultation undertaken regarding flue gas volumes on 5th October.
Hungary	Final clarification received 23rd November for all queries submitted.
Ireland	Final clarification received 11th July for all queries submitted.
Italy	Most recent clarification received 11th October. Data gaps remain for optional data.
Latvia	Final clarification received 27th September for all queries submitted.
Lithuania	Final clarification received 21st July for all queries submitted. Data gaps remain for optional data.
Luxembourg	No data gaps for consultation.
Malta	Final clarification received 11th July for all queries submitted.
Netherlands	Most recent communication received 23rd September. Data gaps remain.
Poland	Most recent communication 2nd December. Data gaps remain for opted out plants and optional data.
Portugal	Final clarification received 26th August for all queries submitted.

Member State	Status of discussions
Romania	Final clarification received 26th July for all queries submitted.
Slovakia	Final clarification received 10th August for all queries submitted.
Slovenia	No data gaps for consultation.
Spain	Most recent communication received 25th July. **Follow-up emails and telephone messages in August and September have not been acknowledged or answered.** Data gaps remain.
Sweden	Most recent communication received 30th September indicated that outstanding data gaps will only be resolved through resubmission of the 2007/8 inventories which were not received in time for this report. Data gaps remain.
United Kingdom	Most recent clarification received 25th November. Data gaps remain with Article 15(3) reporting.

Appendix B
Selected data tables

February 2012
Doc Reg No. 29499-02

Table B.1 Total reported energy input relating to net calorific value in 2007 to refinery LCPs, split by fuel type

Member State	Biomass		Other solid fuels		Liquid fuels		Natural gas		Other gases		Total
	PJ	%	PJ	%	PJ	%	PJ	%	PJ	%	PJ
AT	0	0%	3	8%	12	31%	1	2%	22	59%	**38**
BE	0	0%	0	0%	10	22%	0	0%	34	78%	**43**
BG	0	0%	0	0%	7	42%	8	47%	2	11%	**18**
CY											
CZ	0	0%	26	70%	8	21%	2	6%	1	2%	**37**
DE	0	0%	1	0%	62	22%	14	5%	205	73%	**283**
DK	0	0%	0	0%	0	0%	0	0%	15	100%	**15**
EE											
EL	0	0%	0	0%	12	47%	0	0%	14	53%	**26**
ES	0	0%	0	0%	60	51%	0	0%	59	49%	**120**
FI	0	0%	0	0%	3	21%	12	73%	1	7%	**16**
FR	0	0%	0	0%	64	37%	1	1%	106	62%	**171**
HU	0	0%	0	0%	2	27%	2	32%	3	40%	**8**
IE	0	0%	0	0%	6	100%	0	0%	0	0%	**6**
IT	0	0%	17	8%	56	24%	18	8%	137	60%	**228**
LT	0	0%	0	0%	3	30%	0	0%	7	70%	**11**
LU											
LV											
MT											
NL	0	0%	0	0%	19	26%	5	7%	48	67%	**72**
PL	0	0%	0	0%	42	89%	0	0%	5	11%	**47**
PT	0	0%	0	0%	13	79%	0	0%	3	21%	**16**
RO	0	0%	0	0%	2	23%	3	30%	4	47%	**9**
SE	0	0%	2	5%	1	3%	1	3%	33	89%	**37**
SI											
SK	0	0%	0	0%	12	95%	0	0%	1	4%	**13**
UK	0	0%	0	0%	37	21%	16	9%	122	70%	**175**
EU-27	**0**	**0%**	**49**	**4%**	**432**	**31%**	**84**	**6%**	**823**	**59%**	**1,387**

Note: Cyprus, Estonia, Latvia, Luxembourg, Malta and Slovenia have reported zero refinery LCPs.

Table B.2 Total reported energy input relating to net calorific value in 2008 to refinery LCPs, split by fuel type

Member State	Biomass		Other solid fuels		Liquid fuels		Natural gas		Other gases		Total
	PJ	%	PJ	%	PJ	%	PJ	%	PJ	%	PJ
AT	0	0%	3	8%	12	32%	1	2%	23	61%	**39**
BE	0	0%	0	0%	7	17%	0	0%	38	87%	**45**
BG	0	0%	0	0%	4	20%	3	18%	1	8%	**8**
CY											
CZ	0	0%	26	70%	7	20%	9	26%	2	5%	**44**
DE	0	0%	1	0%	57	20%	16	6%	212	75%	**286**
DK	0	0%	0	0%	0	0%	0	0%	14	93%	**14**
EE											
EL	0	0%	0	0%	12	45%	0	0%	13	49%	**25**
ES	0	0%	0	0%	56	47%	0	0%	55	46%	**110**
FI	0	0%	0	0%	3	18%	12	74%	1	7%	**16**
FR	0	0%	0	0%	63	37%	2	1%	109	64%	**173**
HU	0	0%	0	0%	2	31%	2	32%	3	33%	**7**
IE	0	0%	0	0%	6	103%	0	0%	0	0%	**6**
IT	0	0%	13	6%	58	26%	22	10%	130	57%	**224**
LT	0	0%	0	0%	4	38%	0	0%	13	119%	**17**
LU											
LV											
MT											
NL	0	0%	0	0%	18	25%	5	7%	60	84%	**83**
PL	0	0%	0	0%	41	87%	0	0%	5	10%	**46**
PT	0	0%	0	0%	11	68%	1	6%	3	18%	**15**
RO	0	0%	0	0%	2	27%	7	72%	3	36%	**12**
SE	0	0%	0	0%	1	2%	1	2%	17	45%	**18**
SI											
SK	0	0%	0	0%	13	98%	0	0%	2	12%	**14**
UK	0	0%	0	0%	36	20%	23	13%	127	72%	**186**
EU-27	**0**	**0%**	**43**	**3%**	**413**	**30%**	**104**	**7%**	**829**	**60%**	**1,388**

Note: Cyprus, Estonia, Latvia, Luxembourg, Malta and Slovenia have reported zero refinery LCPs.

Table B.3 Total reported energy input relating to net calorific value in 2009 to refinery LCPs, split by fuel type

Member State	Biomass		Other solid fuels		Liquid fuels		Natural gas		Other gases		Total
	PJ	%	PJ	%	PJ	%	PJ	%	PJ	%	PJ
AT	0	0%	3	8%	12	33%	2	6%	22	57%	**39**
BE	0	0%	0	0%	5	12%	0	0%	32	75%	**38**
BG	0	0%	0	0%	4	25%	3	20%	1	6%	**9**
CY											
CZ	0	0%	24	65%	7	18%	3	9%	1	4%	**35**
DE	0	0%	3	1%	58	20%	20	7%	198	70%	**278**
DK	0	0%	0	0%	0	0%	0	0%	15	99%	**15**
EE											
EL	0	0%	0	0%	12	44%	0	0%	12	46%	**24**
ES	0	0%	0	0%	52	44%	0	0%	73	61%	**125**
FI	0	0%	0	0%	3	21%	12	76%	1	3%	**16**
FR	0	0%	0	0%	54	32%	0	0%	111	65%	**165**
HU	0	0%	0	0%	2	27%	2	31%	3	42%	**8**
IE	0	0%	0	0%	5	90%	0	0%	0	0%	**5**
IT	0	0%	12	5%	52	23%	19	8%	124	54%	**206**
LT	0	0%	0	0%	4	33%	0	0%	13	119%	**16**
LU											
LV											
MT											
NL	0	0%	0	0%	4	5%	5	7%	52	73%	**61**
PL	0	0%	0	0%	41	87%	0	0%	6	12%	**47**
PT	0	0%	0	0%	6	39%	1	4%	4	23%	**11**
RO	0	0%	0	0%	1	13%	4	46%	3	33%	**8**
SE	0	0%	0	0%	0	1%	0	0%	18	50%	**19**
SI											
SK	0	0%	0	0%	13	97%	0	1%	0	4%	**13**
UK	0	0%	0	0%	29	17%	15	9%	119	68%	**163**
EU-27	**0**	**0%**	**41**	**3%**	**365**	**26%**	**88**	**6%**	**808**	**58%**	**1,302**

Note: Cyprus, Estonia, Latvia, Luxembourg, Malta and Slovenia have reported zero refinery LCPs.

Table B.4 Total reported energy input relating to net calorific value in 2007 to non-refinery LCPs, split by fuel type

Member State	Biomass		Other solid fuels		Liquid fuels		Natural gas		Other gases		Total
	PJ	%	PJ	%	PJ	%	PJ	%	PJ	%	PJ
AT	14	8%	49	27%	7	4%	88	49%	23	13%	**181**
BE	15	4%	62	19%	11	3%	211	64%	33	10%	**332**
BG	1	0%	262	82%	2	1%	52	16%	3	1%	**321**
CY	0	0%	0	0%	50	100%	0	0%	0	0%	**50**
CZ	5	1%	636	91%	11	2%	16	2%	34	5%	**701**
DE	51	1%	2,755	70%	82	2%	813	21%	226	6%	**3,926**
DK	17	9%	136	69%	12	6%	33	17%	0	0%	**198**
EE	0	0%	123	89%	0	0%	11	8%	3	2%	**138**
EL	0	0%	343	68%	57	11%	105	21%	0	0%	**504**
ES	4	0%	691	55%	95	8%	413	33%	59	5%	**1,261**
FI	61	15%	230	58%	6	2%	90	23%	9	2%	**395**
FR	23	4%	286	51%	93	17%	89	16%	66	12%	**557**
HU	13	6%	62	28%	6	2%	134	60%	9	4%	**224**
IE	0	0%	68	32%	25	12%	118	56%	0	0%	**212**
IT	14	1%	422	21%	224	11%	1,224	59%	174	8%	**2,058**
LT	4	6%	0	1%	9	14%	50	80%	0	0%	**63**
LU	0	0%	0	0%	0	0%	17	100%	0	0%	**17**
LV	0	0%	0	1%	1	3%	30	96%	0	0%	**32**
MT	0	0%	0	0%	26	100%	0	0%	0	0%	**26**
NL	14	2%	212	31%	1	0%	350	51%	115	17%	**693**
PL	22	1%	1,532	95%	4	0%	10	1%	37	2%	**1,606**
PT	6	3%	111	50%	20	9%	84	38%	0	0%	**221**
RO	0	0%	310	65%	13	3%	153	32%	2	0%	**479**
SE	146	58%	52	20%	33	13%	13	5%	10	4%	**253**
SI	0	1%	60	97%	0	0%	1	2%	0	0%	**62**
SK	3	2%	74	58%	0	0%	41	32%	10	8%	**129**
UK	25	1%	1,207	50%	32	1%	1,090	45%	51	2%	**2,404**
EU-27	**438**	**3%**	**9,685**	**57%**	**820**	**5%**	**5,238**	**31%**	**863**	**5%**	**17,044**

Table B.5 Total reported energy input relating to net calorific value in 2008 to non-refinery LCPs, split by fuel type

Member State	Biomass		Other solid fuels		Liquid fuels		Natural gas		Other gases		Total
	PJ	%	PJ	%	PJ	%	PJ	%	PJ	%	PJ
AT	7	4%	55	30%	7	4%	92	51%	22	12%	**183**
BE	21	6%	53	16%	5	2%	195	59%	33	10%	**308**
BG	1	0%	272	85%	2	1%	38	12%	1	0%	**314**
CY	0	0%	0	0%	52	104%	0	0%	0	0%	**52**
CZ	9	1%	587	84%	6	1%	15	2%	35	5%	**651**
DE	52	1%	2,583	66%	85	2%	901	23%	220	6%	**3,841**
DK	16	8%	165	83%	11	6%	34	17%	0	0%	**225**
EE	0	0%	104	76%	0	0%	10	8%	4	3%	**119**
EL	0	0%	338	67%	63	13%	100	20%	0	0%	**501**
ES	3	0%	501	40%	111	9%	567	45%	1	0%	**1,183**
FI	73	18%	162	41%	5	1%	93	24%	9	2%	**341**
FR	22	4%	270	48%	86	16%	91	16%	62	11%	**532**
HU	14	6%	86	38%	4	2%	114	51%	9	4%	**226**
IE	0	0%	65	31%	18	8%	123	58%	0	0%	**207**
IT	10	0%	413	20%	178	9%	1,229	60%	174	8%	**2,004**
LT	2	3%	0	0%	9	14%	42	66%	0	0%	**52**
LU	0	0%	0	0%	0	0%	13	80%	0	0%	**13**
LV	0	0%	0	1%	1	2%	29	92%	0	0%	**30**
MT	0	0%	0	0%	26	99%	0	0%	0	0%	**26**
NL	20	3%	203	29%	1	0%	334	48%	110	16%	**669**
PL	31	2%	1,475	92%	2	0%	11	1%	36	2%	**1,555**
PT	6	3%	99	45%	16	7%	95	43%	1	0%	**216**
RO	0	0%	314	66%	10	2%	132	28%	1	0%	**457**
SE	169	67%	85	34%	24	9%	10	4%	10	4%	**298**
SI	2	3%	67	109%	0	0%	2	3%	0	0%	**71**
SK	4	3%	72	56%	0	0%	53	41%	11	8%	**141**
UK	39	2%	1,151	48%	44	2%	1,142	48%	46	2%	**2,422**
EU-27	**499**	**3%**	**9,123**	**54%**	**767**	**4%**	**5,465**	**32%**	**783**	**5%**	**16,637**

Table B.6 Total reported energy input relating to net calorific value in 2009 to non-refinery LCPs, split by fuel type

Member State	Biomass		Other solid fuels		Liquid fuels		Natural gas		Other gases		Total
	PJ	%	PJ	%	PJ	%	PJ	%	PJ	%	PJ
AT	6	3%	43	24%	7	4%	88	49%	20	11%	**166**
BE	25	8%	49	15%	4	1%	237	71%	18	5%	**334**
BG	1	0%	246	77%	3	1%	33	10%	0	0%	**283**
CY	0	0%	0	0%	51	101%	0	0%	0	0%	**51**
CZ	9	1%	552	79%	5	1%	29	4%	28	4%	**623**
DE	52	1%	2,378	61%	85	2%	824	21%	178	5%	**3,517**
DK	17	9%	164	83%	13	6%	34	17%	0	0%	**228**
EE	4	3%	84	61%	1	0%	25	18%	4	3%	**117**
EL	0	0%	335	67%	39	8%	67	13%	0	0%	**441**
ES	2	0%	368	29%	82	6%	537	43%	23	2%	**1,012**
FI	64	16%	176	45%	6	1%	78	20%	6	1%	**330**
FR	16	3%	257	46%	80	14%	113	20%	48	9%	**514**
HU	29	13%	72	32%	8	4%	84	37%	7	3%	**200**
IE	1	0%	56	26%	11	5%	118	56%	0	0%	**185**
IT	13	1%	379	18%	146	7%	1,020	50%	127	6%	**1,685**
LT	2	4%	0	0%	19	30%	40	64%	0	0%	**61**
LU	0	0%	0	0%	0	0%	17	99%	0	0%	**17**
LV	0	1%	0	1%	1	3%	24	75%	0	0%	**25**
MT	0	0%	0	0%	24	92%	0	0%	0	0%	**24**
NL	25	4%	207	30%	1	0%	356	51%	134	19%	**724**
PL	52	3%	1,439	90%	2	0%	15	1%	24	1%	**1,532**
PT	7	3%	112	51%	9	4%	85	38%	1	0%	**213**
RO	0	0%	266	56%	17	4%	104	22%	0	0%	**387**
SE	111	44%	21	8%	22	9%	19	8%	9	4%	**183**
SI	1	1%	57	92%	0	0%	3	5%	0	0%	**61**
SK	4	3%	64	49%	0	0%	41	32%	11	8%	**120**
UK	26	1%	950	39%	32	1%	1,172	49%	51	2%	**2,231**
EU-27	**465**	**3%**	**8,276**	**49%**	**668**	**4%**	**5,164**	**30%**	**690**	**4%**	**15,264**