



Ricardo
Energy & Environment

Industrial emissions policy country profile – Spain

Report for European Commission
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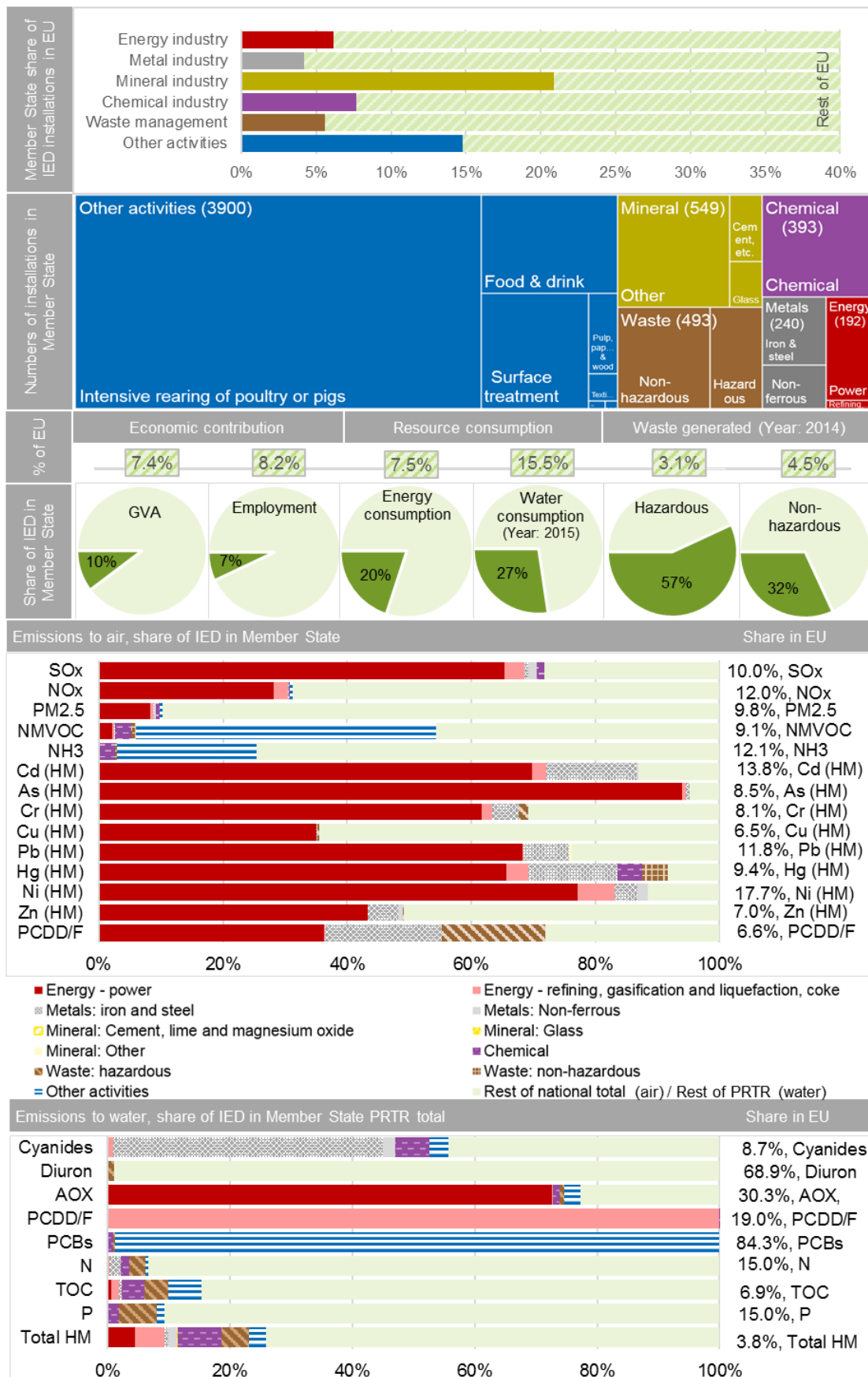
Appendix 1 Mapping industrial sectors across data sources for Spain

Appendix 2 Emissions to air by pollutant and industrial sector (detail)

Abbreviations and units

AOX	Adsorbable Organic Halides
As	Arsenic
Cd	Cadmium
CLRTAP	Convention on Long-range Transboundary Air Pollution
CO ₂	Carbon Dioxide
Cr	Chromium
Cu	Copper
DG	Directorate-General
EEA	European Environment Agency
E-PRTR	European Pollutant Release and Transfer Register
ES	Spain
EU	European Union
EUR	Euros
GVA	Gross Value Added
HCBs	Hexachlorobenzenes
Hg	Mercury
HM	Heavy Metals
IED	Industrial Emissions Directive
IPPCD	Integrated Pollution Prevention and Control Directive
kg	Kilogram
ktoe	Kilotonne of oil equivalent
MW	Megawatts
N	Nitrogen
NACE	General Classification of Economic Activities within the European Communities
NH ₃	Ammonia
Ni	Nickel
NMVOG	Non-Methane Volatile Organic Compound
NO _x	Oxides of Nitrogen
P	Phosphorus
PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead
PCBs	Polychlorinated Biphenyls
PCDD	Polychlorinated Dibenzodioxins
PCDF	Polychlorinated Dibenzofurans
PJ	Petajoules
PM	Particulate Matter
SO _x	Oxides of Sulphur
TOC	Total Organic Carbon
Zn	Zinc

Summary of industrial statistics for Spain



1 Introduction and summary of methodology

1.1 The industrial emissions policy country profiles

Industrial activities play an important role in the economic welfare and development of countries contributing to their economic growth. They can also have a significant impact on their environment. Directive 2010/75/EC on Industrial Emissions (IED) aims to prevent and reduce harmful industrial emissions across the EU while promoting the use of techniques that reduce pollutant emissions and that are energy and resource efficient.

This document is part of a series of industrial emissions policy profiles that provide an overview of industrial activities regulated by the IED for each Member State. This profile covers Spain.

The profiles show the economic significance of activities regulated by the IED in terms of the number of IED installations, their economic contribution (measured by gross value added and employment), and resources consumed (measured by energy and water consumed) – sections 2 and 3 respectively. The profiles also show the environmental impacts in terms of emissions to air and water (section 4) and waste generated (section 5).

The significance is shown both for the latest year of available data (typically 2015), as well as assessing the trends over time of key metrics. The data shown in the profiles is accompanied by descriptive analysis to bring together the various assessments made and draw out the salient messages. EU data sources used for each metric are described in a separate methodology paper together with their data limitations. The specific data sources used in this profile are summarised in Appendix 1. Each of the sections 2, 3, 4 and 5 consider the gaps in these data sources specific for Spain and how they have been addressed.

The profile also identifies the impact of industrial sectors or activities in Spain, within the scope of the IED policy, and the importance and political attention paid to this (section 6).

1.2 Definition of industrial sectors

The approach taken in the country profiles identifies data and trends wherever possible for a set of industrial sectors. However, in the data sources used to develop the profiles, there are several different approaches to sectoral classification. Since the definition of an ‘industrial sector’ differs across data sources, an approach has been taken to try to consistently report ‘sectors’ as much as possible. This has been aligned with the grouping of activities in Annex I of the IED where possible, but in practice the available datasets limit this.

The sectors defined in these profiles are referred to as ‘industrial sectors’. Together these industrial sectors represent activity regulated by the IED, albeit subject to certain limitations as described here. The grouping for the industrial sectors has been chosen to reflect the level of granularity most commonly reported from EU data sources across the different metrics assessed while trying not to lose detail where it is available. The industrial sectors used in the profiles are shown in Table 1. A consistent colour scheme – also illustrated in Table 1 – is used throughout the profile.

Where available, the industrial sectors split out the energy, metal, mineral and waste management sectors into subsectors. Where this split is not possible, we refer to the respective IED sector group, e.g. metal in the case of the IED activities iron and steel and non-ferrous metals. Due to the large number and wide variety of activity within the IED sector ‘other activities’, these have also been grouped as ‘other activities’ in this profile, but split out into constituent industries when they are important sectors in the Member State in their own right, and where data are available.

Table 1: Industrial sectors used in the profiles with their corresponding IED Annex I activities

Industrial sectors used in the profiles	Corresponding IED Annex I activities	
Energy industries , split where possible into:	Energy: power	Combustion of fuels (activity 1.1)
	Energy: refining, gasification and liquefaction, coke ovens	Refining, gasification and liquefaction, coke ovens (activities 1.2, 1.3, 1.4)
Production and processing of metals , split where possible into:	Metals: iron and steel	Iron and steel manufacturing (activities 2.1, 2.2, 2.3, 2.4)
	Metals: non-ferrous	Non-ferrous metal production (activity 2.5)
Mineral industry , split where possible into:	Mineral: Cement, lime and magnesium oxide	Production of cement, lime and magnesium oxide (activity 3.1)
	Mineral: Glass	Manufacture of glass (activity 3.3)
	Mineral: Other	Other mineral industries (activities 3.2, 3.4, 3.5)
Chemical industry	Chemical	Chemical industry (activities 4.1, 4.2, 4.3, 4.4, 4.5, 4.6)
Waste management , split where possible into:	Waste: hazardous	Hazardous waste (activities 5.1, 5.2(b), 5.5, 5.6)
	Waste: non-hazardous	Non-hazardous waste (activities 5.2(a), 5.3, 5.4, 6.5, 6.11)
Other activities , split when constituent activities are important:	Other activities	<ul style="list-style-type: none"> Pulp, paper and wood production (activity 6.1) Pre-treatment or dyeing of textile fibres or textiles (activity 6.2) Tanning of hides and skins (activity 6.3) Food and drink (activity 6.4) Intensive rearing of poultry and pigs (activity 6.6) Surface treatment (activities 2.6, 6.7) Production of carbon (activity 6.8)

Note: No installations operated with IED activity 6.9 in 2015 or before. The limited data available for activity 6.10 means it is excluded from the analysis.

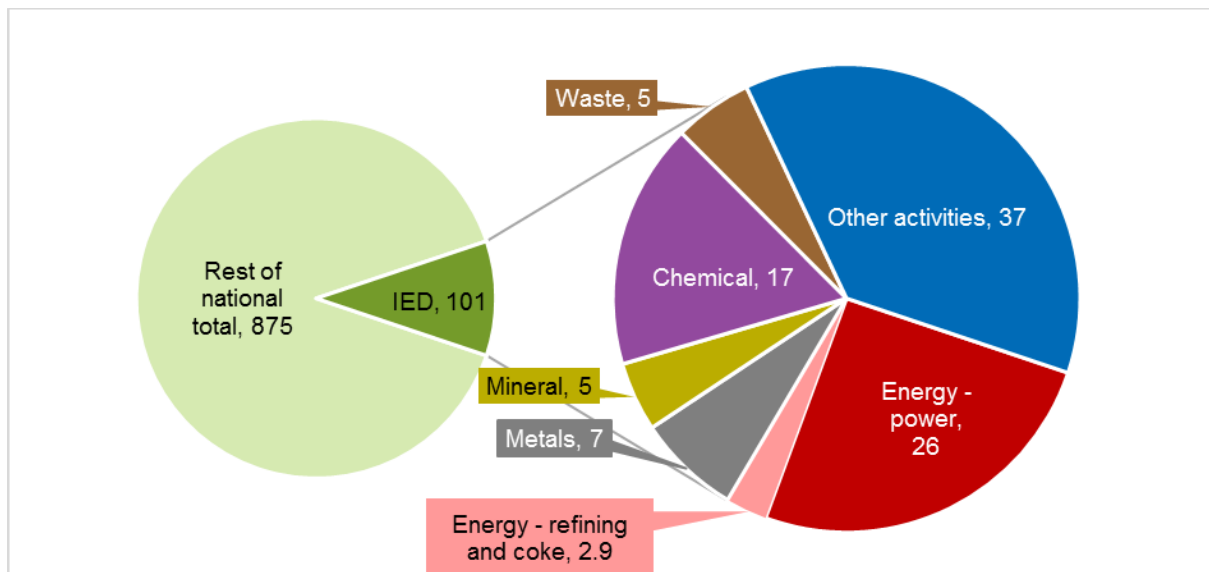
2 Economic significance of industrial sectors

2.1 Economic contribution

Gross value added (GVA) and employment are the indicators used to denote the economic contribution of IED activities.

Industrial sectors contribute a relatively small share (10%) of the total GVA across all economic activities in Spain; in 2015 they contributed €101 billion to Spain's economy (Figure 1). Of this share, 'other activities' account for the largest contribution (37%), followed by the energy - power (25%) and chemical (17%) industrial sectors. The reported GVA for 'other activities' consists mainly by food and drinks production (three quarters of 'other activities' GVA), followed by textiles and tanning [of leather products].

Figure 1: Gross value added of industrial sectors in 2015 (Current prices, billion EUR)

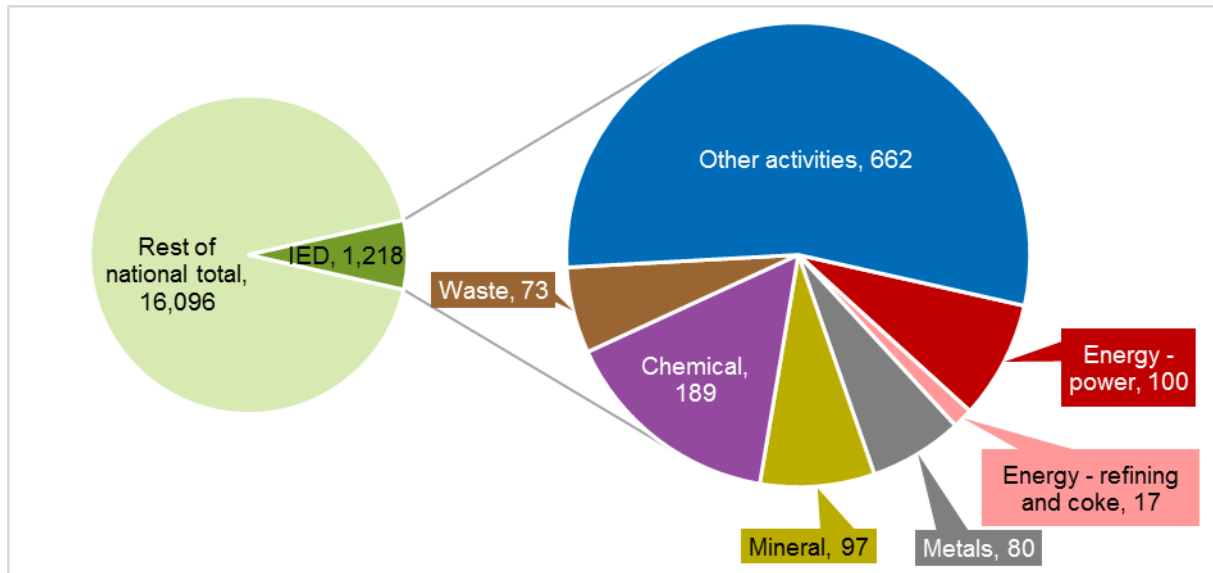


Note: Rest of national total means all NACE activity minus the industrial sectors shown here. GVA for metals, minerals, chemical, waste and 'other activities' were linearly extrapolated for year 2015 based on reported data for 2012-2014. GVA data for energy - refining and coke was a gap but has not been extrapolated, and instead has been updated with the most recent data marked as provisional from Eurostat.

Source: Eurostat (2017a)

The economic significance of industrial sectors shows a similar snapshot for employment (Figure 2). However, for employment, the chemicals sector is more significant compared to energy - power. Taken together, the GVA and employment indicate that 'other activities' (mainly food and drink production), chemical and energy - power industrial sectors are the most economically significant industrial sectors in Spain. However, it is necessary to take into account that GVA and employment data available from Eurostat do not include data on intensive rearing of poultry and pigs, which is an important economic sector in Spain.

Figure 2: Employment within industrial sectors in 2015 (thousands, aged 15 to 64 years)



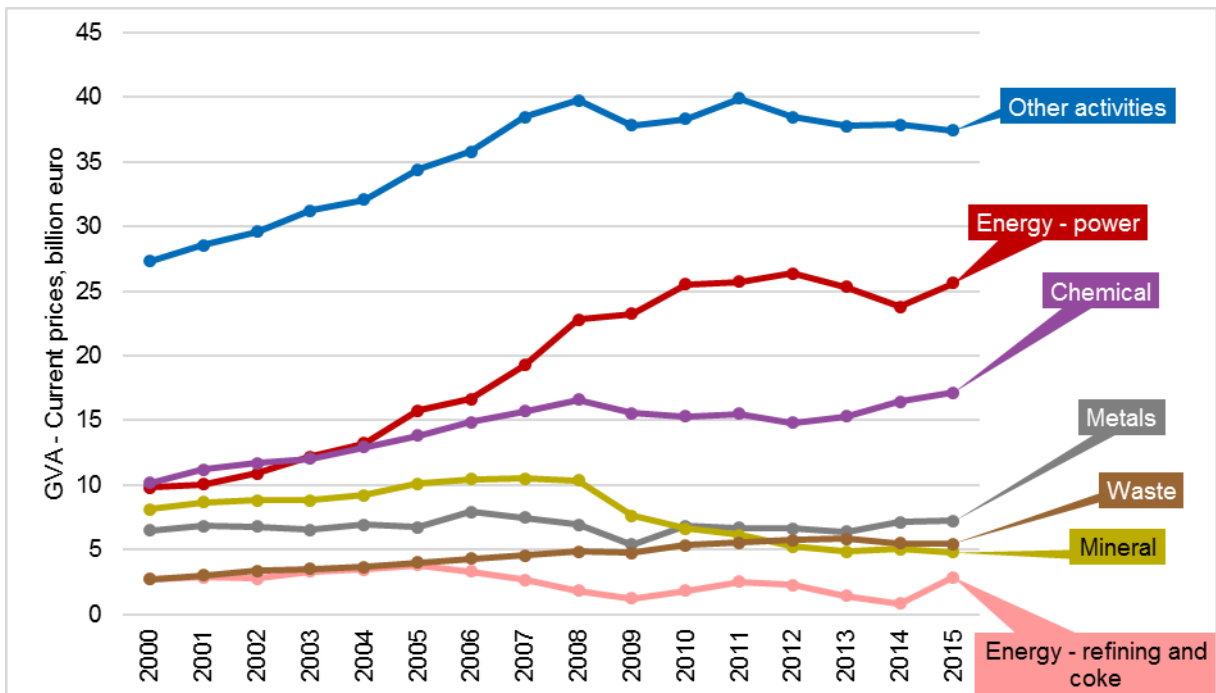
Note: Rest of national relates to all NACE activities minus industrial sector activity shown here.

Source: Eurostat (2017b)

The main areas of economic growth in Spain, as measured by growth in GVA over the period 2000 to 2015, are 'other activities' (mainly food and drink production), energy - power, chemicals and waste management sectors. The GVA of all these industrial sectors increased over the period 2000 to 2015, with most of the growth occurring in the 2000s (Figure 3). The economic contribution of the metals industrial sector remains approximately level over this period, whilst the minerals sector GVA has decreased over this period. The energy-refining and coke sector GVA has fluctuated, with latest estimates showing a similar GVA in 2015 to the early 2000s.

Taken together with the trends in employment (Figure 4), it can be observed that the trends in GVA have not necessarily correlated with trends in employment levels of the industrial sectors from 2008 to 2015. For the most economically significant sector, 'other activities', both GVA and employment levels fell between 2008 and 2015 (by ~ 6% and ~19% respectively). The energy-power sector however grew economically in terms of both GVA (by ~12%) and employment (~37%) between 2008 and 2015, as did the waste management sector. Employment in the chemical and metal industrial sectors declined despite a small growth in GVA between 2008 and 2015.

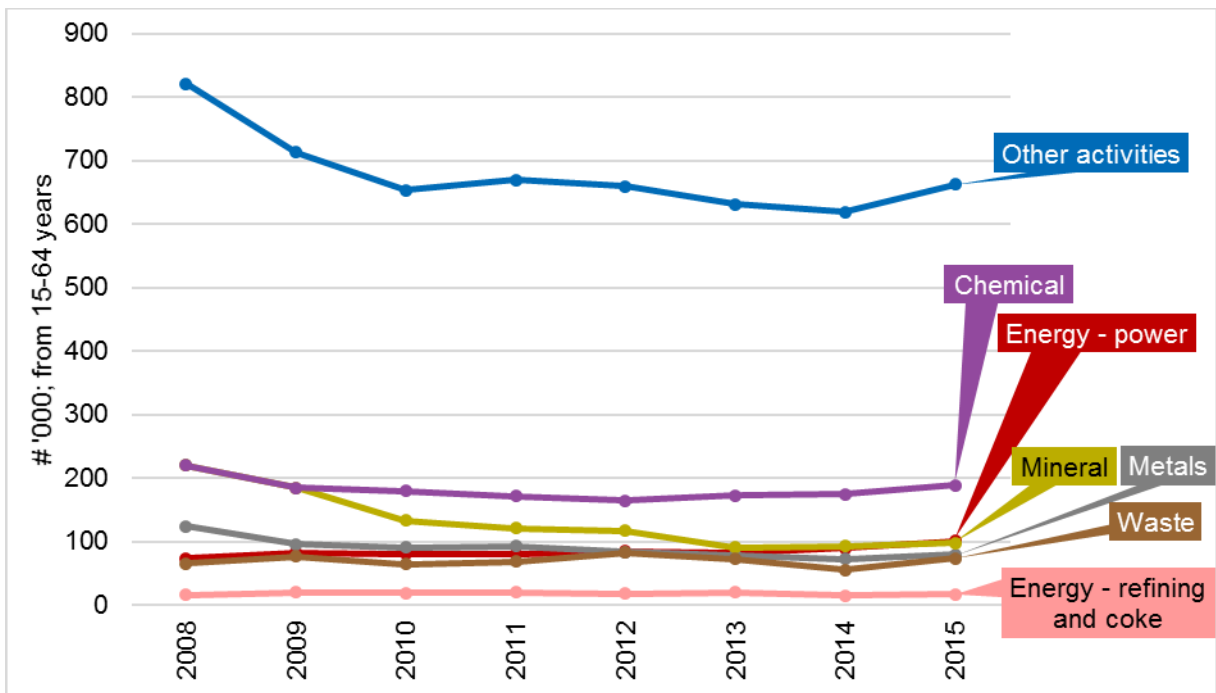
Figure 3: Gross value added of industrial sectors (2000-2015)



Note: GVA for all sectors (except energy – power and energy-refining and coke) is extrapolated for the year 2015 based on data reported for 2012-2014. For the energy-refining and coke industrial sector, data on GVA for the year 2015 is provisional.

Source: Eurostat (2017a)

Figure 4: Employment in industrial sectors (2008-2015)



Source: Eurostat (2017b)

Limitations

The use of NACE classifications for reporting has generally led to overreporting for both GVA and employment data against each industrial sector compared to a scope strictly limited to the IED. Overreporting is expected to be greatest for the waste management GVA data because it not only includes waste management, but also water supply, sewerage and waste remediation. No data could be included within 'other activities' to reflect the IED activity intensive rearing of poultry or pigs as reporting was not at the appropriate level of NACE classification.

Table 2: Gaps in GVA data for Spain

Missing data	Description	Conclusion and actions taken
Data gaps	No data for metals, minerals, chemicals, waste management and 'other activities' were available in the accessed Eurostat dataset for year 2015 (NACE activities C24, C23, C20, C21, E37-E39, C10-C12, C13-C15, C16 and C17)	Extrapolation undertaken for 2015 when preceded by 3 years of data. Gaps may be filled by subsequent updates by Eurostat

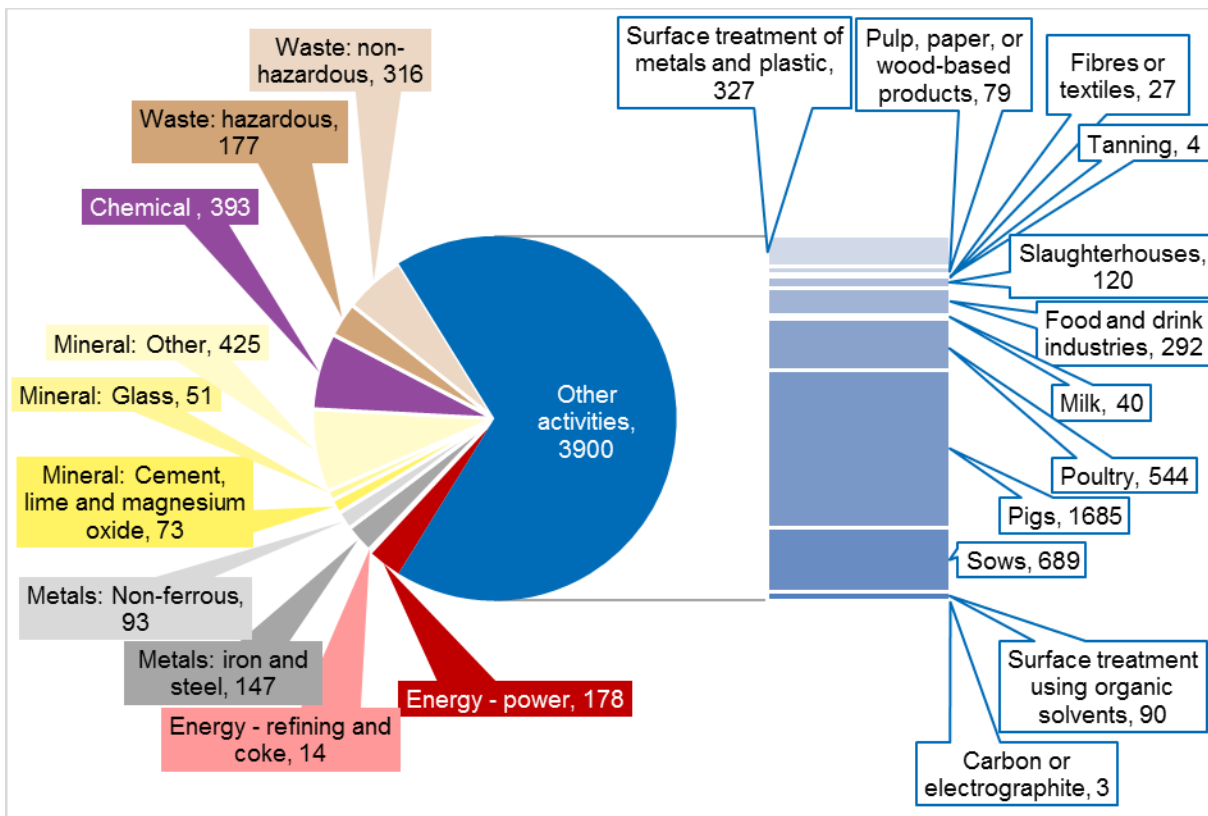
No national specific limitations were identified for the employment data used.

2.2 Number of IED installations

The most significant industrial sector in Spain in 2015, according to the reported number of permitted IED installations, is 'other activities'. It comprises 68% of total IED installations in 2015 (Figure 5 and Table 3). The activity within this sector with the most installations is intensive rearing of poultry and pigs making up nearly 50% of all permitted IED installations. In decreasing order of size, it is followed by the mineral, waste management and the chemical industrial sectors. Waste management industrial sectors, which are significantly represented by number of installations, do not contribute significantly to the GVA of industrial sectors in Spain. Intensive rearing of poultry and pigs is not reflected in GVA and employment data reported above.

According to this same dataset, most IED activities occur in Spain, except for gasification or liquefaction.

Figure 5: Number of installations by industrial sector in 2015, with 'other activities' split by IED activity



Source: IPPCD and IED reporting / DG Environment, Personal Communication

Table 3: Number of installations in 2011 and 2015 by industrial sector, with IED activity detail

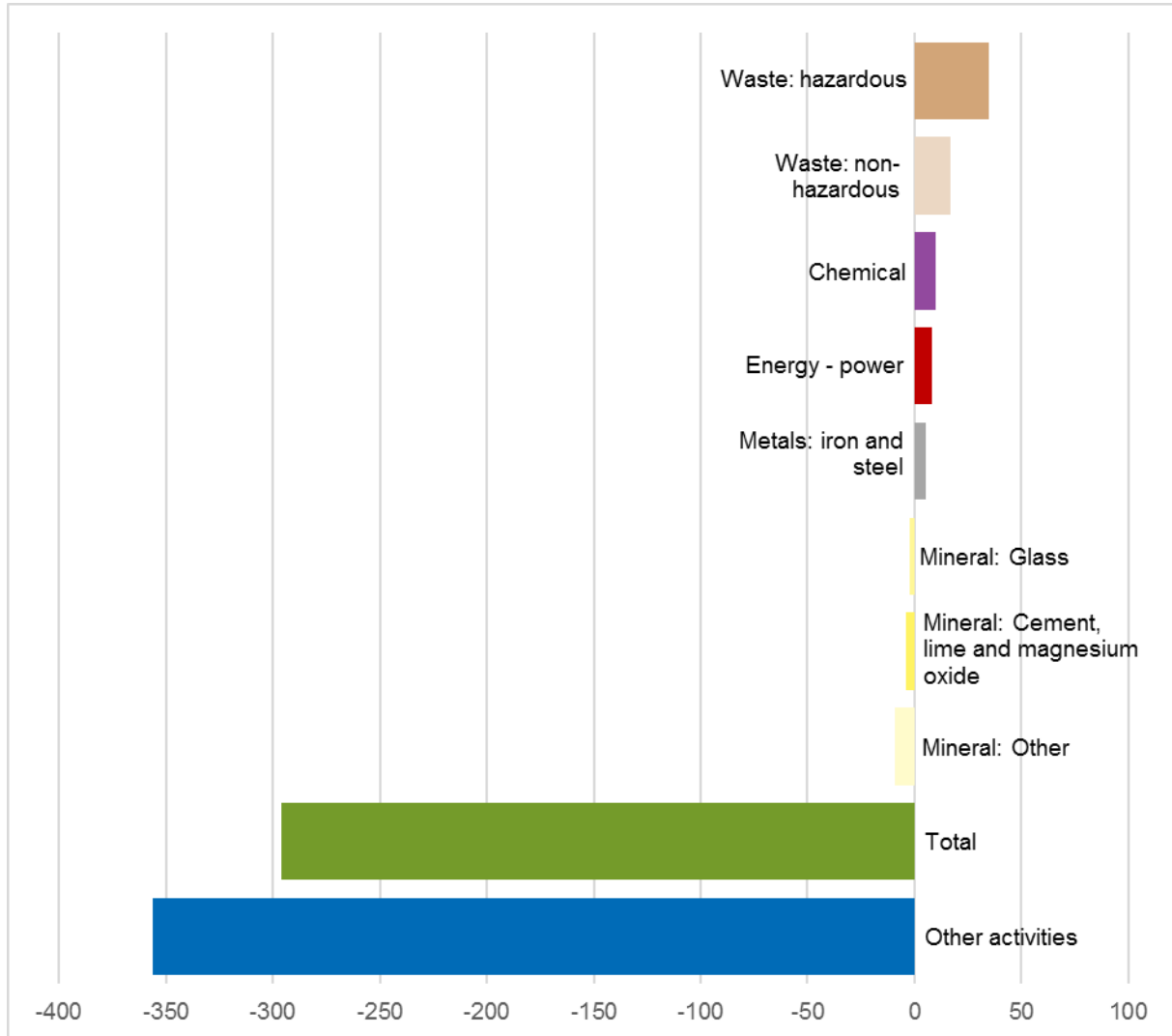
Industrial sector, with IED activity detail	2011	2015	Change in number of IED installations 2011 to 2015
Energy: power (1.1 combustion)	170	178	8
Energy: refining and coke	14	14	0
1.2 Refining	11	11	0
1.3 Production of coke	3	3	0
Metals: iron and steel	142	147	5
2.1 Metal ore	3	3	0
2.2 Pig iron or steel	29	29	0
2.3 Processing of ferrous metals	49	54	5
2.4 Ferrous metals foundries	61	61	0
Metal: non-ferrous (2.5 Non-ferrous metals)	93	93	0
Mineral: Cement, lime and magnesium oxide (3.1 Cement, lime and magnesium oxide)	77	73	0
Mineral: Glass (3.3 Glass)	53	51	-2
Mineral: Other	434	425	-9
3.4 Mineral fibres	2	1	-1
3.5 Ceramic	432	424	-8
Chemical	383	393	10
4.1 Organic chemicals	196	198	2
4.2 Inorganic chemicals	75	74	-1
4.3 Phosphorus-, nitrogen- or potassium-based fertilisers	35	38	3
4.4 Plant protection products	17	16	-1
4.5 Pharmaceutical products	55	61	6
4.6 Explosives	5	6	1
Waste: hazardous (5.1 Disposal / recovery only)	142	177	35
Waste: non-hazardous	299	316	17
5.2 co-/ incineration of hazardous and non-hazardous waste	13	13	0
5.3 Disposal of non-hazardous	18	33	15
5.4 Landfills	202	202	0
6.5 Disposal of animal carcasses	66	68	2
Other activities	4,256	3,900	-356
6.1 Pulp, paper, or wood-based products	80	79	-1
6.2 Textiles	29	27	-2
6.3 Tanning	4	4	0
6.7 Surface treatment using organic solvents	86	90	4
2.6 Surface treatment of metals and plastics	340	327	-13
6.4 (a) Slaughterhouses	111	120	9
6.4 (b) Food and drink	272	292	20
6.4 (c) Milk	39	40	1
6.6 (a) Poultry	415	544	129
6.6 (b) Pigs	2,200	1,685	-515
6.6 (c) Sows	677	689	12
6.8 Carbon or electrographite	3	3	0
Total	6,063	5,767	-296

Note: IED activities are in italics. The IED activity 5.2 (Disposal or recovery of waste in waste incineration plants or in waste co-incineration plants) relates to non-hazardous waste (5.2(a)) and hazardous waste (5.2(b)). Owing to the generally small number of installations reported within this category across the EU, these installations have been categorised as non-hazardous waste management. Data for permitted installations carrying out IED activity 6.11 is not included in the reported data and therefore not included in this table.

Source: IPPCD and IED reporting / DG Environment, Personal Communication

Between 2011 and 2015, there was a decrease in the number of permitted IED installations in Spain (comparing IPPCD installations to IED installations in this timeframe) (Figure 6). This decrease is mainly due to decreased number of installations for intensive rearing of pigs in the 'other activities' industrial sector (from 2,877 installations in 2011 to 2,374 installations in 2015) (Table 3).

Figure 6: Change in number of installations per industrial sector 2011 to 2015



Note: No change reported for the energy - refining and coke and non-ferrous metal sectors and so they are not included in the chart.

Source: IED reporting / DG Environment, Personal Communication

Limitations

The dataset used to reflect IED activity in Member States has a limited timeseries inherent to the reporting requirement and thus the number of permitted installations is only reported for the years 2011, 2013 and 2015. The industrial sectors indicated to be operating in Spain according to the data on numbers of installations matches the industrial sectors reporting to E-PRTR.

No national data limitations were identified for this dataset.

3 Resource use in industrial sectors

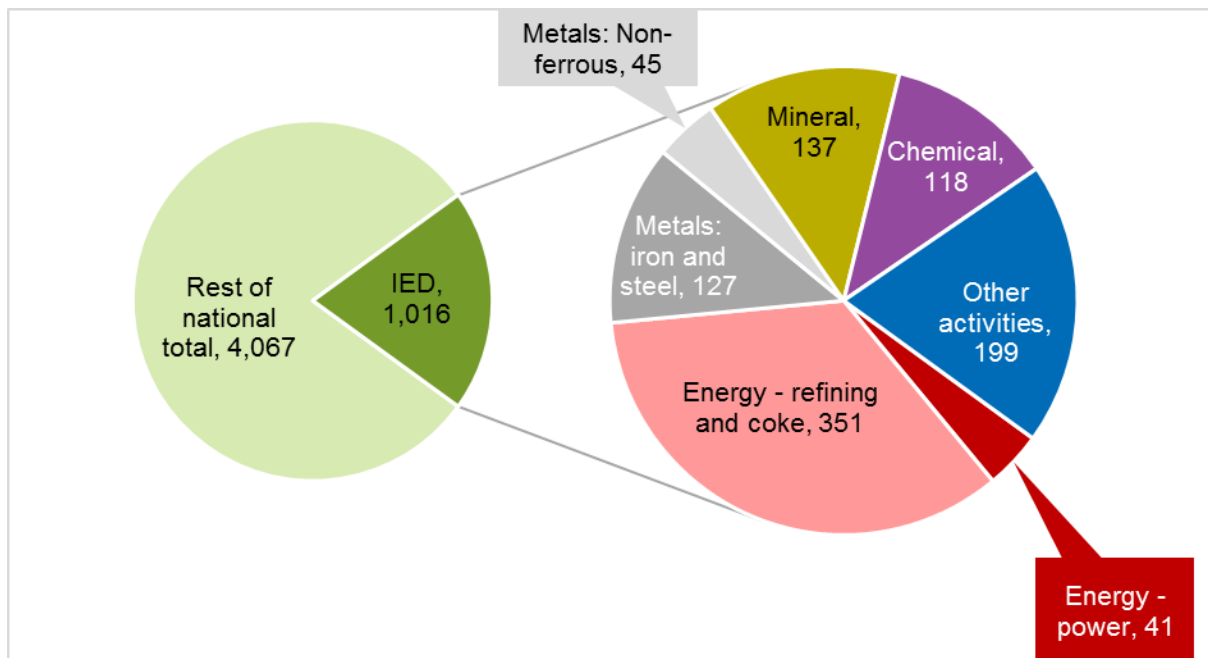
3.1 Energy consumption

Together with the overall number of permitted IED installations and contribution to the economy, the reported energy consumption of industrial sectors (Figure 7) indicates that the energy - refining and coke sector has a high energy intensity. The ‘other activities’ sector is the second greatest energy consuming industrial sector (mainly food and drink production (96 PJ) and paper and pulp production (70 PJ)). Other significant sectors are the mineral, the chemical and the iron and steel sectors.

The energy consumed by the ‘other activities’ sector and the chemical sector, while significant, suggests a lower intensity owing to the larger number of installations and contribution to the economy (whereby less energy is consumed per number of installations and relative output in terms of contribution to the economy). The mineral sector and iron and steel sector are also quite low energy intensive in relation to the permitted number of installations in 2015 (549 and 147 installations respectively). Energy consumption by the energy - power sector refers to consumption at electricity plants, combined heat and power plants, and heat plants (both own produced energy). With 178 installations operational in 2015, the relative energy consumed is quite low.

Note that no data was reported for the waste management industrial sector and no indicators are available for intensive rearing of poultry and pigs (explained in Table 4).

Figure 7: Energy consumption by industrial sector in 2015 (PJ)



Note: Rest of national total relates to Gross inland consumption minus industrial sector activity shown here. No data available for waste management.

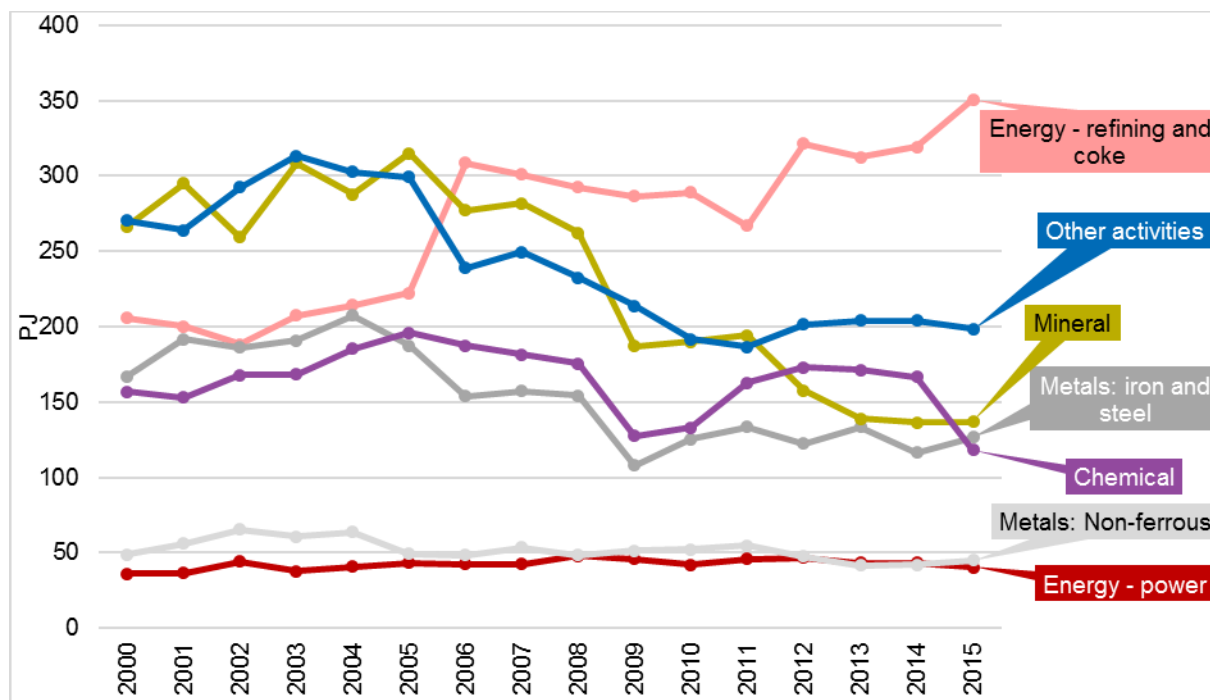
Source: Eurostat (2017c)

The time series in Figure 8 shows that energy consumption has remained relatively static for some industrial sectors (non-ferrous metals and energy-power) between 2000 and 2015. In the industrial sectors ‘other activities’ and minerals, energy consumption has decreased between 2000 and 2015. The majority of this decrease for ‘other activities’ occurred in the 2000s, with relatively level consumption from 2011 onwards. In the chemicals and iron and steel industrial sectors a slight decrease in energy consumption can be observed, albeit with reported values fluctuating substantially over time. As an exception, the energy-refining and coke sector has had strong growth in energy consumption for the period 2000 to 2015, again with fluctuations in this overall trend. This strong growth has led to the energy-refining and coke sector have the largest energy consumption of all industrial sectors in 2015, which is considerable compared to the relatively small economic significance of the sector in terms of

its trend in GVA (small and decreasing) and the small and stable number of permitted IED installations in this sector.

No energy consumption data is available for the waste management industrial sector and no indicators are available for intensive rearing of poultry and pigs. This is a significant gap in the data in light of the number of installations within this industrial sector operating in Spain, as well as the waste generated by these sectors (see section 5).

Figure 8: Energy consumption (in PJ) of industrial sectors (2000-2015)



Note: No data for the waste management sector.

Source: Eurostat (2017c)

Limitations

Generally, the use of energy balance indicators is expected to lead to overreporting against IED activities as no thresholds apply to the economic activities reported against (similar to NACE classifications). The energy consumption data that have been used has only limited coverage of the waste management sector. Data for this sector is therefore expected to be underreported as only one energy balance indicator was identified as relevant to this industrial sector: the energy consumed by gasification plants for biogas. Thus, where no data for the waste management sector is identified, as is the case for Spain, this is rather a limitation that the energy consumption dataset has a poor representation of the waste management sector.

Table 4: Gaps in energy consumption data for Spain

Missing data	Description	Conclusion and actions
No data for waste management	No data reported for all waste management	No action

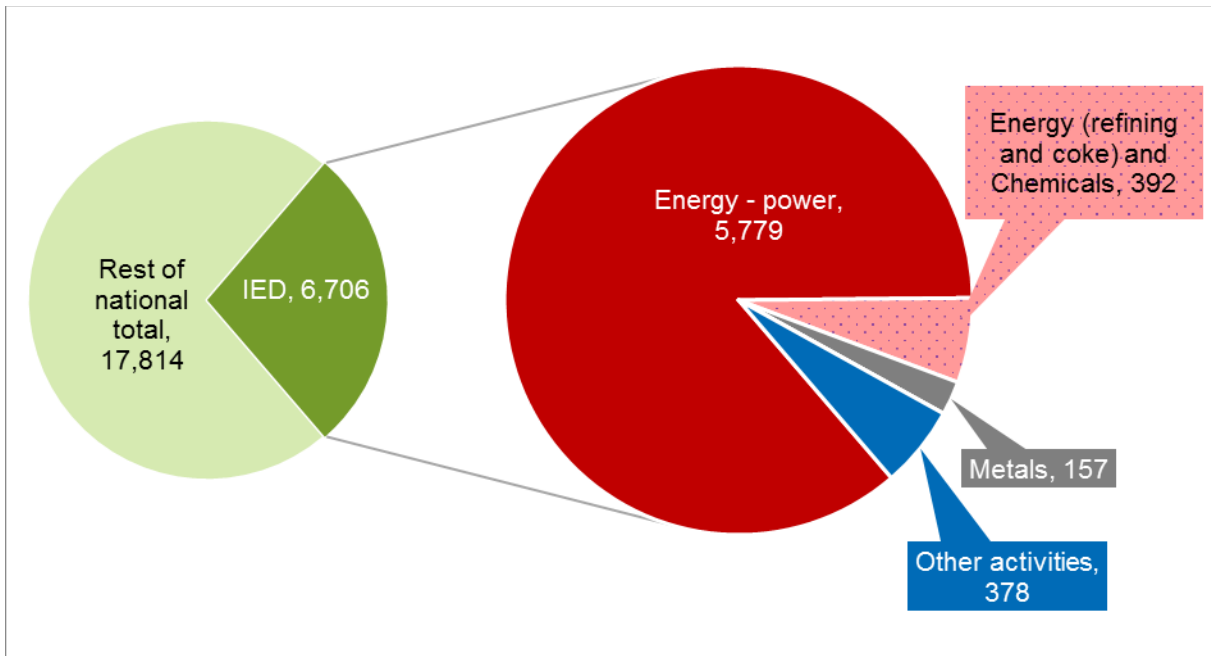
3.2 Water consumption

The data available to show water consumption by industrial sector in Spain is quite poor. Only limited data is available in Eurostat (2017d) in terms of years and coverage of sectors. For 2015, only data for the chemical and energy - refining and coke sectors and the national total water consumption were available. The missing data for 2015 for the energy-power, metals and 'other activities' industrial sectors could be filled by extrapolation, as data were available for previous years. Still, data showing water consumption by industrial sector for 2015 is only available for a limited number of industrial sectors (Figure 9).

According to these data, the industrial sectors represent around one quarter of the total national water consumption. The highest water consumption was reported for the energy - power sector, followed by energy (refining, coke) and chemicals combined, 'other activities' and the metals sector.

In light of the other data presented in this profile, the lack of water consumption data for the mineral industrial sector and intensive rearing of poultry and pigs within the 'other activities' industrial sector are considered to be major gaps.

Figure 9: Water consumption (million m³) for selected industrial sectors (2015)

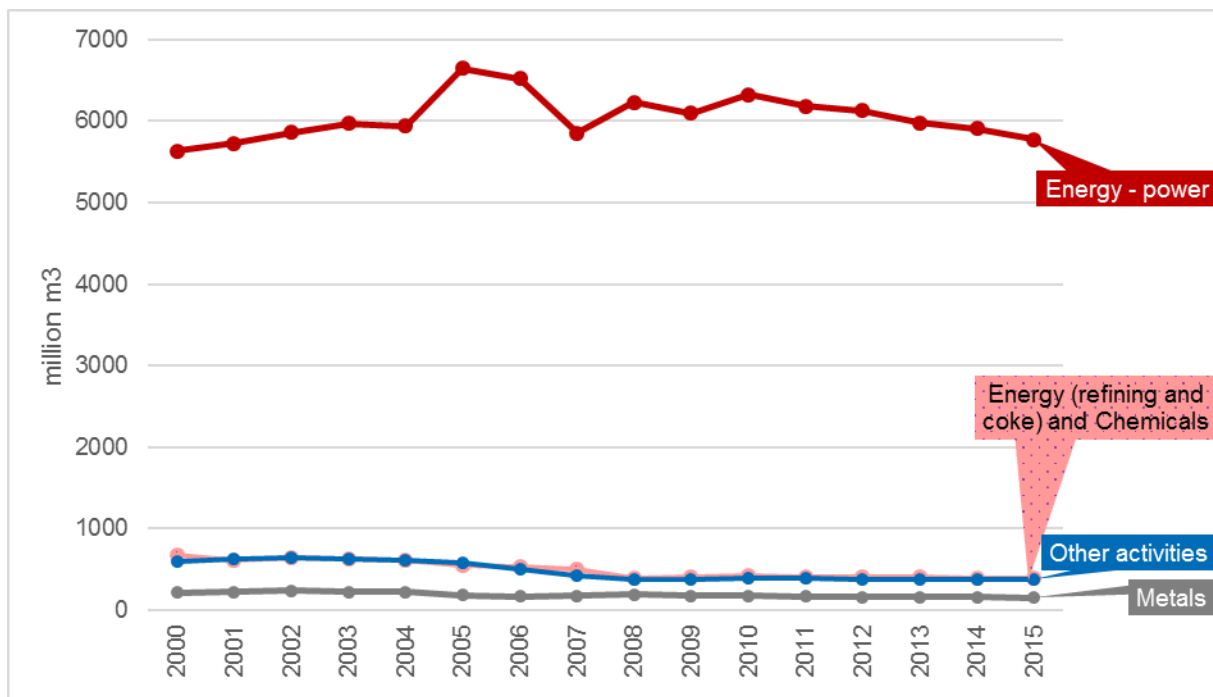


Note: Rest of national total relates to all NACE activities minus the industrial sectors shown here (data for the year 2015). No data reported for the year 2015, values for all sectors have been extrapolated based on the reported data for 2012-2014; however the split in sectors for 2015 is almost identical to that of 2014.

Sources: Eurostat (2017d)

The reported trends in water consumption are shown in Figure 10. Within the energy - power industrial sector water consumption has slightly increased until 2010 and has slightly decreased from there onwards until 2015 despite an increasing number of permitted IED installations in this period (170 installations in 2011; 178 installations in 2015). Water consumption in the other industrial sectors for which data are available have been consistently far below that of the energy-power sector, and have slightly decreased until 2008 and remained level afterwards.

Figure 10: Water consumption (million m³) for selected industrial sectors (2000-2015)



Notes: No data reported for the year 2015, values shown for 2015 for all sectors have been extrapolated based on 2012-14 trends.

Sources: Eurostat (2017d)

Limitations

Limitations have arisen from the mapping owing to combined reporting of NACE classifications for energy (refining, coke) and chemicals so that the water consumption of these sectors cannot be separately identified. Water consumption by the mineral sector is combined with many other NACE activities and could not be used without significant overreporting. An additional category is reported by Eurostat to show water used for cooling; however, the data is also reported within other NACE classifications and so could not be included in the charts without double counting. No data are available to represent the intensive rearing of poultry and pigs.

Table 5: Data gaps in water consumption data for Spain

Missing data	Description	Conclusion and actions taken
Data gaps	2015 data not reported when the Eurostat source was accessed.	Linear extrapolation undertaken when preceded by 3 years of reported data

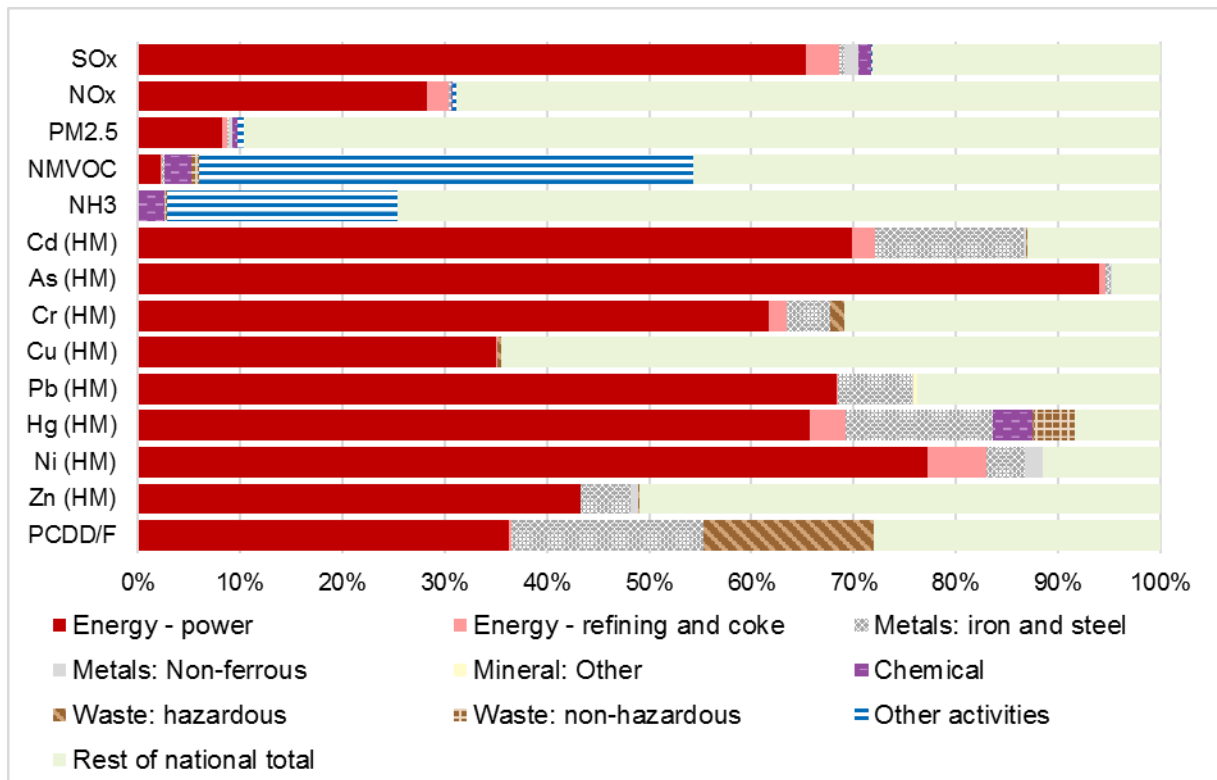
4 Emissions from industrial sectors

4.1 Emissions to air

Data were taken from inventories submitted by Member States under the CLRTAP (EEA, 2017a). Overall, industrial sectors are responsible for more than half of the emissions of most of the pollutants in scope of this profile emitted to air in 2015 (Figure 11). Heavy metals, SO_x, NMVOC and PCDD/F appear to be more intensely emitted from industrial sectors compared to the rest of the national total.

For all heavy metals, SO_x, NO_x, PM_{2.5} and PCDD/F the energy - power sector, and, for NMVOC and NH₃ the 'other activities' industrial sector are responsible for the greatest share of emissions to air among all industrial sectors (Figure 12). These are followed by the iron and steel (for certain heavy metals and PCDD/F), hazardous waste management (for PCDD/F and Cr) and energy - refining and coke (for SO_x, NO_x, PM_{2.5} and several heavy metals) industrial sectors. Although several IED installations are reported, only small quantities of emissions to air are reported for the mineral, non-ferrous metal, chemical and non-hazardous waste industrial sectors. As regards the mineral sector, only limited data were reported for 'other minerals'.

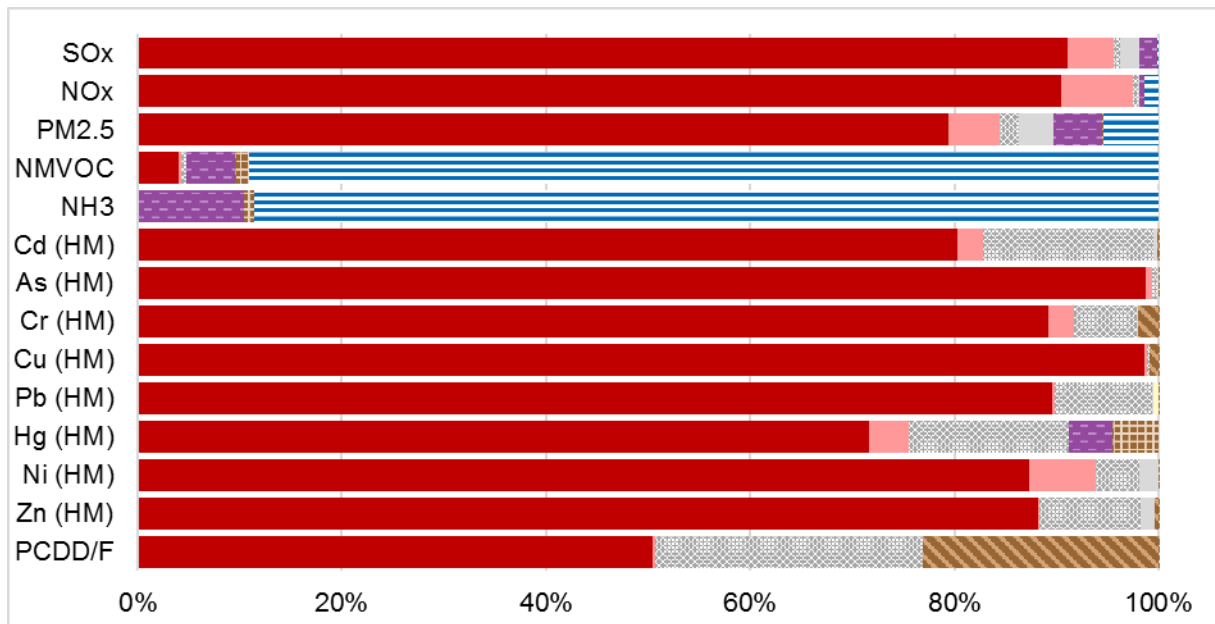
Figure 11: Emissions to air from industrial sectors and rest of national total (2015)



Note: Rest of national total relates to the national total for the entire territory (based on fuel sold) minus the industrial sector emissions shown here. No data was reported for cement, lime and magnesium and glass production (mineral industrial sector)

Source: EEA (2017a)

Figure 12: Emissions to air from industrial sectors (2015)



Note: The key for this chart is shown in Figure 11.

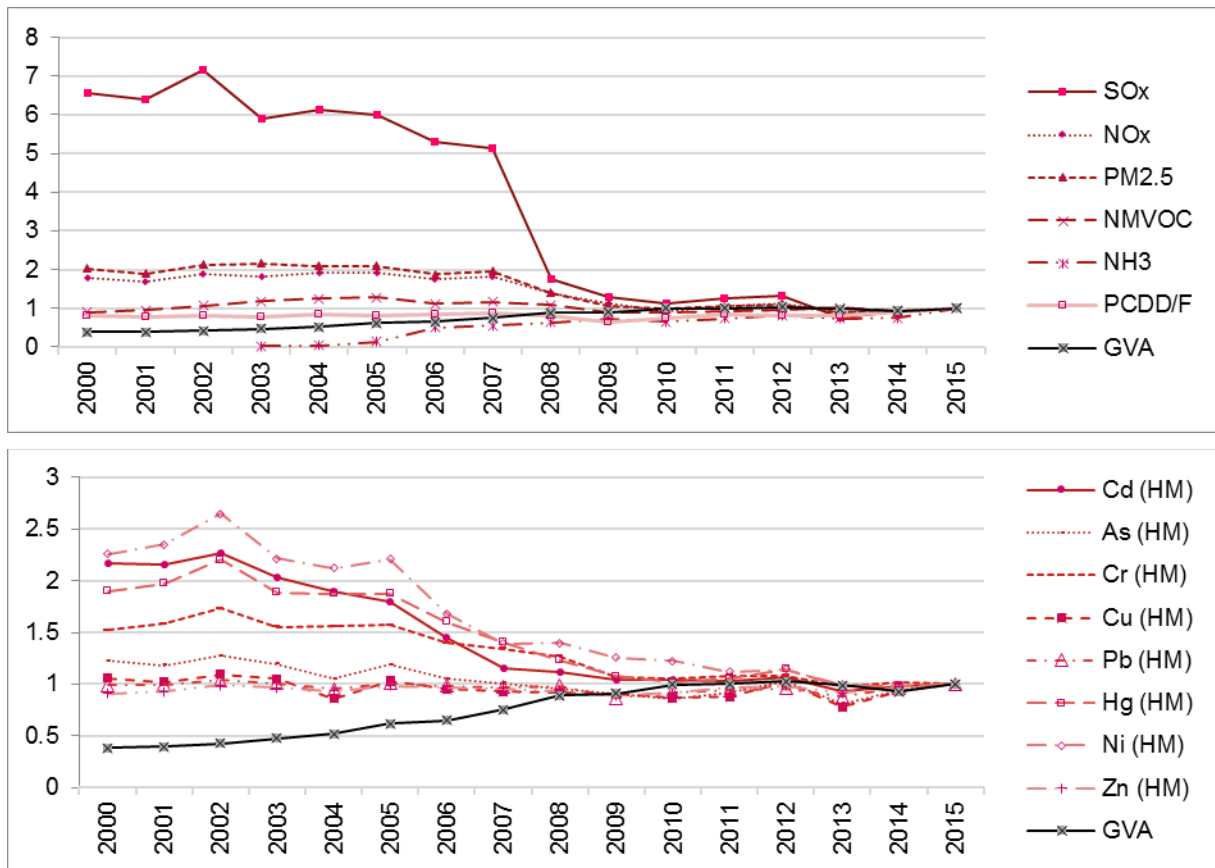
Source: EEA (2017a)

In the following subsections, emissions to air are shown in indexed charts by sector. This was done to compare the development of pollutant emissions with the GVA in specific sectors in the time period 2000 to 2015. For many industrial sectors, emissions to air show decreasing trends while GVA has grown. All trends are shown in indexed charts in the following subsections by sector, with the exception of the glass and cement, lime and magnesium oxide industrial sectors for which there was no emissions data reported to plot trends indexed to 2015. Appendix 2 includes full details on the emissions reported by industrial sector and year.

Energy industry

Overall for the **energy-power sector**, there was a significant reduction in emissions to air for all pollutants here (particularly SO_x) between 2000 and 2010; after which there has been a more static trend in emissions (Figure 13). Emissions of NH₃, PCDD/F and NMVOCs have slightly increased. However, in this time, eight additional installations have been reported, suggesting further growth in the industrial sector, despite general improvements in emissions to air. The reductions in SO_x particularly between 2007 and 2008 are expected to emanate from compliance with the Large Combustion Plant Directive which had a significant impact on SO_x emissions across the EU in that time period. Cd, Cr, Hg and Ni emissions from energy-power have also decreased between 2000 and 2010, after which they have followed a more static trend which was the case for As, Cu, Pb and Zn over the whole time period (Figure 13). The energy - power sector is the only industrial sector for which all pollutants here were reported.

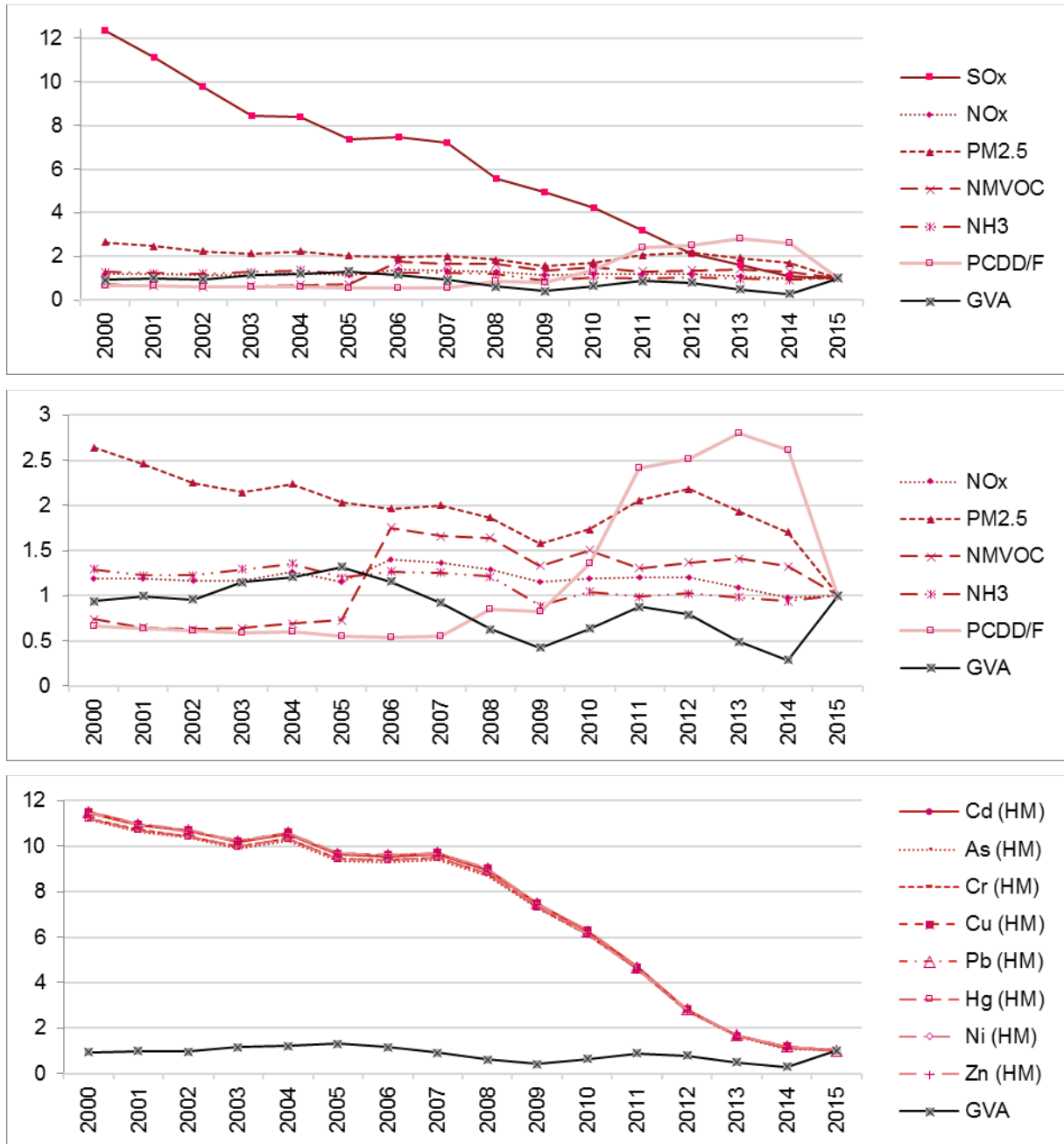
Figure 13: Indexed emissions to air from the energy - power industrial sector (indexed to 2015=1)



Source: EEA (2017a), Eurostat (2017a)

Within the **energy - refining and coke sector** air emissions have declined most substantially over time for SO_x and heavy metals, reducing by a factor of around 12 since the year 2000 (Figure 14). This is against a backdrop of fluctuating economic significance (in terms of GVA) of the sector over this period. Emissions of PM_{2.5}, whilst declining during the 2000s, appears to have increased, along with PCDD/F emissions since 2009, which matches a growth and decline in GVA of the sector in the same period.

Figure 14: Indexed emissions to air from energy – refining and coke (energy industrial sector) sector (indexed to 2015=1)



Note: GVA data for energy – refining and coke in 2015 is provisional not extrapolated. The second chart of this triplet has artificially removed the SO_x emission trend so show the detail in changes of other pollutants.

Source: EEA (2017a), Eurostat (2017a).

Metal industry

Overall air emissions from the **iron and steel sector** have reduced from 2000 to 2015, with a slight increase from 2000 to 2008, a significant decrease from 2008 to 2012 and a light increase or stable trend from 2012 onwards (Figure 15). Only SO_x emissions have slightly increased over time. Pollutant emissions from this sector seem to be closely coupled to the trend in GVA.

Figure 15: Indexed emissions to air from iron and steel (metal industrial sector) (indexed to 2015=1)



Note: No data reported for NH₃

Source: EEA (2017a), Eurostat (2017a)

Within the **non-ferrous metal sector** emissions to air of PM_{2.5} have reduced the most from a peak in 2003 to 2015 (Figure 16). GVA of this sector has not varied substantially over this period, and emissions of NO_x and SO₂ have similarly remained at approximately the same level. Emissions of NMVOC and some HM (Ni, Cd and Zn) follow the same trend of gradual increases from 2000 to 2008, then a reduction to 2015 with the exception of a peak in 2011. However, other HM emissions such Pb, Cu, As and Cr emissions slightly increased over time. Note that the trend lines for several heavy metal emissions generally are the same from 2000 to 2015. This may indicate that the emission factors used for these pollutants in this national emission inventory are static over time, with changes in all pollutants driven by changes in activity levels.

Figure 16: Indexed emissions to air from non-ferrous metal production (metal industrial sector) (indexed to 2015=1)



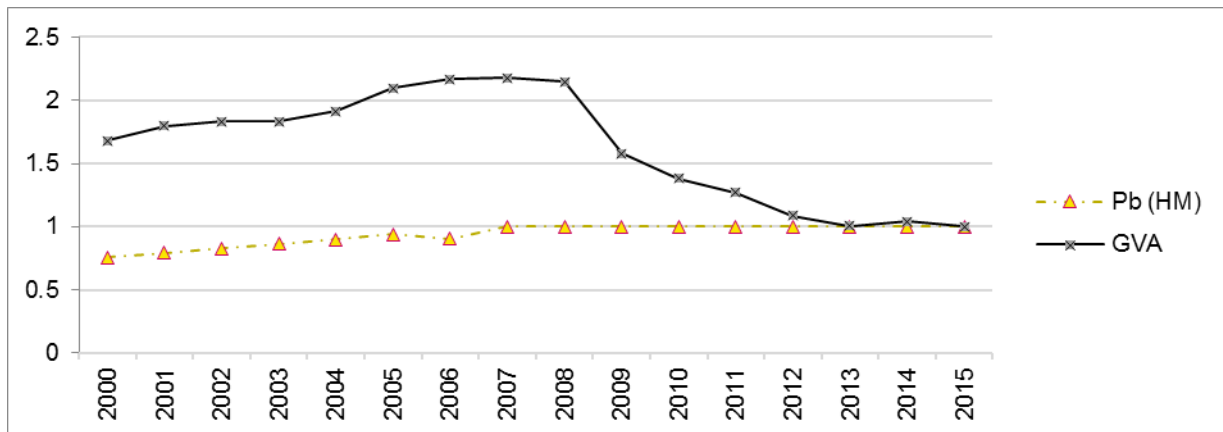
Note: No data reported for NH₃, PCDD/PCDF and Hg

Source: EEA (2017a), Eurostat (2017a)

Mineral industry

Within the mineral industrial sector, only Pb emissions to air were reported for other mineral production (Figure 17). No emissions to air are reported for the glass and cement, lime and magnesium oxide production across all the years even though 51 and 73 permitted IED installations were reported respectively in 2015. Pb emissions have slightly increased from 2000 to 2015. The GVA increased in line with the pollutant emissions from 2000 to 2008, however, from 2008 onwards, emissions of Pb appear to be decoupled from the decrease in GVA.

Figure 17: Indexed emissions to air from other mineral production (mineral industrial sector) (indexed to 2015=1)



Note: only Pb reported.

Source: EEA (2017a), Eurostat (2017a)

Chemical industry

Despite increasing GVA, emissions of most pollutants from the chemical industrial sector have decreased from 2000 to 2015, especially Hg and NO_x (Figure 18). Only Cd emissions have slightly increased and NMVOC emissions remained stable over time.

Figure 18: Indexed emissions to air from chemical industry (indexed to 2015=1)



Note: No data reported for PCCD/PCCF and most heavy metals.

Source: EEA (2017a), Eurostat (2017a)

Waste management industry

As regards the hazardous waste management industrial sector, all pollutants bar Hg follow the same trend, fluctuating both above and below the level of emissions in 2015, against a backdrop of a doubling in the GVA of the sector between 2000 and 2015. For Hg, there is a marked decrease from 2000 to 2006 (Figure 19).

Figure 19: Indexed emissions to air from hazardous waste (waste management industrial sector) (indexed to 2015=1)

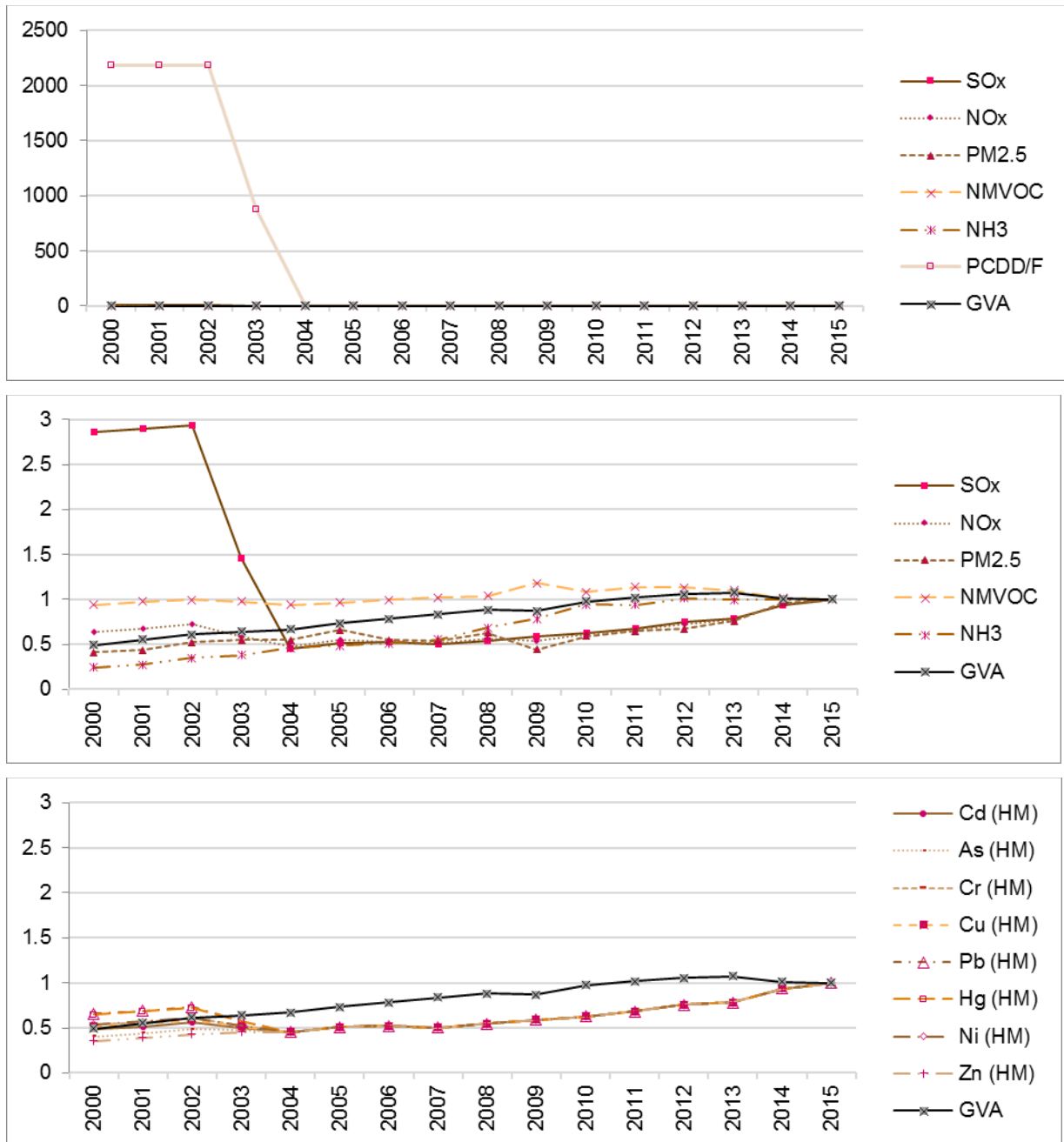


Note: No data reported for NH₃

Source: EEA (2017a), Eurostat (2017a)

Within the non-hazardous waste management industrial sector, emissions of PCDD/F have decreased considerably from 2000 to 2004 (and also, to a lesser extent, SO_x). All other reported pollutant emissions, and also PCDD/F and SO_x from 2004 onwards, have increased approximately in line with the increasing trend in GVA of this sector (Figure 19) and so may reflect sector activity levels and does not show the impact of any increase in environmental controls. The increase may also be related to an increased number of installations reported from 2011 to 2015.

Figure 20: Indexed emissions to air from non-hazardous waste (waste management industrial sector) (indexed to 2015=1)



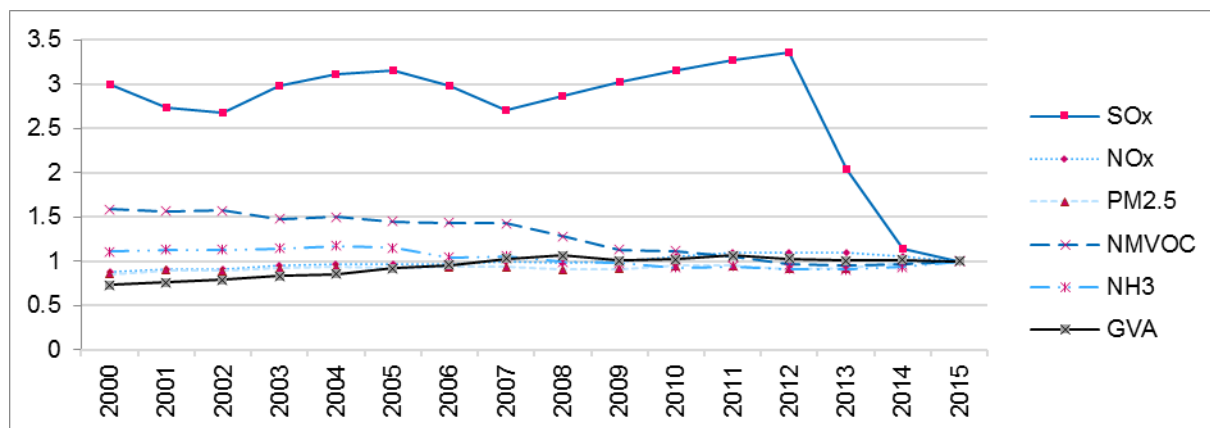
Note: The second chart here excludes PCDD/F to make detail for other pollutants more visible.

Source: EEA (2017a), Eurostat (2017a)

‘Other activities’

Within ‘other activities’ NMVOC and NH₃ emissions (both mainly in relation to surface treatment activities and manure management from intensive rearing of poultry and pigs) have decreased over time, with a slight increase observed from the last years (2012 to 2015). PM_{2.5} and NO_x emissions (both mainly in relation to food processing and beverage, other product use, wood processing and manure management from intensive rearing of poultry and pigs) have slightly increased from 2000 to 2015 (Figure 21). No heavy metals nor PCDD/F emissions were reported for this sector. SO_x emissions dropped substantially between 2012 and 2014.

Figure 21: Indexed emissions to air from ‘other activities’ (indexed to 2015=1)



Note: No data reported for SO_x, PCDD/PCCF as well as heavy metals. GVA data does not include intensive rearing of poultry or pigs within ‘other activities’.

Source: EEA (2017a), Eurostat (2017a)

Limitations

The use of emissions data reported to LRTAP has generally led to overreporting against IED activities as emissions are reported by NFR classification and thus no activity thresholds apply as in the case of IED annex I activities.

Table 6: Gaps in emissions to air data for Spain

Missing data	Description	Conclusion and action taken
Limited data for the mineral industrial sector	Only data for other mineral production and only pollutant reported is Pb	No action
Data gaps	There is no data on heavy metal emissions for ‘other activities’	No action

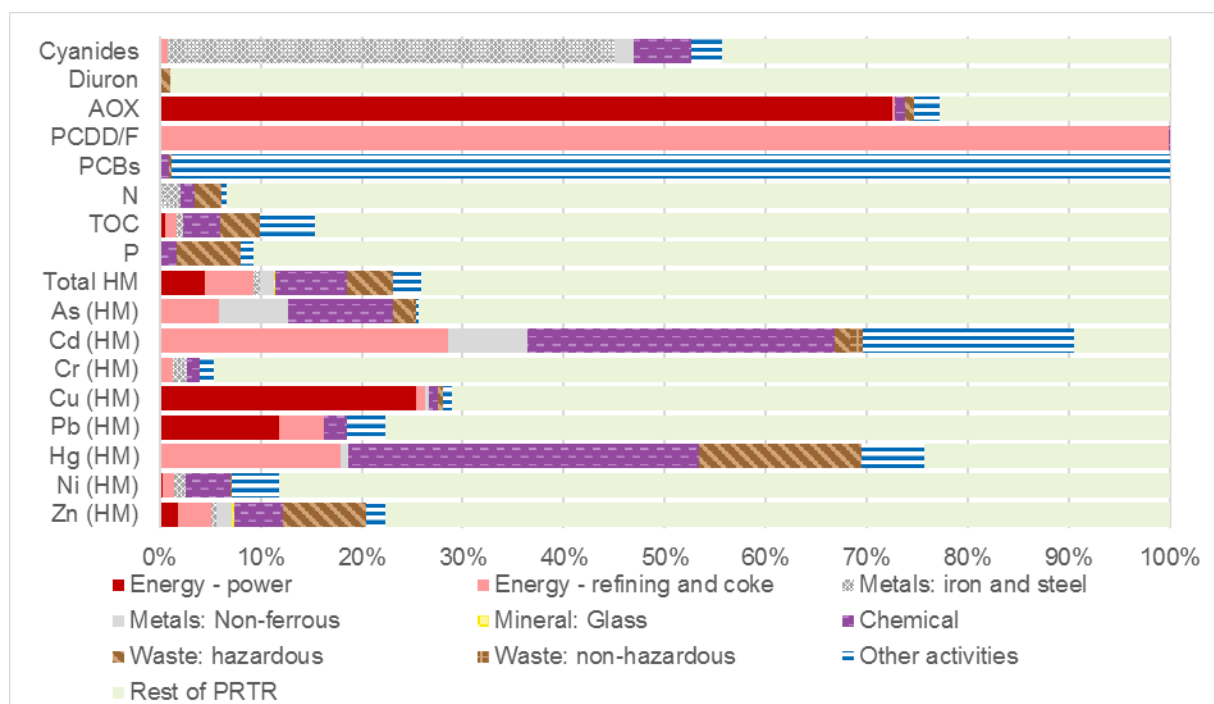
4.2 Emissions to water

Emissions to water data were obtained from the E-PRTR (EEA, 2017b), which has a broader industrial scope than the IED but is not a national total. The figures in this section, apart from Figure 22, aggregate the separate metals into a single heavy metals metric based on their relative toxicity (reciprocal predicted no effect concentrations), expressed in Hg equivalents.

Pollutant emissions are reported for all important industrial sectors. For the mineral industrial sector, only few heavy metal pollutant emissions are reported for the glass industry. For the non-hazardous waste management sector reported data are scarce. For most of the other sectors, emissions are not or rarely reported for PCB, PCDD/F and diuron.

Figure 22 presents, per pollutant, the proportion of emissions to water by the industrial sector compared to the data reported by Spain to the E-PRTR in 2015. Overall, industrial sectors are responsible for over half of Spain's total emissions to water of cyanides, AOX, PCBs, PCDD/F, Cd and Hg. Almost all PCDD/F emissions reported for Spain in 2015 are from the energy - refining and coke sector whereas PCB emissions, only reported for industrial sectors, was mainly emitted from 'other activities'. Cyanides were mainly reported for the iron and steel industrial sector whereas AOX was mainly emitted from the energy - power sector. Heavy metals were reported for almost all sectors, predominantly in the energy – refining and coke, energy - power, hazardous waste management and 'other activities' industrial sectors.

Figure 22: Pollutant emissions to water from industrial sectors and rest of PRTR total (2015)



Note: Limited data for the mineral industrial sector.

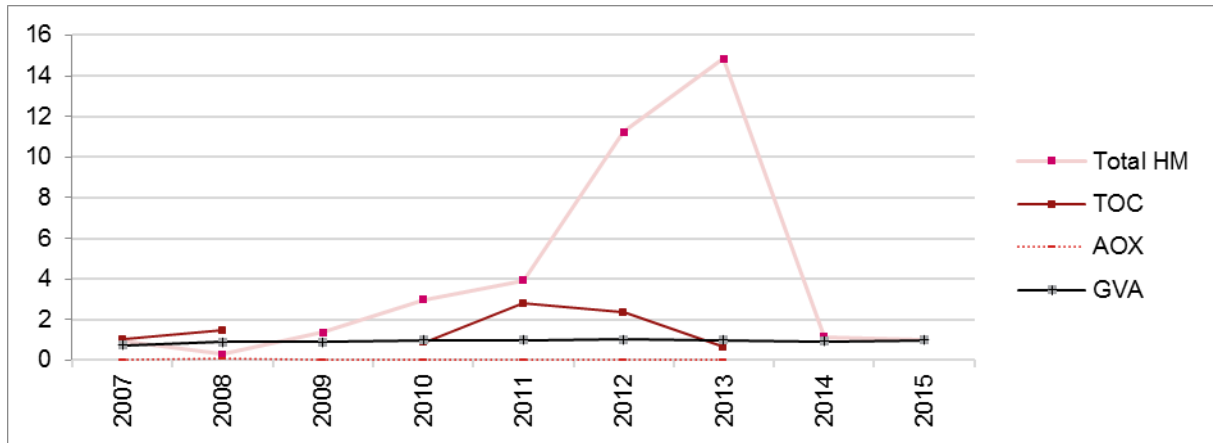
Source: EEA (2017b)

In the following subsections, emissions to water are shown in indexed charts by industrial sector. The emission data were indexed to compare the development of pollutant emissions with the GVA in specific industrial sectors from 2007 to 2015. The graphs show the relative development of pollutant emissions and GVA over time; the absolute quantity of emissions is not presented. In general, it can be observed that especially in the more recent years, pollutant emissions decreased. This can be related to regulations with stricter limit values entering into force such as the IED in 2010. Full details on the emissions reported by industrial sector and year are presented in tabular format in Table 8.

Energy industry

Emissions to water from the energy - power industrial sector are reported for the heavy metals As, Ni, Zn, Hg, Pb, Cr, Cd and Cu (in the graph represented as total heavy metals, aggregated by toxicity as Hg equivalent), TOC and AOX (Figure 23). Emissions of total heavy metals are much higher in 2012 and 2013 than in 2015. These are due to increased Cr and CU emissions in these two years and due to Cd, which was only reported in 2012. TOC emissions have varied over the whole period whereas GVA slightly increased over time.

Figure 23: Indexed emissions to water from energy-power sector (indexed to 2015=1)

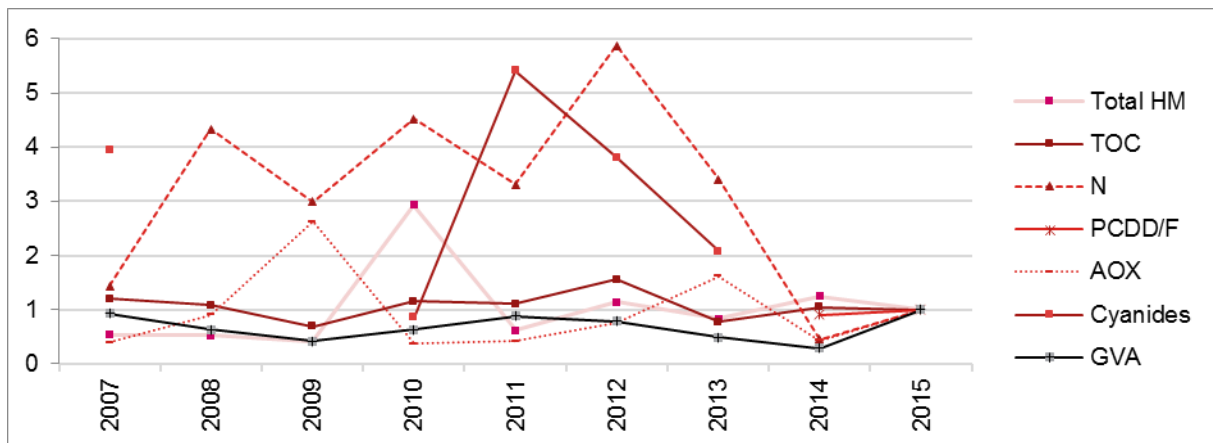


Note: P, N, PCB, PCDD/F, diuron, cyanides excluded. Zero emissions reported for TOC in 2009 and 2014, and for AOX in 2014. No values are plotted for this pollutant in these years to avoid misrepresenting a trend.

Source: EEA (2017b), Eurostat (2017a)

Overall emissions to water from the energy - refining and coke industrial sector have varied over the period 2007-2015 whereas GVA decreased from 2007 to 2009, increased until 2011, and decreased again from there onwards. This development is not reflected by pollutant emissions except for N and cyanide emissions, for which also a peak can be observed between 2011 and 2012. This cannot be explained by the number of installations which remained the same from 2011 to 2015. TOC, N and cyanide emissions decreased for whole period with some variations. PCDD/F, HM and AOX emissions increased slightly, also with some variations, from 2007 to 2015.

Figure 24: Indexed emissions to water from energy – refining and coke sector (indexed to 2015=1)



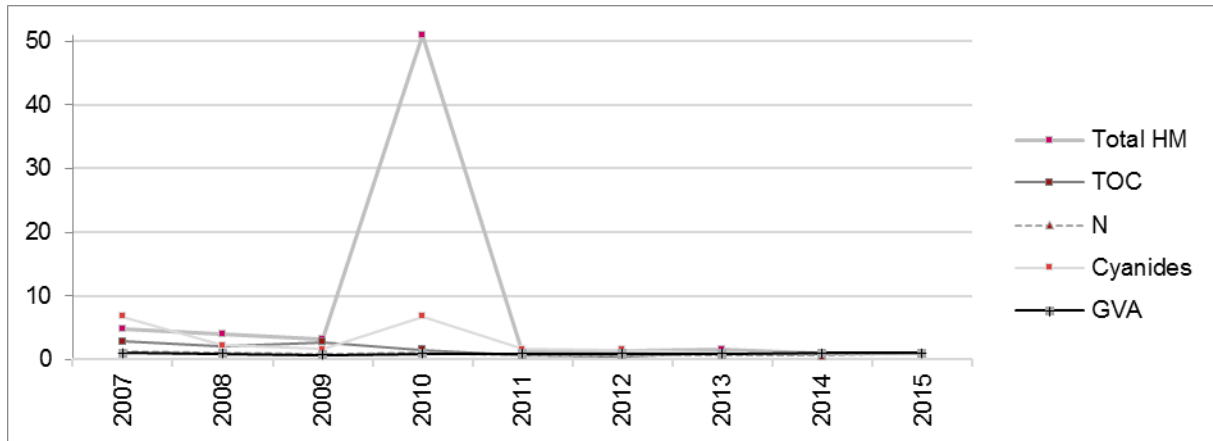
Note: No data were reported for total P, diuron and PCBs. Zero emissions reported for cyanides in 2008, 2009, and 2014. No values are plotted for this pollutant in these years to avoid misrepresenting a trend. GVA data for energy – refining and coke in 2015 is provisional not extrapolated.

Source: EEA (2017b), Eurostat (2017a)

Metal industry

Emissions to water from iron and steel production were reported for total heavy metals, TOC, total N, and cyanides. Total heavy metals (all single heavy metals aggregated by toxicity as Hg equivalent) significantly decreased over time as well as other pollutants (TOC, cyanides and total N) and GVA (Figure 25). The peak for total heavy metals in 2010, which is due to a high value reported for Zn in this year for one facility reporting under IED activity 2.2.

Figure 25: Indexed emissions to water from iron and steel (metal industrial sector) (indexed to 2015=1)

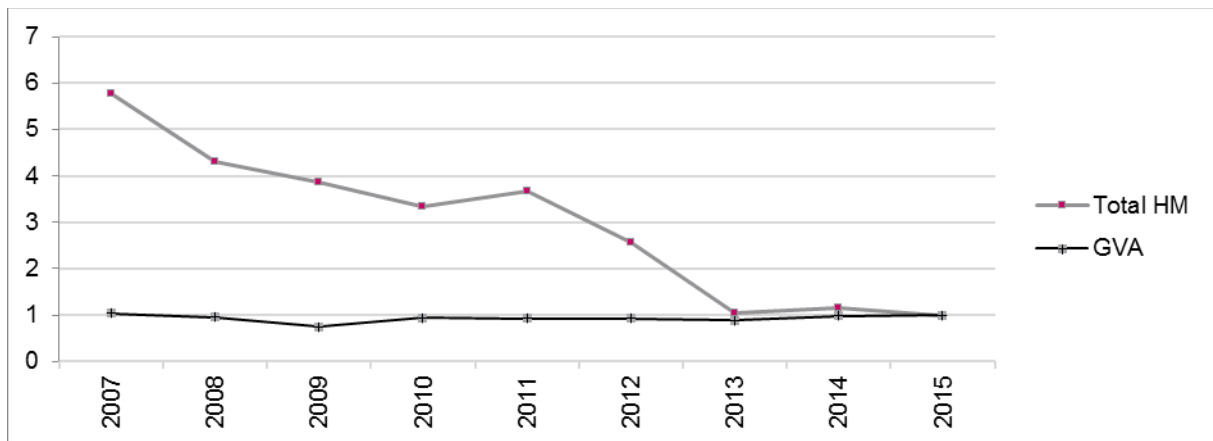


Note: No data were reported for total P, diuron, PCB and PCDD/F

Source: EEA (2017b), Eurostat (2017a)

For the non-ferrous metal industrial sector only heavy metals and cyanides were reported. Total heavy metals emissions decreased by a factor of 6 from 2007 to 2013. Cyanide data were only reported for 2015.

Figure 26: Indexed emissions to water from non-ferrous metal (metal industrial sector) (indexed to 2015=1)



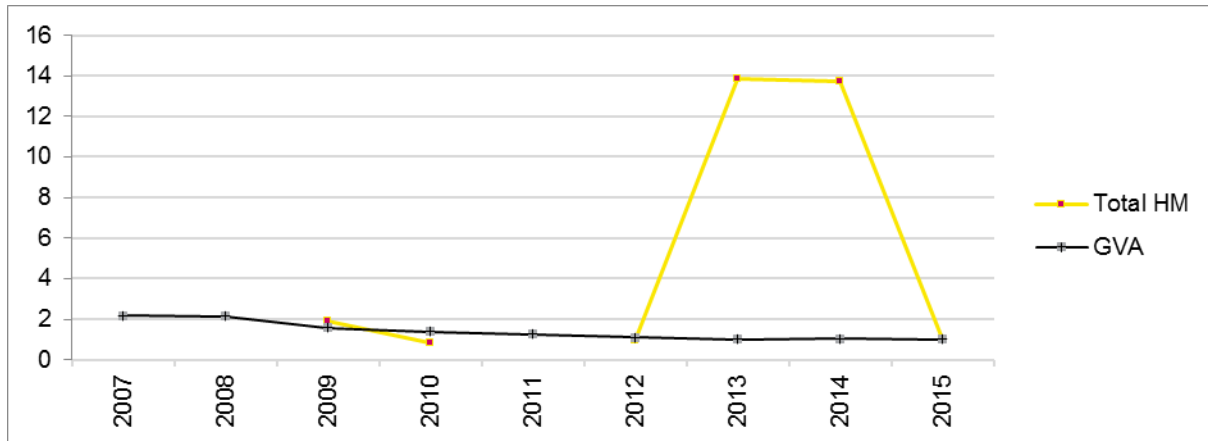
Note: Only heavy metals reported, and cyanides only in 2015.

Source: EEA (2017b), Eurostat (2017a)

Mineral industry

Emissions from the mineral sector make up an extremely small proportion of total national emissions. Furthermore, emissions from this sector are negligible in comparison with other sectors. Within the mineral industry, only data were reported for some heavy metals in the glass production industry. However, as emission data were only reported for Hg in 2013 and 2014 and for Zn in 2009, 2010, 2012, 2014 and 2015, no real trend can be derived.

Figure 27: Indexed emissions to water from mineral glass (mineral industrial sector) (indexed to 2015=1)



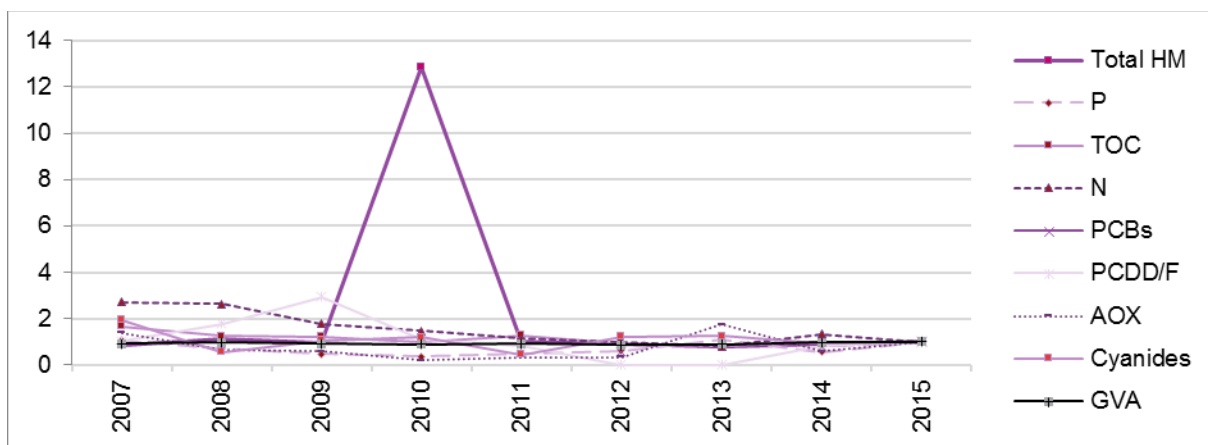
Note: Only data reported for total heavy metals. Zero emissions reported for all heavy metals in 2007, 2008, and 2011. No values are plotted for this pollutant in these years to avoid misrepresenting a trend.

Source: EEA (2017b), Eurostat (2017a)

Chemical industry

Emissions to water from the chemical industrial sector mainly come from the production of organic chemicals, inorganic chemicals and pharmaceutical products including intermediates. Emissions were reported for all pollutants here except for diuron (Figure 28). All pollutant emissions to water increased slightly from 2007 to 2015 with some variations, except for total N and cyanides, for which a slight decrease or stagnation can be observed. The peak for total heavy metals in 2010, which is due to a high value reported for Cr for the production of inorganic chemicals (IED activity 4.2). Since 2010, no Cr emissions have been reported from the production of inorganic chemicals. The peak is due to a reported release of 31 tonnes of Cr to water from a single facility which did not report Cr emissions in 2009 nor in 2011.

Figure 28: Indexed emissions to water from the chemical sector (indexed to 2015=1)



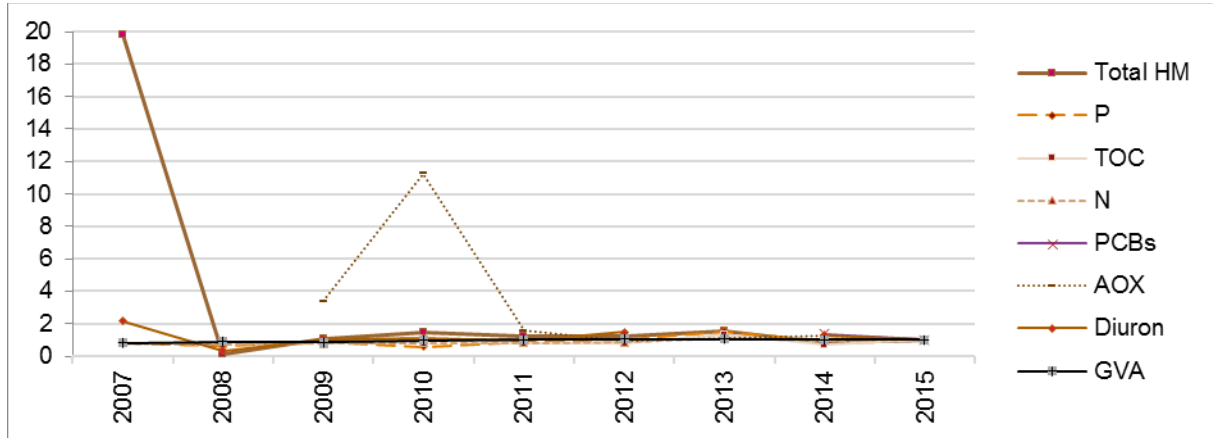
Note: No data reported for diuron. Zero emissions reported for PCBs between 2007 and 2011, and in 2013. No values are plotted for this pollutant in these years to avoid misrepresenting a trend.

Source: EEA (2017b), Eurostat (2017a)

Waste management industry

Within the hazardous waste management industrial sector, emissions were reported for all pollutants except PCDD/F and cyanides (Figure 29). For 2007 for all heavy metals particularly high values were reported. The reason for this is not clear. Also the peak in AOX emissions in 2010 cannot be explained. From 2008 onwards, emissions for all reported pollutants have increased (matching the trend in GVA increase) except for AOX, for which emissions have decreased since 2010.

Figure 29: Indexed emissions to water from hazardous waste (waste management industrial sector) (indexed to 2015=1)

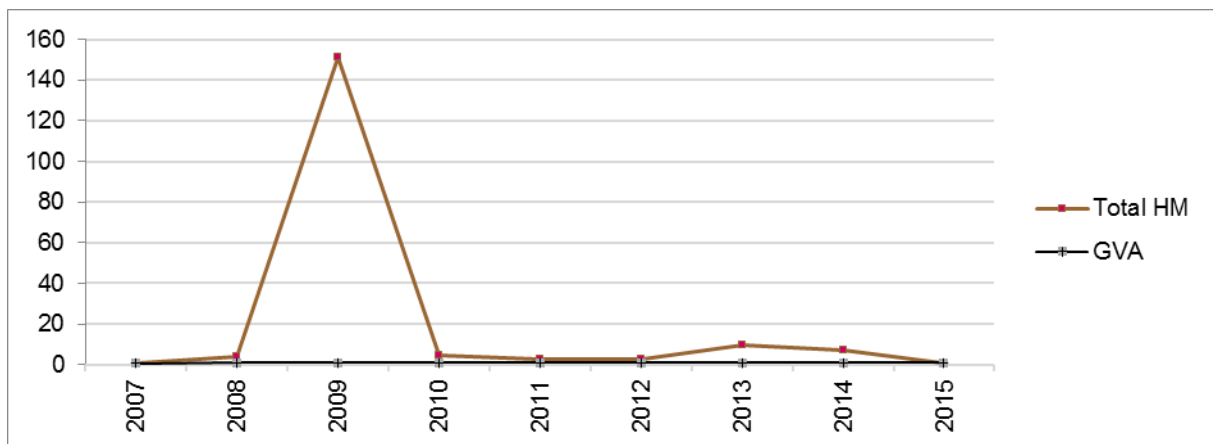


Note: No data reported for PCDD/PCDDF, cyanides. Zero emissions reported for TOC and AOX in 2007 and 2008, for PCBs between 2007 and 2013, and for diuron in 2013. No values are plotted for these pollutants in these years to avoid misrepresenting a trend.

Source: EEA (2017b), Eurostat (2017a)

Within the non-hazardous waste management industrial sector only data for total heavy metal emissions was reported (Figure 30). Reported total heavy metals include data for As, Cd, Hg, Zn and Ni for several years. The peak for total heavy metals in 2009, which is due to a high value reported for Hg in this year from a single landfill facility.

Figure 30: Indexed emissions to water from non-hazardous waste (waste management industrial sector) (indexed to 2015=1)



Note: Only data reported for heavy metals.

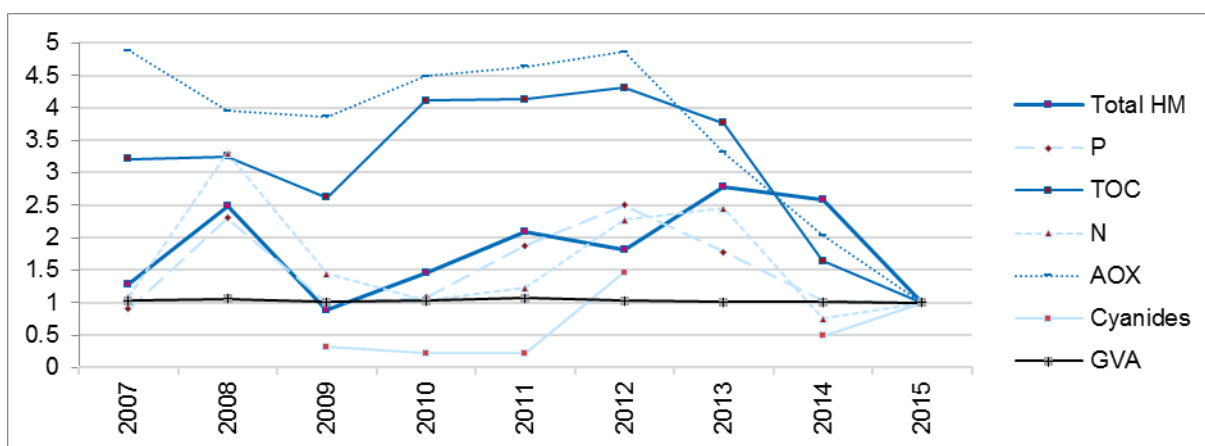
Source: EEA (2017b), Eurostat (2017a)

‘Other activities’

Emissions to water from ‘other activities’ are dominated by emissions reported for the pulp and paper production (IED activity 6.1) and for surface treatment of metals and plastic and using organic solvents (IED activities 2.6 and 6.7). For surface treatment only heavy metals were reported.

Emissions to water were reported for total heavy metals (including Zn, Ni, Hg, Cr, Pb, Cd and As) total P, TOC, total N, PCBs, AOX and cyanides. Emission trends of these pollutants from 2007 onwards are shown in Figure 31. Most pollutant emissions to water from the ‘other activities’ sector have decreased overall over the reporting period time, but significantly fluctuating with increases from 2009 to 2012 and subsequent decreases from 2012 onwards. Only emissions of cyanides increase – between 2009 and 2015.

Figure 31: Indexed emissions to water from ‘other activities’ (indexed to 2015=1)



Note: Diuron and PCDD/F not reported. No emissions reported for cyanides in 2007 and 2009 and for PCBs only in 2015: values for these pollutants and years are not plotted in this chart to avoid misrepresenting a trend.

Source: EEA (2017b), Eurostat (2017a)

Limitations

No limitations arise as a result of the mapping to IED activities as E-PRTR activities are well aligned in this respect. However, it is generally expected that emissions to water reported to E-PRTR will be underreporting against IED activities because of the activity thresholds which apply (as well as inconsistencies between years). E-PRTR also has a limited time series.

Table 7: Gaps in emissions to water data for Spain

Missing data	Description	Conclusion and action taken
Data gaps	No data available for cement lime and magnesium as well as for other minerals production and only limited data for glass production. Data were reported only for some heavy metals emitted from non-ferrous metal production and non-hazardous waste management	No action
Gaps in time-series	No gap-filling for emissions data has been carried out – as explained in the accompanying methodology paper	No action

Additional data for emissions to water

Additional data reported to E-PRTR for emissions to water are presented in Table 8 – including for pollutants with limited time series that couldn't be shown on the charts indexed to 2015 emission levels.

Table 8: Emissions to water by pollutant and industrial sector (all available data)

Pollutant	Units	2007	2008	2009	2010	2011	2012	2013	2014	2015
Energy - power										
HM	kg	131	38	184	398	523	1,499	1,982	152	133
P	t	8.1	-	27	7.01	7.49	-	-	43.1	-
TOC	t	210.2	300	-	174	565	478	130	-	203
N	t	-	-	453	-	955.1	802.4	197	-	-
AOX	t	4.77	65.02	1.24	1.07	8.01	9.4	10.1	-	954.9
Energy - refining, coke										
HM	kg	76	75	60	416	88	163	119	177	142
P	t	-	12.37	8.03	14.55	8.73	22.45	-	5.76	-
TOC	t	512.5	464.1	294	493.6	472.7	666	330.8	450.4	428.6
N	t	162.4	489	337.5	510.8	373.7	662.3	385.1	51.5	112.9
AOX	t	1.35	3.07	8.85	1.27	1.42	2.53	5.47	1.46	3.38
Cyanides	kg	306	-	-	67	419	295	161	-	77
Metals: iron and steel										
HM	kg	91	78	61	969	24	24	30	20	19
P	t	8.29	10.7	10.4	8.15	8	-	-	-	-
TOC	t	623	443	592	321	140	103	219	205	216
N	t	1,293	1,143	847	1,079	765	786	811	699	1,061
AOX	t	5.95	-	1.4	-	1.75	3.78	-	-	-
Cyanides	kg	28,900	9,440	6,830	28,800	6,970	6,590	4,460	4,340	4,260
Metals: Non-ferrous										
HM	kg	245	182	164	141	155	108	45	49	42
P	t	-	-	-	31.3	-	-	-	-	-
TOC	t	-	-	-	-	-	-	57.3	-	-
Cyanides	kg	-	-	-	-	-	-	-	-	186
Mineral: Glass										
HM	kg	-	-	4	2	-	2	30	30	2
Chemical										
HM	kg	181	246	200	2,756	222	198	170	194	214
P	t	99.22	69.4	45.04	35.7	45.34	56.78	103.56	53.07	94.65
TOC	t	2,203	1,648	1,617	1,320	1,693	1,270	1,099	1,287	1,331
N	t	2,180	2,113	1,422	1,187	918	791.2	658.2	1,064	803
PCBs	kg	-	-	-	-	-	0.52	-	0.70	0.87
AOX	t	18.74	8.44	7.85	2.79	4.41	4.57	23.64	7.89	13.44
Cyanides	kg	1,062	300	572	660	243	670	678	504	548
Waste: hazardous										
HM	kg	2,638	20	142	198	159	164	205	116	133
P	t	269	226	288	202	304	350	523	313	339
TOC	t	-	-	1,100	1,470	1,170	1,090	1,880	970	1,410
N	t	1,250	1,110	1,180	1,230	1,230	1,330	1,740	1,500	1,520
PCBs	kg	-	-	-	-	-	-	-	0.33	0.24
AOX	t	-	-	38.2	127	17.5	10.6	12.2	14.2	11.3
Diuron	kg	23.40	3.75	11.60	12.40	9.91	16.20	-	14.10	10.80
Waste: Non-hazardous										
HM	kg	1.41	8.26	301.09	8.53	5.34	5.94	19.14	13.51	1.99
P	t	14.6	13	11.1	8.33	11.5	13	-	-	-
PCBs	kg	-	-	-	0.42	-	-	-	-	-
AOX	t	126	-	-	81	63.9	76	-	-	-
'Other activities'										
HM	kg	104.53	201.97	71.82	118.24	170.04	146.99	225.17	209.7	81.06
P	t	62.19	159.66	68.74	74.94	129.91	173.24	123.38	71.44	69.31
TOC	t	6,321	6,412	5,154	8,092	8,137	8,482	7,418	3,228	1,970
N	t	307.7	931.9	406.9	292.7	344.6	639.9	692.4	212.3	282
PCBs	kg	-	-	-	-	-	-	-	-	92
AOX	t	163.83	132.63	129.6	150.47	155.4	163.2	111.06	68.2	33.55
Cyanides	kg	-	-	93	62	62	420	-	140	288

Note: Total heavy metals in kg is expressed in Hg equivalents using reciprocal predicted no effect concentrations.

Source: EEA (2017b)

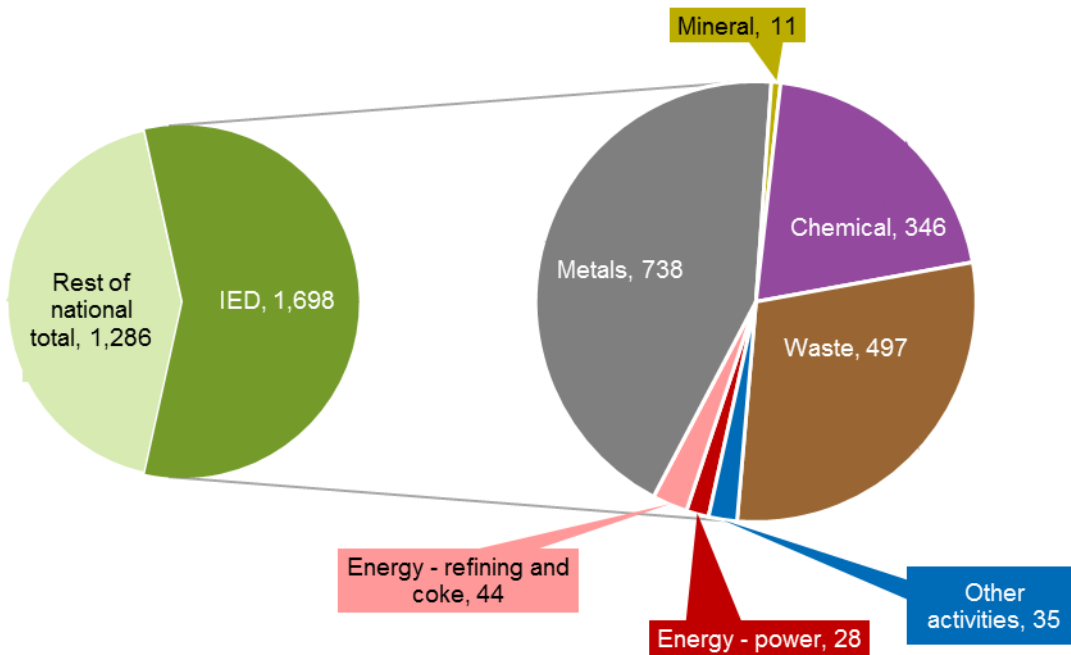
5 Waste generated by industrial sectors

The data presented in this section is the generation of waste by waste category (hazardous and non-hazardous) (Eurostat, 2017e). Data is reported by Member States biennially.

Industrial sectors account for a significant share of total hazardous waste generated in Spain in 2014 (Figure 32). Of this, the metal industrial sector generates the largest quantity (46%), followed by the waste management and the chemical industrial sectors.

Together with the size of the industrial sectors (in terms of the installations permitted, 240 out of 5,767 for metal production), the metal industrial sector in Spain generates comparatively more hazardous waste per installation than other industrial sectors.

Figure 32: Hazardous waste generation by industrial sector in 2014 (kt)

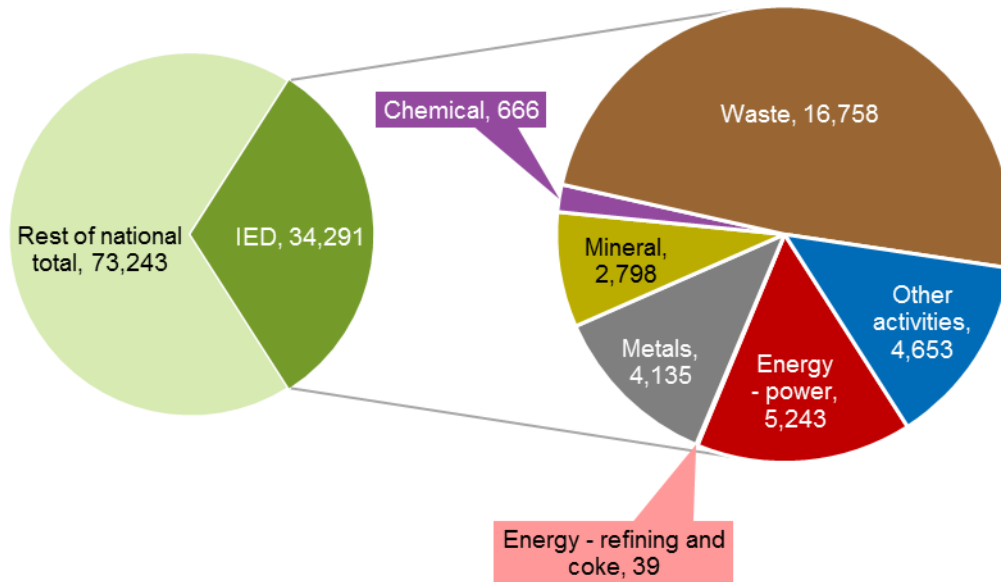


Note: Rest of national total relates to all NACE activities minus the industrial sectors shown here.

Source: Eurostat (2017e)

The share of total non-hazardous waste generated in industrial sectors contributes to 32 % of total non-hazardous waste generated in 2014 (Figure 33) – with the waste management industrial sector accounting for half of this. It is followed by the energy-power, ‘other activities’ and the metals industrial sectors. Typical waste streams that require final disposal include a mixture of ash, carbon and lime residue, bottom ash, leachate, bioaerosols and discards.

Figure 33: Non-hazardous waste generation by industrial sector in 2014 (kt)



Note: Rest of national total relates to all NACE activities minus the industrial sectors shown here.

Source: Eurostat (2017e)

Non-hazardous waste generation has decreased between 2004 and 2014 in the metals, minerals, chemicals and ‘other activities’ industrial sectors in Spain. However, in the case of the waste management industrial sector, it grew 30 fold over this period. The non-hazardous waste generated in the energy sectors remained approximately the same in 2014 as in 2004 with some variations observed over time (Figure 34).

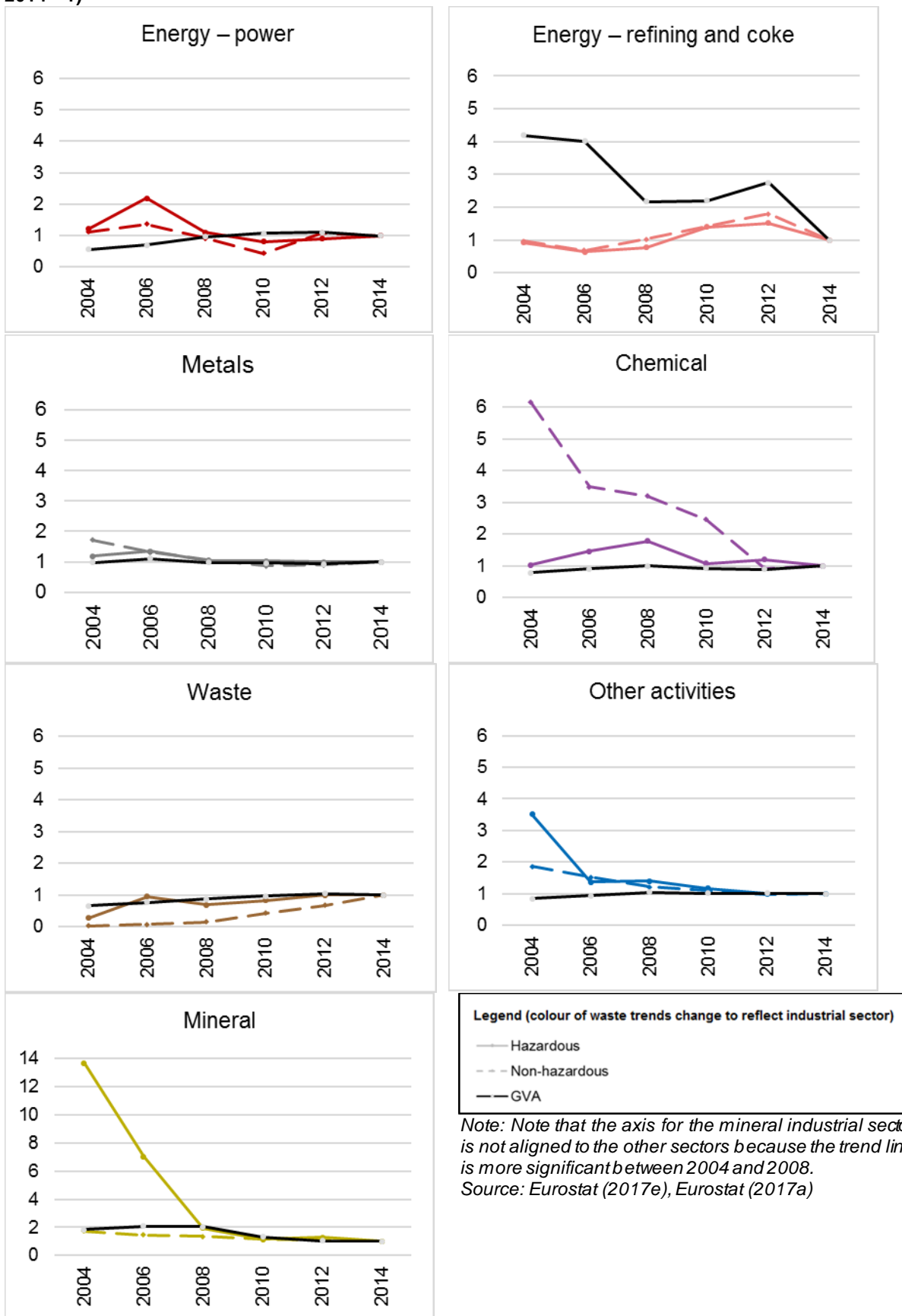
Similar trends are observed also for hazardous waste generation (Figure 34). The hazardous waste generated by the waste management industrial sector more than trebled over the period 2004 to 2014. For the industrial sectors metals, minerals, and ‘other activities’ generated less hazardous waste over this period. Hazardous waste generation fluctuated for the energy and chemicals sectors between 2004 and 2014, but overall across this period did not change significantly.

It is not clear what has led to the significant increases in waste generation in the waste management sector – although the sector has had an increasing number of reported IED installations in this sector, this is only since 2011 to 2015. The GVA of the waste management sector has increased over time, but not by the proportions that waste generation has increased. For the other sectors, the trends in sectoral GVA do not appear to be closely related to the trends in waste generation.

Limitations

The use of NACE classifications for reporting has generally led to overreporting for waste generation data against each industrial sector compared to a scope strictly limited to the IED. No data could be included within ‘other activities’ to reflect the IED activity intensive rearing of poultry or pigs as reporting was not at the appropriate level of NACE classification.

Figure 34: Hazardous and non-hazardous waste generation by industrial sector relative to GVA (indexed; 2014 = 1)



6 Challenges and Pressures

This section identifies the political and environmental challenges and pressures related to sectors or specific activities which are within the scope of the IED, and in particular whether the impact of these in a region or Member State is substantially above the EU average for that activity or sector. It is about the specific circumstances of the environmental impact of the industrial sectors or activities in that Member State which may have been indicated for example by public complaint, high profile media attention, political intervention, implementation of a specific national policy and/or which are evident from literature or analysis¹.

As shown in section 2, key industries in Spain in terms of the reported number of IED installations in 2015 are intensive rearing of poultry or pigs (50 % of total in 2015), followed by the mineral industrial sector (10%), the waste industrial sector (9%) and the chemicals industrial sector (7%). The sectors identified as making the largest contribution to the Spanish economy as measured by gross value added are 'other activities' (37%), followed by the energy – power (25%) and chemical industrial sectors (17%). The reported GVA for 'other activities' consists mainly of food and drinks production (~27% of total GVA of industrial sectors).

The industrial sectors identified in section 4 as contributing the largest burden to the environment for emissions to air were: the energy - power sector (for all heavy metals, SO_x, NO_x, PM_{2.5} and PCDD/F) and the 'other activities' industrial sector (as regards NMVOC and NH₃ emissions). These were followed by iron and steel, hazardous waste management and energy – refining and coke industrial sectors. The metals, energy-power, energy - refining and coke, chemicals, hazardous waste management and 'other activities' industrial sectors were identified as having significant environmental burdens for emissions to water whereas the metals, chemicals and the waste management industrial sectors mainly contribute to hazardous waste generation.

The key industry 'intensive rearing of poultry and pigs', significantly contributing to certain air and water pollutants, also seems to be a key challenge for Spain as indicated in challenge ES-3 (Table 9). The same was observed for power generation and steel production, which both contribute significantly to air and water pollution (see challenge ES-1 and ES-4). Two other challenges, which were identified, refer to co-incineration of waste in cement plants and to high electricity prices which hinder the investment in more environmentally friendly technologies². Some challenges are experienced at national and regional scale and one challenge has only been reported for Catalonia. The most important are expanded in the boxes below.

Further challenges have been investigated for the national scale and for the regional scale in Catalonia due to the economic importance of this region but are not listed here.

¹ The challenges and pressures included here do not concern the implementation of the IED.

² Electricity prices: http://www.minetad.gob.es/es-ES/IndicadoresyEstadisticas/DatosEstadisticos/IV.%20Energ%C3%ADa%20y%20emisiones/IV_12.pdf. Accessed on 18.12.2017

Table 9: Key challenges identified in Spain

Permissible emission values of coal-fired power plants		ES-1
IED activities/ sectors	1.1. Combustion of fuels in installations with a total rated thermal input of 50 MW or more	
Medium and pollutants	Air pollutants, in particular SO ₂ but also NO _x , dust and heavy metals	
Description	<p>There is a significant coal-fired energy industry in Spain. However, the nationally extracted coal is of lower quality having high sulphur content. Therefore, in general there are emission problems when burning this type of coal and not importing lower sulphur coal.</p> <p>This challenge is related to the use of permissible flexibilities for the coal power sector in Spain under both the previous legislative regime (LCPD) and the IED. Local organisations argue that the resulting pollution levels from the coal fired installations are not in line with both EU and national emission legislations. According to the IED, derogations can be granted. Several facilities in Spain benefit from those derogations including the coal-fired Soto III and Litoral I and II power stations, which are located near protected areas under the Natura 2000 network. The majority of Spanish coal plants are in the Transitional National Plan (TNP). According to Greenpeace (2016), 10.1GW of coal plants are in the Spanish TNP, 0.6GW apply the Limited Lifetime Derogation, and 0.05GW have no derogation.</p> <p>Moreover, the local coal mining sector is a key economic sector in several Spanish regions, therefore policies against local coal industry are unpopular and difficult to implement.</p>	
Years applicable / current	Recent years since negotiation of the LCP BREF (i.e. since ~2013).	
Related infringement cases	No.	
Public complaints	<p>There have been several public complaints. Many NGO's have raised petitions and have requested reports to authorities in this regard. Lately the amount of the public complaints has decreased, but there is still a significant amount of them ongoing.</p> <p>One example is that the prominent NGO IIDMA (Instituto Internacional de Derecho y Medioambiente) and Greenpeace Spain have challenged the derogations granted at European level (including the TNP) based on a number of arguments: Natura 2000 zones protection (Anllares, Soto III and Litoral power stations), infringement of national air quality regulations (Besós 3 and Aboño), among others. See links in the section below.</p>	
Media Attention	<p>It has had and still has a lot of media attention. Many articles can be found, e.g. http://www.energias-renovables.com/panorama/iidma-y-greenpeace-recurren-ante-la-ue-20150715, and http://www.energynews.es/english/iidma-denounces-coal-plants-in-spain-still-fail-to-fulfill-the-law/ and http://www.energias-renovables.com/panorama/las-termicas-de-carbon-espanolas-no-cumplen-20161013</p>	
Political interventions	IED Art. 15(4) derogations have been requested, and approved by the EC for certain power plants. In some cases emissions reduction systems have been implemented, such as the DeNO _x system in the Aboño plant.	
Policies implemented to address challenge	At the moment, there is the intention by authorities to reduce subventions on coal.	
Related policies	NEC Directive and the Air Quality Directive	

Emissions from co-incineration in cement kilns		ES-2
IED activities/ sectors	3.1. Production of cement, lime and magnesium oxide	
Medium and pollutants	Air emissions, i.e. Furans, Benzopyrene, etc.	
Description	<p>The application of the European BAT Reference Document on Cement and Lime Manufacturing practice of co-incineration in cement kilns has been included in several permits in Spain. The co-incineration of waste as fuel has cost benefits for the operators and is in general considered as BAT from the waste management perspective.</p> <p>Regulators and industry state that the emission levels are not higher than the combustion of conventional fuels. However, the local population as well as NGOs have concerns that it could also lead to higher harmful emissions to the environment for some pollutants e.g. furans. For this reason, the local population often raise concerns when such permits are issued and complaints at political level.</p>	
Years applicable / current	Since the financial crisis in 2008 cement plants have been incorporating waste co-incineration capacities for cost saving reasons.	
Related infringement cases	No.	
Public complaints	NGOs and local municipal organisations (organizaciones vecinales) have raised complaints at rather local level, e.g. during town hall meetings (Ayuntamientos).	
Media Attention	<p>There has been varying media attention. Recently, the media attention has been relatively high.</p> <p>One prominent example is the media attention related to the Montcada I Reixac cement plant: http://www.lavanguardia.com/local/barcelona/20141017/54418012372/un-experto-de-la-oms-relaciona-las-emisiones-de-la-cementera-de-montcada-con-el-cancer.html</p> <p>Another example can be found here: http://www.elmundo.es/cataluna/2015/07/13/55a36bfd2704e84658b456f.html</p>	
Political interventions	<p>The state created so-called committees (comités) or groups of neighbours, workers, local and regional authorities for the assessment of the issue. They were supposed to discuss the problem and provide a statement from a consensual and more neutral perspective.</p> <p>Public hearings have been carried out as well as information campaigns by the private sector (operators) to convince the local population that the pollution levels are similar to conventional fuels and of the advantages of co-incineration of waste.</p>	
Policies implemented to address challenge	No policy has been implemented so far. Currently, the discussion is centred around the revision of environmental permits of these plants.	
Related policies	Related policies are inter alia the Waste Framework Directive ³ and the NEC Directive ⁴ and its related national legislation.	

³ Directive 2008/98/EC on waste and repealing certain Directives

⁴ Directive 2016/2284/EU on the reduction of national emissions of certain atmospheric pollutants

Groundwater pollution and air (odour) emissions from IRPP sector		ES-3
IED activities/ sectors	6.6. Intensive rearing of poultry or pigs	
Medium and pollutants	Nitrate emissions to water Ammonia emissions to air	
Description	The high intensity of the pig rearing sector in Spain is putting a pressure on the environment due to mainly ammonia (air) and nitrate (water/soil) emissions. As Spain is a rather dry country, water contamination is a more sensitive issue than in other countries within EU. Local population also complains about the odour of piggeries when they are located close to residential areas. On the other hand the rearing of pigs is a very important source of income in many regions as it supplies local and external (large quantities for export) markets.	
Years applicable / current	Since several decades	
Related infringement cases	No.	
Public complaints	The public complaints are mainly related to odour issues than to emission breaches, for example in Segovia and Catalonia regions. Local administrations (town halls) have raised complaints as well related to the quality of groundwater.	
Media Attention	There has been low media attention.	
Political interventions	None. However, as a related BAT Conclusion has been adopted, there are initiatives of evaluation and negotiation together with agricultural sector representatives. Catalonia passed the decree 136-2009 that sets a program and measures to control the nitrate pollution from agricultural and rearing activities. There have only been minor fines issued at local regional level by regional authorities (comunidades autónomas).	
Policies implemented to address challenge	Decree 136-2009 for Catalonia was not effective enough, , a new decree is expected to be released soon.	
Related policies	Related policies are inter alia the Nitrates Directive ⁵ as integral part of the Water Framework Directive ⁶ , the NEC Directive ⁷ and the Fertiliser Regulation ⁸ , currently under revision	

⁵ Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources

⁶ Directive 2000/60/EC establishing a framework for the Community action in the field of water policy

⁷ Directive 2016/2284/EU on the reduction of national emissions of certain atmospheric pollutants

⁸ Regulation 2003/2003/EC relating to fertilisers

Emissions from steel factories		ES-4
IED activities/ sectors	2.2. Pig iron or steel	
Medium and pollutants	Various emissions to air, water and soil	
Description	Neither authorities (issue of regulations and permits) nor plants are following the BAT AELs defined in the BAT conclusion on Iron and Steel and whose deadline for implementation was last March 2016. The plants are reluctant to make costly investments in emission reduction and control systems. A prominent case is the Acelor-Mittal plant in Avilés, Asturias.	
Years applicable / current	Since 2016 (deadline for BAT implementation under the IED directive)	
Related infringement cases	None at EU level. Recently (March 2017), the national government approved a €1.5m fine to Acelor-Mittal due to the high pollution levels from the steel factory in Avilés, Asturias. This is a historically major fine in this sector in regards to environmental issues. See http://www.lne.es/asturias/2017/03/11/sancion-maxima-arcelor-vertidos-contaminantes/2070992.html	
Public complaints	There are general public complaints, especially by NGOs and the general public through newspapers and public campaigns. The Avilés steel factory is a prominent case with many complaints.	
Media Attention	There has been a lot of media attention, e.g. in newspapers. Some examples are: http://www.elcomercio.es/economia/empresas/201703/10/asturias-gobierno-multa-arcelor-20170310161450.html and http://www.lne.es/asturias/2017/03/11/sancion-maxima-arcelor-vertidos-contaminantes/2070992.html	
Political interventions	NGOs started public campaigns.	
Policies implemented to address challenge	Currently there is discussion ongoing about upcoming revision of the environmental permits.	
Related policies	This case relates to multiple policies concerning water, soil and air.	

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Appendices

Appendix 1 Mapping industrial sectors across data sources for Spain

Appendix 2 Emissions to air by pollutant and industrial sector (detail)

Appendix 1 - Mapping industrial sectors across data sources for Spain

Industrial sector	GVA Eurostat (2017a) NACE Rev 2	Employment Eurostat (2017b) NACE Rev 2	Energy consumption Eurostat (2017c) Energy balance indicator	Water consumption Eurostat (2017d) NACE Rev 2	Emissions to air EEA (2016c) NFR14 sector classification	Emissions to water EEA (2017) E-PRTR	Waste generated Eurostat (2017e) NACE Rev 2
<i>Time series available</i>	<i>2000-2015, annually</i>	<i>2008-2015, annually</i>	<i>2000-2015, annually</i>	<i>2000-2015, annually</i>	<i>2000-2014, annually</i>	<i>2007-2015, annually</i>	<i>2004-2014, every 2 years</i>
Energy power	D (electricity, gas, steam and air conditioning supply)	D35 (electricity, gas, steam and air conditioning supply)	B_101301 - Own Use in Electricity, CHP and Heat Plants	D (electricity, gas, steam and air conditioning supply)	1A1a Public electricity and heat production; 1A2a-f Stationary combustion in manufacturing industries and construction	Power generation (1c)	D (electricity, gas, steam and air conditioning supply)
Energy - refining and coke	C19 (coke and refined petroleum products)	C19 (coke and refined petroleum products)	B_101307 - Petroleum Refineries; B_101312 - Coke Ovens; B_101320 - Non-specified (Energy)	DATASETS COMBINED: C19 (coke and refined petroleum products) AND C20 (chemicals) and C21 (pharmaceutical products)	1A1b Petroleum refining; 1A1c Solid fuels and other energy industries	Refining (1a), coke ovens (1c)	C19 (coke and refined petroleum products)
Metals: iron and steel	C24 (basic metals)	C24 (basic metals)	B_101315 - Blast Furnaces B_101805 - Iron and Steel B_101810 - Non-Ferrous Metals	C24 (basic metals)	2C1 Iron and steel	Iron and steel manufacturing (2a-d)	C24-C25 (basic metals; fabricated metal products, except machinery and equipment)
Metals: non-ferrous					2C2-7 Non-ferrous metals	Non-ferrous metal production (2e)	
Minerals, in aggregate (cement, lime and magnesium oxide, glass and other)	C23 (non-metallic mineral products)	C23 (non-metallic mineral products)	B_101820 - Non-Metallic Minerals	Insufficient granularity in reported data	2A1 Cement; 2A2 Lime; 2A3 Glass; 2A6 Other	Cement, lime and magnesium oxide (3c); Glass (3e); Other (3f-g)	C23 (non-metallic mineral products)
Chemical	C20 (chemicals); C21 (pharmaceutical products)	C20 (chemicals); C21 (pharmaceutical products)	B_101815 - Chemical and Petrochemical	DATASETS COMBINED: C20 (chemicals) and C21 (pharmaceutical products) AND C19 (coke and refined petroleum products)	2B1 Ammonia; 2B6 Titanium dioxide; 2B2 Nitric acid; 2B7 Soda ash; 2B3 Adipic acid; 2B10a Other; 2B5 Carbide; 2J Production of POPs	Chemical industry (4a-f)	C20-C22 (chemicals; pharmaceuticals; rubber and plastic products)
Waste: hazardous	E37-E39 (water supply; sewerage, waste management and remediation)	E38 (waste collection, treatment and disposal activities; materials recovery)	No indicator	Insufficient granularity in reported data	5C1bi Industrial waste incineration 5C1biv Sewage sludge incineration 5C1bii Hazardous waste incineration 5C1bvi Other waste incineration 5C1biii Clinical waste incineration	Hazardous waste (5a)	E37-E39 (water supply; sewerage, waste management and remediation)
Waste: non-hazardous			B_101318 - Gasification plants for biogas	Insufficient granularity in reported data	5A Solid waste disposal on land; 5C1a Municipal waste incineration; 5B1 Composting; 5C1bv Cremation; B2 Anaerobic digestion at biogas facilities; 5D2 Industrial wastewater handling	Non-hazardous waste (5b-e; g)	
Other*: Food and drink products	C10-C12 (food and drinks and tobacco)	C10 (food products); C11 (drink products)	B_101830 - Food and Tobacco		2H Food and beverages industry	Food and drink (8a-c)	C10-C12 (food products; drink products; tobacco)
Textiles and tanning	C13-C15 (textiles; wearing apparel; leather)	C13-C15 (textiles; wearing apparel; leather)	B_101835 - Textile and Leather	DATASETS COMBINED: C10-12 (food and drinks and tobacco); C13-15 (textiles; wearing apparel; leather); C16-17 (paper and wood products)		Pre-treatment or dyeing of textile fibres or textiles (9a); Tanning of hides and skins (9b)	C13-C15 (textiles; wearing apparel; leather)
Pulp, paper and wood-based products	C16 (wood products) C17 (paper and paper products) Insufficient granularity in reported data	C16 (wood products); C17 (paper and paper products) Insufficient granularity in reported data	B_101851 - Wood and Wood Products B_101840 - Paper, Pulp and Print	Insufficient granularity in reported data	2I Wood processing 2H1 Pulp and paper industry	Pulp, paper and wood production (6a-c)	C16 (wood products) C17-C18 (paper and paper products; printing) Insufficient granularity in reported data
Intensive rearing of poultry and pigs	Insufficient granularity in reported data	Insufficient granularity in reported data	No indicators	Insufficient granularity in reported data	3B4gi Manure management - Laying hens; 3B4gii Manure management - Broilers	Intensive rearing of poultry and pigs (7a)	Insufficient granularity in reported data
Surface treatment	Insufficient granularity in reported data	Insufficient granularity in reported data	No indicators	Insufficient granularity in reported data	2D3d Coating applications; 2D3e Degreasing; 2D3f Dry cleaning; 2D3g Chemical products; 2D3h Printing; 2D3i Other solvent use; 2G Other product use; 2H3 Other industrial processes	Surface treatment (2f; 9c); Production of carbon (9d)	Insufficient granularity in reported data
Rest of national total	<i>All NACE activities</i>	<i>All NACE activities</i>	<i>B_100900 – Gross inland consumption</i>	<i>All NACE activities</i>	<i>National total for all E-PRTR activities reported</i>	<i>All NACE activities plus households</i>	<i>All NACE activities</i>

Notes:

† Number of IED installations is reported against IED activities for years 2011, 2013 and 2015.

Appendix 2 - Emissions to air by pollutant and industrial sector (detail)

Notes: Emissions rounded to two decimal places unless data is less. Industrial sectors and pollutants with no data reported across the timeseries have been removed.

Source: EEA (2017a)

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Energy - power																	
SO _x	kt	1,171.70	1,143.73	1,280.92	1,052.97	1,096.60	1,070.39	944.72	920.27	313.94	228.98	198.29	222.88	238.39	136.09	163.01	178.70
NO _x	kt	458.09	432.61	484.75	465.94	489.75	493.23	447.63	467.39	352.06	286.87	234.48	273.99	286.42	230.71	238.40	255.43
PM _{2.5}	kt	20.77	19.36	21.68	22.04	21.30	21.36	19.14	20.03	14.23	10.91	10.05	10.70	11.15	9.08	9.39	10.21
NMVOOC	kt	11.49	12.14	13.65	15.21	15.87	16.44	14.34	14.95	13.89	11.32	11.40	11.71	12.35	12.93	11.69	12.80
NH ₃	kt	-	-	-	0.0006	0.0011	0.0036	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Cd (HM)	t	12.98	12.94	13.63	12.22	11.41	10.82	8.67	6.96	6.72	6.26	6.26	6.17	6.37	5.55	5.85	6.00
As (HM)	t	18.49	17.82	19.32	18.04	15.87	17.91	15.87	15.24	14.42	13.64	13.01	13.79	15.53	12.29	14.18	15.12
Cr (HM)	t	25.66	26.68	29.18	26.17	26.28	26.41	23.55	22.55	21.32	17.87	17.67	18.23	18.18	16.48	17.04	16.83
Cu (HM)	t	89.39	86.18	92.25	88.58	72.31	87.12	80.13	78.20	77.39	76.85	72.90	74.25	85.42	65.73	78.98	84.33
Pb (HM)	t	141.66	142.66	148.66	144.28	136.43	144.92	141.27	139.39	140.81	123.95	131.88	134.90	137.29	125.61	138.04	143.48
Hg (HM)	t	6.79	7.06	7.86	6.73	6.70	6.71	5.73	5.02	4.39	3.86	3.65	3.79	4.09	3.49	3.49	3.57
Ni (HM)	t	196.24	204.23	230.31	192.83	184.74	192.00	146.51	120.76	121.60	109.08	106.48	97.25	99.23	86.31	85.61	86.91
Zn (HM)	t	191.19	195.41	208.42	202.87	196.87	206.50	204.11	201.73	196.22	186.93	192.61	202.94	206.94	193.10	205.02	210.53
PCDD/F	g	47.8	46.0	47.1	46.0	48.8	48.5	49.4	51.8	48.1	37.7	44.4	49.2	46.8	48.4	53.7	59.1

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Energy - refining, coke																	
SO _x	kt	109.37	98.61	86.75	74.84	74.10	65.22	65.97	63.71	49.40	43.78	37.53	28.37	18.81	14.46	9.64	8.85
NO _x	kt	23.96	23.84	23.28	23.28	25.26	23.20	28.01	27.48	25.89	23.07	23.80	24.08	24.02	21.82	19.65	20.06
PM _{2.5}	kt	1.67	1.55	1.42	1.35	1.41	1.28	1.24	1.26	1.17	0.99	1.09	1.30	1.38	1.22	1.07	0.63
NMVOG	kt	0.78	0.68	0.67	0.67	0.73	0.77	1.85	1.75	1.74	1.41	1.59	1.38	1.45	1.49	1.40	1.06
NH ₃	kt	0.10	0.09	0.09	0.10	0.10	0.09	0.10	0.10	0.09	0.07	0.08	0.08	0.08	0.08	0.07	0.08
Cd (HM)	t	2.16	2.06	2.01	1.92	1.99	1.82	1.80	1.82	1.69	1.40	1.18	0.88	0.53	0.31	0.21	0.19
As (HM)	t	1.09	1.04	1.01	0.96	1.00	0.91	0.90	0.91	0.85	0.70	0.59	0.44	0.27	0.16	0.11	0.10
Cr (HM)	t	5.45	5.20	5.07	4.85	5.03	4.59	4.56	4.60	4.27	3.54	2.98	2.22	1.34	0.80	0.57	0.49
Cu (HM)	t	2.18	2.08	2.02	1.94	2.01	1.83	1.82	1.84	1.70	1.41	1.19	0.88	0.53	0.32	0.22	0.19
Pb (HM)	t	2.85	2.72	2.65	2.53	2.63	2.40	2.38	2.40	2.23	1.85	1.55	1.16	0.70	0.41	0.29	0.25
Hg (HM)	t	2.17	2.07	2.02	1.93	2.00	1.82	1.82	1.84	1.70	1.42	1.19	0.89	0.54	0.32	0.23	0.19
Ni (HM)	t	75.64	72.14	70.35	67.27	69.67	63.55	63.09	63.76	59.17	49.14	41.44	30.87	18.49	10.92	7.73	6.57
Zn (HM)	t	2.26	2.15	2.09	2.01	2.08	1.90	1.89	1.91	1.78	1.47	1.21	0.90	0.55	0.33	0.23	0.20
PCDD/F	g	0.22	0.21	0.20	0.20	0.20	0.18	0.18	0.18	0.29	0.27	0.46	0.81	0.84	0.94	0.87	0.34
Metals: iron and steel																	
SO _x	kt	1.29	1.34	1.31	1.28	1.39	1.40	1.40	1.45	1.45	1.05	1.31	1.30	1.17	1.26	1.35	1.39
NO _x	kt	1.55	1.63	1.63	1.67	1.80	1.80	1.94	1.95	1.91	1.48	1.64	1.56	1.35	1.33	1.35	1.36
PM _{2.5}	kt	0.29	0.30	0.30	0.30	0.32	0.32	0.34	0.35	0.34	0.26	0.29	0.28	0.24	0.24	0.25	0.25
NMVOG	kt	1.41	1.44	1.44	1.40	1.52	1.52	1.55	1.60	1.55	1.19	1.39	1.35	1.15	1.22	1.33	1.35
Cd (HM)	t	1.43	1.50	1.51	1.55	1.67	1.66	1.80	1.81	1.77	1.37	1.51	1.44	1.25	1.22	1.24	1.25
As (HM)	t	0.10	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.12	0.09	0.10	0.10	0.08	0.08	0.08	0.09
Cr (HM)	t	1.32	1.39	1.39	1.41	1.52	1.51	1.62	1.64	1.60	1.24	1.38	1.32	1.14	1.14	1.15	1.17
Cu (HM)	t	0.27	0.28	0.28	0.26	0.28	0.28	0.30	0.31	0.30	0.23	0.26	0.25	0.21	0.21	0.21	0.22
Pb (HM)	t	17.53	18.46	18.49	19.01	20.48	20.37	22.08	22.20	21.75	16.82	18.60	17.73	15.31	15.01	15.22	15.33
Hg (HM)	t	0.89	0.94	0.94	0.97	1.04	1.04	1.12	1.13	1.11	0.85	0.94	0.90	0.78	0.76	0.77	0.78
Ni (HM)	t	4.76	5.01	5.02	5.17	5.57	5.54	5.99	6.03	5.91	4.57	5.05	4.82	4.16	4.09	4.15	4.18
Zn (HM)	t	26.93	28.36	28.41	29.23	31.49	31.32	33.93	34.12	33.44	25.85	28.59	27.25	23.55	23.10	23.42	23.60
PCDD/F	g	34.97	36.85	36.91	37.99	40.93	40.72	44.14	44.37	43.48	33.62	37.18	35.43	30.61	30.00	30.42	30.63

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Metals: Non-ferrous																	
SO _x	kt	4.12	4.01	3.64	3.61	3.74	3.82	3.65	3.61	3.74	3.32	3.36	3.50	3.69	3.15	3.55	3.67
NO _x	kt	0.37	0.38	0.38	0.39	0.39	0.40	0.40	0.41	0.41	0.36	0.37	0.41	0.35	0.35	0.35	0.36
PM _{2.5}	kt	0.67	0.66	0.79	0.93	0.76	0.78	0.72	0.66	0.66	0.45	0.42	0.44	0.42	0.39	0.43	0.43
NMVOG	kt	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.08	0.08	0.10	0.07	0.07	0.07	0.08
Cd (HM)	t	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.02	0.02	0.02	0.02
As (HM)	t	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.0025	0.01	0.01	0.01	0.01	0.02	0.01
Cr (HM)	t	0.0023	0.0027	0.0030	0.0031	0.0040	0.0039	0.0036	0.0038	0.0043	0.0007	0.0029	0.0026	0.0023	0.0034	0.0041	0.0036
Cu (HM)	t	0.0044	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0013	0.01	0.01	0.0046	0.01	0.01	0.01
Pb (HM)	t	0.12	0.14	0.16	0.16	0.20	0.20	0.18	0.20	0.22	0.0346	0.15	0.13	0.12	0.17	0.21	0.18
Ni (HM)	t	2.52	2.54	2.56	2.60	2.62	2.63	2.67	2.68	2.71	2.21	2.13	2.67	1.85	1.76	1.80	1.91
Zn (HM)	t	3.91	4.04	4.17	4.24	4.48	4.47	4.44	4.51	4.67	3.11	3.56	4.21	3.04	3.19	3.43	3.43
Mineral: Other																	
Cd (HM)	t	0.0018	0.0018	0.0018	0.0018	-	-	-	-	-	-	-	-	-	-	-	-
Pb (HM)	t	0.55	0.57	0.60	0.63	0.65	0.68	0.66	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
Chemical																	
SO _x	kt	5.94	5.84	5.78	5.35	5.00	5.35	5.62	5.48	4.91	3.75	4.49	3.82	3.47	3.26	3.38	3.45
NO _x	kt	3.13	3.02	2.61	2.47	1.68	1.77	1.38	1.28	1.11	1.12	1.33	1.35	1.26	1.23	1.28	1.17
PM _{2.5}	kt	0.76	0.71	0.71	0.75	0.70	0.69	0.64	0.66	0.58	0.45	0.61	0.55	0.62	0.59	0.59	0.61
NMVOG	kt	15.31	15.42	15.47	15.15	14.36	13.69	13.41	13.29	11.67	12.18	13.88	13.63	12.91	12.66	14.89	15.00
NH ₃	kt	15.14	14.38	14.62	14.77	14.01	13.81	13.11	14.35	11.60	8.37	12.52	10.85	12.77	11.93	11.84	12.50
Cd (HM)	t	0.0009	0.0009	0.0009	0.0008	0.0009	0.0009	0.0010	0.0009	0.0012	0.0003	0.0016	0.0011	0.0015	0.0017	0.0017	0.0018
Hg (HM)	t	0.78	0.68	0.68	0.69	0.67	0.61	0.51	0.48	0.39	0.34	0.28	0.25	0.25	0.24	0.24	0.21

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste: hazardous																	
SO _x	kt	0.0039	0.0032	0.0037	0.0039	0.0021	0.0021	0.0020	0.0044	0.0044	0.0030	0.0031	0.0031	0.0037	0.0037	0.0037	0.0036
NO _x	kt	0.07	0.06	0.07	0.07	0.04	0.04	0.04	0.08	0.08	0.06	0.06	0.06	0.07	0.07	0.07	0.07
PM _{2.5}	kt	0.0003	0.0002	0.0003	0.0003	0.0002	0.0002	0.0002	0.0004	0.0004	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
NMVOG	kt	0.54	0.44	0.53	0.58	0.31	0.31	0.32	0.70	0.69	0.48	0.48	0.48	0.58	0.58	0.58	0.57
Cd (HM)	t	0.01	0.01	0.01	0.01	0.0044	0.0044	0.0043	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
As (HM)	t	0.0012	0.0009	0.0011	0.0012	0.0007	0.0007	0.0007	0.0015	0.0015	0.0010	0.0010	0.0010	0.0013	0.0013	0.0012	0.0012
Cr (HM)	t	0.36	0.29	0.36	0.39	0.21	0.21	0.21	0.47	0.47	0.32	0.33	0.32	0.39	0.39	0.39	0.39
Cu (HM)	t	0.74	0.60	0.72	0.78	0.42	0.42	0.43	0.94	0.93	0.64	0.65	0.65	0.79	0.78	0.78	0.77
Pb (HM)	t	0.09	0.08	0.09	0.10	0.05	0.05	0.06	0.12	0.12	0.08	0.09	0.08	0.10	0.10	0.10	0.10
Hg (HM)	t	0.01	0.01	0.01	0.01	0.01	0.0047	0.0024	0.01	0.01	0.0036	0.0037	0.0036	0.0044	0.0044	0.0044	0.0043
Ni (HM)	t	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Zn (HM)	t	0.72	0.58	0.71	0.78	0.41	0.42	0.43	0.94	0.93	0.64	0.65	0.65	0.79	0.78	0.78	0.77
PCDD/F	g	41.52	34.25	36.25	36.12	21.00	18.75	15.03	33.04	32.56	22.53	22.92	22.72	27.52	27.43	27.27	27.05
Waste: non-hazardous																	
SO _x	kt	0.05	0.05	0.05	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
NO _x	kt	0.10	0.10	0.11	0.09	0.07	0.08	0.08	0.08	0.09	0.08	0.09	0.10	0.11	0.12	0.14	0.15
PM _{2.5}	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
NMVOG	kt	3.71	3.86	3.94	3.87	3.72	3.83	3.94	4.04	4.12	4.67	4.28	4.52	4.49	4.36	4.01	3.96
NH ₃	kt	0.31	0.34	0.43	0.48	0.57	0.61	0.63	0.69	0.85	0.97	1.18	1.17	1.26	1.24	1.24	1.24
Cd (HM)	t	0.0004	0.0004	0.0004	0.0004	0.0003	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0006	0.0006	0.0007	0.0007
As (HM)	t	0.0008	0.0009	0.0010	0.0010	0.0009	0.0010	0.0011	0.0010	0.0011	0.0012	0.0013	0.0014	0.0015	0.0016	0.0019	0.0020
Cr (HM)	t	0.0011	0.0011	0.0012	0.0011	0.0009	0.0010	0.0011	0.0010	0.0011	0.0012	0.0013	0.0014	0.0015	0.0016	0.0019	0.0020
Cu (HM)	t	0.0009	0.0010	0.0011	0.0009	0.0008	0.0009	0.0010	0.0009	0.0010	0.0011	0.0011	0.0012	0.0014	0.0014	0.0017	0.0018
Pb (HM)	t	0.0029	0.0031	0.0032	0.0025	0.0020	0.0023	0.0023	0.0022	0.0024	0.0026	0.0028	0.0030	0.0034	0.0035	0.0042	0.0044
Hg (HM)	t	0.14	0.15	0.16	0.13	0.10	0.11	0.12	0.11	0.12	0.13	0.14	0.15	0.17	0.17	0.21	0.22
Ni (HM)	t	0.0014	0.0015	0.0016	0.0013	0.0012	0.0013	0.0013	0.0013	0.0014	0.0015	0.0016	0.0017	0.0019	0.0020	0.0024	0.0026
Zn (HM)	t	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
PCDD/F	g	8.72	8.73	8.73	3.50	0.0018	0.0020	0.0021	0.0020	0.0022	0.0023	0.0025	0.0027	0.0030	0.0031	0.0037	0.0040

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Other activities																	
SO _x	kt	0.47	0.43	0.42	0.47	0.49	0.50	0.47	0.42	0.45	0.47	0.50	0.51	0.53	0.32	0.18	0.16
NO _x	kt	3.41	3.48	3.48	3.64	3.69	3.71	3.69	3.85	3.79	3.84	4.04	4.22	4.20	4.21	4.07	3.84
PM _{2.5}	kt	0.59	0.62	0.62	0.63	0.65	0.64	0.65	0.65	0.63	0.63	0.66	0.66	0.63	0.64	0.68	0.69
NMVOC	kt	447.09	441.91	443.64	416.64	422.95	409.66	405.77	402.23	361.16	318.28	314.97	296.93	272.72	267.00	271.30	282.09
NH ₃	kt	118.99	120.90	121.07	122.66	125.55	123.95	111.61	113.60	106.72	105.15	99.16	101.33	98.00	97.27	100.45	107.18



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